FAKULTÄT
FÜR !NFORMATIK

Faculty of Informatics

Mobile Participation Meets Pervasive Gaming

DIPLOMARBEIT

zur Erlangung des akademischen Grades

Diplom-Ingenieur

im Rahmen des Studiums

Medieninformatik

eingereicht von

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an der
Fakultät für Informatik der Technischen Universität Wien

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Wien, 27.11.2014

_____   _____
(Unterschrift Verfasser)   (Unterschrift Betreuung)

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Mobile Participation Meets Pervasive Gaming

MASTER'S THESIS

submitted in partial fulfillment of the requirements for the degree of

Diplom-Ingenieur

in

Media Informatics

by

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Registration Number 0725169

to the Faculty of Informatics
at the Vienna University of Technology

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Vienna, 27.11.2014   _____   _____
                              (Signature of Author)   (Signature of Advisor)

Erklärung zur Verfassung der Arbeit

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Acknowledgements

Abstract

Citizen participation in public discussions about urban topics is an essential democratic process to inform citizens and involve them in decision-making processes. Electronic participation tools are emerging, such as collaborative online platforms or web-based polls. Mobile devices allow citizens to engage on-site but current mobile participation solutions are often limited to a one-way communication. There is a lack of mobile participation applications that leverage strategic actions and enable an interactive dialogue at the same time to build a sustainable participation. Applying game principles on mobile participation is a promising approach to motivate for instance younger generations to participate and can foster a long-term citizen engagement.

This thesis explores a novel approach to integrate game elements into a m-participation application in a user-centered design process. The applied methods include (1) a literature research and an online survey for the *requirements analysis*, (2) several prototyping techniques and a focus group resulting in a *game design*, (3) the *development* of a functional game prototype including backend server and mobile app and (4) an *evaluation* of the prototype in the field with test participants.

A gamified situated engagement concept is proposed named "Community Circles" with a dynamic game mechanic to keep citizens constantly engaged. Aspects of this concept were implemented in a functional game prototype which is utilized to assess research questions including (1) which effects a gamified participation tool has on citizens, (2) how game elements are perceived and (3) what potential a gamified participation has to keep citizen engaged long-term. The prototype is feasible for conducting future long-term studies on civic participation.

The evaluation reveals that such a tool awakes interest and encourages citizens to voice opinions and discuss urban topics. Although a gaming approach can be an initial motivator, it is crucial that municipalities actively involve in the participation process for the future success of a gamified situated participation.

Kurzfassung

Bürgerbeteiligung in öffentlichen Diskussionen über urbane Angelegenheiten ist ein essentieller demokratischer Prozess um Bürger zu informieren und sie in Entscheidungsprozesse einzubinden. Elektronische Beteiligungs-Tools, wie beispielsweise kollaborative Online-Plattformen oder Umfragen im Web, verbreiten sich vermehrt. Mobile Anwendungen erlauben den Bürgern sich vor Ort zu engagieren, allerdings sind aktuelle mobile Beteiligungslösungen oft auf eine Einwegkommunikation beschränkt. Es mangelt an mobilen Beteiligungs-Applikationen, welche eine strategische Entscheidungen bewirken und gleichzeitig einen interaktiven Dialog ermöglichen, um eine nachhaltige Beteiligung aufzubauen. Spielprinzipien auf mobile Beteiligung-Tools anzuwenden ist ein vielversprechender Ansatz, um beispielsweise jüngere Generationen zu motivieren sich zu beteiligen und kann ein langfristiges bürgerschaftliches Engagement fördern.

In einem benutzerzentrierten Design Prozess erforscht diese Diplomarbeit einen neuartigen Ansatz, Spielelemente in einer mobilen Beteiligungs-Applikationen zu integrieren. Die angewandten Methoden beinhalten (1) eine Literaturrecherche und eine Onlineumfrage zur *Anforderungsanalyse*, (2) verschiedene Prototyping-Techniken und eine Fokusgruppe welche zu einem *Spieldesign* führen, (3) die *Entwicklung* eines funktionalen Spiel-Prototypen, bestehend aus Backend Server und Mobiler App und (4) die *Evaluation* des Prototypen im Feld mit Testteilnehmern.
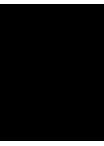
Ein gamifiziertes und situationsbezogenes Beteiligungskonzept mit dem Namen "Community Circles" wird vorgestellt, welches eine dynamische Spielmechanik beinhaltet um Bürger konstant zu beteiligen. Aspekte dieses Konzepts wurden in einem funktionalen Spielprototypen implementiert, welches herangezogen wurde, um folgende Forschungsfragen zu untersuchen: (1) welche Effekte ein gamifiziertes Beteiligungs-Tool auf Bürger hat, (2) wie Spielelemente wahrgenommen werden und (3) welches Potential eine gamifiziertes Beteiligung um Bürger langfristig zu engagieren hat. Der Prototyp ermöglicht die Durchführung von künftigen Langzeitstudien zu Bürgerbeteiligung.

Die Evaluation zeigt, dass ein solches Tool Interesse wecken kann und Bürger unterstützt eine Meinung auszudrücken und urbane Themen zu diskutieren. Wenngleich ein Spielansatz ein initialer Motivator sein kann, ist es ausschlaggebend, dass Stadtverwaltungen sich aktiv in den Beteiligungsprozess einbringen, um den künftigen Erfolg einer gamifizierten und situationsbezogenen Beteiligigung zu gewährleisten.

Contents

Introduction

The quality of modern democratic societies is essentially dependent on the active involvement of their citizens. However, for today's citizens, it is far from obvious how to best possibly support public decision-making processes. For example, people are not supported with adequate information on where they could contribute, and actions cannot be embedded in everyday schedules, such as physical townhall meetings. Furthermore, it is not always obvious for people how their input will result into a political decision and therefore it is difficult to motivate people to spend their time to engage. These circumstances are hindering many people to engage in governance, which results in a gap among the municipality and citizens.

The dialog between officials and citizens is a crucial factor for a decision-making process to establish better plans for a better living [8, 13, 49]. At the same time we carry smartphones with us, that allow us to stay connected with others and are aware of our context (e.g. the location). Consequently, applications exist to get citizens engaged in civic discussion processes, supporting deliberation and active participation [57]. Utilizing mobile participation techniques enables governments to improve the citizen dialog and foster participation on-site. Currently available apps are to a large extent reporting tools to make officials aware of issues or democracy tools to improve participation approaches, but they do not exploit the full potential. They lack in functionality or only provide a one-way feedback channel and fail to create sustainable participation.

There is a need for tools that foster an interactive dialogue between citizens and officials to leverage strategic decisions. At the same time they should engage and motivate people to do so. Games have the power to motivate people [41] and numerous *gamification* approaches are available for the general public transferring game elements into non-gaming contexts [12]. The rise of popular *pervasive games*, games that are played on-site with mobile devices and mix reality with virtual elements [44], are good resources for designers to learn how to transform a game into a real setting. In this work the author seeks for a novel approach to integrate gamification features and game-like elements into a mobile participation application in order to foster a sustainable participation of citizens in form of a mobile application.

1.1   Attribution

This work has been carried out within the interdisciplinary research project *b-Part*[1], which "investigates novel concepts and solutions for citizen e-participation utilizing latest mobile device technology and appliances embedded in today's urban environments" in cooperation with the *Telecommunications Research Center Vienna (FTW)*[2]. Throughout this research other FTW employees were involved while conducting trials and developing the platform. The team consists of a project leader, a full-time researcher, a developer, assistants and the author.

1.2   Thesis Structure

This thesis explains the design process that led to development of a functional prototype, its evaluation and includes the following chapters.

Background and Related Work
> This chapter establishes the background information of the thesis and identifies the motivation to build a mobile citizen application. It builds up the theoretical foundation from different facets. Electronic and mobile participation are highlighted, which are promising enabler to involve citizens into governance activities. However, these approaches have its pitfalls when it comes to a continuous usage and long-term motivation. This section continues with an overview of gamification, an attempt to transfer gaming elements into non-gaming contexts. Pervasive games that blur the border between the virtual and real world, are motivating people to play on-site and outlined in this section. Current work on persuasive technologies and models to measure enjoyment (e.g. of pervasive games) is introduced, to understand the human factors to design and evaluate such a system. Finally, a state-of-the art overview of existing gameful e-participation approaches is presented.

Methodology
> The methods applied for this thesis are introduced in this chapter to give the reader an overview how the research questions were assessed. These are structured in the requirements, design, development and evaluation, and state the motivation of each phase.

Design Process
> This chapter includes the process how the game concept was designed and the results of the applied methods in this phase. It highlights the initial online survey to undestand gamer's motivations and needs, the ideation and prototyping of a game concept and the results from a focus group with gamers, that led to further design decisions.

Game Concept: Community Circles
> The outcome from the design process were directing to a game concept called *Community Circles*. This chapter explains the motivation for the resulting design and describes the intentions of each game element.

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[1]Further information on the project is available online under `http://www.b-part.eu`.
[2]`http://www.ftw.at`

App Development

Developing the mobile app with the corresponding backend server resulted in a complex system utilizing a variety of technologies. The major frameworks that build up the architecture with its service definitions are introduced. Finally, the developed app is explained with a screenshot of each feature to give an overview of the usage.

Game Evaluation

In a game trial the prototype was tested and discussed with participants in the field. This chapter clarifies about the study design and the results from the trial. The results are then compared with results from previous trials.

Discussion

This chapter discusses results from the game trial from several perspectives and provides suggestions on how to improve the resulting prototype. The final section concludes with the author's view on how such an application could be applied in a real scenario.

Conclusion

The thesis concludes with a summary of the thesis, highlighting the whole process and the gained learning from this thesis' work with respect to the research questions. It frames the limitations that this work is confronted with and gives an outlook how this work will be continued in the future.

1.3   Research Questions

The objective of this thesis is to develop a mobile participatory sensing app enriched with game elements that are familiar from pervasive games and gamification approaches. This prototype then allows investigating the following research questions in-depth in several user trials.

RQ1: Which effects has a gamified participation tool on citizens?

Understanding this question will provide insights if and how a game mechanic influences contributions and discussions among citizens, how such a tool influences the behavior, or for instance whether it harms the quality of contributions on the other hand.

RQ2: How will gaming elements be perceived in a participation tool?

In particular, which game elements are important. Do people enjoy playing the game and which aspects are enjoyable? This question should explore which elements are necessary for the game play.

RQ3: What potential has a gamified participation approach to motivate people long-term?

The game elements may awake interest, however, it is unclear how such a system would be used long-term. Although the question on a long-term usage cannot be assessed within this thesis, the chosen methods should give an outlook.

The above-mentioned research questions are framing the methods and approaches applied within this thesis. The main instrument of investigation was the development of a functional

prototype of a gamified e-participation application that can be utilized for further long-term studies. This thesis provides answers to the stated research questions by utilizing a platform that was designed to follow an iterative user-centered design process. Further, attributes of pervasive games were investigated and can guide the design process of future pervasive games.

CHAPTER 2

Background and Related Work

> Literature already discusses opportunities to **motivate civic engagement** with **playful approaches**. Learning from gamification and pervasive game concepts can address the challenge to **encourage younger generations to become active** in governance processes utilizing latest mobile technologies.

This chapter provides a literature background, highlights opportunities extracted from literature and mentions notable examples illustrating the state-of-the-art solutions on electronic participation to motivate the development of the mobile participation platform enriched with gaming elements. Furthermore, the related work of research fields this thesis is settled in will be introduced, including electronic and mobile participation, gamification, pervasive gaming, persuasive technologies and metrics to evaluate enjoyments in games. It concludes with the presentation of projects that are already trying to create a playful participation process.

2.1 Motiviation

Involving citizens into the urban participation process is challenging since they often act "rationally ignorant", for instance in participatory urban planning [30]. This results when the cost of participation is higher than the actual benefit for a person, an effect that can be often observed on current participation approaches. A common reason is that citizens believe their actions won't show any outcome and therefore they don't bother trying to get active. But a shift from decision making by planning authorities to *participatory planning*, where discussions happen among all stakeholders including citizens, requires investigating these issues. Therefore, motivating citizens to bridge that gap must be studied and addressed with novel and innovative approaches.

Participation involves many stakeholders, most importantly the citizens. It is crucial to identify the right target group to build a participation solution, for example literature shows that there is a need to strengthen the civic competence among young generations. Institutions

such as schools, businesses, governments, non-profit and charity organizations, media and researches are responsible to adapt their policies to "prepare for the next generation of political leadership" [62]. In a study on youth civic engagement, a location-based storytelling platform called "I'm your Body" [27] came to some interesting conclusions through a qualitative analyses: "memories, feelings, and attitudes" were mainly used by the youth to express themselves which led to civic discussions, even breaking the barriers of neighborhoods. Consequently, the authors argue "for an approach to locative civic engagement systems that takes a vantage point in youth's emotions rather than a very rational and dry approach to deliberation" and that civic engagement systems should focus on people's emotions to "understand what is actually behind people's opinions and arguments". Megan Boler argues, that "emotions give us information about what we care about and why, informing both our cognitive and moral perceptions" [7].

Sharing stories and the associated emotions or discussing experiences are important aspects for the younger generation. Adding game components is an opportunity to make citizen participation more attractive to them. Gaming literature shows, that games are suitable to keep people motivated, foster creativity and encourage people to do things, they wouldn't do otherwise [41]. Gamers are willing to invest a lot of resources on cognitive tasks and games in general are enjoyed by their audience. Channeling this "power" on other tasks than entertainment is achieved with *serious games*, for instance by making learning activities more fun [43]. Introducing gaming elements in public participation has already been discussed in a paper by Alenka Krek, where she introduced the concept of "playful public participation" [31]. The author argues, that game elements raise the motivation and address the problem of rational ignorance and can even foster a *flow experience* among citizens (a mental state that is highly enjoyable [10]).

Merging on-site participation with gaming suggests investigating a recently emerging genre of gaming: *pervasive games* that mix virtual and real elements [44]. Utilizing the power of the crowd in pervasive games is already happening, for instance in Google's *Ingress*[1] [21]. In this case the players of the game are offered with a compelling story and an interesting gameplay motivating them to play the game on-site. At the same time the players indirectly verify location-based data, which can be used to enhance Google's services. Pervasive games have the potential to make gaming outside attractive, for example aspects such as "social walking" or "discovering and exploring places" are motivating elements [45].

The last section summarizes the arguments for the validity of the chosen approach but doesn't consider the form factor of providing a participation tool. The prototype for this thesis was developed for mobile platforms, such as smartphones. Despite the nature of pervasive games, which typically take place outside and therefore require mobility, there are other reasons to choose a mobile platform. It can be argued that mobile platforms can increase participation, for instance Tolmie et al. mention an interesting observation: "a mobile platform would appear to be more productive than something based on a computer because mobile phones travel around into settings where interactions with families and friends are likely to occur, whereas people are often isolated when using their PCs" [58]. Simply put, the form factor plays an important role since a smartphone can be easily shared with other persons and has a different affordance to interact compared to desktop computers. This is a welcomed side effect for participation, where it is important for people to interact with each other.

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[1] https://www.ingress.com

The motivation for the underlying work and the resulting mobile prototype is to make the civic engagement process motivating and fun by creating a more enjoyable experience with elements known from games to bridge the gap between the youth and civic participation. Eventually, the next generations are shaping the future and participating should meet their requirements and goals to benefit the whole community. In the following sections the theoretical background is clarified and gives an overview on the practices and approaches used in this thesis from different directions.

2.2 Electronic and Mobile Participation

As connected and mobile technologies emerged, so called *e-participation* approaches were developed to engage citizens into the participation process. Whereas traditional participation techniques, such as town hall meetings or paper-based polls are still present, online platforms for citizens became more popular. These online solutions are available for the general public and include examples such as *Better Reykjavik*[2], which provides the citizens of Iceland's capital Reykjavik an online platform where they can post and vote ideas, and discuss with the city council. Other established platforms include *Community PlanIt* or *MindMixer*, both also gaining popularity (these projects are explained later in this section). It is of great value to understand e-democracy tools, categorize them and analyze existing e-participation approaches to identify the needs and opportunities for future applications [37, 57].

However, e-participation has many facets, for instance one approach is *participatory sensing*, a method to collect and share citizens' feedback [9]. This can also include sensor data, for example location, images, audio, video, or even the data provided by a smartphone's accelerometer. Scientific investigations on participatory sensing systems has been undertaken by Whitney et al., where collaborative mobile web-apps were developed to allow users to share information on parking lots or the bus schedule on a university campus [60]. Another example is the mobile app *Street Bump*[3], which encompasses participatory sensing in their offering to the public: it reads the phone's accelerometer sensors to detect bumps in the streets when driving and automatically creates and submits reports on the street's condition.

In a more recent research, Matthias Korn introduced the term *situated engagement* in his PhD thesis, meaning that citizens can effectively engage for example in planning processes and discuss on-site with mobile devices [26]. He explored the opportunities with several prototypes, including *Mobile Democracy*, a mobile app that allows citizens to create location-based topics on-site and supports discussions [6]. Furthermore, the prototype offered to add photos and vote on topics. Another example is *Mening@park*, a tool enabling the users to get active in location-based discussions [28].

In a study on existing mobile participation apps (referred as *m-participation*) Titiana Ertiö provides a typology for these apps, as shown in Figure 2.1 [57]. The described tools a compared by their *leverage* opportunities, and *goals*. Interestingly, a notable amount of apps was found in the *(1) information sharing apps* category, including the nowadays common reporting apps, such

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[2]`https://betrireykjavik.is`
[3]`http://www.streetbump.org`
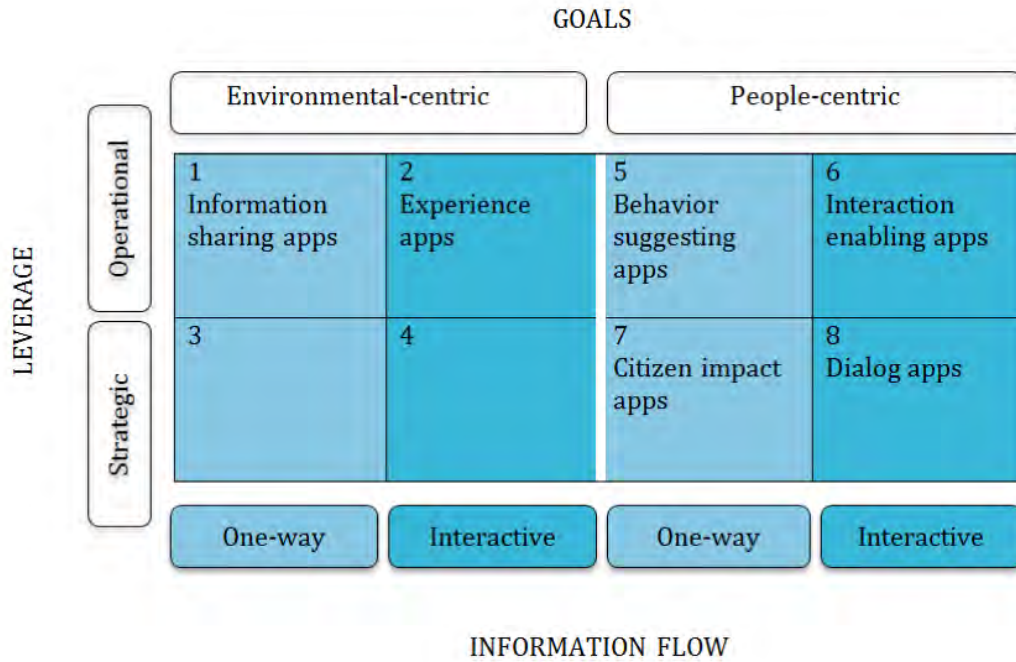
Figure 2.1: Typology of m-participaton apps [57]

as *FixMyStreet*[4] or *Citizens Connect*[5]. However, there is a gap on apps that leverage strategic actions and are interactive at the same time, both important factors to build a long-term participation. Moreover, the fields *(3) & (4)* are non-existent and even *(8) Dialog apps* are few in number and there is an opportunity to build interactive apps, either environmental- or people-centric, to foster strategic decisions.

2.3 Gamification

Utilizing gaming aspects has been applied in several fields to motivate people and keep them engaged. The term *gamification* is defined by "the use of game design elements in non-game contexts" [12]. Nowadays we see a lot of gamified applications in the mainstream that successfully utilize gaming elements in a variety of fields. A notable example is *Foursquare*[6], a location-based app allowing users to check-in at venues, which is then rewarded with points and badges (interestingly, the app was re-launched as *Swarm*[7] recently, where the gamification elements are not in the foreground anymore). Other examples include *Fitbit*[8], a self-monitoring tool, that measures the step count constantly, lets users compare with other users and introduces

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[4]https://www.fixmystreet.com
[5]http://www.cityofboston.gov/doit/apps/citizensconnect.asp
[6]https://foursquare.com
[7]https://www.swarmapp.com
[8]http://www.fitbit.com

other game elements, such as points and badges. *Foldit*[9] is a civic science tool that includes gaming elements to motivate users to solve complex protein folding tasks, which would be a complex task for a computer.

The mechanics that gameful applications utilize are commonly known in games and can be found in various applications. For instance Kumar and Herger provided an overview of common gaming elements in their book, constisting of the following aspects [32]:

Points: Allowing players to have a single unit of quantification aggregated from their actions.

Badges: Virtual achievements that can be collected by the players, e.g. when reaching a goal.

Leaderboards: Social component for players to compare points and badges with others.

Relationships: "Motivational driver of connection" on social beings ("peer pressure").

Challenge: Motivating people to achieve something "bigger" and another motivational driver.

Constraints: E.g. deadlines can motivate people (with "urgent optimism") to get active.

Journey: Recognize the player's personal journey, e.g. a progress that reports to the player.

Narrative: Adding a story and including the player in the role play to express themselves.

Emotion: Plays a role on how people experience a product e.g. through aesthetics.

Game Economy: Basic currencies (fun, things, social capital and self-esteem) reward the player.

These game mechanic elements can provide a basic set of common techniques to "gamify" an application, although it is not limited to this selection. Typically, they are applied in an *engagement loop*, a "feedback loop that keeps the player engaged in the game" [24, 32]. In a repeating loop the application needs to (1) motivate emotion, (2) call to action, (3) re-engage the player, (4) provide feedback and (5) give rewards.

However, these design elements must be carefully considered, since it is usually not enough to put it "on-top of the surface". Instead a designer should understand the user's (or the player's) intensions and motivation to enrich the experience in a meaningful way with the introduced game elements. A common mistake is that gamification elements are simply added without further meaning, for instance receiving a badge for no obvious reason and with no relation of the value why a player might have received it. It is doubtful to interfere in long-term behavior with such a strategy, for example to make people do tasks if it is pointless to them and they see no meaning behind it or to change a person's attitude by simply adding a gamification layer.

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[9]http://fold.it

2.4   From Play to Pervasive Gaming

Huizinga provides as commonly accepted definition of play: it is as a voluntary activity taking place outside of the ordinary and takes physical or mental effort [22]. Based on that definition of play, current gaming literature introduced the term *magic circle*: a social and cultural structure constructed during the act of play where both, players and outsiders are aware of the playful activity taking place outside the ordinary life [53]. With the wide distribution of smartphones a new field of digital games emerged called *pervasive games*. These games carry the *digital* world into a *real* setting, giving them a new meaning and blurring the border between these worlds. These games show features that "expand the contractual magic circle of play socially, spatially or temporally" [44]. Possible genres of pervasive games are *smart toys*, *affective gaming*, *augmented tabletop games*, *location-aware games* and *augmented reality games* [39]. The concept of a ludic city is not new and has historical origins as pointed out by de Souza e Silva and Hjorth [11]. Historical movements such as Charles Baudelaires *flâneur*[10] and the transformation to the *phoneur* [36], Guy Debord's idea of the *dérive* [11] and the subculture *parkour* have turned cities into *playful spaces* before the emergence of mobile technologies.

Pervasive games evoke a great fascination on people. Notable examples include *Can you see me now*, a mixed reality game in which runners in a city were chasing online players who could move on a virtual map [5]. Both parties were connected through GPS and runners could communicate via walkie-talkies. This communication was intercepted by the online players, which caused exciting tensions as well as other factors, such as the unreliable GPS signal. The interactive urban game *REXplorer* was designed for tourists and allowed them to participate in urban adventures at several sightseeing spots [1]. A handheld device equipped with GPS and a display was handed out to the participants and offered location-based puzzles and playfully educated about history.

Commercial projects include *Geocaching*[12], a real-world treasure hunting game. The geocaching community needs to find so-called *caches* (e.g. a small box containing items such as a guestbook), which are hidden in regular places in a city or even countryside. The GPS coordinates of these places are available online or obfuscated with puzzles in different difficulty levels. Another recent example that became popular is *Ingress*, where two parties need to virtually conquer places, for instance famous spots that are assigned to one of the two factions. The game was initiated with a campaign setting the story for the game which is still present in the game through various channels (therefore this game contains aspects from *alternate reality games*[13]).

It is crucial to adapt to the target audience when designing a pervasive game. One cannot simply assume that players will invest their time when a game demands it, instead the game-play should interweave into the player's daily routines. This is especially important for pervasive

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[10]The flâneur is "a person who walks the city in order to experience it", Baudelaires 1863.

[11]A concept shifting the view of a city, defined by a "playful-constructive behavior and awareness of psychogeographical effects", `http://www.bopsecrets.org/SI/2.derive.htm`.

[12]`http://www.geocaching.com`

[13]An *Alternate Reality Game (ARG)* can share attributes of pervasive games and consists of a "compelling storyline and a collaborative game play", usually available through multiple channels [25]. The story can e.g. contain mystery elements and players perceive the story through channels such as websites, online discussion boards, text messages and so on.

games, since they usually require a player to be on-site due to the nature of these games. For a player this means to take that extra effort to physically travel to a certain place leaving a risk that a player will decrease the motivation to achieve this task. However, pervasive gamers are willing to adapt their daily routines [4, 34]. For example the gamers are taking longer routes to work and in general it is a good approach to link into these daily routines.

In the location-based game *Feeding Yoshi* first long-term insights of interweaving a mobile game with the everyday life were drawn [4]. In this game players must feed "Yoshis" and therefore plant virtual fruits on-site where these creatures can be fed. The game applies a *seamful*[14] design and was created to run long-term. The players could engage in the game while going after their daily routines, for example when they were traveling to work. Within the study of this game some interesting findings were mentioned, for instance the players extended their daily routines on journeys and the game blended into the player's everyday activities. Furthermore, they started to plan their time and the game was a welcomed distraction. They learned to interpret the urban environment to play the game and social interactions also played a role. These aspects are important factors when considering to the design a playful e-participation tool since they share many attributes and wanted behaviors. Investigating pervasive game concepts can uncover interesting insights, as it was done within this thesis (see section 4.1).

2.5   Models in Literature

Human Computer Interaction (HCI) literature provides suitable approaches to abstract human factors, such as the capability of technology to change user behavior or measure enjoyment. This becomes important for the evaluation as well, when applying these models. In the following are adapted models from fields originating outside of HCI (e.g. psychology or sociology) that consider human factors and relate to the thesis' topic. They are important since these models build a basic framework for the design process and the evaluation of the prototype.

Persuasive Technologies

Technology is causing emotions on humans and can have the power to change the behavior. The term *persuasive technology* coins this effect and so far only few research in HCI exists [15]. The *Fogg Behavior Model (FBM)* tries to model human behaviors to design persuasive technologies [16]. To influence a person's behavior some requirements need to be fulfilled: (1) the person must be motivated (2) have the ability to take the required action and (3) must be triggered to take action. Figure 2.2a gives an overview of the model on how to persuade the user to create a certain target behavior. If a person has a high motivation and high ability to do a certain task, the likelihood that she or he takes this action is higher when triggered appropriately. This simplified model can help to understand when a desirable action (e.g. discussion an urban topic) is likely to happen and to design an application to change a behavior.

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[14]The term "seamful" was coined early in the field of ubiquitous computing by Mark Weise [59]. A "seam" denotes a gap between technologies [3].

(a) The Fogg Behavior Model (FBM) [16]

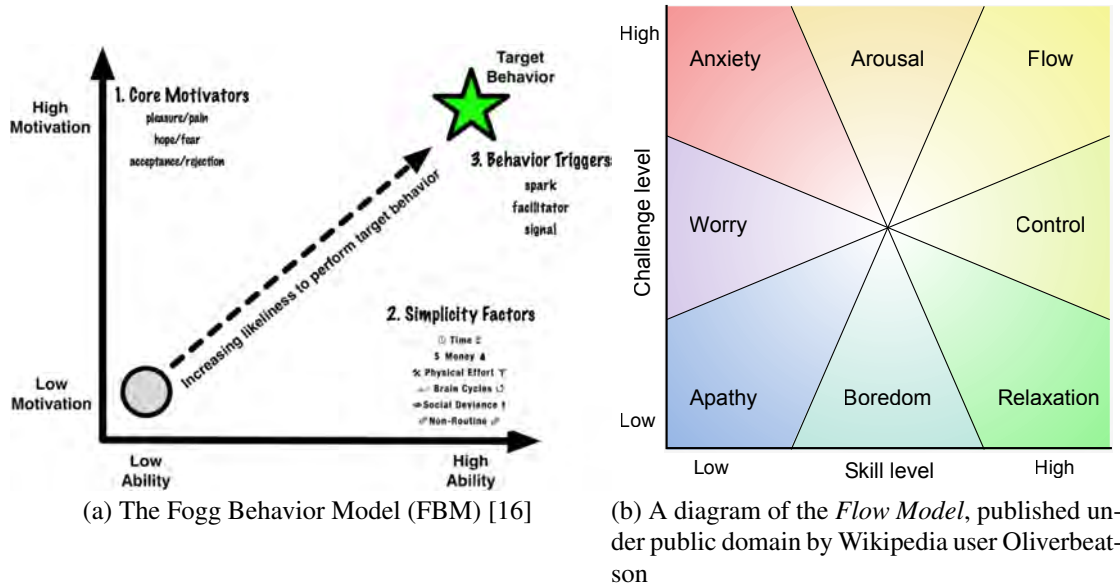(b) A diagram of the *Flow Model*, published under public domain by Wikipedia user Oliverbeatson

Figure 2.2: Models on persuasive technologies and flow

Game Enjoyment

Measuring the enjoyment of games is a subjective and difficult task, however, there are models in literature that provide an understanding on how people enjoy tasks, such as games and further models to evaluate the enjoyment of games. In the following is an overview of the literature that partly was used for the evaluation of this thesis' resulting game prototype.

Mihaly Csikszentmihalyi describes optimal experience as *flow* [10]. He defines flow as a "mental state where you are feeling that you are not doing your ordinary everyday routines"[15]. This is a state where the person's *skill level* and *challenge level* of a task are high. At this point the person's "existence temporarily suspenses" and the focus limits the perception around the person (roughly explained, due the human's brain limited neurological processing power). Figure 2.2b provides an overview of the *Flow Model* showing all other states, for example *arousal* is a state that can lead to *flow* and can occur when a person is mastering the next level of a challenge. On the other hand, *control* is a state where a person is mastering a challenge and feels comfortable. If the challenge drops this can lead to *boredom* or even worse to *apathy* if skill level and challenge level is low. Csikszentmihalyi points out, that many people are staying in the *apathy* state and this issue should be addressed especially. In his study he conducted numerous interviews (e.g. with creative people) and identified following factors, which are important to reach the flow state: (1) complete involvement, (2) a sense of ecstasy, (3) inner clarity, (4) skills that are adequate to the task, (5) a sense of serenity, (6) timelessness and (7) intrinsic motivation This model is a basic foundation to understand how and why people keep on doing tasks, such

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[15]From the TED talk "Flow, the secret to happiness" by Mihaly Csikszentmihalyi, available under `http://www.ted.com/talks/mihaly_csikszentmihalyi_on_flow`, accessed: 2014-08-28

as games, even in their spare time and in general invest a resources without a direct measurable incentives (in forms of goods etc.).

Gaming can provide this "optimal experience" to their players, and it was argued that naturally it is very important to make games enjoyable. The flow model was adapted for gaming and is referred as the *Game Flow* model [54]. The authors identified eight categories that make a game enjoyable: (1) the game should require *concentration*, (2) be *challenging* for the player, (3) support the *player skills*, (4) give the player the feeling of *control*, (5) provide *clear goals* and (6) appropriate *feedback* (7) the player should *immerse* into the game and (8) have opportunities for *social interaction*. In another work this model was synthesized into the *Pervasive Game Flow Model (PGM)* where these categories were evaluated for pervasive games, which need to meet different requirements than their counterparts since these games are played in a different setting [23][16]. In this work the PGM was used as a criteria to evaluate the game since it shares attributes of pervasive games. The game flow model was also extended in other related fields, including *alternate reality games* [38] and in the context of *gamification* [20].

2.6   Playful Civic Participation

While there are only few approaches bringing pervasive gaming elements into e-participation, there are discussions of a meaningful combinations and that this approach has potential to raise participation [14,51,55]. Existing attempts to bring gaming concepts into a participation process for example include the serious public participatory game *NextCampus* [48]. The game deals with a real-world problem of moving a university campus to another location and the goal was to create an optimal solution to satisfy all stakeholders. Other examples that educate people include *SimCity*, *PlastiCity* or *City Creator*, which are highlighted in [47]. These serious games teach on topics such as urban planning, however, they don't take a step further by shifting this context into reality.

Attempts to merge gamification elements in democracy apps are also available. Notable examples include *Commons*[17], a mobile game designed to reward the reporting of geo-tagged issues and suggestions to improve the local environment [50]. Other participants can vote these issues and the game utilizes classic gamification elements to encourage people to get more involved. The project *Community PlanIt*[18] offers a web platform that allows citizens to submit ideas, report issues and suggestions on how to improve a specific problem [17]. A rewarding mechanism (e.g. points and voting) should keep the people engaged and foster discussions. Participants can earn coins by solving (pre-defined) missions or discussing topics. These virtual coins can be spent to support actual projects. The game ended with a workshop. A similar project is *MindMixer*, a web platform that aims to create a community engaging people in civic topics. The municipality states a problem and lets communities take part in the planning process, a similar approach as crowd sourcing. People can share their ideas and discuss them on this platform, while officials can also participate in these discussions. Gamification elements motivate to

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[16]The elements and criteria of the PGM are attached in Table C.1 in the appendix C.

[17]http://www.commonsthegame.com/

[18]https://communityplanit.org/

engage in discussions on different topics. Discussions are getting rewarded with points, which can then be exchanged for discounts.

There have also been event-based solutions presented at festivals, for example *Gentrification: The Game!*[19]. It is a smartphone-driven mixed reality game that explores the gentrification of an urban space through a playful and social event. Novel approaches also include the urban game *ZWERM*, a public installation to foster community participation [33] or the virtual reality game *Participatory Chinatown*, where people play the role of a local resident in order to plan Boston's Chinatown [18].

Solutions to include gaming aspects are emerging and seem to be promising to further motivate people to participate in urban governance process. Creating long-term pervasive games for citizens might be a proper way to create local neighborhoods and interact with remote communities. Other aspects, such as crowd sourcing can be utilized to gain high-quality and valuable feedback for officials.

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[19]http://www.atmosphereindustries.com/gentrification/

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CHAPTER 3

Methodology

Requirements	Design	Development	Evaluation
Literature Research	Prototyping	Backend Server	Technical Pre-Trial
Online Survey	Focus Group	Mobile App	Walkshop
			Game Evaluation
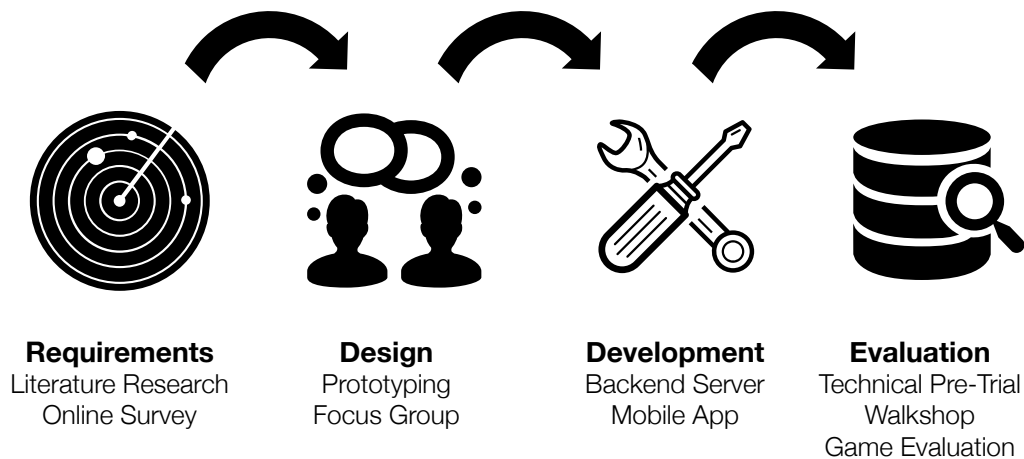
Figure 3.1: A conceptual overview of the applied methods in this work[1]

This chapter introduces the methodology applied for this thesis. It follows an iterative user-centered design process that finally leads to a functional prototype and is later evaluated and discussed. The methods, as shown in Figure 3.1 and described in the following sections, were chosen to assess the research questions, as introduces in section 1.3:

RQ1: Which effects has a gamified participation tool on citizens?

RQ2: How will gaming elements be perceived in a participation tool?

RQ3: What potential has a gamified participation approach to motivate people long-term?

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[1]Image credits: Radar designed by Karsten, Brainstorming designed by Icons8, Tools designed by Michela Tannoia and Data Analysis designed by Brennan Novak from the thenounproject.com.

3.1 Requirements

During the very first phase necessary requirements were assessed to build a game for participation. In the following are the methods that were applied for this phase.

Literature Research. Current literature on e-participation, gamification and pervasive games was studied to gain an understanding of the related fields. This method further includes the investigation of currently available e-participation platforms and pervasive games, as well as solutions trying to combine game elements with civic engagement.

Online Survey. This step involved the investigation of pervasive games and their players. An online survey was created and posted to two major communities of the game *Ingress* and received interesting results that led the further design process.

3.2 Design

During the design process it was necessary to determine how to design the right app for citizens. Prototyping a solution went in conformity with gamer's feedback on pervasive games. This process included the methods described below.

Prototyping. This phase was focused on developing a game concept to create a gameful e-participation app. It involved methods, such as brainstorming, pen & paper sketches, low fidelity wireframe mockups and high fidelity interactive prototypes.

Focus Group. Finally, in a focus group with two gamers of pervasive games the generated material from the previous step was discussed, evaluated and further ideas were generated that led to the game concept described in this work.

3.3 Development

During the development phase a mobile app including a backend system was implemented utilizing latest state-of-the-art technologies. The app covers the major functionality proposed in the design phase which was further required for the evaluation of the concept. The process involved the investigation of front- and backend technologies, and the actual implementation in several iterations

Backend Server. This component was built to handle the business and game logic, utilizing a location-based database, a REST API and a web interface for administration.

Mobile App. The mobile app provides an appealing front end to play the game on mobile platforms including Android and iOS. It was iteratively developed and enhanced to meet the requirements for the user trials.

3.4 Evaluation

The developed app was tested and evaluated in different scenarios. The evaluation was staged in three chronological phases:

Technical Pre-Trial. The first pre-trial over several weeks was focused on functional and usability testing. During this phase the app was handed out internally to gain early user feedback regarding usability and to evaluate the technical framework. Having colleagues as testers assured a quick response.

Walkshop. As a follow-up to the *Technical Pre-Trial*, a more focused field trial was conducted during an afternoon in form of a walkshop[2]. This trial wasn't planned from the beginning but the lack of created content and a general low participation during the pre-trial motivated to gather the internal test users for an afternoon session and ended with an organized barbecue. This was the first time the app was tested in a more realistic scenario on-site with relevant tasks.

Game Trial. Finally, a set of the introduced game concept features (see chapter 5) was tested with participants who were not familiar with the concept. Similar to the *Walkshop*, this was achieved during an afternoon session and included a feedback round. The play-testing was important for participants to gain hands-on experiences on the prototype to have a more profound discussion basis.

The first two phases didn't include the gaming mechanism in the app. This was motivated by several factors: (1) these phases were focused on technical testing and content creation, therefore having game elements was not necessary, (2) it was interesting to see how the app would perform with and without gaming elements, since technically the game mechanics were built on-top of the platform and (3) the developing of the whole platform, including backend server and mobile app was time-consuming and therefore made sense to test parts of the app before it was finished in every aspect. This thesis focuses on the outcome of the *Game Trial*, whereas results of the previous trials are reported in a paper [56][3]. Further material on the *Technical Pre-Trial* and *Walkshop* including the paper are attached in the appendix A and B.

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[2]The term *walkshop* is inspired by a method to evaluate location-based applications in realistic settings [29].
[3]Authored by a colleague and in-review when this thesis was written.

Design Process

> **Learning from** existing **games and their players** is important when designing a game. **Prototyping** games requires **interactive tools** that should be utilized to **consequently gather player's feedback** throughout the design process.

The requirements to build a gamified participation platform required understanding existing pervasive games. The design process was initiated with an online survey to gain experience on how current pervasive games work and what makes them motivating and fascinating for the players. The results led to an ideation phase resulting in a basic app concept. This was then illustrated with paper mockups and an interactive prototype. These outcomes were further utilized for an in-depth analysis within a gamer focus group. The experiences gained in these sessions were then used to refine the overall concept, which is covered by this chapter.

4.1 Online Survey with Players of Pervasive Games

To design a pervasive game one has to understand the players, a process referred as *player-centered design*, which conveys the principles from human-centered design into a game-related context [2, 32]. The author's approach was to investigate why pervasive games are attractive to their players, what keeps them motivated to play and the game elements of pervasive games. An online survey distilled the essential motivational elements and provided a foundation for the design phase. The detailed results were published as work-in-progress [34][1], therefore this section will summarize the core findings which were important to derive a concept for a gameful long-term m-participation tool.

The questionnaire's objective was to investigate the main motivators for playing location-based games and included questions on gamer's demographic, digital games, experience with location-based games and the fascination they cause, usage behavior while playing (e.g. the

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[1]Co-authored by team members.

influence on daily routines), experiences while playing location-based games (e.g. negative, positive and memorable experiences) and finally the participants were asked to rate enjoyable aspects of location-based games.

The online survey was posted in two major Austrian Ingress online communities and received 33 responses (6 females) aged between 15 and 51 years (mean=29, median=30). Investigating the results revealed some interesting insight, for example playing the game had an impact on the player's behavior: 94% play between their daily routines and are willing to adapt their daily routes. 87% play in their spare time while only 26% allocate time. The players were asked on important aspects regarding fascination, positive and negative experiences and the responses where clustered into following themes:

1. **Sociability:** This theme was most prominent and mentioned by 61%. Players enjoy to meet other people, feel bond to community and like team play.

2. **Exploration:** The city as playground is challenging and exciting, players are engaging more with their environment.

3. **Activity and achievement:** Pervasive games are a good reason to stay active and healthy and it is an adventurous experience, where players get satisfaction through leveling or organized missions.

4. **Novelty:** A new way of gaming is exciting and also creates new challenges for the players.

When designing the game concept and crafting the game mechanism the above mentioned principles built the conceptual framework. It helped to evaluate concepts in the ideation phase, for instance when introducing a new mechanic or changing a mechanic, this provided a practical way to justify this by asking "does the game meet the categories?".

4.2 Ideation of a Pervasive Gaming Concept

The ideation phase involved classical techniques, such as scribbling on white boards, brainstorming and discussions with colleagues. In the very first phase it was decided that the concept should gamify a situated engagement platform. Through location-based topics (later referred as *contributions*) users can report on issues, initiate polls or share ideas. Those topics are then discussed and voted, as it is already done in similar apps, which are available in some cities (e.g. the mobile reporting tool *Schau auf Linz*[2], where citizens of Linz in Austria can report on issues of their town and discuss these). The major issue was to create a concept that involves location-based aspects coupling a use-case for civic engagement with a game play. First sketches were incorporating the idea of gaining local area for some actions, inspired by current pervasive games such as *Ingress* or a similar approach that can be found in the game *MyTerritory* [35], where players are required to circle an area to conquer this space and tag it with a music track.

The idea of having communities or neighborhoods of interacting players was attractive and fitted to the engagement theme. Teamwork and a positive competition could be fostered at

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[2] http://schau.auf.linz.at

the same time. To overcome the problem of how to build up communities a simple technique was chosen: each contribution was assigned to a location and could gain an area defined by a radius at the point-location. Furthermore, the area (or radius) will reflect the importance of the contribution by taking comments and votes into account. Assuming that contributions with more comments or votes have a higher impact, this could provide a powerful visualization technique when viewed on a map. Communities can then simply be formed when two or more contribution areas are overlapping.

After this idea was settled, the concept was given the name "Community Circles", a location-based mobile game that allows citizens to participate and discuss urban topics in a playful and motivating manner. The content would consist of user-generated and georeferrenced contributions where each contribution has a certain impact radius, which is derived from its activity and responses from others, as previously described. A contribution has a lifetime until it disappears on the map and as long as this contribution shows some activity, in form of comments or votes, the lifetime will be extended. Eventually it "dies" when the contribution is not relevant anymore. When contributions form a community, this community has positive influence on the contributions' ranges inside that community. With this game mechanic, a dynamic network of contributions where players are required to actively engage will emerge and the overall goal is to grow communities and keep them alive.

4.3   Sketching and Mockups

The online survey from the section 4.1 identified the main objectives and attributes to design a pervasive game. During the initial ideation phase the overall concept was created. The very first attempts were drafted with pen and paper and these mockups were later transformed into a digitalized wireframe layout with further enhancements. The mockups were supposed to get a sense of how the app could be laid out and provide a navigation flow, based on common user interface patterns as they are used in social platforms. In another phase they were also used in a focus group with gamers to give them a feel of the app. Figure 4.1 depicts the resulted mockups and following is a description of each screen with its purpose.

Login (see Figure 4.1a). The initial entry point for a user is the login screen where a user can login. To authenticate a player must provide a username and a password. Additionally, a Facebook login is available to create a quicker access to the game. A text should provide some basic information on the game.

Map (see Figure 4.1b). After a user is logged in this is the first screen, which displays a map informing about the user's current whereabout. On the top a quick overview of the user's profile is presented, including metrics such as the number of posts. The notifications are available by tapping the top-right icon. The map itself displays contributions with a profile icon and includes the number of comments and votes. A community is displayed opaque with an outlined border and overlapping contributions have a visual link between them. On the bottom are two buttons: on the left is a search button navigating to a filterable list and a plus icon to add a new contribution.
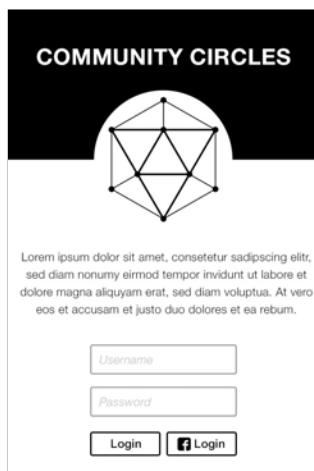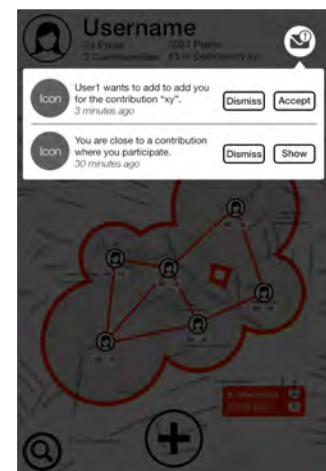
(a) Login (b) Map (c) Notifiction overlay

(d) Contribution list (e) Contribution detail (f) Add contribution

(g) Profile overview (h) Own contributions (i) Player's communities

Figure 4.1: Wireframe mockups of the initial game concept

Notification overlay (see Figure 4.1c). Notifications, for example about nearby contributions with some extra information are available within the map screen by tapping the mail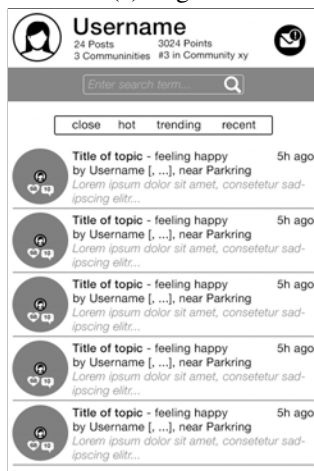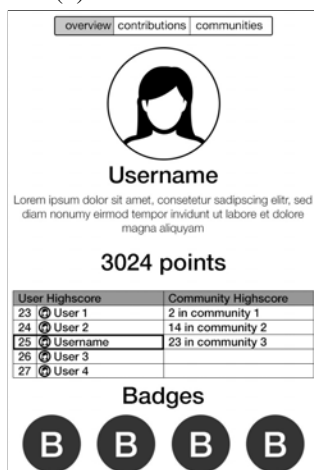 icon on the top right. Without leaving the context, the notifications are drawn above the map and can be dismissed, accepted or navigate to another screen, when appropriate.

Contribution list (see Figure 4.1d). Alternatively, contributions can be displayed as list and be filtered by a search term and sorted by several criteria such as "close" or "hot". The top bar is the same as shown in the map view. The items in the list include data, such as an icon, title, creation date, username, location name and an outline of the description.

Contribution detail (see Figure 4.1e). When selecting a contribution, either via the map or the list view, the app navigates to the contribution's detail screen. On top is a visual reference with a map giving the user information where the contribution was created including the contribution type. The contribution photo is placed very prominent below and basic information such as title, author and description follow. Icon buttons allow voting and commenting the contribution. Finally, the comments are presented in a list below the contribution.

Add contribution (see Figure 4.1f). Within this screen a player can submit a new contribution. On top is a minified map view with an icon in the center informing about the current location and a button to select a name for the location. The available contribution types can be selected through a tab bar. Two text fields receive the title and description (the "Add option" button was drawn to demonstrate the input mechanism for polls). In a dropdown list the user can select a mood and two buttons below enable to append a photo or tag a friend who co-authored this contribution. Finally, the plus button on the bottom submits the contribution

Profile overview (see Figure 4.1g). This view displays a user's profile including some statistics and rankings, for example the number of gained points. The received badges are also displayed in this screen. On top is a tab bar where a user can switch between different views. Beside this profile overview, the user's contributions and communities can be accessed.

Own contributions (see Figure 4.1h). This view is also part of a user's profile and lists the contributions, similar to the contribution list described above. Additionally, contributions that aren't active anymore are listed below appearing less prominent.

Player's communities (see Figure 4.1i). In the community section of the user profile the communities a user currently belongs to are listed. The list contains information on each community, for example an icon with the location, the community age, members of the community and other meta data.

These mockups don't cover every aspect of the game design and provide a basic feel of the app without connecting every user interface elements to the described concept (e.g. meta data in the list views or the profile were just an indication how such data could be presented). They were used as a guideline when developing the app, however, not every detail was implemented

Figure 4.2: Screenshot of an early design experiment of the network behavior in the game

as suggested by these designs. For example when appropriate the user interface approach was changed if the mockups didn't meet the user requirements for the prototype or other details couldn't be implemented within the technical framework that easily.

4.4 Interactive Demonstrator Prototype

Pervasive games add a level complexity compared to "classic" games due to their nature, for example the location can be essential for the game play. Creating early prototypes to explore the design is important and of course, pervasive games are no exception [2, 46].

The core game mechanic in this thesis' prototype is the dynamic network of contributions and communities, which evolves and changes over the time. Static images were not suitable to convey this idea and a tool was needed to easily experiment with parameters and visualization techniques. Therefore an interactive prototype was developed using *Processing*[3] to demonstrate and experiment with the dynamic network of the gameplay.

The prototype was iterated several times, for example in the first version it was only possible to place nodes with a random radius on a static map which were connected when they were overlapping (see Figure 4.2). This evolved to a richer interactive prototype, where the map could be panned and zoomed, the game mechanics were implemented in code and several visualization techniques could be tested. Further, it was possible to simulate the effects of voting and commenting (see Figure 4.3) and supported other features: it could be run in full-screen or window mode, display a device frame to get a feeling of the mobile version or had an adjustable

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[3]Processing is an easy-to-learn programming environment based on Java for fast interactive prototyping, available under http://www.processing.org.

(a) Demonstrator with user interface elements and simulated device frame

(b) Contributions with icons

(c) Contributions with profile images
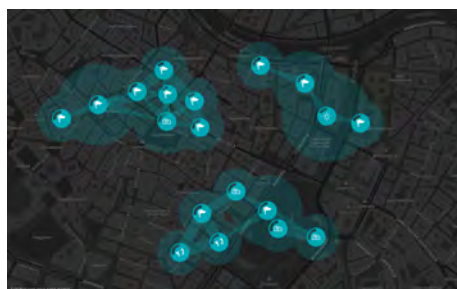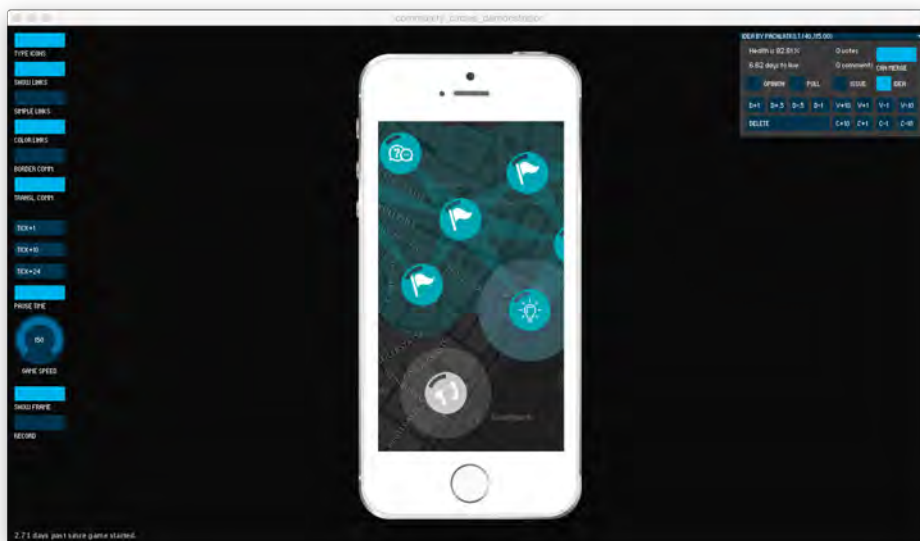
Figure 4.3: Latest demonstrator version and visualization alternatives

fast-forward option. It supported several visualization alternatives accessible through the user interface, for instance contributions could display an icon or a profile picture (see Figure 4.3b and Figure 4.3c). Other visualization techniques regarded the impact area of the contributions, for example it was possible to display the impact areas as a translucent circle shapes or with outer borders and the links between connected contributions could be displayed as a single line or arrows (the arrow was directed to the contribution with a smaller area).

Contributions could be placed freely on the map and rearranged by dragging them. When a contribution was selected, the prototype showed an interface (see top right corner in Figure 4.3a) where the contribution type could be selected, lifetime be increased or decreased, votes and comments added or removed and it showed basic meta data, namely the health, time to live and the number of votes and comments. The prototype allowed quick interaction and utilized for discussing use cases and possible game scenarios. It was used internally and also in a focus

group to have a more meaningful discussions basis on the game play.

Another use-case for the prototype was to generate material for presentations, for instance to better explain the dynamic of the community evolving the prototype could export each frame which was then converted to a video[4].

4.5   Focus Group with Gamers

The interactive prototype was discussed with a small focus group consisting of two persons during three hours. The participants had experiences with pervasive games, are male (26 and 27 years old), technology affine and were recruited through friends. Each phase was recorded with audio (in-between, the author also took notes), transcribed and categorized for the evaluation. Furthermore, the participants also filled out the online survey from the previous section after the focus group. It consisted of three phases, described next in this section.

1. **Interview.** A semi-structured interview with open-ended questions regarding experiences while playing the pervasive game *Ingress*, since both participants where actively playing this game over a longer period. The interview was framed by the following questions: (1) What location-based games do you play? (2) How often and when? (3) Does it have impact on your daily life? If yes, how? (4) What do you like about these games? (5) What keeps/kept you motivated to play? (6) What was the most *positive* moment you remember when playing? (7) What do you not like about these games? (8) What was the most *negative* moment you remember when playing?

2. **Wireframes Demonstration.** The concept of the game *Community Circles* was explained to the participants before, for example the different types of contributions, the impact of the radius and how communities can be formed and how they grow. Afterwards the wireframes demonstration started and the participants were invited to discuss the general app usage behavior. The wireframes are depicted in Figure 4.1, were printed roughly in the size of a smartphone screen including a device frame and presented on a table.

3. **Interactive Prototype Demonstration.** Finally, the prototype was presented on a laptop and the participants were shown several visualization options, could interact with the system afterwards and discuss the game-play in detail.

Results

This section summarizes the results regarding further design decisions. Overall, the concept was perceived positive and the interactive prototype was a good discussion igniter allowing the participants to create valuable input to improve the game mechanics.

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[4]A video of the dynamic contribution and community evolving is available online under `https://vimeo.com/107456261`.

Interview

The results from the interview were drawn from a transcription based on an audio record, which lasted approximately 45 minutes.

The interview revealed, that the two participants were formerly players of the pervasive game *Ingress* and had different motivations for playing: one person enjoyed the social and challenging aspects, while for the other person the game was a motivation to spend some enjoyable time and it was an opportunity to go outside and visit places that he hasn't been before, or even once for a trip on a weekend. This also reflects their behavior during the game, for example one person became active in the online community, participated in dedicated events for the game to gain progress and partly participated in social events outside the gaming context with people not known before. In comparison, the other person played when there was time left, for instance while taking public transport and was even willing to take different routes.

Both played for about a summer season (with some breaks and becoming partly active afterwards) and eventually quitted playing the game. The reasons go in conformity with their attitudes and motivation of playing the game: one person wasn't satisfied with the community evolvement, claiming that some players *"took it too serious"* and therefore it wasn't fun anymore (similar opinions were mentioned in the online questionnaire). The other person lost interest in the game over time, since it didn't offer new challenges and the system was penalizing behavior where one wouldn't play for a longer time and other player's would level up so that there was no chance to compete. Another frustrating aspect was that a player was strategically building up an area which was destroyed by other players (although this was not "virtual vandalism" but part of the game).

Positive experiences included community bonding, for example doing trips with other team members or achievements in the game when one developed a strategy to level up and succeeded. Both participants also played together from time to time, for instance by the game design itself it is a good strategy to have an "experienced mentor" who can guide and help the other player to level up, as it was the case with the two participants.

It is remarkable that both persons seemed to differ in their personal attitudes regarding the cause of playing the game, yet it offered motivational aspects for both of them. One person also mentioned a few times that the optimal time for playing this game was between daily routines, for example when taking public transport to work.

Wireframes Demonstration

The participants were briefed about the game concept and in this phase first questions were raised and improvements suggested. Some comments regarded the user experience in a sense that the app should be context-aware and on how to interact with it.

For example the app can notify people nearby if there is an issue close and therefore warn in this situation. A possible use-case would be a broken traffic light where pedestrians should pay attention.

They agreed, that including the context is important for the game, for instance if one is living in a neighborhood and feels annoyed by cars driving by, she or he should have more power to speak (compared to the person who drives the car). It was even mentioned, that issues can

have a timespan or only be valid at for a certain time period, for example during rush hour. The participants were focused on issue reporting and stated that the motivation must be positive driven. Other comments regarded the handling of an online community and the risks were mentioned, for instance spamming or inappropriate content. They suggested including moderation and reporting possibilities to compensate the possible exploitation of the game.

An indication of a game design flaw was raised: how does the game start and what is motivating you to create the first contribution? Another comment regarded including tutorial at the beginning or provide a certain task, for example when a player is waiting somewhere the app can suggest to find issues nearby. This can further be supplemented by winning badges, getting points and so on. However, the user's context (e.g. location or what she or he is currently doing), is very important to achieve such meaningful suggestions by the app.

When confronted with the wireframes it seamed clear to the participants what the purpose was and they could imagine how to use the app. Some comments were concerning that the screens contained too much information to be displayed on a smartphone. However, there were some longer discussions on two screens, which are described next.

Login (see Figure 4.1a). There was confusion regarding two login buttons. However, one participant misunderstood it, while this approach was familiar to the other person. It would be best to do a best-practice approach and adapt the behavior of similar apps, such as *Instagram*, *Spotify* etc., which offer two login types. Although the login seems like a rather trivial functionality, it raises questions on *how* people want to access such a service.

Add Contribution (see Figure 4.1f). Both participants agreed, that this is the most crucial part of the app. It requires the most effort from the user to add high quality input and should therefore be easy-to-use. In their opinion a classical title and description input method is not comfortable. Instead the app should suggest meaningful input, for example the title could be pre-filled with data from nearby POIs and the contribution type ("Issue at POI") or give a glimpse what other people posted nearby. Assuming that many people are posting similar contributions this might be an interesting addition. Further comments regarded a tag-cloud solution to visualize popular nearby contributions, the lack of social features, such as a Facebook or Twitter button, and the suggestion that an emotion could be directly inserted through an emoticon.

The most important learning from this demonstration was that users require a quick and easy way to interact. Since most user input is required from the creation of a contribution this screen needed a redesign guided by the comments from this phase. At this stage this screen tried to combine too much so the consequence was to reduce and rearrange the complexity.

Interactive Prototype Demonstration

In the last phase the functional prototype was demonstrated and discussed. At this stage the participants were aware about the game mechanics. First the author demonstrated the prototype and showed the visualization alternatives and the handling of the prototype. Finally, the participants could interact freely with the demonstrator, which fostered some interesting discussions. Following is the summary of the collected resulted clustered into the corresponding themes.

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User interface. In general the participants found the prototype appealing, however, they raised the question if the map is too dark and concluded that it is a personal preference[5]. They also noted, that the icon size can be problematic, for example when a lot of contributions are placed close to each other and therefore become very dense. When they were confronted with the weighted and directed contribution links (see Figure 4.3b) they were confused about the direction, and mentioned that it *"looks nice but not very helpful"*. However, they agreed that it is important to see the history how an impact area developed. A combination of the contribution icon and profile photo would be a good solution, although the prototype couldn't display both at the same time. Both participants argued that a profile picture as contribution icon is important, because it allows to recognize a person, for example meeting this person in a neighborhood would provide an opportunity to talk.

Gameplay. Very early a question on the design mechanic itself was raised: why is a contribution more important or relevant, when someone nearby added a contribution? They pointed out, that *"it doesn't correlate"* which raised a discussion on how to improve the game play, described later. Further, the motivation of the community relevance and the influence for every contribution was doubted, although giving points for votes and comments to reflect the contribution's success is a good idea. A similar question regarding the usefulness of communities was raised: *"What is the benefit of a community?"* and other aspects, for example whether one would belong to one or more communities?

Improvements. The interactive prototype fostered discussions and suggestions on how to improve the concept. One discussion addressed the problem of motivating people to be part of a community. Both members agreed that there must be a benefit of being in a community in order that it is important for people to reside in a community. Members of a community should have more power, for example have the right to decide inside the community. This could raise the voice inside the person's community when the person is an active member and close to relevant problems that probably affect her or him. One person stated that *"I feel responsible for my community, if I post something in a community; I'm here more often"*. However, those privileges should only exist as long as the person's contribution is active (by receiving comments or votes). A weighted impact factor could be introduced that correlates to successful contributions, for example when a person created a traffic-specific contribution that is well rated, then in other communities this person is proven to have a good reputation on traffic topics and can have more impact on those contributions when voting.

Other ideas were more open for example they suggested combining the app with open data and mentioned that accidents statistic could be matched to communities (e.g. if there are fewer accidents in a person's community then this community could receive more points). Since this app is played on an irregular basis and on-site both participants agreed that it is important to combine information about the person's context, e.g. if a player is waiting somewhere the app can notify this person (*"There seems to be a trouble, would you like to go after that?"*).

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[5]The final version of the prototype switched to a lighter map, simply due to readability issues that came with the dark map when used outside on a phone in sunlight.

They concluded that the presented concept sill lacks in basic gaming elements. It misses more game elements and to compensate this issue they suggested to allow communities to compete with each other, for example a person could raise a negative issue and "hurt" the corresponding community because they have not discovered this issue. Furthermore, missions can be introduced to motivate a player to participate. Both agreed that including missions is a very crucial aspect in this concept.

Concluding the focus group it can be said that the initial concept was leading to the right direction, however, it needs some rethinking of the game concept, especially regarding the community concept and rewarding. As the participants pointed out, the next steps should concentrate more on designing the gaming elements, since gamers will seek for these features.

CHAPTER 5

Game Concept: Community Circles

The game **Community Circles** is a **location-based mobile game** that allows citizens to **participate and discuss** urban topics in a **playful and motivating** manner to **foster long-term citizen participation**. Strolling through the city, a player aims to create **contributions on-site** – each contribution has an **impact area** that grows with its activity and can **merge into communities**. The long-term goal is to **grow** and **keep communities alive**.

The outcome of the previous steps is a game concept addressing the derived principles and avoiding pitfalls of existing pervasive games. The game titled *Community Circles* with its game mechanics and efforts to keep citizens engaged is introduced in this chapter. It describes the holistic game principles in detail and is understood as a *vision of the complete concept*. Although not every aspect of the game was developed in the prototype within this thesis, this chapter provides an outlook for future work. It concludes with a reflection on the findings raised from the requirements during the design process.

5.1   Overview

Although the core concept of the game should be easily graspable, it is important to have a common understanding of the game's terminology. The game's core is based on *contributions* – these are georeferenced pieces of content authored by at least one player. A contribution is provided with a title, an additional description, a photo, a mood, a location and is of a certain type (only type, title, and additional description are necessary to submit a contribution). It can be freely generated by a user but usually addresses a topic regarding the urban environment. The player can only post a contribution *on-site* with the app installed on a smartphone. The point where the player is standing while creating the contribution is the contribution's location (accessed through the smartphone's location service). By providing these meta data, the contribution gets more meaning – a user can express her or his emotion or capture an informative

Figure 5.1: Screenshot of the demonstrator prototype showing contribution and community evolvement

photo and therefore be better understood by other users. Furthermore, these contributions can be *commented and voted* by the players. A single player can vote each contribution once. By voting she or he indicates an agreement with the author about the contribution. To discuss the contribution, a player can post a textual comment below a contribution. Similar to contributions, a comment can be voted.

The major purpose of this concept can be summarized as a location-based discussion platform. However, the concept aims to strengthen meaningful content and discussions. Therefore two essential elements are introduced to the gameplay for each contribution: an (1) impact area and a (2) lifetime .

Impact Area. This area is defined by a radius which results from the implication of the player's contribution, for example if it gets appreciated with votes and comments the area expands. A contribution has an initial area when posted and can be extended by adding meta data, such as a photo, location name or by creating a contribution with other players.

Lifetime. A contribution has a lifetime until it disappears. It increases, if a contribution gets attribution, again through comments, votes and other activities. This mechanism allows a dynamic network of the contributions and provides a regulation system to avoid spam posts – if a contribution doesn't get feedback it might be irrelevant and therefore disappear again.

Both metrics are visualized on a map – the central user interface for the gameplay: the area as an opaque circle and the lifetime in form of a progress bar placed around the contribution

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icon informing about the remaining lifetime. The contribution itself is presented with an icon symbolizing the type (idea, issue, opinion or poll). Increasing the area or lifetime can only happen through actions of other players in order to avoid heavy self-promoting of players (one could constantly post comments to own contributions to gain more area and lifetime).

Since each contribution has a certain area, these areas can overlap if two or more contributions are in close proximity. Overlapping contributions will therefore build a *community*. In first place, communities will have a more prominent visual appearance and stand out compared to single contributions. The introduction of communities to the gameplay allows a more sophisticated game mechanics, as explained later in the section 5.3. Basically, it means for a player that being in a community will be rewarded, for example by strengthening own contributions in a community. Communities should motivate the player to place contributions in other areas where there are already ongoing discussions. Figure 5.1 shows several contributions with their lifetimes (visualized as circular progress bar surrounding the contribution icon), as well as colored contributions which merged into communities and non-colored contributions without communities. The opaque circle around each contribution is the impact area.

The long-term goal of the game is to grow contributions and keep communities alive. Therefore a player must actively involve in discussions and post content that is valued by other players. This mechanic aims to keep an on-going participation process motivating and fun. The core measurement for a player is the sum of the gained area (in square meters) of all active contributions (contributions which lifetime ran out won't be taken into account). The area sum of all players can be compared with each other and allows having highscores and rankings, but at the same time it avoids a stagnation of the gameplay (compared to other games, where the top list is usually occupied by pro gamers not leaving room for newcomers). As long as a player is active in the game, the player has realistic chances to achieve a good score. This mechanism allows players to join and leave the game at any time without risking to abandon the gained game progress. Beside the contributions area, other metrics can be taken into account, such as the community areas.

The areas provide a measurement of the success for a certain moment. However, achievements over time are still available in forms of badges, that will rewards certain achievements as described later in the section 5.5. Also other game elements, such as *missions* (see section 5.4), are introduced.

The app is addressed to citizens on one hand as well as municipalities on the other hand. Both roles can be part of the game and it is clear to all participants which user belongs to which role (officials will have a special icon next to their username). It is a platform for both groups to stay in contact, share and discuss ideas, raise issues, state opinions and initiate polls on-site. The role of the municipality is important to the gameplay, since the feedback of the authorities is an important factor for e-participation tools. For citizens this app is a playful approach to participate in urban topics, while there are several opportunities and use cases for municipalities[1].
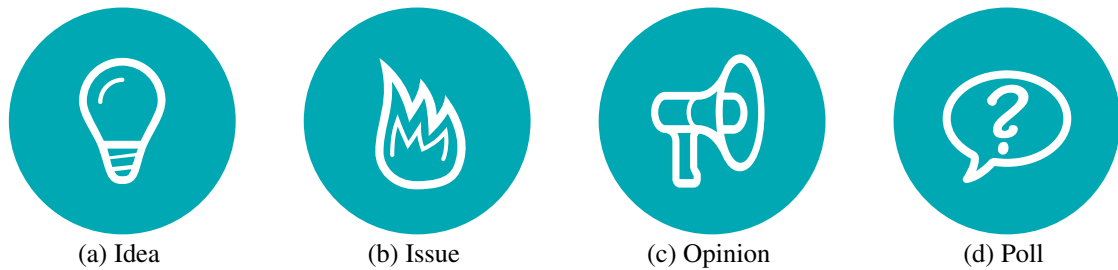
(a) Idea   (b) Issue   (c) Opinion   (d) Poll

Figure 5.2: Available contribution types

5.2 Contributions

Contributions are the "core essence" of the concept. Compared to classical approaches, the contributions can have different characteristic based on the citizen's need to express her or him. The *Community Circles* game offers the following four contribution types: (1) *Idea* (2) *Issue* (3) *Opinion* and (4) *Poll* . These types resulted from of a brainstorming in the design phase and address different needs to communicate an urban topic. Each type is assigned to an icon, as depicted in Figure 5.2. A contribution is assigned to exactly one location (expressed in GPS coordinates) and can only be created at this position. This decision was felt mainly for two reasons: the constraint that the player has to be on-site to contribute goes hand-in-hand with the concept of pervasive games and makes it harder to exploit the game (e.g. creating spam posts to succeed) and on the other hand being at the location helps to understand the context better [29]. A contribution must at least consist of a location, the type, a title and a description (or in case of a poll the actual poll options instead of the description).

Idea. By posting an idea, a citizen can suggest any concern and allow others to discuss it and get supporters, for example she or he thinks that a crossroad would be much safer, if the municipality deploys a stop sign.

Issue. Urban environment is complex and a feedback channel is important to report the city of issues. For example, this could be used while a player walks to work and she or he encounters a broken traffic light that needs to be fixed soon.

Opinion. Citizens may want to share an opinion that can possibly lead to a discussion, for example sharing a personal opinion about an "insider information" when visiting a lovely spot.

Poll. Polls are a powerful instrument for citizens and municipalities to specifically raise questions and ask for opinions. A possible use case is to ask people whether a building should be refurbished.

Furthermore, the contribution can be supplemented with extra information. A photo can be captured or chosen from the phone's picture library and uploaded with the contribution. Having

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[1]A landing page pitching the idea of the *Community Circles* concept is available under `http://cc.b-part. eu`.

a picture will allow other players to better understand the post's intention and also be displayed throughout the app. A list of possible moods can be used to express the user's emotion. This feature is comparable to similar approaches done by social platforms. Thus a player can easily distinguish between a positive or negative mood the author had at the time writing the contribution. Beside the location in GPS coordinates, a point of interest can be selected from a list of nearby location names (fetched through a location service). This should help to better identify the location, since location names might be associated better. If another player was part when creating a contribution she or he can be checked-in to this post. This mechanism would foster a social engagement between citizens. Finally, a mission can be assigned to a contribution (see section 5.4). All previously described meta information will be rewarded in terms of additional area and lifetime, as shown in Table 5.1.

5.3 Communities

Another crucial element of the game are communities. Whenever two or more contributions have overlapping circle areas, they will form a community. Introducing communities should provide more motivation to create contributions, since contributions within a community will be more prominent and have other incentives. Communities are introduced as a further design element to foster socializing and act as competitive elements. There is a further distinction between communities: (1) *home communities* and (2) *neighbor communities* to make the community concept more sophisticated, as described next in this section.

Home Communities

Each player will be assigned to exactly one home community. Therefore, a player must define a home location, for example during the registration process. The closest community to this location will be assigned as home community. Choosing the location is up to the player, but should be a place a player can connect to, for instance home, work, school, university or any other place the player might spend time. To avoid the chance that a very distant community will be assigned as home community, the distance must be within a certain threshold. The home community is visible in the player's profile and the player can identify the home community on the map through a more prominent appearance (e.g. the home community has a distinguishable color). Contributions placed inside the player's home community are displayed differently, for example with an additional user profile photo visible for members in that home community (since members of a home community will more likely recognize familiar faces).

Introducing the home community concept should meet a realistic scenario because there's a good chance that a player has a higher interested in topics around hers or his neighborhood. Each vote and comment for contributions in a home community will be given an extra weight to the area increase (e.g. + 50% to the regular increase) and therefore strengthen the home community. At the same time players have more influence on relevant local topics, because they can "boost" other home community contributions. This mechanic should foster building communities and keeping them alive and involve more citizens in the own neighborhood. Another aspect is to enable a positive competition between other communities (if a player is proud of the own com-

munity's outcome). Although the home community bonus doesn't directly benefit the player's own success (measured in the gained area) when commenting or voting other contributions it can still help to stay in communities, for example by supporting nearby contributions that can influence the player's contributions. Showing some generosity by supporting other contributions might also lead to a "social equilibrium" where players gratitude these actions by also participating in other's contributions (of course depending the attitudes and strategies of players).

Neighbor Communities

Since a player has (at most) one home community, all other communities in the game will be referred as neighbor communities. Any activity of players in a neighbor community will be rewarded. One opportunity for players is to participate in neighbor contributions by voting or commenting on them: this will *boost the lifetime* of *all* the player's contributions by a fixed amount of time. This mechanism should invite a player to participate in other communities than the home community. It is an opportunity to make own contributions stay active longer, for example when the player's contributions would disappear soon she or he has some more chances to extend these lifetimes[2].

Additionally, when posting into a neighborhood this contribution can be visualized differently, so that all other players see that this contribution happened outside of someone's home community (e.g. with an additional icon next to the contribution icon). Whoever posts a contribution into a neighbor community will be named a "good citizen", an achievement visible on the player's profile (see section 5.5). This mechanism allows determining on one glimpse whether mainly players of this community or other participants form a community. Home community players might need the feel to post more in the own community if it get's crowded by neighbor contributions.

Contributions without community

If a contribution didn't form a community yet (because no other contribution is within proximity), this contribution will look differently so that it doesn't appear that prominent on the map. This doesn't affect the growing of the contribution, although it doesn't have the benefits of being in a community. If a player has no home community, because no home location was set or there is no close community, the rules are not affected in any way.

5.4 Missions

A more traditional gaming element in this concept are missions: they are specific task descriptions and can be constrained to a certain area and/or a specific duration, for example a campaign in a district. They were introduced as a resulting outcome of the gamer's focus group (see section 4.5) and the *Walkshop* (see chapter 3), since this trial indicated the importance of targeted

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[2]An alternative approach would be that each received lifetime boost can be stored into a player's "lifetime credit account" and the player can freely decide when these lifetime credits will be spent on contributions to exceed their lifetimes. These can include on own contributions or other's, e.g. if a player shows generosity or supports a good idea.

Table 5.1: Rewards for certain activities while playing (these are suggestions and can vary)

Activitiy	Times Applied (Per Contrib.)	Area Increase	Lifetime Increase
Post contribution	1	$800m^2$	$3days$
Add photo	1	$600m^2$	$2days$
Add POI	1	$500m^2$	$0.5days$
Add mood	1	$500m^2$	$0.5days$
Participate in mission	1	$800m^2$	$3days$
Check-in supporter [*]	n	$1200m^2$	$2days$
Receive vote *w/o self*	n	$50m^2$ / $75m^2$ [*]	$0.1days$
Receive comment *w/o self*	n	$100m^2$ / $150m^2$ [**]	$0.5days$
Comment in neighbor community	n	—	$0.25days$ [***]
Vote in neighbor community	n	—	$0.1days$ [***]

[*] only when creating a contribution, must be approved by supporter(s)
[**] regular increase / home community increase
[***] applies for all the player's contributions

objectives for citizens. It can be difficult to find suitable topics to post a contribution, which can lead to rather trivial posts. When posting a contribution a player can choose whether it should be part of a mission. If so, it will be rewarded with an extra amount of area and lifetime. Missions can be created by city officials and be utilized to address specific needs (e.g. a contest for urban planning).

5.5 Incentives and Rewards

So far, the progress in the game is mainly measured in the area and the incentive system in the game. Table 5.1 lists all rewards influencing the contribution's area and lifetime for each activity in the game. All the mechanics described above mainly reflect the current state of the game progress. They are designed to lead to a dynamic game play, where newcomers have a chance to succeed, since current pervasive game seem to struggle with such flaws [34]. Due to the "contribution dying" a continuous involvement is needed, making it easier to join and leave the game at any time and creating a more enjoyable experience for the players [23]. However, it is important to respect players past achievements, progress and status in the game. These factors are rewarded with *achievements*, as described in the following section.

Achievements

Achievements (or badges) are common gamification techniques to reward players of their accomplishments. So does the *Community Circles* concept and proposes some possible badges that can be collected by the players:

Hello Contribution
For the first contribution

Hello Community
For the first community

Creative Citizen Level x
For every 10th, 20th, etc. idea

Curious Citizen Level x
For every 10th, 20th, etc. poll

Attentive Citizen Level x
For every 10th, 20th, etc. issue

Critical Citizen Level x
For every 10th, 20th, etc. opinion

Active Citizen Level x
For every 10th, 20th, etc. posted comment

Valuable Citizen Level x
For every 10th, 20th, etc. received vote

Discussion Igniter Level x
For every 10th, 20th, etc. received comment

Traveller Level x
For every 10th, 20th etc. contributions in a certain distance

Community Lead Level x
For every 10th, 20th etc. contribution in a home community

Team Player Level x
For every 5th, 10th, etc. contributions with contributors

Healthy community Level x
For contributions which have been part of the same community since 1, 2, 3 etc. weeks

Commander Level x
For every 1st, 5th, 10th, 20th etc. participated mission

In the above mentioned badges *Level x* means that the badge can be increased over time, applied by the conditions described for each badge. For example one badge can increase over time and also give the player a feedback, how and when the next goal can be achieved.

Good Citizens

Being a *good citizen* is a status for players who have active contributions posted in neighbor communities. In these communities these contributions are indicated with an extra icon. Furthermore, the username of good citizens will be prefixed with a good citizen badge. Players with no assigned home community are therefore not capable of earning the good citizen status.

5.6   Player Profile

The player's profile is the central hub of all the described game metrics and should be easy to grasp. It aggregates all the areas into a sum, which is used to determine the rank of the player. A local rank shows, which rank the player has and who is close to the player. On the other hand a global highscore shows the current top players regarding the areas. The player's achievements are mentioned and the good citizen status is available. Other interesting metrics can include the communities the player belongs to, the number of contributions, comments posted or given votes since she or he started playing. In case the profile belongs to an official, a special icon will

imply that this account belongs to a municipality (similar to the good citizen icon). Profiles are available for every player and accessible for everyone participating in the game.

5.7 Game Concept in Conformity with the Design Process

Based on the results from the gamer's online survey, five key concepts were identified that build up the initial concept of *Community Circles*. This concept was evaluated in a focus group with gamers (see section 4.5) which led to some design decisions and refinements for the final design, described previously in this chapter. The following list cites the key features of the initial game concept [34] and adds some comments after each principle (marked with the words "**Final design**"), describing how the final design was modified or extended due to the learning from the focus group.

1. **Social interactions** "among citizens play a central role in our game design and are actively promoted through the concept of growing and shrinking impact (i.e. geographical range) of contributions. To be successful in the game, a player needs to create valuable contributions and keep these activities alive by discussing them or credit other contributions with votes. Forming communities by interacting with other players and merging communities is rewarded as well."

   Final design: This fundamental concept is present in the final concept, however, contributions cannot shrink. The lifetime is already a mechanism to handle non-successful contributions and also reduces the complexity of the community building, due to the dynamic resizing of its contributions.

2. **Challenges** "can be created in *Community Circles* by both players and the city. City representatives can start georeferenced contests, e.g. calling for ideas for the reshaping of the town square, and players who are located nearby are invited to share their opinion. On the other hand, *Community Circles* enables players to start location-based multiple choice polls themselves to learn about the opinion of adjacent citizens and uncover so far unknown or neglected concerns and citizen views."

   Final design: Challenges are available through the *mission* feature in the game, which wasn't a dedicated feature from the beginning. Officials have a tool to address specific issues or can utilize crowd sourcing directly within the game.

3. **Teamwork** "is not only encouraged by spatially growing a community but also by jointly making contributions on-site. For example, when inserting a contribution, the creator can add other community members as supporters if they are in close vicinity (i.e. going places together). Such team contributions have a higher impact and spatial range."

   Final design: Furthermore, the *home community* concept should foster teamwork and engage player to strengthen their home community. Players usually belong to such a community where they may spend the majority of time or have a particular interest.

4. **Competition** "between teams is addressed in our concept by allowing players to build communities with their contributions and comparing community attributes such as size,

number of contributions and active members to other nearby communities. Further, players can be especially rewarded with points for contributing to another community than their home community."

Final design: In the final concept the rewarding mechanism of *neighbor communities* has been refined to meet the requirements. For example the communities can be visually distinguished and the *good citizen* status rewards players who contribute outside their community.

5. **Exploration** "of the urban environment is another highly relevant reason for playing pervasive games and we learnt that users are willing to adapt their daily routes to progress in the game. The concept of *Community Circles* fosters this explorative character by the overall goal of growing communities. Players are actively encouraged to explore the border areas of their communities and make contributions there to increase the size of their communities. Further, we plan to link into a user's daily routines by providing meaningful notifications such as alerts at community-relevant locations or when being close to potential collaborators."

Final design: Exploration of the environment is required by the concept and therefore didn't need to be addressed especially.

CHAPTER 6

App Development

> The **functional prototype platform** consists of a **hybrid mobile app** and a **backend server** with location-based extensions that can be **assessed for future trials**. It is built upon **solid and state-of-the-art** technologies.

This chapter gives an overview of the technological implementation of the prototype during the development phase. It contains insights about the used technologies, both for mobile application and the backend server. The resulting app is fully functional and was utilized in several trials.

6.1 Mobile Platform

The application was built with the objective to run on many devices and platforms. Since developing native apps for each platform is a very time-consuming task, an approach to develop a so-called *hybrid application* was chosen. These applications are based on common web technologies, such as HTML5, JavaScript or CSS and utilize the device integrated web browser to run the application and provide an API to common hardware features, such as a phone's location service. Nowadays, those apps can feel very native to the user due to better frameworks and faster devices. The downside on the other hand is that they won't enable all features a modern smartphone operating system would offer, since there is always a layer between the hybrid app and the OS that is generalized for every platform. There are attempts to enable certain features via plugins, however, this limits the "platform agnostic" principle. For the development of the thesis' app these limitations were accepted since the functionalities didn't require utilizing a lot of modern OS features.

Apache Cordova[1] was chosen as the hybrid framework. This decision is mainly based on the preference of using *AppGyver Steroids*[2], a framework that enables the use of native user interface

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[1] http://cordova.apache.org
[2] http://www.appgyver.com/steroids

elements of the mobile OS and automates the build and deployment process. Furthermore, the development workflow is smooth, since they offer the so-called *AppGyver Scanner* app, an app that loads the development code into their app and executed the application. Therefore, it is not necessary as developer to compile the application and upload it to the smartphone via cable; instead the desktop developing environment generates a QR code that can be scanned with the *Scanner* app. Afterwards the app downloads the code from the local network or from a server, if the app was deployed into a cloud. This is very practical for controlled user tests and enables quick and short-term deployments and updates on the smartphones, since this process bypasses the need of deploying apps in an app store and loads necessary binary packages on the test devices.

The app itself is written in *CoffeeScript*[3], a "dialect" of JavaScript with a more modern syntax that compiles the code into JavaScript. Some build automation scripts (in that case pre-defined scripts included with Steroids and executed with *Grunt*[4]) packaged the app into a format that can be executed with *Steroids*.

On-top of this application architecture some other frameworks enriched the development. Most notable is *Ionic*[5], a mobile HTML5 app development framework consisting of a comprehensive CSS framework and useful JavaScript plugins tailored for mobile apps. It provides necessary modules to develop a web based smartphone app, such as the navigation flow, form elements, common user interface elements or an icon set. Ionic itself is built upon *AngularJS*[6] – a modern web MVC framework and utilized by the app.

Another crucial factor was the map, which was enabled with the *Leaflet*[7] library. This is a JavaScript library that enables interaction with map data on desktop and mobile platforms, comparable to Google Maps. It is independent from the map source and can include several map providers – in this case the map tiles were provided by *OpenStreetMaps*[8].

The mobile app communicates with the backend server through a *Representational State Transfer (REST)* service, discussed in the next section. Therefore the app requires an Internet connection to operate. To use its entire features, it must have access to the device's location service and camera API.

At the time of development these technologies were state-of-the-art and well-known among the web developer community. They enjoy a great popularity and are a hot topic, also reflected by the large amount of community support. The app was released on the *Apple AppStore* and *Google Play*, although without the proposed gaming features. Given that the app was used for a public event to vote for beautiful tree pits gardened by citizens in Vienna[9], the gaming features weren't necessary at this time.

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[3]`http://coffeescript.org`

[4]`http://gruntjs.com`

[5]`http://ionicframework.com`

[6]`https://angularjs.org`

[7]`http://leafletjs.com`

[8]`http://www.openstreetmap.org`

[9]More information (in German) is available online under `http://www.meinbezirk.at/wien-02-leopoldstadt/chronik/die-schoenste-baumscheibe-im-zweiten-d1054181.html`, accessed November 2014.

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6.2 Backend Platform

The business logic is mostly handled on the backend platform. A colleague initially developed basic core concepts that the author enhanced and extended afterwards. The server has a defined REST service interface that enables communication with the client. Furthermore, this connection is secured via SSL and uses a permission system that requires a request to authenticate if necessary.

The server is written in *Python* with the *Django*[10] web development framework – a framework that enables a quick and agile development technique. It provides an *Object Relational Mapper (ORM)*, meaning that a developer defines data models in the code and the framework will scaffold some common requirements, such as an admin interface for a data model to edit a data set. Whenever custom functionality is necessary the developer can link into the Django framework and adapt the functionality to the custom needs, for example the concept of signals allows executing custom code when a data model is saved in order to manipulate it.

Conceptually the server interface is designed as a REST service, supported by the *Django REST Framework*[11], which service definition is discussed later in this section. The data is stored in a *PostgresSQL*[12] database extended with *PostGIS*[13]. PostGIS was chosen since the data required location-based lookups and calculations, for example to retrieve contributions within a certain distance or calculate the community shapes of merging contributions. Whenever contributions merge into communities, an activity inside a contribution affects the whole community, since it grows and can potentially merge with another community if it is close enough. Therefore the community management is not a trivial task, since it requires to do complex calculations with circle shapes on a projected surface. However, the PostGIS extension provides useful operations on a spatial level, making the implementation less extensive.

The game logic is designed to be modular, meaning it can be turned on and off on the same backend server without interfering the functionality. Therefore it utilized Django's *Signals* concept to listen to changes in the underlying data models. For example whenever a contribution is voted, a code is executed that reorganizes the effected communities. The gaming parameters can be easily configured inside Python script containing all incentive variables of the game concept (an example for the game trial is provided in the appendix A.3).

Managing the data set for administrators was achieved with Django's *Admin* functionality, which enables all the necessary data manipulation methods. It was extended in several ways, for instance with an export functionality for contributions and comments or better-tailored data editing methods.

REST Service

The REST interface was deployed on a server available under `https://api.b-part.eu` and offered the service end points described in this section. Supported HTTP methods include `GET` for receiving items, `POST` submitting data (including binary data), `PUT` for updating and

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[10]`https://www.djangoproject.com`

[11]`http://www.django-rest-framework.org`

[12]`http://www.postgresql.org`

[13]`http://postgis.net`

`DELETE` to remove items. However, not every API endpoint supports all methods and therefore only the necessary methods to run the prototype were implemented. To retrieve single entities from the REST API the `id` refers to the primary key. Some interfaces accept additional request parameters, for example to set filter criteria.

[GET, POST] `https://api.b-part.eu/contrib/contribution`
> Interface to interact with contributions. It allows retrieving a list of contributions with several filter criteria (closest, newest, by author, by distance, inside a rectangular given by a coordinate system etc.) and further can convert the result as GeoJSON, a format that is commonly used to handle location-based data. Existing APIs, such as Leaflet, can handle this data format. The same interface is also used to upload contributions.

[GET] `https://api.b-part.eu/contrib/community`
> Interface to retrieve communities inside a given rectangular specified in GPS coordinates. It returns the community shapes in the *EPSG:4326 projection*[14] and GeoJSON format, which can be directly drawn on common web-based maps.

[DELETE, POST] `https://api.b-part.eu/votecontribution/{id}`
> Gives or removes a contribution with a certain id a vote from a user or removes it. A contribution can only be voted once by a user.

[GET, POST] `https://api.b-part.eu/comment`
> Interface to send and retrieve comments for a certain contribution.

[DELETE, POST] `https://api.b-part.eu/votecomment/{id}`
> Interface to vote a certain comment or remove that vote. A user can only vote a comment once.

[DELETE, POST] `https://api.b-part.eu/votepolloption/{id}`
> Interface to vote a certain poll option (the contribution type "poll" has poll options attached, instead of a description) or remove that post. A user can only vote a poll option once.

[POST] `https://api.b-part.eu/accounts/register`
> Service to register as a new user with a username, password and email.

[GET] `https://api.b-part.eu/accounts/api-token-auth`
> The REST service uses a token-based approach to authenticate a user. All service requests must be supplemented with a token in the request header to identify the client to the server (instead of a username and password). This token can be retrieved through this interface, by submitting the username and password once.

[GET, POST] `https://api.b-part.eu/photo`
> This service end-point is used to upload a photo to a contribution and obtain details on a photo.

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[14]`http://spatialreference.org/ref/epsg/wgs-84/`

[GET] `https://api.b-part.eu/download`
>   With a given id in the request parameter, this interface returns a binary stream of the image data.

[GET] `https://api.b-part.eu/missions`
>   Returns a list of available missions.

[GET] `https://api.b-part.eu/mission/{id}`
>   Returns the mission's details of a given mission id.

[GET] `https://api.b-part.eu/profile/{username}`
>   Returns the profile, including leaderboard, area, etc. of a user or in case no username is provided, the profile of the authenticated user.

6.3   Community Circles Mobile App

The design follows a minimal and slick approach, as it is common nowadays in modern apps. This means it avoids a "skeuomorphism" approach and uses clean user interface elements with a reduced color palette instead. Clarity, a clear hierarchy, legibility and content should be in the foreground with minimal visual cluttering. Following is a description of the app from a user perspective that was used in the game trial (see chapter 7) with a brief description screen by screen. The app is available in English and German language which can be easily switched by a user[15].

Login (see Figure 6.1a).   This is the initial screen presented when a user starts the app the first time. She or he can either login with an existing username and password or register a new account. The user's session is stored in the memory so that the login will be bypassed if the player opens the app at a later time. As long as the user didn't provide the correct credentials or didn't register an account no other interaction with the app is possible[16].

Map (see Figure 6.1b).   After the login (or registration respectively) the user is presented with a map view, the central view for the player. At the first startup it will zoom to the current location, which is always indicated with an animated position marker. If there are any contributions within the map's viewport they will be visible on the map. The button on the top left opens a drawer menu to access the navigation and the button on the top right allows creating a new contribution. The map also contains a button to set the map's viewport to the current location.

Navigation (see Figure 6.1c).   The navigation is available from a button on the top left side and lists all available features. This includes the map, a list view to browse and filter for contributions, a list view that shows the latest contributions, a list of available missions, access to the notifications including a badge icon showing the number of un-read notifications,

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[15]The app store version also includes Finnish translations, since it was used for a workshop in Turku, Finland.

[16]However, it would be a good design strategy to allow to display the map with contribution as an incentive to use the app to users who are not registered.

(a) Login   (b) Map   (c) Navigation

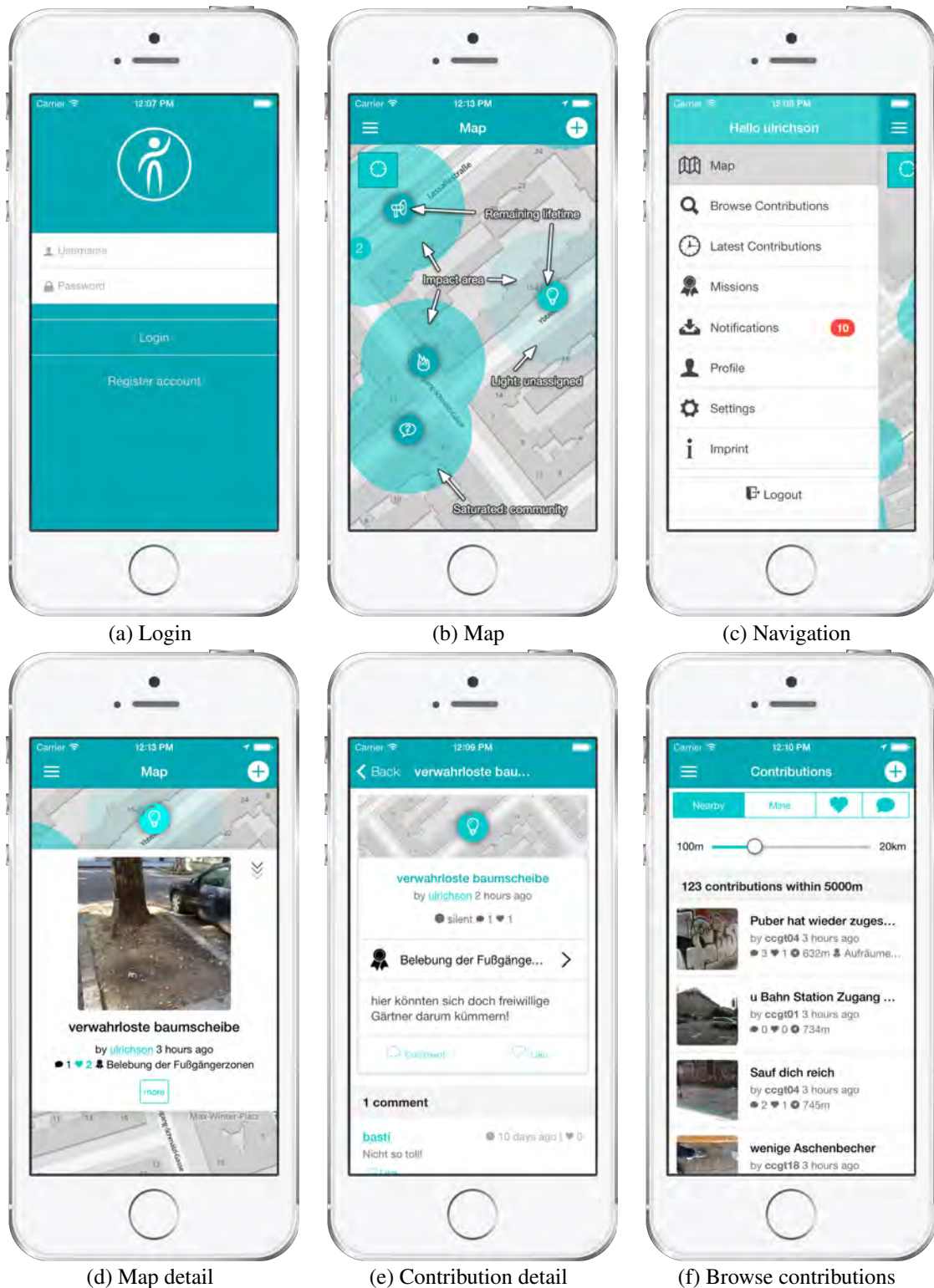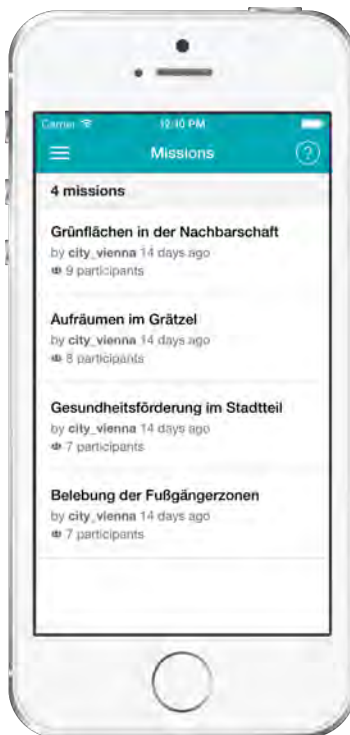(d) Map detail   (e) Contribution detail   (f) Browse contributions
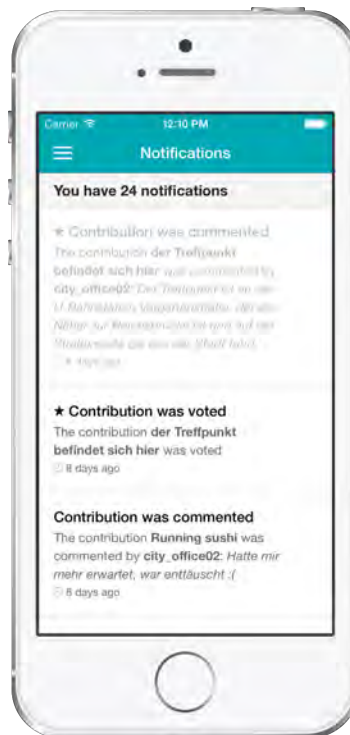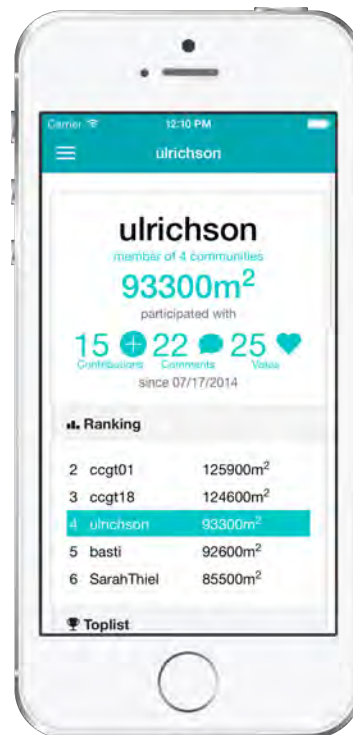
Figure 6.1: Screenshots of the developed app
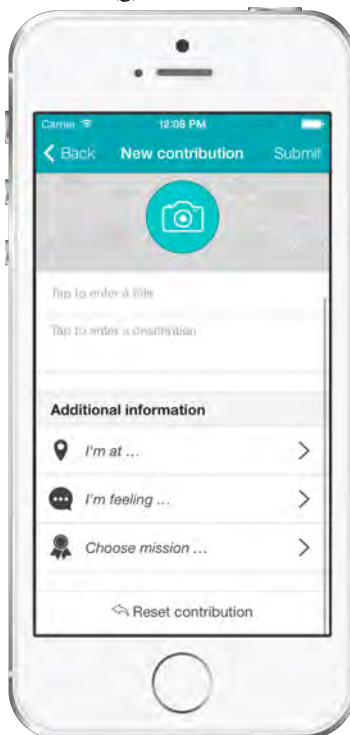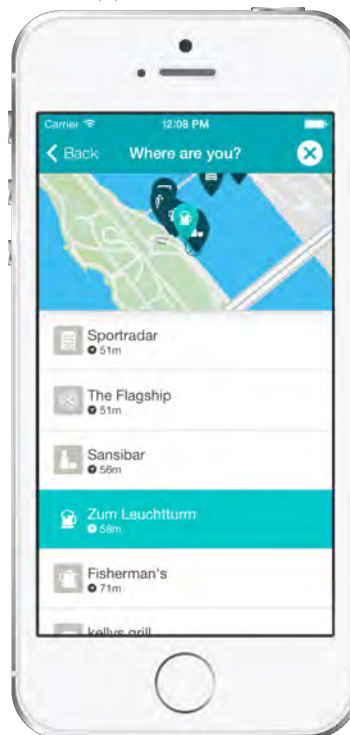
(g) Missions   (h) Notifications   (i) Profile

(j) Add contribution   (k) Add point of interest   (l) Add mood

Figure 6.1: Screenshots of the developed app (cont.)

access to the personal profile, a settings screen and an imprint screen. Furthermore, a logout button closes the session and a help button opens the phone's e-mail client to request for support (not visible in the screenshot).

Map Detail (see Figure 6.1d). When a user taps on a contribution icon on the map an animated panel will appear with some basic information about this contribution. Most noticeable is a photo that belongs to this contribution with other information such as the title, the author, when it was created and how many votes and comments it received, an icon indicating that it belongs to a mission and the location name. When the user taps on the photo or on the "more" button the app navigates to the contribution detail view including the description and a stream of comments.

Contribution Detail (see Figure 6.1e). The contribution detail view contains all information on the contribution itself, including the photo (not visible in the screenshot), an overview on the map where the contribution is located, the participated mission if available and the description (or in case of a poll it displays poll option which the user can vote on). Below are buttons to write a comment or vote these contributions. The last section includes a stream of comments, where users can discuss the contribution. There is also a button for each comment to vote it, although this has no effect on the game and is only another way to attribute some user's input.

Browse Contributions (see Figure 6.1f). Within this screen a player can filter the contributions in several ways. If the "Nearby" tab is selected all contribution within an adjustable distance will be presented, the closest contributions appear on top. The tab "Mine" lists all contributions that the player created and the remaining tabs with the heart and chat bubble icon will list contributions a player has voted or commented earlier respectively. The lists are scrollable and show the number of items in the header row, a tap on a contribution item navigates to the detail view. This screen also includes the possibility to create a new contribution with the button on the top right side.

Missions (see Figure 6.1g). The mission section lists all available missions and displays the title, the author and when it was created as well as the number of players who contributed to this mission. A help icon on the top right outlines the purpose of missions. A tap on a mission icon navigates to the mission detail view, where an additional description is displayed with more information. The participants are then listed by names and their profiles can be accessed.

Notifications (see Figure 6.1h). This view informs the player on relevant events on contributions, for example when the own contribution was voted or commented or when an activity a player voted on previously occurred. The set of available notifications is similar one would experience on social media platforms. The star icon left to the title indicates, that the notifications regards a contribution the player created. Sliding from right to left on a contribution item displays further options, namely to set the read status or delete the notification. Tapping a list item navigates to the contribution. Read contributions are grayed out, either because the status was set manually or the user tapped on an item.

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Profile (see Figure 6.1i). This view provides basic information on the player's success and allows comparing with other players. On top it displays core statistics, such as the number of communities, the total gained area, total number of created contributions, written comments and given votes. Below is a ranking of the user compared to others and the toplist of the best players. Further below is also a list of participated missions and an overview of the latest progress (e.g. when area and lifetime were gained for a received vote). The profile is available for all players. The app can also distinguish between regular player accounts and "city official" accounts, indicated with an icon and label.

Add Contribution (see Figure 6.1j). When a player decides to create a contribution the GPS location is "locked" so that it doesn't change when the player moves on and didn't submit yet. First a player has to decide for a contribution type and provide a description or poll options. A photo can be assigned by capturing one on-site or choosing a picture from the device's library. Additionally, the user can select a mood and a location name. If missions are available, the user can choose one similar to the mood and location name selection. This form is validated before it will be submitted (checking that at least a name and description/poll options are provided) when tapping the "Submit" button on the top right.

Add Point of Interest (see Figure 6.1k). This screen is presented when a user wants to choose a nearby location venue for a contribution. A map displays the available venues with an icon characterizing the type (e.g. office, restaurant etc.). In the list below a venue can be selected which shows the venue name and distance from the current position. The location venue names and icon are fetched from *Foursquare*. The map view is interactive, meaning it will zoom in and out depending which venue is selected.

Add Mood (see Figure 6.1l). If a user decides to assign a mood for a contribution she or he can do this in this view. In a grid view several pre-defined moods are presented with a corresponding icon. This icon will be displayed in several other views, for example the contribution list or detail view.

Implemented Game Features

The app developed for the *Technical Pre-Trial* and *Walkshop* didn't include the proposed gaming elements. Compared to the non-game app versions, the *Community Circles* app was enhanced with the game features described in the following and evaluated in the game trial (see chapter 7).

Incentive system through contribution impact. A contribution's success can be visually measured by its opaque impact area (see Figure 6.1b). When creating a contribution, the author can choose to provide extra information including a photo, a named location, a mood and a mission (if available). This results in a larger initial area for the contribution and therefore making it more apparent. A contribution will be rewarded by activities from other users than the author of the contribution. Given votes and posted comments will increase the contribution's impact area as well as the lifetime.

Communities. The overlapping contribution impact areas are forming communities (see Figure 6.1b). At this stage being part of a community resulted in a different visual appearance. The contribution and its surrounding impact area have a more prominent style (saturation and contrast is increased) indicating a "higher visual importance". Although the whole game concept suggests a more sophisticated role of the communities (see chapter 5), it is still a technique to allow a certain "community bonding" and provides a measurement for players to compare their results (e.g. number of communities they contributed to).

Missions. contribute to a specific task, such as generating ideas for urban planning. Similar to the location and mood selection, a mission can be selected when creating a contribution. The missions are available through a list view, which can accessed in the menu. Figure 6.1g shows a list of missions. The player can browse these and tap on an item to read more details about the mission. When creating a contribution such a mission can then be associated.

Profile with statistics. The profile contains a highscore of all players and a ranking for the player. Figure 6.1i depicts an example profile showing key metrics, such as the total area of the users contributions, number of comments, number of given votes a report on the latest game progress (e.g. it states that a contribution earned area and lifetime for a received vote).

Although the game concept describes the introduction of a more sophisticated community mechanism (with home and neighbor communities aiming for a long-term motivation), these features were not included in the game trial. Mostly due the nature of the limited time span, since this concept would have made the game more complex to grasp for the participants in so little time. Further this concept wouldn't reflect the nature of the game trial event, where participants meet at a certain point instead of playing in different locations, for instance in their neighborhood or workplace area. Instead, the game trial tried to give the participants the feeling of the game play as a solid basis for feedback and subsequent discussions.

Game Evaluation

Evaluating the game prototype revealed that **gaming can be an initial incentive**, but the **major motivation** comes from the need to **raise a voice** while citizens expect **feedback from municipalities**.

The functional game prototype enabled to conduct the game trial which aimed to investigate the research questions as described in section 1.3. The trial addresses the questions on the *effects a gamified participation tool has on citizens* (RQ1), how the *game elements are perceived* (RQ2) and wheter this game can *potentially motivate long-term participation* (RQ3) through a field test. Before the game trial was carried out, two previous studies without game elements were conducted (see chapter 3): (1) the *Technical Pre-Trial*, an in-house study with colleagues mainly for functional testing and (2) the *Walkshop*, a field-trial with colleagues to create content and evaluate the app. When the game mechanics were ready to test with a real audience the game trial was planned as a successor with the objective to evaluate the introduced features. This chapter will mainly reflect on the game trial and mention the previous trial when appropriate.

7.1 Methods

The data collected during the game trial primarily address the research questions introduced in section 1.3. In the following is an overview of the methods applied in the trial in respect to the specific research questions.

Data logging

The posted contributions offered qualitative feedback regarding the content (title and description/poll options) and captured photos as well as quantitative data such as time, mood, location, contribution type and other measurements such as contribution count, given/received votes or given/received comments. The collected data provided insights for the research question RQ1, when relating them to the results from the previous trials.

Observation

During the trial, the behavior was observed passively by the researchers and addressed the research questions RQ1 and RQ2. The attention of the observation was directed to aspects such as:

1. When and where do participants stop walking?

2. When, where and about what do they discuss with other participants on-site?

3. How often do they user their smartphone?

4. Do they post on their own or in groups?

5. If they are forming up groups, how is the group dynamic? Are there "team leaders" etc.?

6. How long do they stay at a location?

7. Do they distribute and how?

8. How does their involvement change over time?

9. How do they react on posts from other participants/spectators?

Due to logistic reasons, the observers could not follow all the participants and give insights to all of the previous questions during the gameplay phase but were present, followed single persons and provided support in case there were open questions.

Discussion round

Subsequent to the game phase the participants were asked to join a discussion round in a meeting room in the office building after the tested the prototype in the field. Participants gathered in a meeting room and open-ended questions to foster discussions were presented on a projector:

1. Can you imagine using this app long-term?

2. How do you expect that your behavior would change over time?

3. Which game elements do think are useful for a long-term usage?

4. Which game elements do you think are hindering for a long-term usage?

5. How could the game be improved?

6. Did you encounter any ways to cheat the game?

The answers were noted down and recorded with audio. This method's objective was to give insights for RQ3 (and partly gave insights on RQ2, since participants were also discussing aspects of the game prototype). Further, it should provide an outlook for the future development of the app and the game concept.

Post Survey

The survey covered aspects to give insights on all stated research questions. It included sections, such as demographics, experiences with location-based apps, games and e-participation apps and general questions on preferences of e-participation channels. To understand what makes the game enjoyable, the survey was based on the *Pervasive Game Flow Model (PGF)* [23], a model tailored to evaluate the enjoyment of pervasive games. The PGF and a section of the underlying survey consisted of the following categories: (1) Concentration (2) Challenge (3) Player skills (4) Control (5) Clear goals (6) Feedback (7) Immersion and (8) Social interaction. The survey concludes with a section regarding long-term motivation of using this game.

7.2 Study Outline

The game trial took place during an afternoon session and within a pre-defined area. The participants were recruited through an internal database of test users and received a 25 € voucher for their effort. This trial consisted of 9 participants, 3 female and 6 male. Two of them were playing in a team with one smartphone, another participants was a colleague who was new the game, but participated in a former dry-run before the trial. The participants were aged between 18 and 68 years, with a mean of 33.78 years and a median of 29 years. About the half of them were students (5 participants), 3 working and 1 pensioner. Every one of them stated, that they had previous experience with games (e.g. on mobile, PC or console).

Group Assignment

The participants were assigned to the *players* group and trying to post contributions and keep them alive in the field. Another group of colleagues were assigned as *spectators*, who simulated a live audience by answering to posts and comments and giving votes while staying "hidden" in the office building. The spectator's role was important, since the previous *Walkshop* study indicated, that the participants had little time to actively observe other's contributions and reply to them, most likely due to the limited time frame of the trial.

Players. This group consisted of people participating outside in the "field". Participants of the players group needed to be equipped with a modern smartphone running on iOS (7.0 or above) or Android (above version 2.3).

Spectators. People assigned to this group were invited to browse through contributions and could comment, reply and vote on contributions. They were not located on-site and simulated the role of people interested in urban topics, as well as officials from the city. Since this group was required to simulate a real audience and monitor the game play, the participants were selected from colleagues who were familiar with the game concept.

Missions

From the beginning of the trial four missions were available the players could contribute to. The missions' descriptions were present in the app and an additional printout was handed out as a

Figure 7.1: Map of the location where the game trial takes place (part Leopoldstadt, a district in Vienna)

quick reference. It was freely up to the players to contribute to a specific mission. However, they were aware that posting to a mission could increase the own success on the game. A colleague who was in contact with the district administration of this trial's location and has know-how of the urban concerns created the missions. The mission's topics ranged from green areas, cleanup and health to revitalization of unpopulated places.

Location

The game trial was situated in the district *Leopoldstadt* in Vienna. Participants started at the subway station *Praterstern* where they were briefed and met again at the station *Vorgartenstraße*, near *Mexikoplatz* at the end of the trial. Figure 7.1 shows a satellite image of the playground. This area has a high urban density and covers a lot of everyday aspects, for example it is an area where people live, has parks, an amusement park, train stations, construction sites, controversial areas and so on. Beside these aspects, it is in vicinity to the office building, where the participants filled out the survey afterwards. The participants could freely walk within this area, the only constraint was to stay within this area and meet again at *Vorgartenstraße*.

Schedule

The trial was supposed to run during an afternoon session and planned to last for 4 hours, where 2 hours involved the active gameplay. If necessary, the schedule could be extended in order to ensure that the trial's objectives could be completed. Table 7.1 shows the detailed schedule with a description of each phase.

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Table 7.1: Schedule for the game trial

Phase	Description
Briefing *Praterstern* 14:00 (15 min)	The *player* group was briefed about the game concept and the game objectives. The briefing should ensured that there were no uncertainties during the game (e.g. because participants did not completely understand the rules). The detailed briefing is explained in the section 7.2.
Installation *Praterstern* 14:15 (15 min)	The participants' devices were prepared with the app and registered an account, if that didn't happen so far.
Gameplay *Leopoldstadt* 14:30 (120 min)	During the main phase of the trial, the participants could freely move around and interact with the app. Researchers observed the participants and were available for any upcoming questions and issues.
Gathering *Vorgartentstraße* 16:30 (30 min)	At the end of game session the participants gathered at Vorgartenstraße, continued to the office building and had a short break.
Feedback *Office building* 17:00 (60 min)	Subsequent to the trial phase the participants discussed their experience regarding a the trial and long-term participation and filled out the printed survey afterwards.

During the game phase 3 researchers accompanied the trial, one of them actively posted, voted and commented with the app on-site (under the username "city_office02"). Another researcher followed a participant directly (due to a technical problem one participant needed an extra phone) and another one helped to organize the event. At the same time 2 researchers in the office building were monitoring the trial with two smartphones and actively voted, commented and replied on the participants' contributions and comments. Therefore they used 6 official accounts in order to be able to credit contributions with more votes (the usernames followed the naming convention "city_officeXX").

After the gameplay phase the participants gathered again and continued to a meeting room in the office building. The questions for the feedback round were presented on a projector and moderated by the author and a colleague. This discussion was recorded on audio and three researchers took notes during this phase. At the end of the trial the participants filled out a printed survey and received a voucher of their choice as a compensation for investing their time and effort.

Briefing

All participants were provided with a briefing document by e-mail the day before the trial was conducted, which gave an overview of the app's intention and handling. However, all necessary information was briefed on-site and the printed document handed out to the participants when they met at *Praterstern*. This documented included a manual explaining the app with screen-

Table 7.2: Rewards for activities during the game trial

Activitiy	Times Applied (Per Contrib.)	Area Increase	Lifetime Increase
Receive vote w/o self	n	$50m^2$	$2min$
Receive comment w/o self	n	$100m^2$	$5min$
Add photo	1	$600m^2$	$2min$
Add POI	1	$500m^2$	$1min$
Add mood	1	$500m^2$	$1min$
Participate in mission	1	$600m^2$	$1min$

shots and included information how certain activities in the game will be rewarded, as shown in Table 7.2. Additionally to the briefing document, each player received a printed sheet with a user credential so that no registration process would be needed. Compared to the proposed game concept, the initial lifetime was limited to 20 minutes in order that the game dynamics are present when playing for a short period. This was communicated to the participants and clarified that the game mode was "accelerated" to demonstrate to gameplay. Furthermore, consent forms were handed out and signed by the participants. Following is an outline of the most important aspects that the participants needed to be aware of.

1. **Understand the game principles.** Participants should be aware how they advance in the game. The objective is to gain area, by posting meaningful contributions that receive comments and votes. Furthermore, the lifetime increases with these actions. There are also missions available that will gain more area and can be a source of inspiration.

2. **Check your notifications.** Every action in the game play can be observed, for example if a participant's contribution gets voted or something happened in a contribution the player participated recently.

3. **Observe profiles.** The profile gives an overview of activity, ranking between players and other metrics. It is possible to view the personal profile, as well as the profiles from other players.

4. **Be active.** Posting comments and giving votes doesn't necessarily lead to a higher area for the player's contribution, but can foster other players to do the same for the own contributions.

5. **Other players are watching.** They will reply to contributions or comments and vote these, if they appreciate the effort.

(a) Shortly after the trial began participants spread out

(b) Participant taking a seat while posting a contribution

(c) During the discussion round the questions were presented on a projector

(d) At the end the participants filled out a printed survey

Figure 7.2: Photos captured during the game trial and the feedback round afterwards

7.3 Results

This section provides an overview of the study results during the game trial. It consists of an analysis of the collected data in the backend service, the observation, the feedback round and survey after the trial.

During the gameplay phase the participants posted 86 contributions in total (34 opinions, 22 issues, 17 polls and 13 ideas). Out of these contributions, 64 have uploaded a picture (however, on one device the picture upload failed – this user posted 6 contributions), 53 posted contributions with a mood, 39 of them had a named location and another 39 were contributing to a mission. Figure 7.3 shows an overview on a map where each participant posted the contributions and to which type they belonged to. Following are the summarized results of each method.

Observation

After the trial started the participants quickly spread out and didn't coordinate each other. Only the two persons who shared a phone stayed together for obvious reasons. Naturally, it was difficult to observe the whole situation on-site. However, since the location service wasn't working
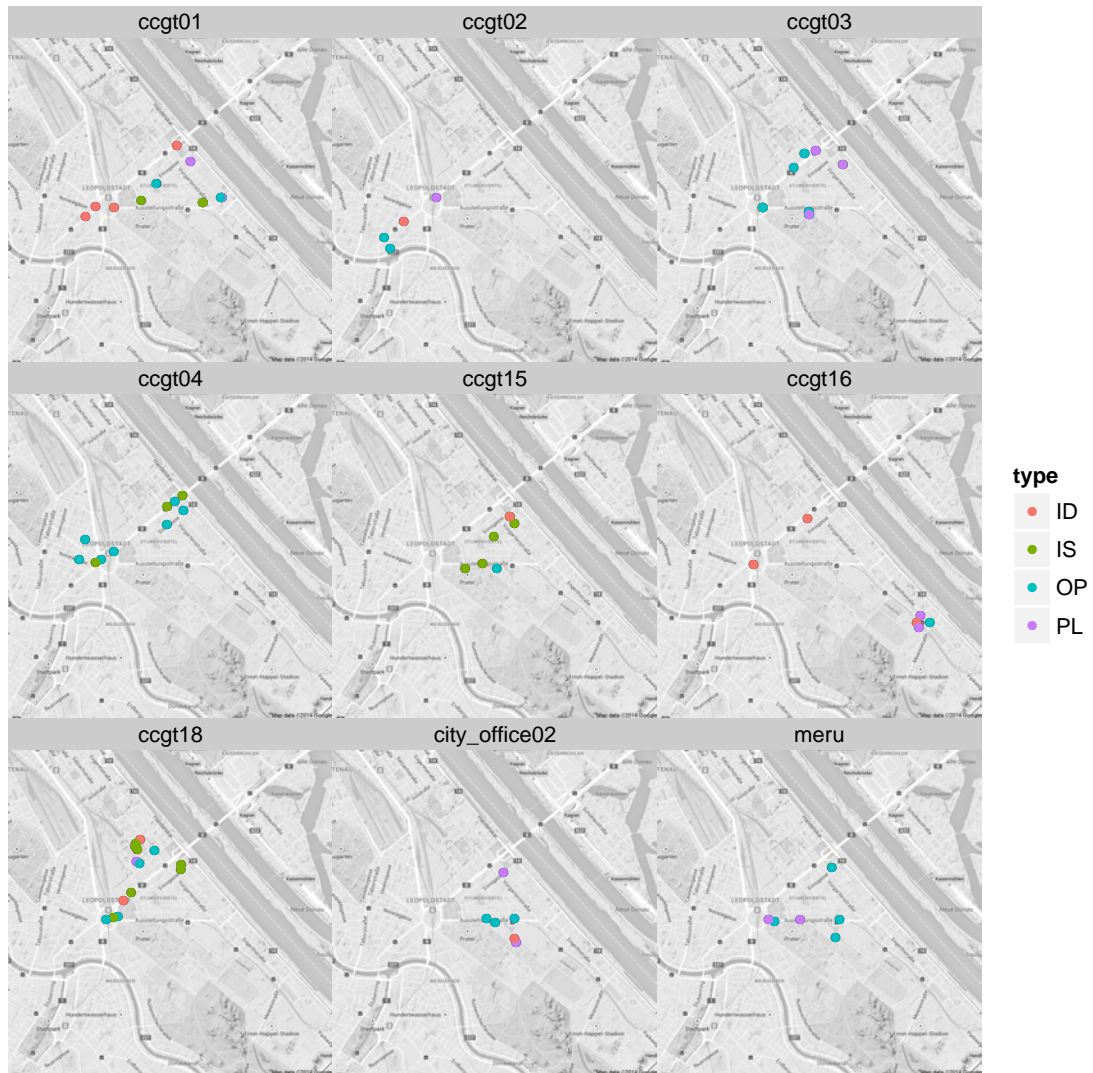
Figure 7.3: Overview of contributions posted during the game trial from each participant (ID = Idea, IS = Issue, OP = Opinion and PL = Poll)

on one participants phone, a researcher[1] accompanied this person with a separate device during the trial. This was a good chance to observe the participants behavior and gain feedback via a think-aloud method. Some usability issues were identified and the participant also suggested some improvements for the app (improvements are later discussed in the section 8.1). Most noticeable was how this person changed the habit of using this app: while at the beginning this person spent a lot of time writing the post, the formulation of posts and comments got more *"sloppy"* over time. She argued, that when she started to receive comments, this app reminded her of a social network and therefore she didn't feel the need to accurately revise her input. Further, she chose to walk into directions she hasn't been before. When creating posts she preferred to stop walking to write the contribution and continued the walk afterwards.

The game phase wasn't spared from technical issues: somewhen after the second half of this phase the map tile server couldn't deliver map graphics and therefore the map partly grayed out, however the contributions still appeared and were functional. Most likely the map tile server was overloaded or a network limitation was reached (the app uses map tiles from a host who is offering them for free). This scenario hasn't been tested beforehand since it was difficult to simulate these simulations requests. However, the app still provided alternative approaches to access contributions and interact with those.

Feedback round

After the game phase the participants had a break and proceeded to the office building. The room was provided with drinks, coffee and cookies to create a relaxed atmosphere. The participants where placed on tables arranged in a circle (see Figure 7.2c) and the open questions were presented on a projector. During the feedback round three researchers collected notes which were categorized and are described next in this section.

Critique on the app. The participants missed the possibility to raise a question without having to provide answer options. The contribution types, as they were provided in this trial didn't allow this. The critique also mentioned that the participants expected more customization on how to search and filter for contributions (e.g. filter on contribution type, allow that contributions can be seen where the lifetime ran out or define how recent the contributions are when displayed). To better distinguish contribution types or activities one participant suggested introducing a color coding. Furthermore, the participants couldn't distinguish the *officials* from *regular* users. At this stage the officials were only identified with an icon on the profile page (which was overseen, as the survey results suggests) and the naming convention of these accounts (e.g. city_official01). Choosing an emotion for a contribution was not obvious for some players and therefore they claimed that this would be needless. Also a feature which hinted the user that more area can be gained when adding meta data was perceived as annoying since this popup appeared every time before submitting a contribution if it was not filled out completely. The point of interest list wasn't complete or didn't fit the needs for the participants.

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[1]The author was the researcher.

Suggestions to improve the app. The participants agreed that commenting is a crucial aspect and should be enriched by its functionality. For example it should be possible to include photos (similar to posting a contribution) or allow hyperlinks in the comments. This would give users more freedom to express their opinions. The practical usage of the app also showed an essential and missing feature: the users weren't able to edit or delete contributions they previously posted. At the same time another person commented, that it can be dangerous to edit contributions afterwards, since this is a way to manipulate. However, a history log and a visual cue of edited contributions could compensate this. At this stage it wasn't possible to view contributions that weren't active anymore, which was mentioned by a participant. The notifications could be enhanced in a way by grouping them into the corresponding contributions. Some other aspects were also mentioned, such as the ability to follow users (like *Twitter* allows) or to form groups of people to play against friends and acquaintances. E-mail communication could be introduced to, for example to forward notifications or provide a weekly overview of activities. Many of these suggestions consider features that one would expect from matured social media or communication platforms and could refer to past experiences of the audience with such systems.

Doubts. During the feedback the participants also raised some doubts concerning the concept. The captured images might need the consent of other persons to depict these persons or others properties. While playing the game one participant was asked by a stranger why he captured a picture of a particular bike. Irrelevant post could harm the reliability of the content driven by players who want to succeed and exploit the game mechanism. Some of the participants also claimed that highscores could be demotivating. However, at this point the trial took place in a short period and the basic design concept of having a fair chance to succeed might not have been grasped completely.

Offical Feedback. To keep citizens engaged it is crucial that there is an active dialogue between officials and citizens. The participants also discovered this requirement early in the discussions. They pointed out that without feedback the motivation to use this app would decrease. Even a "simulated" official answer during the game phase was criticized and understood as ridiculous. The participants wanted to be taken serious and therefore a careful communication from the municipality is important. In general they wanted more information and feedback from officials.

Gamification. Some of the participants noted, that the game elements were an initial incentive for the participants but became monotonous over time. One participant claimed that including gaming elements makes the concept less valuable and annoying. However, the missions were welcomed and a good support to create contributions. Another participant had the idea that missions could also be limited to a certain period. Overall, the participants were less willing to give feedback on the gaming elements and they didn't seem to be the top priority among the participants. It should be noted, that the small time frame of this trial was not an optimal scenario for testing the concept, which was designed to take place on a longer period. Therefore, the game dynamics were played quicker than it made
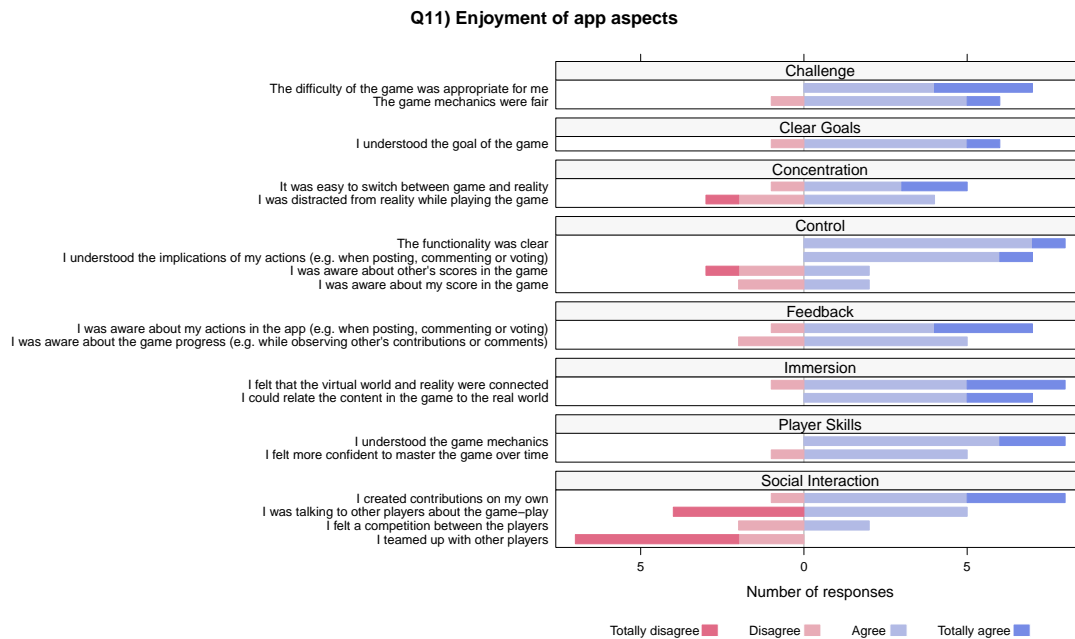
Figure 7.4: Responses from questionnaire when asked for several enjoyment aspects

obviously sense. Although the participants were briefed about this fact (before and after the game phase) there was a negative connotation among the participants since they didn't seem to understand why the contribution would disappear so fast.

Survey

In the last phase of the trial the participants were asked to fill out a survey asking about several aspects while using the app. One central aspect was to evaluate whether the audience enjoyed the game. Therefore a five-scale likert scale was introduced based on themes identified through the *Pervasive Game Flow Model* [23]. In a section of the survey the participants were asked to rate several statements regarding their agreement. The questions and results are shown in Figure 7.4, excluding neutral opinions. As mentioned in the feedback round, the gaming aspect was not that relevant for some participants, which also is reflected in the "Control" category: it got a rather weak rating when asked whether the participants were aware of their own or other's actions (one person even stated *"I didn't notice the profile at all"*). Also "Social Interaction" regarding cooperation or competition wasn't prominent during the game trial, however, this could be explained by the limited time frame of the trial and that the participants were unfamiliar to each other. The other categories indicate that the app was perceived well and suggest that the overall concept has no major flaws and can be enjoyed by the players.

When asked for specific features of the app, it appears that it has a good mixture (also noted during the discussion round) as shown in Figure 7.5. Not surprisingly, the major functionality of posting contributions scored well. Again, having a picture is very important, which was also
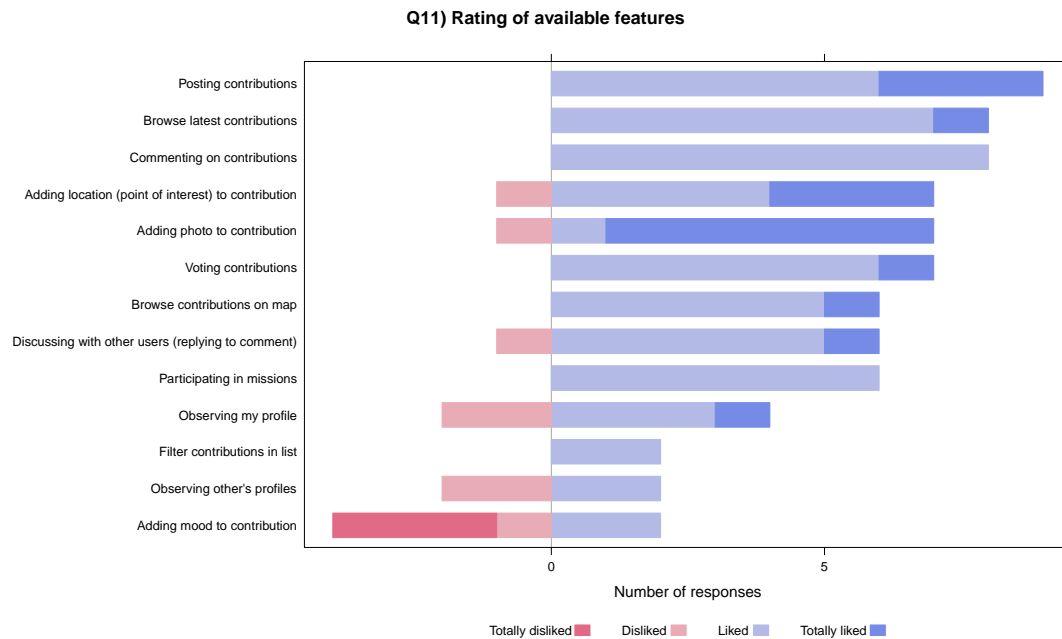
Q11) Rating of available features

Figure 7.5: Results of the rated features available in the app

mentioned multiple times in the previous trials. It is notable, that this feature was "totally liked" by 6 participants.

Posting contributions and adding a picture was most often done by the participants (see Figure 7.6). Contributions were commented by the participants, although not that often. The limited time frame of the trial could explain this observation, since this was also the case in the *Walkshop*. Browsing through the map was mostly "rarely" or "never" used during the game trial. This seems surprising but there are some possible explanations: (1) the map view was missing some user requirements, for example better filter criteria or offering more data as suggested in the discussion round, (2) there were alternative list views where users could browse through contributions quickly and (3) during the game phase (after the second half) the map tile server was overloaded and therefore the map became unusable. Most unnoticed for the participants was to "visit other profiles", however, the profile still contained information about other players.

In general, the usefulness of such an app was appreciated as Figure 7.7 indicates. Most participants think that it was easy to find opportunities to contribute and can think of possibilities to use this app. They agree that the purpose of the app is useful. Regarding the social interaction, this audience preferred to create contributions on their own instead of a team. Further, almost the half disagree that they found the information they needed in the app, which was indicated in the discussion round (missing criteria to filter etc.).

The major motivation to use the app was to make others aware of problems, voicing the own opinion and discussing relevant issues (see Figure 7.8). The participants were also using the app because they believed that their post had an impact. Aspects such as socializing or succeeding the game were not relevant for the participants.
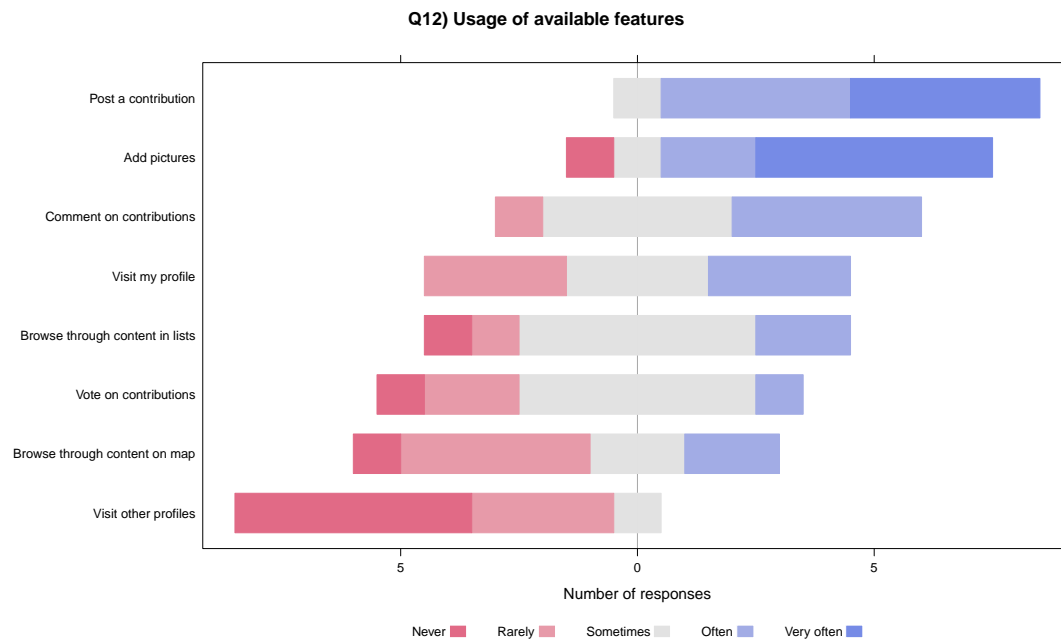
Q12) Usage of available features

Figure 7.6: Results of the rated usage of available features in the app
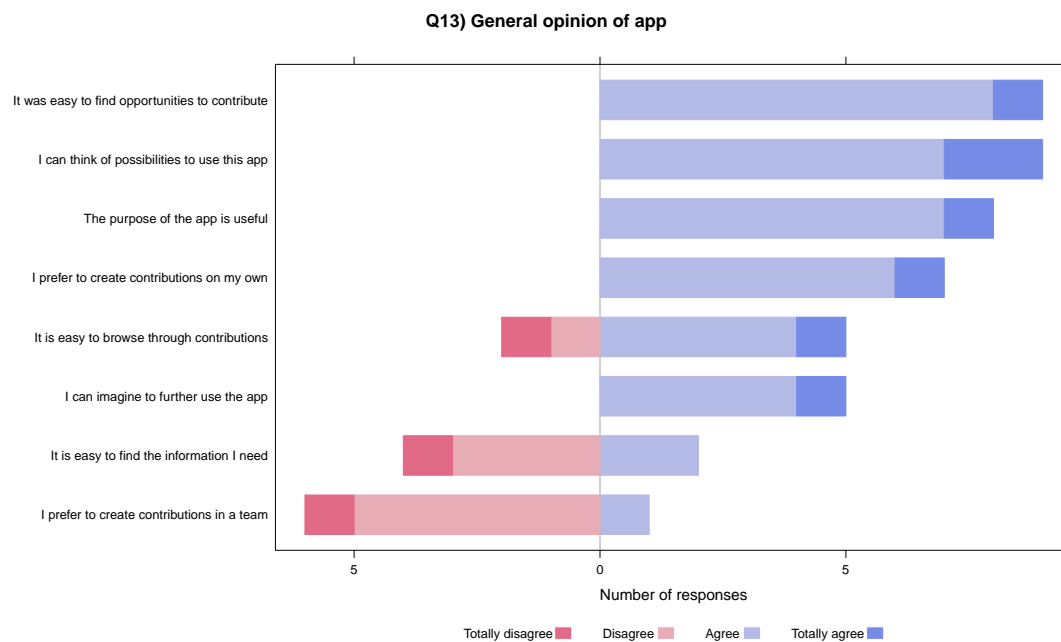
Q13) General opinion of app

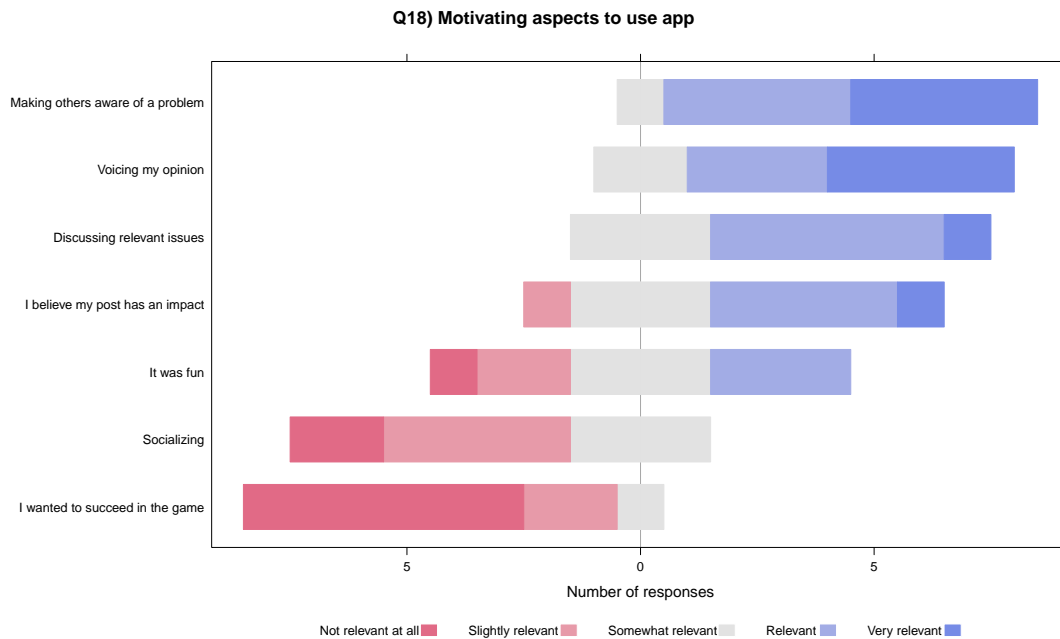Figure 7.7: Results of the rating of general opinions

Figure 7.8: Results of rating the motivation of using the app

When asked why they participated in missions some responses reported that they *"gave a certain focus to the game"* and helped in general to identify possibilities to create contributions. For two players the missions fitted to their situation while playing the game. Two other reported that mission were part of the game or resulted in more points in the game. Another one participated in mission out of curiosity.

Another qualitative question was regarding aspects they did not like in the question. Beside technical issues and limitation they experienced during the trial, two participants mostly disliked the *"gamification"* approach in the app, another two disliked the *"emotions"* and one complained about that *"it seemed less serious due to somewhat irrelevant posts"*.

7.4 Content Compared with Previous Trials

A quantitative comparison based on data logs of the *Technical Pre-Trial*, *Walkshop* and *Game Trial* is shown in Table 7.3. Further the contributions from each trial were categorized and assigned to a topic by the re-occurring themes. This categorization evolved from analyzing the contribution's *title*, *description* (or in case of a poll the *answer options* and the *photo*, since some of the textual data was not sufficient enough to draw conclusions. The identified topics are chosen from a city's perspective and regard urban concerns. In the following is the list of topics posted by all the participants over the trials and a description how this category is assigned to a contribution.

Table 7.3: Quantitative comparison of the trials

	Game Trial	**Walkshop**	**Technical Pre-Trial**
Posted contributions in total	86 (100%)	62 (100%)	36 (100%)
Posted ideas	13 (15.1%)	20 (32.3%)	5 (13.9%)
Posted issus	22 (25.6%)	10 (16.1%)	4 (11.1%)
Posted opinions	34 (39.5%)	29 (46.8%)	24 (66.7%)
Posted polls	17 (19.8%)	3 (4.8%)	3 (8.3%)
Assigned photos	64 (74.4%)[*]	53 (85.5%)	30 (83.3%)
Assigned moods	53 (61.6%)	50 (80.6%)	31 (86.1%)
Assigned location names	39 (45.3%)	37 (59.7%)	30 (83.3%)
Participated in mission	39 (45.3%)	0 (0%)[**]	0 (0%)[**]
Number of participants	9	7	11

[*] due to technical reasons, one participant could not upload photos
[**] missions were not available in this trial
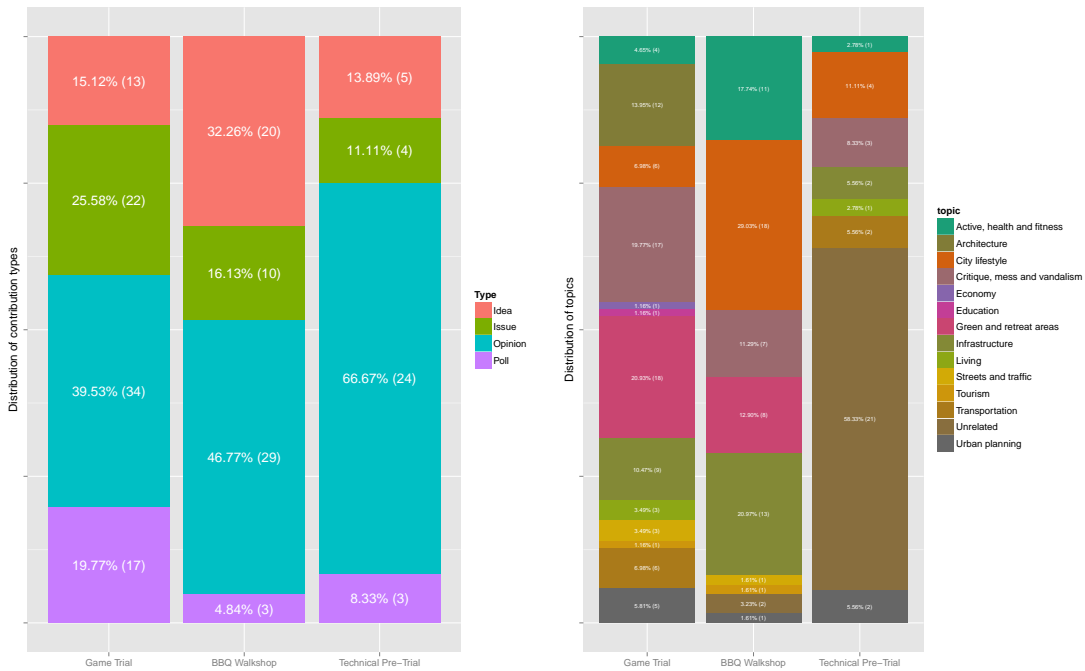
(a) Distribution of contribution types

(b) Distribution of topics

Figure 7.9: Contribution types and topics posted in each trial

Active, health and fitness

It is important for the wellbeing to stay active and healthy. Opportunities to do sports and other activities to improve the fitness fall into this category.

Architecture

A city's aesthetic can be perceived through its architecture. This can gives a glimpse to the historical evolvement of a city. When people refer to the cityscape or how the structural environment interacts with the citizens, this category is chosen.

City lifestyle

Everything that makes a city *livable* or gives a certain *coolness* factor and makes it individual. This can include recreational activities, nice spots to be at or refer to places where people may hang out after a hard working day. This category is chosen, when users express their feelings and emotions.

Critique, mess and vandalism

A city is a complex structure and naturally not everything works well. People might criticize and point out what is going wrong. Places are sometimes messed up and vandalized.

Economy

It is important for a city's welfare that the economy is working and therefore a city should make it attractive for the economy to stay. Economy invests into a city, brings innovation and can offer incentives for citizens to live in a city.

Education

This category involves topics that refer to schools, Universities and other training facilities for learning. Cities are a hub for education and a motivation for people to move to a city and chances for the personal life.

Green and retreat areas

Since a city is a complex system and can be overwhelming it is important to have counterparts in form a green areas and places where people can retreat. They can be completely apart from the city life in the nature, just a single bench to rest a couple of minutes, or places that offer a save environment for children to play.

Infrastructure

A good infrastructure can increase well being when it can fulfill the citizens' needs. This can include food places to eat, grocery stores or official buildings.

Living

A central aspect in the city is the living situation. Offering a home for large amount of people is challenging and contributes a lot the quality of a city. Naturally, this is a permanent topic for citizens.

Streets and traffic

The "blood vessels" of a city – it's important that roads, tunnels, bike lanes, walkways and so on are accessible and operational to connect each parts.

Tourism

What is a city offering for visitors? This category is chosen, whenever the perception changes into the view of an "outsider", for example when users see potential to make a place more attractive to tourists.

Transportation. Either walking, taking public transport, riding a bike or taking a car – there are many ways for citizens to travel between places. This category is selected, when the tool of transportation is in the foreground.

Unrelated

Whenever users post something off-topic or unrelated directly to the city this category is chosen.

Urban planning

A city is always alive and changes over time for example due to political decisions. This has an impact to a larger community and can reshape a city. When people are referring to such changes, for instance construction sites or suggestions to improve an area, this category is chosen.

Figure 7.9b provides an overview of the distribution of the topics for each trial. Since each trial had different tasks and locations it is difficult to compare them directly. However, there is a noticeable drop of unrelated topics between the *Technical Pre-Trial* and the other trials. It is likely that this is due the different setting (short and focused session vs. the longer and less strict pre-trial) and the introduced tasks respectively missions in the game trial.

CHAPTER 8

Discussion

> **Gameful approaches** within serious contexts must be **designed carefully**. Future versions of the app should **address issues** identified in the game trial, **refine game elements**, **link into everyday's life** and **involve city officials actively**.

This thesis investigated the implications of adding game elements to a m-participation platform by designing, developing and evaluating a prototype. This work sought for suitable game elements to create a location-based dialog platform. Getting the right design involves several iterations, starting from the beginning of the process. Involving gamers throughout the phases is crucial and led to the decisions taken in the presented prototype. Concerning this work the evaluation could not cover every aspect of the introduced concept and further iterations, again involving feedback from gamers, is required.

   Melting game elements with a serious application makes a differentiation of the app difficult: is it a game or gameful? The author would argue that it is a gameful participatory situated engagement approach at the moment, however, this perspective might not be obvious to the end users. As the game trial revealed, some participants were biased about the game context and dissociated on gamification techniques. After playing the prototype this issue was raised by some participants, since they seemed to struggle that a game can have a serious background and from their experience games are associated with fun but non-serious activities (in serious urban games this is referred to the "this is a game" / "this is not a game" ambiguity [14]). Since no long-term study on this prototype has been undertaken, it would be interesting to know whether this effect would change over time. Critique on gamification is an on-going debate, for instance stated by game designer Margaret Robertson: she claims that points, leaderboards etc. are the "thing that is least essential to games"[1] and concentration should be spent on *what* makes a great game, regarding the actual gameplay instead of the points one earns for an activity. The presented work has a focus on the game design and should differentiate from poorly implemented gamification

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[1]"Can't play, won't play" by Margaret Robertson, `http://hideandseek.net/2010/10/06/cant-play-wont-play`

attempts. For example the *Community Circles* prototype tries to create a game mechanic driven by the *quality* of content instead of just adding points for tedious tasks – the "points" in this app reflect on the current activity and attribution, trying to persuade people to get more involved.

The debate on gamification continues and the question was raised, whether gamification is harmful[2]. However, further research is required to get a clearer picture, for example in a study on gamification elements the authors didn't find evidence these elements would harm intrinsic motivation [42]. Designers should be paying special attention on the game design (which is an own discipline) and iterate it consequently to meet the right requirements for the future users.

Developing the prototype was resource-intensive, since the platform provides a broad functionality and was built from the ground up. New technologies had to be incorporated, both on the front and backend and resulted in experimenting to come to a technical decision. Building a hybrid mobile app with latest frameworks includes the risk to encounter technology limitations, for example parts of the user interface were rewritten since the hybrid app framework at this stage wasn't supporting all major mobile platforms. Serving an app for two major mobile platforms also requires efforts, since the app can potentially run on a wide range of devices. Special care for maintenance must be undertaken and updates from the mobile frameworks and operating systems needs to be handled, since they can potentially break the functionality of the app. Publishing an app for online market places requires a strict and careful implementation, since the apps will be reviewed (e.g. regarding user interface guidelines) and requires marketing material, such as app icons or promotion texts. Even trivial features, such as voting for a contribution has more implications, for example avoiding that one person can vote more than once or deciding whether it should be possible that other people see who voted for a contribution[3]. Handling a system for multiple users is complex to test and requires careful considerations. Choosing a hybrid development framework has its pros and cons, but fitted the needs for this prototype.

These examples demonstrate the challenges when developing such a platform. However, investing this work was worth it and resulted into a solid platform utilizing latest technologies easy to extend. The following sections should give an outlook on the opportunities and challenges the current prototyping platform is facing.

8.1 Improvements

This section addresses concerns that were raised during the feedback with test participants in the game trial and provides several suggestions on how to improve the app in further iterations.

App Refinements

Although the app design was perceived well, it shows some behavior inconsistencies, for example a user needs to tap on "back" after selecting a location name or mood. A more common pattern is to select an item and then immediately return to the precious screen (although it must

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[2] "Achievements Considered Harmful?" by Chris Hecker, `http://chrishecker.com/Achievements_Considered_Harmful`

[3] In this app people cannot see who else voted for a contribution, due to the assumption that such actions a require certain privacy.

be considered, whether it is important for a user to edit a selection) or place the "action" button on the top right. Special care should be taken when it comes to the generalization of the user interface for several platforms: the app is available for iOS and Android, however, they are different in their interface behavior. Many design patterns apply for both platform, but there are subtle differences that need to be addressed, for instance the Android platform offers a hardware back button for the navigation flow, while iOS doesn't.

Further functionality was demanded, for example users missed a functionality to report spam posts or edit a contribution after they created it. For many users it was enough to provide a photo and a title for a contribution and were confused what else to insert for the description field, since this was required. This leads to the conclusion, that the contribution screens need to be revised and other ideas can be considered, for instance the input modalities could be more focused on the corresponding contribution type to differentiate them better within the app.

Although some of the initial issues with the map visualization were addressed (e.g. dense areas of contributions were clustered) there are still some troubles with the current design. To improve the map and contributions, the icons should have more contrast since they are not easy to read in some occasions, for example the narrow lifetime bar. Furthermore, the icons could provide more information, for instance some participants suggested that it would be good to have some general categorization of the contribution's topic (and would allow further filter options).

When a user taps on a contribution icon in the map, a popup dialog appears with more information on the contribution. To provide a more fluent access, this popup dialog could also provide the full contribution details, containing the description and comments. This approach would eliminate the navigation between two screens by combining these into one view.

Improvements regarding the refinement of visualization techniques would also concern the city accounts, since they can only be identified through the profile page at this stage. It makes sense to place an icon identifying the official account next to the username throughout the app.

Other feedback regarding the app interface design is available in the section 7.3, which highlights the participant's comments.

Gameplay

The game trial revealed that the participants didn't focus on the game elements that much and it isn't obvious why they did so. A possible explanation is that the developed prototype still lacks of gaming techniques. The short-term game trial didn't include every game design aspect as discussed in chapter 5, simply because it was not appropriate to mix a game design for a long-term usage within the short time for the game trial. To give the app a more game-like characteristic animations and sounds can be included in the map, for example when a contribution merged with a community or a contribution is running out of lifetime (this would address the game's feedback).

A game design element that hasn't been considered for the prototype so far is *storytelling* and *roleplaying*. However, adding a story or allowing the player to adapt different roles might immerse them more into the gameplay and provide a different perspective (to a certain extent, a storytelling aspect could be achieved through the mission feature in the app, by framing the mission's description). Related projects, such as *Bicker Manor* introduce roleplaying elements where user switch into different roles [58].

A more concrete issue is that the contribution's initial area gets increased when the user provides a photo, mood or location name. While this should encourage a player to submit a qualitative better contribution, it might lead to the effect that players carelessly provide this information just to earn more area. This would be an unwanted motivation, however, providing this extra information might be beneficial for other players since they have a better understanding of the contribution's purpose. Consequently, it might not be necessary that the game itself rewards this effort, instead a player might experience that contributions with more relevant meta data might be rewarded better by others with comments and votes.

Linking into everyday's life

Fogg points out that "timing is often the missing element in behaviour change" [15]. Providing the right information at the right time is not trivial but crucial for an app. Notifications in apps and on operating system level are common practice, however, they can be stressful and must be handled with care as studies suggest [52, 61]. Aspects such as categorizing notifications or considering the update period are important. The notification system in the prototype is basic, but it can be foreseen that these notifications can play an essential role, since they have the opportunity to inform a player on chances to participate. In the following are some thoughts on how to build a suitable notification system.

- *Group notifications* into several categories to give a user an overview, for instance notifications that concern a special topic.

- Rank notifications by their *importance* since not every notification might have the same urgency, for example a poll in a home community could be more important when a player walks by.

- A user should have the possibility to *customize* the notification she or he wants to receive. Another good strategy would be to allow the user to mute notification for a certain period of time (e.g. such as the messenger app *WhatsApp* is doing).

- *Geofencing* can enable location-based notifications, for example making a player aware of other players who are nearby.

- Implementing *push notifications* enables the user to receive notifications when the app is in the background, which is typically the case (however, enabling push notification is another stress-level when poorly designed).

- Knowing the user's *context* can provide meaningful information when a notification should be presented at best, for instance if the system is aware when a user is waiting for a bus or on a walk home from work – this offers completely new scenarios for designers. Of course, this is not trivial and current systems that would provide such information are still in their infancy.

Linking into people's daily routines is a great opportunity to support situated engagement with fewer barriers. Furthermore, we see the rise of wearable technologies on the markets, for example smart watches that offer new ways of interaction on the go.

8.2 Applying in the Wild

The app developed for this thesis enables a location-based dialogue between citizens and officials. However, there are further scenarios how to utilize this tool. The game design has a very dynamic flow and communities evolve over time – when looking at the game at a specific moment it provides a snapshot for this moment. Coupled with the meta data, such as the contribution type and the mood it can be utilized as a mood sampling and monitoring tool. The map shows where discussion are on-going through the characteristic visualization and might reveal "hot" areas, similar to heat maps. Browsing through the map quickly gives an idea of citizens' concerns and opinions for municipalities. This should provide a valuable and fast information flow for officials and give them the chance to use these insights for strategic decisions.

Another opportunity is to use the app as a crowd-sourcing platform, for example municipalities can call for participation within the app. Missions are a way to submit specific topics a city might be concerned with to ask the citizens for their collaborative help. At the same time this would foster players to engage in the game. Face-to-face meetings with subsequent workshops could further deepen the connection with citizens.

The discussion with the participants indicated that feedback from the municipality is crucial for people to use such an app (and adding a game mechanic doesn't compensate a missing dialogue with officials). Participation starts with the municipality and they need to actively engage with citizens. Municipalities should take comments serious and carefully reply to the citizens – they have important concerns and will value a proper communication.

CHAPTER 9

Conclusion

This thesis presented an approach to *design*, *develop* and *evaluate* a gamified situated engagement app for mobile devices. The solution includes the perspective of citizens and municipalities to foster an interactive dialogue between both parties for a better living.

A literature research established the motivation to build such a system and informs about the relevant work in the related research fields. Every phase was described in detail and highlighted the appropriate applied methods. Before the actual design was carried out, pervasive games and their players were investigated. An online survey came to the conclusion, that future gamified m-participation approaches should link into players' daily routines, and identified themes enjoyed in pervasive games including (1) sociability, (2) exploration, (3) activity and achievement and (4) novelty. By applying several prototyping techniques these findings were guiding to a game concept called *Community Circles* and game mechanics were derived to foster a long-term participation. This concept builds up on the investigation of enjoyable pervasive gaming elements and includes (1) social interactions, (2) challenges, (3) teamwork, (4) competition and (5) exploration. A set of the proposed game features were implemented in a functional prototype which was evaluated in a field game trial with test participants.

The evaluation of the game trial revealed some interesting findings concerning the future development of the prototype. Improvements regard usability issues, the need for more customization and next steps towards including more game elements, as stated in this thesis. From the results following conclusions on the initially raised research questions can be drawn.

RQ1: Which effects has a gamified participation tool on citizens?

Participants of the game trials were eager to post contributions and the content mostly included relevant topics. As time allowed during the trial, they read comments, posted comments and voted on contributions. Naturally due the event-based approach participants were asked to perform well, which doesn't necessarily reflect a realist scenario assuming future users would interact with the app on occasion. However, the app was easy-to-use, useful to them and they could think of scenarios for a practical usage. The game concept itself had a lower priority among the participants and awoke interest as

well as critique, although it is doubtful whether gaming elements would harm the usage. A long-term study including further improvement of the game could give more detailed insights on this question.

RQ2: How do the participants perceive the gaming elements?

As mentioned above, the participants were not primarily focused on the game, but instead stated that they had other motivations for using such an app despite having success in the game. However, including game elements can be an initial incentive for future applications. Missions were the most important game element since they provided a clear goal and gave a focus for creating contributions. Other game elements may unfold during a long-term usage, as well as the possible introduction of other game elements, such as adding story or social elements.

RQ3: What potential has a gamified participation approach to motivate people long-term?

The general motivation of using a gamified participation app is based on aspects such as making aware of problems, voicing opinions and discussing relevant issues. It is crucial that the platform has an impact and must therefore include municipalities in an active role. Gaming can awake interest but a reliable dialogue between citizens and officials comes first, according to the participants of the game trial.

In a future work the prototype should refine the game mechanics, investigate the influence on the younger generation and most importantly involve officials as an active part for a long-term evaluation. Literature and results from the thesis' studies are indicating that this is a very crucial factor among citizens to stay motivated to use an m-participation tool.

9.1   Limitations

Although the design and evaluation involved end users, it is unclear how the game would perform in a long-term run. This could not have been achieved within this thesis' time frame and therefore the trials were executed in shorter periods. Thus, the trials were focused on the "task performance", instead of the investigation on long-term behavior and it is difficult to compare the outcome of gaming and non-gaming contexts. However, giving the test participants the opportunity to interact with the app in a realistic scenario should have provided a reasonable basis for the discussions after the game trial for a constructive feedback.

Another aspect that wasn't considered in the design was cheating or exploiting the game, for example in form of spam posts. Although the game is designed to handle some of these issues (e.g. the decaying contributions that wouldn't get attributed), it won't sort out all problems. Mechanism, such as moderation of posts or a reporting option on contributions can compensate these effects, however, the controlled test scenarios didn't require handling these issues.

When deploying the app for the general public it will probably have to deal with the challenge of reaching the "critical mass" of users [40]. This requires efforts to communicate the idea and promote the app among citizens and find the right incentives for them to start using the app. Since the concept relies on active posting and commenting this is a very crucial aspect. Starting

a community from zero is difficult, so it might make sense to utilize existing communities, for example to link into social media communities such as *Facebook* or build on-top of existing e-participation platforms.

9.2 Future Work

The prototype developed during this thesis was part of the research project b-Part, which includes a long-term trial in the city Turku in Finland beginning from April 2014. Future versions of the prototype could incorporate the suggested improvements and implement further game aspects, such as the differentiation of home and neighbor communities, good citizen status and badges which were designed for a long-term usage.

Regarding the evaluation, it can be argued that relying on the flow model is not necessarily the best approach. It is doubtful since a "flow experience" is not the essential part of the game, although it can happen (and would be very delightful), but the major question of the users is: "Will I be heard and taken serious?". Other models can be considered, such as the *Technology Acceptance Model (TAM)*, *Theory of Reasoned Action (TRA)* or *Theory of Planned Behavior (TPB)*, which are used in similar studies [19]. On the other hand, to provide a more "flow-like" experience for future trials specific missions could be created aiming for short-term competitions, (e.g. "Who has the best idea to make this park more attractive for the neighbors?").

As the game trial has shown, the gaming elements were subtle for the participants, although it was not evident that this had a negative effect on their experience. Although a critical attitude was raised against gamification, it is doubtful if future users would abandon such a concept for that particular reason if the outcome still has a purpose.

The gaming aspects were originally introduced to gap a bridge to people who lack of civic engagement but still want to raise a voice. Potentially this includes the younger generation and therefore it can be interesting to investigate how a gamified m-participation approach can foster an increased engagement among them. The presented prototype in this thesis should build a reliable basis for further extensions and evaluations towards a long-term study.

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Trials

A.1   Technical Pre-Trial

Following briefing was handed out to the participant:

We are planning a user trial to evaluate a game concept called Community Circles within the scope of the research project b-Part (http://b-part.eu). It's a location-based mobile game that allows citizens to participate and discuss urban topics in a playful and motivating manner. During the game a player can create contributions, discuss and vote on these topics to succeed in the game. To gain insights for suitable gaming parameters and to create initial content for a later field trial to evaluate the game, this trial doesn't include any gaming elements and is limited the core features to create and discuss contributions.

During the next 3 weeks we kindly ask you to participate in the pre trial:

Optimal: create one contribution per day, e.g. while going to work/home. If you encounter something you think that needs to be improved or want to suggest something, create a contribution. These contributions should ignite discussions among citizens! Although you can post everywhere, it makes sense to look at the Donau City area for possible contributions. Please have at the next page for some inspirations. Browse through contributions on the map. Feel free to discuss and vote! The app is still under development and updates can happen frequently. Please re-download the app each day (next page) and report any problems.

After the trial you will be invited to take part at a follow-up interview on the experiences of the past weeks.

(a) Briefing document prepared by research assistants

(b) Participants are creating contributions on-site

Figure A.1: Briefing material and a photo during the walkshop

A.2   Walkshop

Figure A.1a and Figure A.1b show some impressions of the *Walkshop*.

A.3   Game Trial

This section includes additional material on the game trial that might be helpful to get a better understanding of the trial setup.

Missions

In the following are the mission statements in German language (created by a colleague who coordinated the contacts with a municipality in a district in Vienna).

Grünflächen in der Nachbarschaft
Grünflächen können das Leben im Stadtteil schöner machen. Für engagierte Bewohner bieten kleine Nachbarschaftsgärten die Möglichkeit aktiv mitzugestalten. Wie steht es eigentlich um die kleinen und großen Grünflächen im Nordbahn- und Stuwerviertel? Wieviel Grünflächen sind denn vorhanden und welche machen den Stadtteil schöner und welche sind eher missglückt? Gefallen euch Initiativen der Stadt, wie die Bepflanzung von Baumscheiben durch Bewohner? Fallen euch noch andere Konzepte ein?

Aufräumen im Grätzel
Eigentlich sind wir ja verwöhnt vom öffentlichen Dienst – Mist wird beseitigt, die Straßen wer-

den gereinigt, Grünzonen werden bepflanzt usw.. Dennoch kann manchmal nicht alles abgedeckt werden. Wir möchten untersuchen, in welchem Zustand das Wohngebiet um die Lasallestraße eigentlich aus eurer Sicht ist. Wo gäbe es was zu tun, um den Stadtteil aufzupolieren? Wo ist Ordnung angesagt und wo wird es wieder ungemütlich, weil es zu sauber ist? Was fällt euch auf, z.B. zu Themen, wie:

- Herumliegender Mist

- Vandalismus oder Beschädigungen allgemein

- Verbesserungsvorschläge, Ideen

- Wo fehlt etwas oder was braucht die Stadt noch?

Gesundheitsförderung im Stadtteil

Wie kann in der Stadt ein Gesundheit unterstützendes Umfeld geschaffen werden? Welche Potentiale lassen sich auftun, um für Menschen mit unterschiedlichen Anforderungen einen gesunden Lebensstil zu ermöglichen? Welche Bedürfnisse könnt ihr feststellen, welche Herausforderungen und welche Lösungsansätze fallen euch ein? Mögliche Themenbereiche wären:

- Natur und Erholung, Ruheorte

- Mobilität und Verkehrsmittel, aber auch Unfallprävention

- Anregungen und Angebote in Bewegung zu kommen – Umgestaltung/Umnutzung des Öffentlichen Raums

- Dienstleistungen im öffentlichen Raum: Kursangebote, Gesundheitsaufklärung

Belebung der Fußgängerzonen

Die Wohngebiete rund um die Lasallestraße erfreuen sich zunehmender Beliebtheit. Doch sowohl die Fußgängerzone entlang der Lasallestraße, als auch die Erdgeschoßebene der Neubauten im Nordbahnviertel, sowie das von Leerstand geprägte Stuwerviertel wirken zur Zeit noch etwas unbelebt. Wir suchen Ideen, Konzepte, Bedürfnisse und Meinungen zu dem Thema, wie dieses Gebiet belebt werden könnte. Themen-Anregungen:

- Ideen für Zwischennutzungen

- Müsste der öffentliche Raum umgestaltet werden? Wenn ja, wie?

- Ideen für neue Möglichkeiten den Raum zu nutzen

- Derzeitige Probleme/Herausforderungen

- Welche Angebote fehlen?

Game Server Configuration

The following configuration file is part of the backend server and allows dynamic configuration of the game parameters (parameters were used for the game trial).

```python
import math

# AREA in m^2
# LIFETIME in min
class GameSettings:
    initial_area = 4000
    initial_lifetime = 20
    initial_radius = math.sqrt(initial_area / math.pi)

    class Incentive:
        class AreaIncrease:
            receive_contribution_vote = 300
            receive_contribution_comment = 500
            add_contribution_photo = 1500
            add_contribution_poi = 1000
            add_contribution_mood = 1000
            add_contribution_mission = 1500
            check_in_user = 600

        class LifetimeIncrease:
            receive_contribution_vote = 2
            receive_contribution_comment = 5
            add_contribution_photo = 2
            add_contribution_poi = 1
            add_contribution_mood = 1
            add_contribution_mission = 1
            check_in_user = 3

    # multiplied with area_increase
    class HomeAreaBonus:
        give_contribution_vote = 1.5
        give_contribution_comment = 1.5

    # added to lifetime_increase
    class NeighborhoodLifetimeBonus:
        give_contribution_vote = 0.1 * 1440
        give_contribution_comment = 0.25 * 1440
```

APPENDIX B

Publications

A work-in-progress paper was successfully published at the CHI'14 conference in Toronto, Canada [34][1] and paper in-review on the *Technical Pre-Trial* and *Walkshop* was written [56][2]. In the following are the attached papers.

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[1]By the author of this thesis and co-authored team members.

[2]The paper was authored by Sarah-Kristin Thiel and co-authored by the thesis' author and colleagues, this paper mentions the *Technical Pre-Trial* as *Office trial* and the *Walkshop* as *BBQ trial*.

Civic Engagement Meets Pervasive Gaming: Towards Long-term Mobile Participation

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Abstract

An increasing number of smartphone applications to
engage and involve citizens in themes of urban
government is available and enables mobile participation
on-the-go. However, the current functionality of so-called
"m-participation apps" is often restricted to one-way
reporting of issues by citizens, and thus more strategic
long-term participation is not supported. To enhance
traditional m-participation approaches and encourage
continuous engagement, we investigate their fusion with
location-based games in a user-centered research process.
In this paper, we present the results of a web survey
among 33 gamers which uncover the main motivators for
playing location-based games. Based upon these findings,
we derive a new long-term m-participation concept named
Community Circles and introduce a first functional
prototype to be used in future focus group studies.

Author Keywords

M-participation; e-participation; participatory sensing;
location-based games; pervasive games.

ACM Classification Keywords

H.5.2 [Information interfaces and presentation (e.g.,
HCI)]: User Interfaces.

Introduction

Around the globe, municipalities as well as private organizations increase their efforts to involve citizens in urban governance and political decision-making processes through contemporary information and communication technology. Typical "e-participation" tools include community-driven collaborative web platforms such as *Better Reykjavik*[1], *Community PlanIt*[2], and *MindMixer*[3]. More recently, smartphones have been identified as powerful ubiquitous participation enablers due to their increasing penetration and evolving technical features. One promising application field for citizen participation through mobile devices ("m-participation") is urban planning where the communication, visualization and localization features of today's smartphones are utilized to distribute information on planned reconstructions or collect citizen feedback following a so-called "participatory sensing" approach.

One of the first respective research prototypes was *MobileDemocracy* [1], a smartphone application for "situated engagement" [5], i.e. in-place reflection while being physically close to a planning zone. The map-based application featured location-based contributions, discussions and up/down voting. The related m-participation prototype *Mening@park* [6] allowed smartphone users to attach location-related comments by capturing visual codes. Research on advanced mobile visualizations includes *Scene Memo* [4] for annotating and sharing user-generated photos and *ARCity* [5] utilizing an augmented reality view to visualize planned changes of the cityscape.

In the meanwhile, first participatory sensing apps for the citizen-driven reporting of urban issues to city representatives have become publicly available, e.g. *FixMyStreet*[4] and *Citizens Connect*[5]. However, recent research [3] overviewing these m-participation apps points out that existing approaches are mostly limited to dissemination or reporting purposes (one-way communication) and do not leverage strategic actions and long-term participation.

To foster active long-term participation and encourage vivid interactions among citizens, we investigate the extension of m-participation approaches with *pervasive gaming* aspects in our current work. Pervasive games are location-based apps carrying the digital world into a real setting giving them a new meaning and blurring the border between these worlds by "expanding the contractual magic circle of play socially, spatially or temporally" [7]. In the remainder, we give an insight into our on-going user-centered research process towards a novel m-participation concept named *Community Circles*. We present the results of a web survey highlighting the motivational elements of state-of-the-art pervasive games and derive appropriate rules for an engaging m-participation game. Further, we introduce a functional software prototype providing the envisioned interactive game features and dynamics for focus groups participants.

Studying Pervasive Gaming

As basis for creating an encouraging and attractive m-participation concept, we studied successful pervasive games and their players to uncover typical usage behavior and enjoyable and motivational game elements.
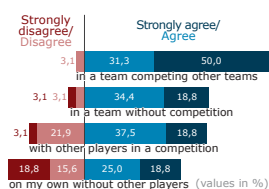
Figure 1: Preferences concerning single/multiplayer game modes

Methodology
We designed a web questionnaire consisting of 27 questions[6]. Starting with a short demographic section and a few general questions on digital games, we asked about the players' experiences with location-based games and the causes of fascination. The next questions targeted the usage behavior such as the average daily play time and the integration of gaming activities in daily life. Highlighting the most extreme moments, we then asked for very positive, negative and the most memorable pervasive gaming experiences. Finally, we asked the participants about the relevance of social interactions as well as to rate the importance of 13 aspects of location-based games, based on results from O'Hara's study on motivational aspects of Geocaching [8] such as *going outside with friends*, *discovering places* or *healthy activity* on five point Likert scales.

To recruit suitable participants we posted the study invitation and the link to the questionnaire in two Web forums for the very popular pervasive game *Ingress*[7], which enables players to collaboratively claim virtual "portals" at real-world locations, and collected the feedback during the following three weeks.

Results
We received 33 responses for our online survey. The participants (6 females) were aged between 15 and 51 years (mean=29, median=30). 55% reported to play location-based games for one to two hours per day, 34% play less than one hour, 7% between two to three hours. According to our participants, location-based games have a surprisingly high impact on the daily routines of the players. 94% report that they play between their daily

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[6]https://www.surveymonkey.com/s/6Z59JZ7.
[7]http://www.ingress.com

activities (e.g. when going to work), 87% play in their spare time and only 26% stated to actively allocate time, e.g. by postponing other activities. To reach game-relevant locations, the majority accepts to walk instead of taking public transport or to take another route.

Concerning single vs. multiplayer game modes, the participants clearly preferred a competitive team mode over an isolated single player mode highlighting sociability as a central element in pervasive games (Figure 1, without neutral answers). This teamwork and competition aspects are emphasized again by the answers regarding the important aspects of location-based games, as shown in Figure 2. Further, participants often stated *discovering new places*, *meeting new people* and *taking part in challenges* as (very) important game elements. The open-ended questions on fascination, positive, negative and most memorable experiences were partially overlapping, thus we summarize and group the findings in the following relevant categories:

Sociability. Again, social interaction was the most prominent factor when asked for the fascination (mentioned by 61%). The players appreciate meeting other players, feel really bond to the community, like to have conversations during the game and in general enjoy the team play. Community events, such as organized *Ingress* missions, enforce this relationship. Also when asked for positive gaming experiences, socializing is mentioned: the participants often remembered moments where collaboration was required and they felt as a part of the whole. They enjoyed the good spirit of the community. On the other hand having this social relationship can lead to tension between players and within the community. As negative experience a few participants pointed out that some other players take the
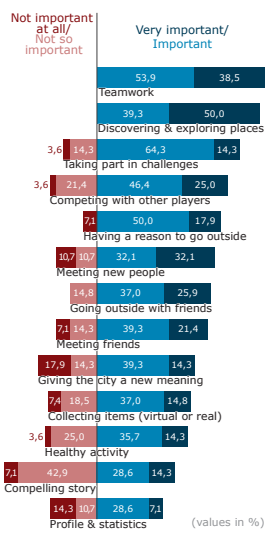
Figure 2: Subjective importance of pervasive gaming aspects

game too seriously and "cannot distinguish between reality and virtuality". Players also complain, that in case of *Ingress* the game play seems to be stuck: high level players make it difficult for newcomers and to proceed in the game it still requires a lot of time to level up.

Exploration. Having the city as a playground is a challenging and exciting aspect in pervasive games. Our participants highly welcomed the opportunity to (re-)discover their neighborhood and felt more engaged with their environment. They were excited, when they had the ability to see new places and explore the city. For some players this also meant going to another city or even abroad to play and proceed in the game, e.g. one player reported that playing *Ingress* is a good occasion to discover interesting places in another city.

Activity and achievement. Location-based games require the player to go outside what is considered a good way to stay active and healthy by our participants. E.g. often the players reported that they combined the game with weekend activities. The most memorable moments of the players were often associated with adventurous experiences. E.g. one player reported the she was "walking 27 km through the whole city from 2 a.m. until 11 a.m." during a game session. Additional to such real-world activities, players enjoy virtual achievements. Beside social factors it is rewarding for players to fulfill a game objective, e.g. it was described as satisfying when they reached a higher level and improved their virtual powers or had the chance to take part in organized missions.

Novelty. Also the novelty and technological sophistication of pervasive games makes them attractive for players. In the case of *Ingress* this is actively supported by futuristic visualizations. The novelty of the game-play blurring the border between the virtual and real world led to several

interesting incidents such as conflicts with officials, e.g. when outsiders who observed players got suspicious. This novel aspects of presentation and game-play are additional motivators for a technology-affine young user group.

Community Circles

Based on the literature review and results from the presented online survey, we derived a game concept entitled *Community Circles* that significantly expands the functionality of traditional participatory issue reporting apps by appreciated pervasive gaming elements.

Similar to *Citizens Connect*, etc., user-generated georeferenced contributions such as unsolved issues are central to the map-based application concept (see Figure 3). Other citizens can browse these contributions, up/downvote them and add textual comments (see Figure 4). In contrast to existing issue reporting apps, *Community Circles* supports additional contribution types such as ideas, opinions, and polls. Each contribution has a certain impact radius (visualized as a surrounding circle on the map), derived from its activity and responses from others. For example, if a contribution is voted up or someone posts a comment its impact increases. Each citizen contribution has a lifetime and will disappear if it is considered as irrelevant (meaning there is no activity). Contributions in a certain distance to each other form communities (cf. Figure 3), which has again a positive effect on the contributions' ranges. Besides a points system for players (e.g. for writing a comment) as a traditional gamification element [2], the players are continuously informed about the size and activity of their communities and are encouraged to grow the community areas by adding new contributions. This basic game concept is designed to create a dynamic network of citizen contributions where players are motivated to actively

Figure 3: Map view with several user-generated contributions forming a community

Figure 4: Contribution details

engage and to continuously participate. The long-term goal of this game is to grow the community and keep contributions and therefore a community alive. The following key features of *Community Circles* address the key motivators in pervasive games learned from our survey results and further extend the functionality of traditional reporting apps:

1. *Social interactions* among citizens play a central role in our game design and are actively promoted through the concept of growing and shrinking impact (i.e. geographical range) of contributions. To be successful in the game, a player needs to create valuable contributions and keep these activities alive by discussing them or credit other contributions with votes. Forming communities by interacting with other players and merging communities is rewarded as well.

2. *Challenges* can be created in *Community Circles* by both players and the city. City representatives can start georeferenced contests, e.g. calling for ideas for the reshaping of the town square, and players who are located nearby are invited to share their opinion. On the other hand, *Community Circles* enables players to start location-based multiple choice polls to learn about the opinion of adjacent citizens and uncover so far unknown or neglected concerns and citizen views.

3. *Teamwork* is not only encouraged by spatially growing a community but also by jointly making contributions on-site. For example, when inserting a contribution, the creator can add other members as supporters if they are in close vicinity (i.e. going places together). Such team contributions have a higher impact and spatial range.

4. *Competition* between teams is addressed in our concept by allowing players to build communities with

their contributions and comparing community attributes such as size, number of contributions and active members to other nearby communities. Further, players can be especially rewarded with points for contributing to another community than their home community.

5. *Exploration* of the urban environment is another highly relevant reason for playing pervasive games and we learnt that users are willing to adapt their daily routes to progress in the game. The concept of *Community Circles* fosters this explorative character by the overall goal of growing communities. Players are actively encouraged to explore the border areas of their communities and make contributions there to increase the size of their communities. Further, we plan to link into a user's daily routines by providing meaningful notifications such as alerts at community-relevant locations or when being close to potential collaborators.

Mockups and Prototypes
To illustrate and further develop this basic game concept, we created prototypes. First, several low-fi paper prototypes were designed. Figure 3 depicts an example of the home screen with a map showing citizen contributions close to the user's current whereabout and other features, such as an add-button to easily create a new contribution. Its design is based on related social apps that support posting on-site with social features, such as comments or voting mechanisms. Further, we designed mockups that illustrate the creation of a contribution, different approaches to browse contributions or user profiles, and rate and comment contributions (Figure 4). To demonstrate the game mechanics, especially to explore the dynamics of adding contributions, forming communities, the "lifetime" of contributions and the impact of comments and votes, we created an interactive

Figure 5: Hi-fi prototype developed with the rapid-prototyping toolkit *Processing*

hi-fi prototype. This prototype has a sophisticated configurable graphical appearance (Figure 5) and allows to place different types of contributions on the map and to modify the comment and vote count to experiment with meaningful impact parameters. We used this interactive prototype in a preliminary focus group study with two game-affine participants where it animated them to active discussions. The idea of having a "home community" was developed to allow constructive competitions and motivate community building in the game. Overall, the feedback (especially with regard to the game dynamics and the screen design) was highly positive and led to several new ideas which will be integrated in the next iteration.

Conclusions

We introduced our on-going research on supporting long-term citizen engagement through mobile devices by linking the traditional participatory sensing concept with pervasive gaming elements. The paper's core contribution are the results of a web survey which highlight the motivational aspects of advanced location-based games and can serve as input for other researchers and practitioners in the field. Further, we presented our m-participation concept *Community Circles* with innovative game features exploiting the survey results.

Society consists of heterogenous citizen groups with different requirements and skills, thus there cannot be a "one-fits-all" participation solution. Ludic m-participation apps (or participative pervasive games) like *Community Circles* might help to involve especially young technology-affine citizens in urban government and planning. After positive feedback in a preliminary focus group with young gamers we plan to further iterate our concept with young, yet less gaming-affine, test persons and conduct in-depth interviews.

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Insights from a m-participation prototype in the wild

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Abstract—Developing web-based as well as mobile platforms to encourage citizens to become involved in urban governance and political decision-making processes is becoming increasingly popular amongst municipalities and organisations. However, the vast majority of them either implement a one-way communication between citizens and governance or tends to be more of a consultation process instead of actively integrating citizens in decision-making. Our research aims to strengthen citizens' involvement in governance and encourage a continuous dialogue between municipalities and citizens. To explore the opportunities and impacts of novel mobile participation concepts, we developed a mobile application. This paper reports on two consecutive studies, which evaluate and explore user acceptance of general concepts of our system. Being still in the development phase, we focused on specific features of the prototype. Results of both studies are presented and discussed in relation to opportunities for m-participation tools. The paper concludes with an outline of future work.

I. Introduction

Participation has become a buzzword across a variety of disciplines. Based on the principle of user-generated content, companies and institutions seek input and feedback from their users or recipients. In the domain of democracy, governances (especially municipalities) engage in efforts to involve their citizens in political decision-making processes. Besides traditional ways, such as organising town hall meetings, there is a trend to employ various ICT applications to broaden and deepen citizen participation - which is summarized as e-participation. Several municipalities developed web-based platforms where citizens can raise their voice. While those platforms differ in functionality as well as interactivity, most of them aim to implement a two-way communication between a city and its citizens. Most of them however really achieve just a one-way communication.

Recently mobile devices (e.g. smartphones) have been identified as powerful ubiquitous participation enablers. Several scholars regard m-government as further development of e-government [17]. Burja et al. summarize m-government as a "complex strategy for efficient utilization of all wireless devices and technologies with maximal benefits for the society" [4]. Ogunleye and Van Belle stress that m-government is more than offering existing services on mobile devices [24]. On the contrary, implementing such concepts requires drastic changes to the systems of government and even the social contract [19].

One of the first attempts to explore the use of mobile technology to foster citizen engagement was the research prototype Mobile Democracy [3]. The main focus of the map-based application was to support collaboration among citizens and between government and citizens in municipal land use planning. The application's spin-off version, Mening@Park

[15] further allowed to users to attach geo-referenced comments by capturing visual codes. Two other applications focus more on visual approaches. While ARCity[14] utilizes augmented reality to map proposed changes on top the cityscape, SceneMemo [13] allows users to tag and share photos.

Despite only few applications being yet publicly available, a recent study [8] has shown that most m-participation apps focus on dissemination and reporting purposes (one-way communication) and fail to achieve a sustainable two-communication between governance and citizens. In fact, most mobile applications that follow a participatory sensing approach. The basic idea behind all those is that citizens report issues by sending messages to the municipality, which then get forwarded to the responsible authority. Those messages in most cases consist of geo-referenced content such as pictures or text. Examples for this category include FixMyStreet[1], Citizens Connect[2] and M.O.R[3] (here pictures are labelled with tags).

Our research aims to explore novel pervasive participation interfaces. As such, we investigate new concepts for enabling mobile interaction and e-participation in urban governance through citizens' personal mobile devices. Our objective is further to provide guidelines on how to make such mobile participation applications attractive to use. To explore requirements, opportunities and impacts of implementing pervasive citizen participation concepts, a prototype application named "Community Circles" has been developed. At the current stage of our research, our main objective was less to analyse the applications' suitability for addressing issues related to urban governance but to identify potential technical problems and usability issues. For this purpose, we conducted two consecutive user studies. This paper reports on these two user studies. In the next sections, we describe the studies and present the results. The paper concludes with a critical reflection of the results and an outline of next steps.

II. The prototype

To explore the potential of citizen participation through mobile devices, we deployed the mobile application *Community Circles*, which has been introduced in [18] (here without gaming elements). The app allows citizens to become involved in political processes in various ways. Citizens can raise their voice and introduce new topics for public debate by posting contributions. Contributions are geo-referenced pieces of content. There are four different contribution types: *Opinion*, *Idea*, *Poll* and *Issue* (see Fig. 1). Contributions can be supplemented by adding a photo, a mood and a point of interest. These

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[1] https://www.fixmystreet.com
[2] http://www.cityofboston.gov/doit/apps/citizensconnect.asp
[3] http://x.appgyver.com/jurrid/57

contributions are visible to all users and be can be commented to spark an active discussion. Users can further express their support for specific contributions by voting on them. The system can serve as crowdsourcing tool and indicator for hot topics, providing governance with an overview of citizens' concerns and opinions. Compared to existing mobile participatory sensing systems, our application allows to create different contribution types, which express different motivations and intentions of citizens and lets those be annotated with icons that correspond to the person's perception of the addressed situation. How the app can be used in relation to urban governance illustrates the following fictional scenario:

A citizen notices how all the kids in her block are always playing in front of the buildings, which borders on a busy street. Realizing the danger, the citizen begins to look for an alternative playground. During one of her errands, she discovers an abandoned park that is quite close to her block. While still at the park, she uses the app Community Circles to post a new contribution stating her idea to turn this unused ground into a playground. She adds a picture of the park using the built-in camera of her mobile phone to support her assertion that the place could be used better. Other citizens read her contribution and especially those living nearby vote for the idea or add comments suggesting components for the playground. As the icon representing the contribution on the map grows with activity, the municipality soon becomes aware of the idea and joins the discussion. They also post a poll asking what kind of elements the playground should contain. Only shortly after the initial idea was posted, the city announces the plan to build the proposed playground.
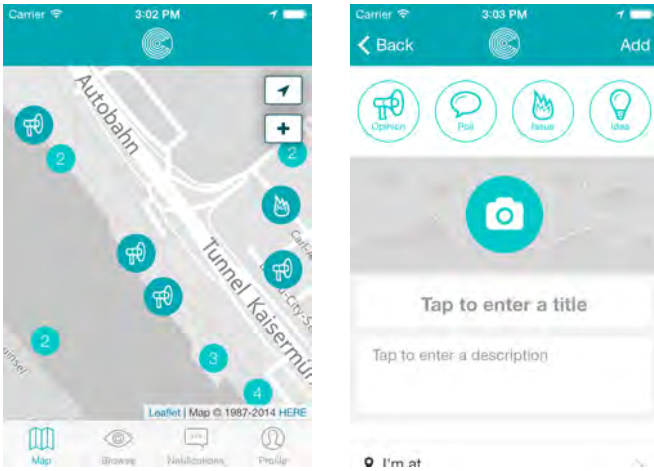

Fig. 1: Screenshots of the application (interactive map and form to submit contribution)

Designing a system for achieving meaningful collaboration between governance and citizens is challenging both on technical and on financial grounds (cf. [7]). While the financial situation of municipalities cannot be influenced by research, studies and evaluations can help identify best practices of what technologies, services and devices to use to achieve (1) a sustainable two-way communication between governance and citizens and (2) encourage citizens to actually make use of this channel. As Åke Grönlund pointed out, good e-service design and good e-participation are complementary to each other [9]. The remaining question is, what classifies good e-service design? The studies describes in this paper aim to find answers to this question. While design can be understood in various ways, the objective of this paper is to give first insights into what features should situated engagement apps encompass and hence addresses a technical perspective of design. One criterion for evaluating the design of e-participation is to analyse whether included functionalities are appropriate in this special domain and use case [23].

By posting a contribution citizens raise their voice, propose ideas or formulate their concern. Instead of just having a geo-referenced piece of content for others (citizens and governance) to read, input from citizens should be better and easier to understand. Hence, we included multiple aspects to augment contributions. Apart from having a title to support fast browsing, a description is required for each contribution. According to several scholars (cf. [2], [21], [27]), visually prominent information can enhance participation and is most accepted by users. To make use of this common language pictures (or photos) can also be added. This visual medium further serves as summary of the description of the contribution. Text and in most cases pictures are both quite neutral forms of statement. The majority of e-participation platforms does not allow expressing emotions. In an attempt to explore the necessity and potential benefit of conveying emotions that are associated to a contribution, we included a set of icons each linked to a certain emotion as optional attribute. To the best of our knowledge, no e-participation tool makes use of such emotion-based tagging mechanism.

III. STUDY SETUP

We conducted two user studies with a sophisticated version of the prototype. For both studies, our focus was to test the system and identify usability issues. A minor aim for this preliminary trail was to evaluate and explore general concepts of our mobile participation system. The latter objective was intensified in the second study. As such, both studies were intended as exploratory trials to test the program and less the use cases. Hence, the findings should be interpreted as pointers to the interface and interaction design of m-participation tools instead of a general suitability for topics related to urban governance.

Already in the beginning of the first study, we realized how difficult the recruitment of participants is to test a new application that supports discussions and ideation. What further complicated the matter was the fact that the app lacked initial content to interact with. Another issue we faced was that participants only used the application in the context of their work place and did not post contributions that would have been relevant to a broader range of people or topics related to urban governance at all. To address these issues, we decided to move participants and the system into the actual context of use where we hoped that the real environment would provide more stimuli. Therefore, for the second study we adopted the concept of "walkshops" [16]. The pivotal idea of walkshops is to have participants use a prototype and carry out concrete tasks on it while on an extended scenario-based walk. The goal is "to further explore and understand the design space together with users in more realistic use settings than workshop rooms" [15].

Advantages of this method include the ability for participants to move about more freely and flexible. Walking further serves as stimulating activity.

A. Office trial

In July 2014, we conducted the first user study with an initial version of the application over a period of four weeks. The goals of this study were to (1) analyse which features participants used; (2) explore how participants interact with the application; and (3) get first insights of the acceptance of the overall concept of the application. The underlying research question was to explore what elements and features in m-participation applications are accepted by citizens. By addressing colleagues from the institute in person, study participants were recruited. Participants were selected based on their experience with mobile technology. At the beginning of the trial, the prototype was only available for iOS devices, which restricted the number of participants considerably. Introducing the Android version about two weeks into the trial, led to a slight increase in the number of participants as well as in-app activity. In the end, 18 (6 female, 12 male) participants had registered to use the application.

For the period of the trial, participants were asked to use the app. More precisely, participants should post about topics they thought were relevant to other participants and hence might be interested to discuss. Such topics could for example include the parking situation at the research institute. Contributions regarding that topic could be ideas how use the available space better or to encourage people to use public transport instead. Participants were free to interact with the app in whatever way they wanted. To avoid any kind of influence, we observed the participants' activities only through the system's backend.

B. BBQ trial

The next study can be seen as a follow-up study of the previous both because we invited the same users to take part and aimed to engross the questions addressed in the Office trial. Again, our objective was to analyse which features would be used by participants to what extent and whether there are any issues related to usability. This was primarily done by analysing the participants input that was tracked in the systems backend. Furthermore, the trial should also give us some insights into the dynamics of using the application in the wild. Eight (6 male, 2 female) persons participated in the field trial. Participants were chosen from the office trial (5) and recruited internally amongst colleagues from the institute (3). As additional incentive to take part, we organised a barbecue (BBQ) at the end of the trial.

Evaluating (social) ubiquitous systems such as our application is difficult in a sense that a "critical mass" [20], [26] of contributing users and time is needed for the system to unfold its use. Moreover, the reluctance of becoming active (e.g. commenting) is considerably high when being the first to respond. To ease this reluctance, discussion topics should be meaningful in a sense that users can relate to it or already feel strong about. Accordingly, we opted to conduct a more lively and meaningful activity in the form of a walkshop [16] that should provide various usage situations and inspirations. In our case, we instructed participants to post contributions

to specific topics. Content generated during the Office trial remained in the system and thus gave participants hints on how contributions could look like in terms of topics and attributes such as mood and POI.
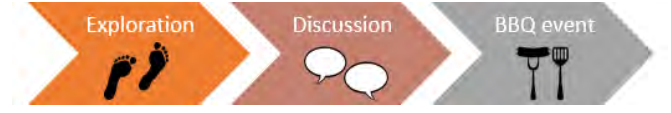

Fig. 2: Three phases of the BBQ trial.

The study consisted of three phases: exploration phase, discussion round, and a barbecue (Fig. 2). The trial started at the office building and the last two phases were situated at the meeting point in a small inlet at the Danube about 1.5 km away. The distance was covered during the exploration phase by walking and formed the actual walkshop. At the beginning, they were briefed in the office building by researchers. The entire field trial took about four hours.

1) Exploration phase: In the first phase participants were divided into three groups. The participants' task was to create contributions by using the mobile application along the way. Each group was assigned a different theme for this task. All contributions being posted during the exploration phase should be according to this specific theme. Group A was asked to identify opportunities for a relaxing lunch break. The theme for group B was to point out ideas for after-work and recreational activities. The third group, group C, was not assigned any theme and was therefore free to post anything they wanted and came across. The topics were less "civic-specific" but convenient due to the setting. By urging participants to carry out concrete tasks while in a realistic use setting, we aimed to get a better understanding of the design space [15].

Group	Theme	Route	#
Group A	Opportunities for a relaxing lunch break	Donaucity	2
Group B	After-work and recreational activities	*No route*	2
Group C	*No theme*	Donauinsel	3

TABLE I: Groups during the exploration phase

In addition to themes, group A und group C were instructed to take different routes to the meeting point. These routes were similar in length and did not intersect. Group B could choose their own way. Maps showing the approximate routes and themes were distributed among the groups. Each group had about one hour to get to the meeting point. Tab. I provides an overview of the group setup.

As the briefing solely explained the basics of how to use the application, we made sure that each group had at least one participant that was already familiar with the prototype due to his or her involvement in the Office trial. Each group was accompanied by a researcher who observed the participants regarding involvement, interaction with the prototype and intra-group dynamics (i.e. topics of conversations).

2) Discussion phase: All groups met at an agreed time at a small inlet at the Danube. Based on a semi-structured interview, experiences with the application in general and the field trip were discussed. Participants also reflected on experiences during the office trial. The interview guideline mostly

concentrated on the prototype, asking what and how often they had used particular features of the application as well as their motivations to become active in the first place. The discussion round provided opportunities for the participants to comment on the prototype and make suggestions for improvement or report bugs.

3) Barbecue: The field trial ended with a barbecue as an incentive to participate in the study. Requisites such as food, tableware and the barbecue grill had been organised by the research team.

IV. RESULTS

This section provides an overview of usage statistics during the enitre trial period of both studies and is derived from our system backend. Although both studies are not comparable due to different study setups, we make an effort to contrast results from both studies. Where appropriate, participants' statements during the discussion round are included.

One has to keep in mind that the Office trial went over four weeks, whereas the BBQ trial took place at one afternoon. Giving participants the assignment to contribute in one afternoon would in any case result in high participation, while participants from the Office trial might have gotten over the novelty effect of the application after a while. Furthermore, the Office trial counted 18 participants, while only eight participated in the BBQ trial. Despite these differences, during the second study almost twice as many contributions were being posted. Groups A and B posted a similar amount of contributions (22, 25). Group C, which was not assigned a theme only posted half as much (13). Measuring the level of participation by the amount of posted contributions may conclude that introducing a theme can increase participation. However, seeing that the two trials were quite different in their setup a separate trial should be conducted with the explicit objective to investigate whether introducing a theme while using a m-participation tool has an influence on the level of participation.

Individuals. According to the 90-9-1 rule for social media online communities [1], 90% are lurkers who never contribute, 9% are users who contribute a little, and 1% of users account for almost all activity. In other frameworks the latter are also called super-users. This participation inequality has been proven to hold true for a variety of domains (e.g. in the enterprise domain [28]). Several scholars found that e-participation tools tend to be popular among citizens who are already interested in politics [11], [22] as well as among technology-savvy citizens [25]. The interest is especially high amongst well-educated young people (known as smart natives) [10]. With participation being about the inclusion of people, citizens from all groups should be enabled and encouraged to participate.

Four participants of the Office trial can be described as lurkers, as they did not become active in any way during the whole trial period. Having posted twice as many contributions as the average, three participants could be classified as super-users. The remaining eleven occasionally became active. During the BBQ trial every participant became active. Half of the participants posted more than the average number of contributions per participants. Two participants together contributed 43% of all activity and might be classified as super-users. Those two had already been super-users in the previous trial.

The vast majority of contributions were *Opinions* (52%) and the least used type was *Poll*. Participants noted that they were not deliberately not using *Polls* but could not think of a situation when this type would "make sense". Only few participants made use of any other than the two most common contribution types (Opinion, Idea) during the Office trial. Whereas all groups had a relatively balanced distribution of contribution types (except *Polls*), group B did not use *Polls* and *Issues* at all but used the type *Opinion* in 64% of their contributions. In the BBQ trial, half of the participants tried to even the usage of the different types out, while two other only posted one type. These results suggest to re-evaluate whether four different contribution types are necessary or for instance Poll can be omitted.

Pictures. The data analysis showed that adding pictures to contributions was very important to all participants. In both trials over 84% of contributions included a picture. During the discussion round one participant stated that the app would be "boring" without pictures. Only one participant from the Office trial did not add pictures to any of his contributions, but this might have been due to technical problems with his mobile device. The most frequent motifs were of urban environment (34%), followed by business (i.e. shops, restaurants) and people (both 16%). While there were no differences in terms of motifs per group for the "urban environment" category, group B accounts for having included the most pictures that featured people and group A for pictures of businesses. This circumstance can partially be ascribed to the topic of group B. According to notes from observations, participants had tried to capture people *while* doing recreational activities. Group A on the other hand had been looking for places to eat lunch. In summary, it can be stated that pictures are a key element in applications where users want to report a place-based situation. Pictures allow to characterize and define situations much faster than writing lengthy descriptions. Keeping in mind that the writing has to be done on a rather small touch keyboard and users being on the move, simply adding a picture as further explanation is a good way to save time and avoid frustration.

Mood. Looking at the feature for including moods, there is a difference between the Office and the BBQ trial. In the first trial 86% of contributions were complemented with a mood, in the BBQ trial only 58%. This difference is due to two of the super-users of the BBQ trial using the mood feature only in rare cases. The interesting point here is that those same participants had used the feature extensively in the previous trial. Something, possible a circumstance during the exploration phase, made them change their behaviour. The contribution type *Idea* was complemented the most often with a mood. When investigating the included moods in terms of their tendency, during both studies most participants indicated to be in a good mood or felt positive towards the topic they were writing about (BBQ: 45%; Office: 48%). Participants chose to add a neutral (i.e. childish, ironic) mood only in 20% when deciding to add a mood at all. Participants noted that they were often missing certain icons representing moods (e.g. "hungry") and they would like to be able to describe moods with words.

POI. Including a POI did not seem to be a valuable addition as less than half of all contributions had a POI attached. Especially during the BBQ trial this feature was rarely used. Only one participant added a POI to all his posts. One the other hand, a super-user did not include POIs for any of her contributions. During the Office trial POIs were added twice as often as in the BBQ trial. It should be noted that the area around the Donauinsel does not provide very many POIs, thus during the larger part of the trial group C could not add this information even if they had wanted to.

As a summary, it can be noted that pictures are an essential element in mobile applications. Moods were only used extensively in the first study but not so much in the second study. As participants in the first study were mostly sitting at their desks, they had more time and comfort to compose contributions as well as look at the application in more detail. The difference in usage contexts is reflected in an overall slight decrease of complementing contributions with additional elements. At the same time, the percentage of contributions with pictures remained about the same in the second trial.

A. Discussion

This section summarizes participants' comments from the discussion round. During the walkshop, participants often had to wait for group members who were still composing a contribution. Participants noted that the process of posting took too long and suggested to have default settings to be able to create contributions faster. They also commented on the system becoming easily overcrowded and that finding specific posts being rather troublesome. They proposed to include a filter with various categories (e.g. distance, age, activity) and being able to add tags in order to categorize contributions and facilitate browsing through content relating to specific topics. Tag-based systems can enable rapid exploration, as shown in [6], [12]. The pre-classification could further help city officials identify prevalent topics and patterns.

During the BBQ trial, participants tended to write about topics that had been discussed recently in real life. They also saw relevance in posting about situations where there are nuisances and changes could be realized with little cost. They thought it redundant to raise awareness about situations that could not be changed anyhow. In that respect, participants already performed a pre-filtering by leaving out topics that would - based on their assessment - not fall in the responsibly of any department within the municipality. However, in order for this pre-filtering to be beneficial from the participation perspective, one must assume that citizens have extensive knowledge not only about the existence but also about the responsibilities of individual departments within a city administration. Considering the complexity of city administrations and the common disinterest of citizens in politics, this assumption is rather far fetched. In fact, people not raising their voice might partly be due to them rating the issue not relevant enough for public discussion. Official representatives providing feedback or responding to a broad majority of posts could give citizens the impression that their input was indeed valuable and encourage them to keep posting. In summary, it was important to participants that their posts reflected topics that (1) were relevant to the community and (2) were implementable by governance. Only if both (1) and (2) applied, participants felt that their post was meaningful and hence could have an influence in changing something and they did not waste their time.

The app was further perceived as an efficient channel to collect ideas and to gather opinions. Participants saw great value in being able to discuss things and situations with others. They suggested using the app for ideation processes for example in order to identify ways to make the area around the office building more attractive. Participants did not include governance in their scenario sketches. Including a member from the municipality who could have responded to input might have made the whole trial more realistic. Overall, participants were aware that long-term motivation without impact is difficult and thus appreciated reactions. Statistics from comments and votes showed that participants only concentrated on posting their own contributions and did not take time to view or reflect on contributions posted by other participants. Participants admitted that they "just wanted to disseminate own ideas" and their goal "was not to see what had already been posted". Although, this might also be due to not having had enough time during the walkshop. Participants were however interested in whether there had been activity on their posts. All participants wanted to receive notifications about recent activities. Moreover, being able to sort and filter posts by creation time was commonly rated as an essential feature.

Participants reported on the issue of the non-existent anonymity as all participants knew each other. A participant said he might have posted about topics that he would normally not talk about. This could be interpreted as an argument for allowing users to take synonyms rather than their real names for in-app activities. De Cindio points out that especially in e-participation platforms users need to show their face and take responsibility for their input by using their actual identity [5].

V. CONCLUSION

We conducted two user studies with a first version of a mobile app that aims to support citizen engagement. The paper's core contribution are the results of these studies, which give first insights into challenges and opportunities of m-participation and despite their limitations (i.e. number of participants, participants knowing each other) help identify factors that enable and motivate the use of m-participation.

The evaluation of the two field trials shows how participants used the m-participation prototype providing research as well as practice with preliminary hints on what types of features might be required on the citizens side to start a discussion with governance on a specific topic. We found that being able to add pictures was rated as one of the most important features. To what extend features as well as the whole application is used further largely depends on the usage context (e.g. travelling vs. at home, colleagues vs. strangers). Although our analysis provides some pointers regarding that matter, the results of the BBQ trial did not allow us to make a profound statement regarding whether providing a mission increases the level of participation. Further studies have to verify the found tendencies. Data from both studies suggests that participants were more likely to post "opinions" rather than "issues". In general, participants' input had a more constructive notion than

those from mere reporting platforms where the majority of posts regards problems and complaints. The positive tendency of added moods underlines this observation.

We identified three aspects that should be addressed in m-participation systems. The first two relate to features of the system: (1) provide a structure that allows easy browsing through content to avoid overloading the user and facilitate agenda setting for governance. (2) Notifications can further help citizens integrate their engagement in their daily life as they are alerted when activity on topics they previously have expressed interest in takes place. The last and arguable the most relevant is (3) the input having an impact. Citizens are most likely to become engaged in topics that directly affect their life. Citizens do not want to spend time on topics that will neither have a direct nor indirect influence on their surroundings or living situation. In addition, statements from participants suggest that citizen do a pre-evaluation prior to becoming active trying to determine the likelihood of the topic being successfully implemented or even considered by governance.

The next steps include re-designing the prototype as well as conducting further user studies to analyse whether our concept of a mobile application is suitable to discuss topics relating to urban governance. Among other things, we want to try to investigate the effect of providing a theme in participatory processes. Moreover, we are planning to explore the impact of introducing game elements to our m-participation system.

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Pervasive Game Flow Model

Table C.1: The Pervasive Game Flow Model by Kalle Jegers (extensions of the game flow model are written in *italic*) [23]

Element	Criteria
Concentration Games should require concentration and the player should be able to concentrate on the game	(1) Games should provide a lot of stimuli from different sources (2) Games must provide stimuli that are worth attending to (3) Players shouldn't be burdened with tasks that don't feel important (4) Games should have a high workload while still being appropriate for the players' perceptual, cognitive and memory limits (5) *Pervasive games should support the player in the process of switching concentration between in-game tasks and surrounding factors of importance*
Challenge Games should be sufficiently challenging and match the player's skill level	(1) Challenges in games must match the players' skill levels (2) Games should provide different levels of challenge for different players (3) Pervasive games should stimulate and support the players in their own creation of game scenarios and pacing (4) *Pervasive games should help the players in keeping a balance in the creation of paths and developments in the game world, but not put too much control or constraints on the pacing and challenge evolving*

Table C.1: The Pervasive Game Flow Model by Kalle Jegers (extensions of the game flow model are written in *italic*) [23]

Element	Criteria
Player skills Games must support player skill development and mastery	(1) Players should be able to start playing the game without reading the manual (2) Learning the game should not be boring, but be part of the fun (3) Games should include online help so players don't need to exit the game (4) Players should be taught to play the game through tutorials or initial levels that feel like playing the game (5) Players should be rewarded appropriately for their effort and skill development (6) Game interfaces and mechanics should be easy to learn and use (7) *Pervasive games should be very flexible and enable the players' skills to be developed in a pace set by the players*
Control Players should feel a sense of control over their actions in the game	(1) Players should feel a sense of control over their characters or units and their movements and interactions in the game world (2) Players should feel a sense of control over the game interface and input devices (3) Players should not be able to make errors that are detrimental to the game and should be supported in recovering from errors (4) Players should feel a sense of control and impact onto the game world (like their actions matter and they are shaping the game world) (5) Players should feel a sense of control over the actions that they take and the strategies that they use and that they are free to play the game the way that they want (not simply discovering actions and strategies planned by the game developers) (6) *Pervasive games should enable the players to easily pick up game play in a constantly ongoing game and quickly get a picture of the current status in the game world (in order to assess how the state of the game has evolved since the player last visited the game world)*
Clear goals Games should provide the player with clear goals at appropriate times	(1) Overriding goals should be clear and presented early (2) *Pervasive games should support the players in forming and communicating their own intermediate goals*
Feedback Players must receive appropriate feedback at appropriate times	(1) Players should receive feedback on progress toward their goals (2) Players should receive immediate feedback on their actions (3) Players should always know their status or score

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Table C.1: The Pervasive Game Flow Model by Kalle Jegers (extensions of the game flow model are written in *italic*) [23]

Element	Criteria
Immersion Players should experience deep but effortless involvement in the game	(1) Players should become less self-aware and less worried about everyday life or self (2) Players should experience an altered sense of time (3) Players should feel emotionally involved in the game (4) Players should feel viscerally involved in the game (5) *Pervasive games should support a seamless transition between different everyday contexts, and not imply or require player actions that might result in a violation of social norms in everyday contexts* (6) *Pervasive games should enable the player to shift focus between the virtual and physical parts of the game world without losing too much of the feeling of immersion*
Social Interaction Games should support and create opportunities for social interaction	(1) Games should support competition and cooperation between players (2) Games should support social interaction between players (chat, etc.) (3) Games should support social communities inside and outside the game (4) *Pervasive games should support and enable possibilities for game oriented, meaningful and purposeful social interaction within the gaming system* (5) *Pervasive games should incorporate triggers and structures (e.g. quests and events, factions, guilds or gangs) that motivate the players to communicate and interact socially*