

Creating Awareness for Demented Persons through a Chatbot Integrated in a Serious Game

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Creating Awareness for Demented Persons through a Chatbot Integrated in a Serious Game

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Abstract

Dementia is a brain illnesses that affect memory, thinking, behavior and ability to perform everyday activities. The number of people living with dementia worldwide is currently estimated at 35.6 million. This number will double by 2030 and more than triple by 2050.

Often the symptoms of dementia like forgetfulness, changes in speech or in behavior get classified as symptoms of normal aging. The aim of this work is to raise the awareness for the symptoms of dementia especially the ones related to the speech of demented persons. For this purpose a serious game, called 'Do I Know You?' game, was designed and implemented, which enables the player to talk to a chatbot, which represents a demented person. The chatbot's character is based on a real person called Jane, who is about 90 years old and suffers from dementia.

During playing the 'Do I Know You?' game the player is able to get to know more about Jane's life and her character in two ways: On the one hand the player is able to press buttons containing input keywords, which result in a textual response of chatbot Jane. As the responses of persons suffering from dementia the responses of chatbot Jane might be partially or entirely correct. Furthermore the player gets documents from chatbot Jane, if the right input keyword button was pressed. These documents can be shown to chatbot Jane to get more information about her and influence the direction of the conversation.

The evaluation of the 'Do I Know You?' game has shown that a chatbot is a good way to transport knowledge about symptoms of dementia related to the speech.

Kurzfassung

Demenz ist eine Erkrankung des Gehirns, die das Erinnerungsvermögen, Denken, Verhalten und die Fähigkeit alltägliche Dinge zu erledigen stark beeinflussen. Die Zahl der demenzerkrankten Menschen steigt stetig. 2011 hatten 35.6 Millionen Menschen weltweit Demenz, diese Anzahl wird sich bis 2030 verdoppeln und bis 2050 verdreifachen. Oft werden Symptome der Demenzkrankheit wie Vergesslichkeit, Veränderungen in Sprache und Verhalten als normale Alterserscheinungen wahrgenommen. Ziel dieser Arbeit ist es Bewusstsein für Symptome der Demenzkrankheit zu erschaffen, besonders jene die Sprache betreffend. Für diesen Zweck wurde ein Prototyp des 'Do I Know You?' Spiels entwickelt. Das 'Do I Know You?' Spiel besteht aus einem Chatbot, der eine reale Person darstellt. Der Charakter des Chatbots basiert auf einer realen Person namens Jane, sie ist ungefähr 90 Jahre alt und leidet an Demenz.

In dem Spiel kann durch das Drücken verschiedener Stichwort-Buttons mit Chatbot Jane gesprochen werden. Die Antwort des Chatbots wird nach Drücken eines Stichwort-Buttons in einer Sprechblase ausgegeben. Diese Antwort kann - wie die Antwort demenzerkrankter Personen - vollständig oder nur teilweise richtig sein. Weiters gewinnt der/die SpielerIn nach Drücken bestimmter Stichwort-Buttons das Vertrauen von Chatbot Jane und diese übergibt Dokumente, wie zum Beispiel Fotos. Diese Dokumente können im weiteren Spielverlauf Chatbot Jane gezeigt werden, um Informationen über sie zu erhalten, bzw. um die Richtung der Unterhaltung zu beeinflussen.

Die Evaluation des Prototyps des 'Do I Know You?' Spiels hat gezeigt, dass ein Chatbot eine gute Möglichkeit zur Vermittlung der Symptome der Demenz bezüglich Sprache darstellt.

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Introduction

1.1 Motivation and Problem Statement

The number of people living with dementia worldwide is currently estimated at 35.6 million. This number will double by 2030 and more than triple by 2050. Dementia is a syndrome, usually of a chronic or progressive nature, caused by a variety of brain illnesses that affect memory, thinking, behavior and ability to perform everyday activities. The four most common subtypes in order of frequency are Alzheimer's disease (AD), frontotemporal dementia (FTD), dementia with Lewy bodies (DLB), and vascular dementia (VaD). But more usually than pure pathologies of one subtype are mixed pathologies. [36]

For family members, caretakers and other persons having direct contact with demented people it is often difficult to talk with them. Demented persons suffer from different symptoms, which influence their ability to follow a conversation or to phrase a statement. The main problems in verbal communication for Alzheimer patients are difficulties in understanding words and sentences and producing words, mainly because of word finding difficulties and to a lesser degree of paraphasia. Furthermore AD patients are impaired in responding to open questions and presenting new information. Whereas they are not disturbed by disorders of speech outflow, speech management and syntactic management. FTD patients also have difficulties in word comprehension and word finding, but are not significantly impaired by phonology or syntactic disorders. But the FTD patients have more difficulties to participate in a conversation, especially in greeting behavior, attention to the interlocutor and engagement in the conversation. DLB patients do not show definite impairment of participation in communication, but they have difficulties in word finding and reduction in speech production. Overall they use the appropriate syntax and understand words and sentences relatively well. Also verbal

pragmatics like answering to open questions are well preserved. [25] Vascular dementia is difficult to differentiate from Alzheimer without neuroimaging, because the symptoms are similar. Both show impairments in word finding, picture naming, letter and category fluency. [27] More detailed information about dementia and its symptoms is discussed in the chapter dementia (cf. chapter 2).

To create awareness for the above mentioned symptoms of dementia, the following research questions are the main motivation for this work:

- How to integrate a chatbot in a serious game to create awareness for the conversational symptoms of dementia?
- How should the interaction with the chatbot be designed to create awareness for the conversational symptoms of dementia?
- How should the interaction with the chatbot be designed to create a joyful, motivating experience for the user?
- How well users could experience the conversational symptoms of dementia through the chatbot?

1.2 Expected Result

The aim of this work is to create a conversational bot, which is integrated in a serious game called 'Do I Know You?' game, to show the user how communication with a demented person works. Furthermore the users should get to know the chatbot by presenting different input to the demented chatbot. According to the user's input the demented chatbot's answer might be partially or entirely incorrect or there might be no answer at all like the answer of a demented person.

Due to the limited knowledge of the user about the artificial intelligence of the chatbot or in other words the personality of the chatbot, it might be difficult for the user to maintain a conversation just through entering text based input in a chat box from scratch. Therefore the user input is created by choosing keywords or key sentences rather than having to type in whole sentences. Depending on the chosen keyword or key sentence the answer of the chatbot will differ. Furthermore the conversational tool will contain other possibilities to help the demented chatbot to answer or to get a more detailed information about a specific conversation topic. For example showing material to the demented chatbot like photographs, images, smells, sound, music, and similar helps the user to get more detailed information about a topic or to solve prior misunderstandings.

The resulting prototype (cf. chapter 4) was evaluated with expert reviews (cf. chapter 7).

1.3 Methodology

Literature Review

The literature review in this work builds the theoretical basis for the development of a demented chatbot. It is about dementia (cf. chapter 2), with a focus on the characteristics of spoken language of demented persons and conversational bots, so called chatbots (cf. chapter 3).

Data Collection

A chatbot should be a kind of artificial intelligence, which represents a human character. To simulate a human character, many information about a human's life has to be gathered or invented before (cf. chapter 5).

Implementation

The implementation of a chatbot requires to preprocess the collected data to get a database for possible inputs of the user and matching answers from the chatbot. These answers are post-processed to include characteristics of the speech of demented persons.(cf. chapter 5)

Expert Reviews

After the implementation the results will be evaluated by expert reviews (cf. chapter 7).

1.4 State-of-the-art

Currently no projects could be found, which are about the development of a demented chatbot. But there are several papers, which describe the development of chatbots for different purposes:

In [15] chatbot was designed and implemented to simulate a historical figure. The data for the knowledge base of the chatbot was extracted from Wikipedia and DBpedia. (<http://dbpedia.org/About>). The data was than saved in the knowledge base with a triplet (subject, action/verb, object). To get the triplets the data from DBpedia was downloaded in RDF format and parsed afterwards. Whereas the data of Wikipedia could only be downloaded as plain text, as the text is written in 3rd person the text had to be transformed to 1st person. The chatbot was then implemented with Chatscript (<http://sourceforge.net/projects/chatscript/>), where fundamentally a 'chat script' is a series of rules. A full rule has a kind, a label, a pattern, and an output, where pattern

describes a word or a series of words of the user input and output is the output of the chatbot. Furthermore the rules are bundled into collections, called topics.

In [13] a ALICE chatbot system was implemented as a domain specific chatterbox named University FAQbot. The knowledge base is created with XML-base AIML (Artificial Intelligence Markup language) files. These include patterns, which contain possible user inputs, and matched templates, which represent the chatbot's answer.

The design of the University FAQbot includes a Semantic Mapper, a Context Mediator, a Topic Navigator and a Response Generator.

The Semantic Mapper maps a user input into semantic elements, the Context Mediator is started if conflicting semantic elements are detected, the Topic Navigator guides the chat robot through the Information repository and the Response Generator generates the natural language output.

In [9] they designed and implemented a web-based client-server architecture, which allows the user to chat with the chat-bot implemented on the server. The chat-bot on the server uses Chatterbean (an implementation of ALICE). Although a large number of AIML files were in the knowledge database of the chatbot, but not every user input could be answered with a matching entry from the knowledge database. Therefore a training system was implemented searching for content related to the user input in the internet. The best found content was chosen by a third party expert system, 'Ultimate Research Assistant' and parsed to AIML entries.

In [24] a chatbot was implemented mainly for advertisement. accounts were created to test the chatbot for different advertisements. In this work the user input is preprocessed to get the input pattern and matched against a knowledge database. The system outputs a matching response if the input pattern was found. To enlarge the knowledge database to user patterns, which were not found in the knowledge database. These were saved and added with matching responses in the knowledge database.

In chapter 3 different chatbot projects are described and analysed to get an overview about existing technologies and their usage.

CHAPTER 2

Dementia

The aim of this work is to create a conversational bot, which is integrated in a serious game, to show the user how communication with a demented person is like. While playing the game the player gets to know the chatbot character and gets the possibility to play minigames with the output of the chatbot. The game design and implementation of the minigames is investigated in 'Designing a Serious Game for Dementia Awareness' by Sebastian Czekierski-Werner, BSc..

The output of the chatbot can be documents or images on the one hand and textual output on the other hand. According to the user's input the demented chat bot's answer might be partially or entirely incorrect or there might be no answer at all like the answer of a demented person.

"Dementia is a syndrome, usually of a chronic or progressive nature, caused by a variety of brain illnesses that affect memory, thinking, behaviour and ability to perform everyday activities." [36] "The number of people living with dementia worldwide in 2013 is estimated at 44.35 million, reaching 75.62 million in 2030 and 135.46 million in 2050." [8] In the sections 'Dementia Subtypes' and 'Dementia Symptoms' the Dementia syndrome and its symptoms are explained more detailed.

According to the latest medical research it is not possible to cure dementia completely. Even though treatments exist to reduce the symptoms of dementia and delay the progress of the disease. Different treatments are based on pharmaceutical medication, but their drawback is that the patient may suffer from negative side-effects. Whereas reminiscence therapy is an important method to enhance the life of persons suffering from dementia without negative side-effects. In section 'Reminiscence and Dementia' methodology and effects of reminiscence therapy are discussed.

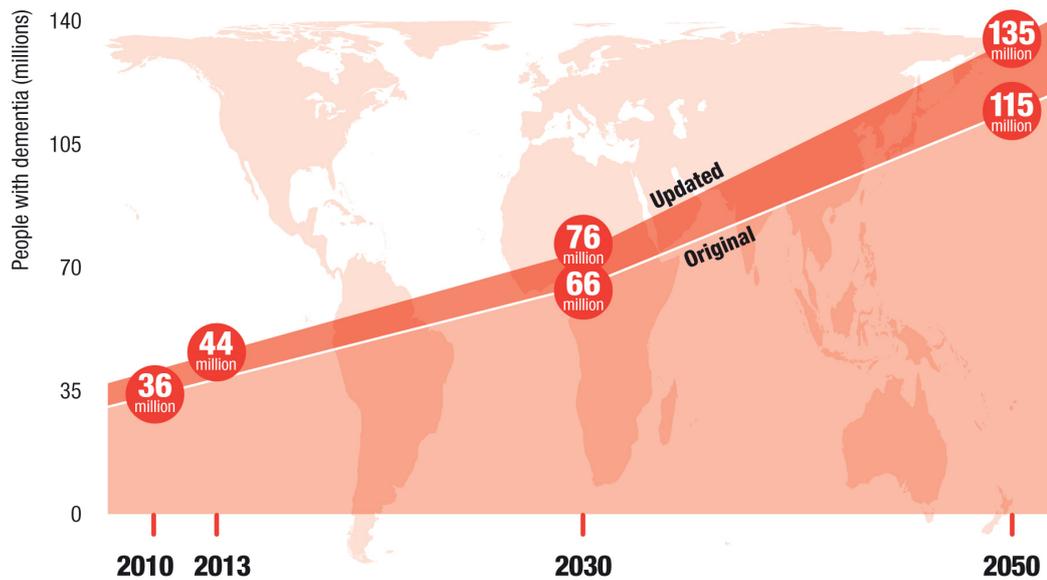


Figure 2.1: Increase in numbers of people with dementia worldwide (2010-2050), comparing original and updated estimates [8]

2.1 Dementia Subtypes

Depending on onset, discourse and symptoms of dementia several subtypes of dementia can be classified. For instance the ICD-10 (WHO [World Health Organisation] 1992; Dilling u. Freyberger 1999) und DSM-IV (American Psychiatric Association 1993) are two international classification systems. The ICD-10 and the DSM-IV enable to classify the most common subtypes of dementia. [12] ”The four most common subtypes of dementia are Alzheimer’s disease (AD), vascular dementia (VaD), dementia with Lewy bodies (DLB), and frontotemporal dementia (FTD).” [36] Furthermore demented symptoms can be diagnosed in combination with other diseases like Parkinson or Chorea-Huntington or demented symptoms can be caused by drug abuse. The classification of subtypes is based on the physical, cognitive and behavioral symptoms, but also the onset and discourse of the dementia. ”But mixed pathologies are more common than pure ones.” [36] In the following section symptoms relevant for verbal conversation are explored in detail.

2.2 Dementia Symptoms

Alzheimer (AD) is the most common form of dementia. Depending on the progress of Alzheimer three stages of Alzheimer are differed: mild, moderate and severe Alzheimer.

A well known early symptom of Alzheimer is losing the ability to remember newly learned information. As the disease progresses symptoms get more severe: disorientation, mood and behavior changes; deepening confusion about events, time and place; unfounded suspicions about family, friends and professional caregivers; more serious memory loss and behavior changes; and difficulty speaking, swallowing and walking. [22]

Referring to the speech demented persons do not seem to make more phonemic paraphasic errors than age-matched healthy seniors. A phonemic paraphasic error is for example substituting a letter within a word, such as 'fetter' instead of 'letter'. [14] Whereas Alzheimer (AD) patients show difficulties in word-finding during conversation, which can result in word-finding pauses. [14,25,27]

Due to the word-finding problems AD patients use several strategies to compensate it. They use references like 'that thing' or 'Mr...oh you know who I mean'. Furthermore AD patients replace words from the same semantic category like 'cat' instead of 'tiger', or use circumlocutions f.i. instead of 'horse' 'You can ride it', or 'where you put a leather thing on its back'. It can be difficult to follow a speech of AD patients, because of their overuse of general nouns ('that', 'the thing'), verbs ('get','do','have') and by an overreliance on pronouns ('this', 'that', 'which') (. [27]

It is assumed that word-finding problems as well as naming problems, f.i. in a picture naming test, occur, because AD patients are impaired by lexical retrieving and semantic difficulty. Semantic memory is the long-term representation and processing of the concepts underlying objects, actions, abstract words, features and the like. Semantic memory plays a crucial role in object categorization, picture naming tasks and the like. To categorize an object it is important to recognize the features of an object to be able to differ it from other objects. As the knowledge about features, especially about new learned ones, decreases with the progress of Alzheimer, it gets more difficult to differ objects of the same category. F.i. the decision if a mushroom is poisonous or not may depend on the knowledge about certain features of the mushroom. [14]

Understanding an AD patient requires listeners to decode the references used ('that', 'His', 'their'...), often across sentence boundaries. On the other hand AD patients also shows difficulties in understanding word meanings as word meanings seem to deteriorate as Alzheimer progresses. Although high-frequently used and familiar words may be preserved for understanding and usage until moderate or severe stages of Alzheimer. Depending on the behavior of the interlocutor the ability for conversational speech of AD patients is often relatively preserved until moderate or late stages of Alzheimer.

The cognitive and linguistic symptoms of vascular dementia (VD) are very similar to those of Alzheimer, this makes it difficult to differentiate Alzheimer from vascular dementia without analysing neuroimages. [3,27,33] Even though both syndromes show similar symptoms, it is mentioned in [3] that VD patients show memory deficits less

frequently than AD patients. Also in [27] it is stated that VD patients usually are better in verbal memory tasks than AD patients.

Patients with dementia with Lewy bodies (DLB) also show difficulties in word-finding and speech outflow like AD patients. [25]

The speech of DLB patients is characterized by a reduced speech rate, mainly because of breaks between utterances. Also DLB patients make more articulation errors than healthy adults, which often is related to their apraxia (movement disorder). Another reason for the unusually long breaks may be that DLB patients show deficits in executive function involving planning and mental organization. Furthermore tests have shown that DLB patients performed worse in the composite measure of sentence structure, that includes well-formed utterances, syntactically complex utterances, and production of required determiners. [2] "Furthermore the speech of DLB patients is marked by con-fabulation." [27]

"The evidence appears to implicate both a linguistic deficit and a generalized cognitive deficit as obstacles to effective communication in these patients." [2]

In [27] Frontotemporal dementia (FTD) is usually described as having three variants that differ in their behavioral manifestation depending on the locus of damage. These include primary nonfluent aphasia, semantic dementia, and frontal-variant FTD. In this work symptoms for all this syndromes are going to be mentioned without making a differentiation among these variants.

The frontotemporal dementia (FTD) patients show severe difficulties at the pragmatic level. In comparison to healthy adults, they were severely impaired in responding to open questions, presenting new information, organizing discourse, adapting to interlocutor knowledge and emitting feedback. But FTD patients also show minor difficulties at maintaining the theme of the exchange, introducing a new theme and adapting to verbal feedback from the interlocutor. Furthermore FTD patients have severe problems in paying attention to the interlocutor. [25]

A consequence of FTD is the progressive loss of semantic and conceptual knowledge. FTD patients show reduced verbal fluency, because the access to or the manipulation of a word causes severe difficulties for them. Whereas sentence grammar seems to be relatively intact. FTD patients tend more to semantic paraphasic errors than phonemic errors, a semantic paraphasic error is for example replacing a word with a word from the same category like saying 'tiger' instead of 'cat'. The speech of FTD patients is therefore characterized by word-finding pauses (often during word searches), circumlocutions (talking around a topic and describing a target word when it cannot be retrieved), and naming difficulty more than the speech of healthy persons. The word-finding pauses indicate that FTD patients have problems with lexical retrieving of words and degraded semantic knowledge. The word-finding problems also influence the ability to tell co-

herent narratives in a negative way and because of pragmatic disorders it is difficult for them to organize their narratives. [27]

Furthermore it was shown in [19] that FTD patients' use less complex language constructions than healthy persons. FTD patients have problems with producing complex morphology and mainly use highly frequent forms of words. It seems that they are still able to follow the mechanisms by which morphological and syntactic forms are sequentially ordered and phonologically realized, but having troubles in retrieving lexical/semantical information.(cf. Table 2.1) (cf. Figure 2.2)

”The range and complexity of their speech therefore shows ever decreasing circles, with the reduced flexibility of lexical retrieval producing a parallel reduction in the range of morphological and syntactic levels of production.” [19]

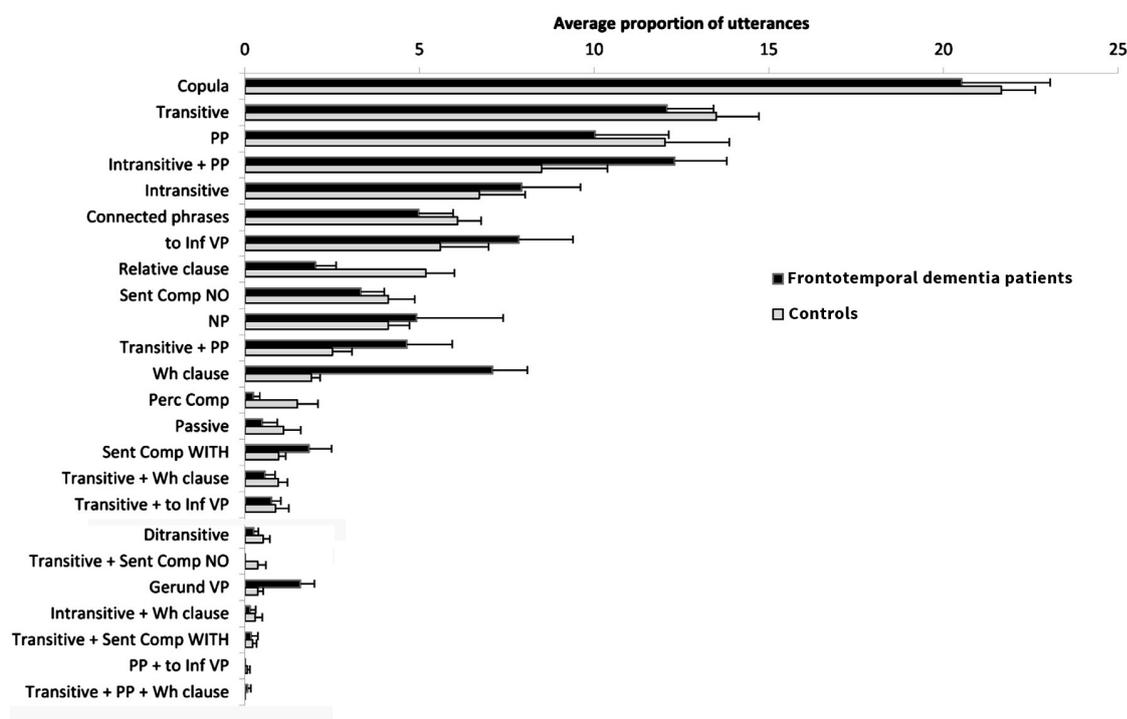


Figure 2.2: Distribution of utterances across hand-scored syntactic constructions. Constructions are ordered from top to bottom on the y-axis as the most to least frequent, according to the Control data. Bars represent the group average, error bars are one standard error. Note that a given utterance (sentence) can have more than one classification. A full label for each construction can be found in Table 2.1 [19]

| Syntactic construction | Example taken from data all |
|---|---|
| Connected phrases | all just [baking in the sun] and [standing out there] |
| Copula | [this is something] I will never ever forget |
| Ditransitive | they [gave me filing] he |
| Gerund VP | he started [eating his sandwiches] |
| Intransitive | and he [stayed] |
| Intransitive + PP | we were all [dressed [in the same colours]] |
| Intransitive + Wh clause | the memory always [comes back [when I see the Olympics]] |
| NP | [lovely house] |
| Passive | it was [sponsored by Cadbury] |
| Perception complement | and that [smelt musty] |
| PP | [down the West valley] |
| PP + to infinitive VP | waited [for the judge] [to say what he thought] |
| Sentence complement NO complementiser | waited [for the judge] [to say what he thought] |
| Sentence complement WITH complementiser | I did not remember [that it was wet going] |
| To infinitive VP | and of course they had [to drive] |
| Transitive | I [saw her] |
| Transitive + PP | we [had our wedding [at Whitham]] |
| Transitive + PP + Wh clause | and I [heard the news] [of [what happened in America]] |
| Transitive + sent comp NO Compl | you just [had this cold shiver] [just went through your body] |
| Transitive + sent comp WITH Compl | we [showed everyone else] [that we were special] |
| Transitive + to infinitive VP | I [want you] [to come and play] |
| Transitive + Wh clause | I and [you had free drinks of Pepsi] [wherever you went] |
| Relative clause | somebody [who I can trust] |
| Wh clause | [how much more do you want to know] |

Table 2.1: Examples of syntactic constructions used by persons suffering from frontotemporal dementia (FTD) [19]

2.3 Reminiscence and Dementia

The memory of patients with dementia fades away as the disease progresses, but often remote memories of the past are well preserved until the moderate or even late state of

dementia. These memories can be used to enable, or improve, communication between carers and dementia patients. In reminiscence therapy carers try to evoke memories of the patients past and engage them in a conversation about it. Beside trying to start the conversation with verbal stimuli, carers also use supporting material like photos, documents or music to engage the dementia patient in a conversation.

As mentioned earlier in this work the medication often leads to strong negative side-effects, whereas reminiscence therapy does not. But also in comparison to other therapies, which try to teach practical abilities useful for the patients like the ROT (Reality Orientation Task), the focus in reminiscence therapy is on the preserved abilities rather than on the deficits dementia patients have. [35]

Many studies regarding reminiscence therapy and its influence on the patients have been conducted in the past. In the following examples for different settings of reminiscence therapy are described.

In [4] the study involved a twenty minutes reminiscence session once per week over the duration of 12 months. A reminiscence session is defined as a one-to-one conversation between a carer and a dementia patient, where the carer also used other stimuli than verbal speech like photographs. The reminiscence sessions took place once a week for twenty minutes over a duration of twelve month. Whereas in [37], [34] and [23] the reminiscence therapy sessions were held in small groups.

In [37] 18 participants took part on the study on the effectiveness of activity reminiscence therapy (ART). The therapy sessions used a typical brain-activating rehabilitation technique - 'reminiscence using old-style tools'. In this therapy tools, such as rice kettle, beanbags for juggling and old textbooks, were used to awake memories in the participants.

The participants seemed to enjoy the ART, and the average number of participants of each single session was high. The authors suggested two reasons why the participants may have liked it. The first is that remote memories are still present and the old-style tools let the participants recall these in a pleasant way. A second reason could be that the participants could explain to the staff how the tools are used. As demented persons often experience the opposite - someone showing them how something works, someone says a word they wanted to say before they remembered it -, the teaching of others is very good for their self-confidence.

The results have shown that a stimulating environment can influence the participant in a positive way. Although the statistical tests did not show a significant difference, the participants seemed to have improved their abilities in communication, interaction and behavior. At the interviews given after ART they smiled more and took more care of their physical appearance.

In [34] the reminiscence therapy included one sixty minute session per week for a period of eight weeks. The group sessions took place with an interviewer and a co-interviewer and the participants. Beside verbal speech also artifacts like photographs, household and other familiar items from the past, old time music, and old time flavor of food were used to evoke memories in the participants.

The results have shown that reminiscence therapy improves cognitive abilities and also alleviates depressive symptoms. The participants also seemed to like the reminiscence sessions, because they took part vividly and were engaged in the conversation actively especially when talking about an artifact.

In [23] eight participants took part in the reminiscence therapy study, the reminiscence sessions took place once a week for a period of five weeks. As a comparison over the same period a control group of eight participant at about the same age and mental state took part in a conversation group. The reminiscence session was held by a group leader, one or two staff members participating as co-leaders and eight participants with dementia. A reminiscence session begins with an informal part, f.i. greeting, the agenda, the date, followed by the reminiscence part. In the reminiscence part the group talked about four themes childhood play, helping with housework, school memories and memories. Each reminiscence session ended with closing greetings.

Even though the reminiscence therapy was held over a short period, it already showed positive results. The participants became more and more interested in each other by each session. The interviews with the participants of the reminiscence group and the control group pointed out that the reminiscence group felt happier after the sessions than the control group. A reason for this may be that for people with dementia it is often easier to recall remote memories than a conversation about an actual topic.

The effects of the reminiscence therapy were on the one hand the participants showed more fluent recalling of memories and more fluent recognition of words, on the other hand the participants of the reminiscence therapy also showed changes in their daily life like in communication with others. Whereas they didn't show improvements on verbal fluency tasks.

In [7] different studies were reviewed and their results were summarized. The experimental setup in the reviewed study was quite diverse, for example duration of the reminiscence therapy sessions ranged from thirty to sixty minutes and they were held three to twelve times. The overall result showed that reminiscence therapy improved the mood, well-being and behaviour of dementia patients and also had a positive effect on autobiographical memory.

The results of the studies presented in this section show, reminiscence therapy is a good way to enrich the life of persons with dementia. Because it puts the focus on the pre-

served abilities rather than on the deficits.

As shown in [34], [37], [23] and [7] artefacts are a helpful tool in reminiscence therapy to evoke memories. Artefacts like old photographs, old-style tools, music or films of the time, when the person with dementia was younger, often bring vivid memories into their mind. This motivates them to engage more in conversation, because they can talk about something they still remember.

The participants mostly did not show improvements in verbal fluency task or learning new things, but they overall seemed to enjoy the reminiscence therapy, which also alleviated the depression symptoms. Also the autobiographical memory improved and the social skills got better.

CHAPTER 3

Chatbots

-A chatbot is a computer program, that tries to simulate an intelligent conversation with one or more users through textual or speech input. In 1950 Alan Turing proposed in [30] a test scenario to evaluate the human-likeness of a chatbot and tries to answer the question 'Are machines able to think?'. Therefore two test persons sit in one room and the interrogator in another. The interrogator is able to converse in textual form with the test persons in the other room. The aim is that the interrogator finds out which gender the test persons have. In a further step one test person is replaced by a chat program. Then the interrogator has to find out, which chat partner is a real human being and which is the chatbot.

The yearly Loebner Contest [17] still uses the Turing Test to award the Loebner prize to the most human-like chatbots. The winner of 2013 was 'Mitsuku' by Steve Worswick, a chatbot which claims to be a 18 year old female human being. 'Mitsuku' was created mainly for entertainment. She has the ability to chat with a user and also play little games or do magic tricks on request of the user. But chatbots can be created for different purposes like advertisement, knowledge acquisition, a.s.o.. F.i. in [5], [20] and in [18] chatbots were designed to enable the user to get information in a more human way than with existing FAQ systems and at the same time they do not use as much resources as for example the personal and infrastructural costs of a call center. Furthermore a chatbot can be used to get access to online resources like in [15], [31] or [9]. Or chatbots can be used to teach social principles like in [26], but also for advertisement/entertainment purposes like in [24].

According to the purpose of the chatbot, the behavior and the knowledge of the chatbot has to be adjusted to fulfill the requirements. The behavior and knowledge of a chatbot is based on its knowledge database and the processing of its information after obtaining a user request. The creation of the knowledge database is an essential part of chatbot

development. The knowledge database can contain simple stimulus/response patterns or gives further instructions to search the online resources for a response to the stimulus. For the processing of the information in the database as well as for the database format existing technologies are often used. For example AIML (Artificial Intelligence Markup Language) was created to enable an easy way to generate a knowledge database for chatbots. AIML (Artificial Intelligence Markup Language) is a xml dialect, which can be used to create knowledge databases for chatbots. AIML contains simple structures for storing stimulus/response entries. A matching stimulus/response pair is stored in the category tag, which contains a pattern tag that is used for user inputs and a template tag that contains the chatbot's answer. Below an example of a simple AIML code can be found:

```
<category>
<pattern>ARE YOU OK</pattern>
<template>yes</template>
</category>
```

In the pattern tag a wildcard - pictured as '*' - can be used to match the pattern to more than one user input. For example the pattern `<pattern>MY NAME IS *</pattern>` can be matched to different user inputs, for example 'My name is Margret.' or 'My name is Ernest'. Furthermore it is possible to add further information like the topic about which is chatted with the '<think>' tag. [1] A further well-known technology is Chatscript, which works similar, it also stores stimulus/response patterns and furthermore gives possibilities to define rules for the processing of the input patterns. For better scalability individually designed and implemented approaches are used. To get an overview of existing chatbot technologies and chatbot purposes in the following projects are presented, which use chatbots to transport knowledge, advertise or entertain.

3.1 Chatbot Projects

A Chatbot as a Web-based Communication Tool

In [5] the project CitizenTalk is described, in which a web-based communication tool was designed and implemented to explore the potential for information processes in spatial planning. The communication tool includes a chatbot interface on the left side of the user interface and place for additional information on the right. The chatbot acts as an advisor and answers user questions typed in the input text field.

The chatbot was implemented with AIML (Artificial Intelligence Markup Language)

and ProgramD. AIML (Artificial Intelligence Markup Language), which is a xml dialect, is used to create knowledge databases for chatbots. ProgramD is a Java program for processing requests to the AIML knowledge database. Instead of filling the knowledge database directly, the design process was divided in three basic steps: Objective/knowledge, design/storytelling, development (cf. Figure 3.1). The problem

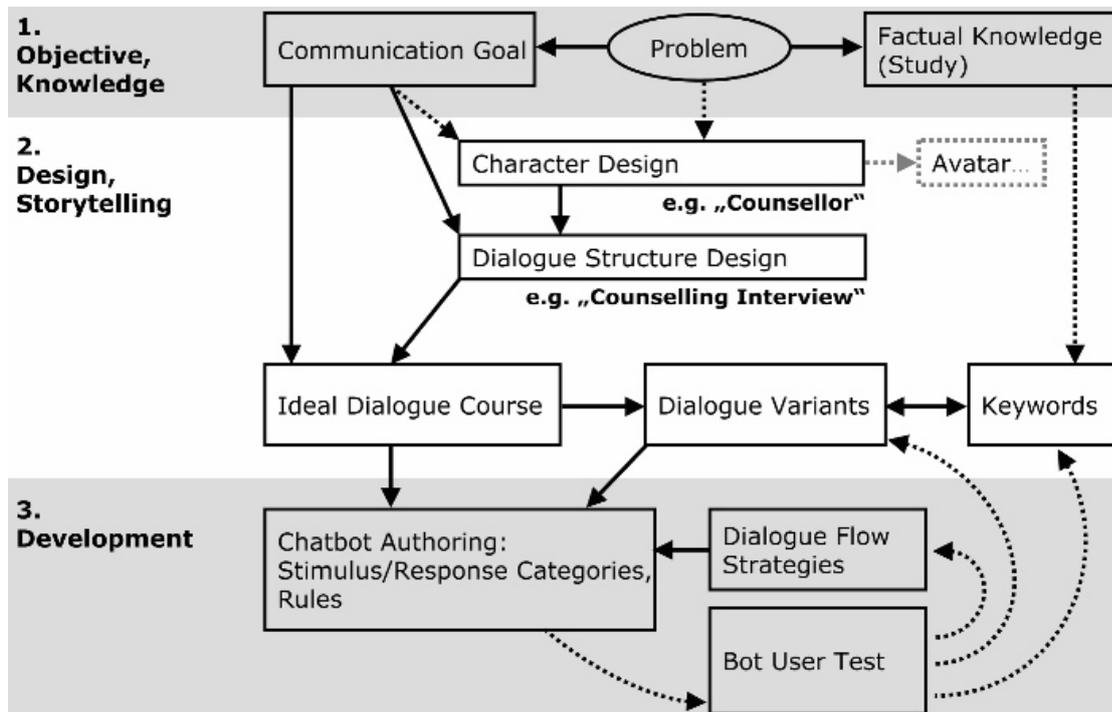


Figure 3.1: Development process of a web-based communication tool, which answers user questions, in the CitizenTalk project. [5]

of adding entries directly to the knowledge database is that this might lead to simple question-answer chatbots. Question-answer chatbots often fail because the user does not know the questions the chatbot is able to answer. To avoid this different concepts have been tested to enable the usage of methods of storytelling for dialog flow control.

1. Firstly the conversation was modeled as a system of states:
 Overall dialogue states are defined to structure the conversation in a begin-, middle- and end state. Furthermore transitions between this dialogue states are created.
 A more detailed structuring of the dialogue states is realized through using topics.
 A topic defines what the conversation is about at a certain chat period.

Also different user types can be set, to adjust the responses of the chatbot to the assumed user interests.

2. Secondly an occurrence counter was implemented to avoid repetitive bot answers and for triggering state transitions.
3. Thirdly it was proposed to add a question pool to the program. This enables the user to choose a question from a predefined collection of questions. The questions the user can choose are selected depending on the state of the conversation. This way the course of conversation can be controlled. Moreover this strategy avoids that the user enters questions/statements, that are not in the knowledge database of the chatbot.

An important aspect of the development of a chatbot is the creation of the knowledge database - in this case persons from different areas of expertise worked together. As the chatbot here represents a fictional character it is important that this character is designed first. Taking into account the knowledge about the designed character dialogues structures are developed, that are taken into account in the next step the creation of dialogues. As a start point it is good to have an ideal dialogue course, subsequently dialogue variants are developed. Furthermore the dialogue data collected has to be translated into AIML and added to the knowledge database of the chatbot. In CitizenTalk a web application has been developed, to enable also non-programmers without knowledge about AIML to add data to the knowledge database of the chatbot. The work flow of the web application represents the above mentioned design process. First the user has to create a basic dialog structure according to the objective of the chatbot application, f.i. dialogue stages, emotional values or user criteria.

Furthermore topics should be added to structure the knowledge database and make the maintenance easier. Also facts retrieved from the conversation can be saved and reused later in conversation. As a last preparation step an ideal dialogue course is added to the knowledge database. After this it is possible to edit the dialogue structure, add or edit themes and variables and add stimulus/response pairs for different dialog situations.

The conclusions of the CitizenTalk project show that creating an all knowing chatbot is not possible. All chatbots have certain limitations depending on their knowledge database. Furthermore the reuse of existing knowledge databases may not be suitable for the project and often leads to simple question-answer dialogues. As the user may not know the right questions to ask, the dialogue may fail. As a solution to these issues concepts of storytelling have been used to create a goal-oriented character in a limited domain. Furthermore a dialogue structure is used to avoid waiting for user input, maybe because the user does not know what or how to ask.

A Chatbot as an Undergraduate Advisor

In [13] a topic-specific chatbot was designed and implemented to explore an alternative to existing FAQ systems. The University FAQbot (UFAQbot) is a chatbot, that enables students to get information about admission or courses.

The UFAQbot also uses AIML tags for the knowledge database of the chatbot. As the data for the UFAQbot is acquired from already existing online resources, the focus in this project is on how the data can be used to obtain satisfying responses from the UFAQbot.

The chatbot utility to process user input and return the chatbot's output was designed and implemented specially for this project. The design of the chatbot includes a Semantic Mapper, a Context Mediator, Topic Navigator and Response Generator (cf. Figure 3.2). The Semantic Mapper processes the user input into a semantic element. For example

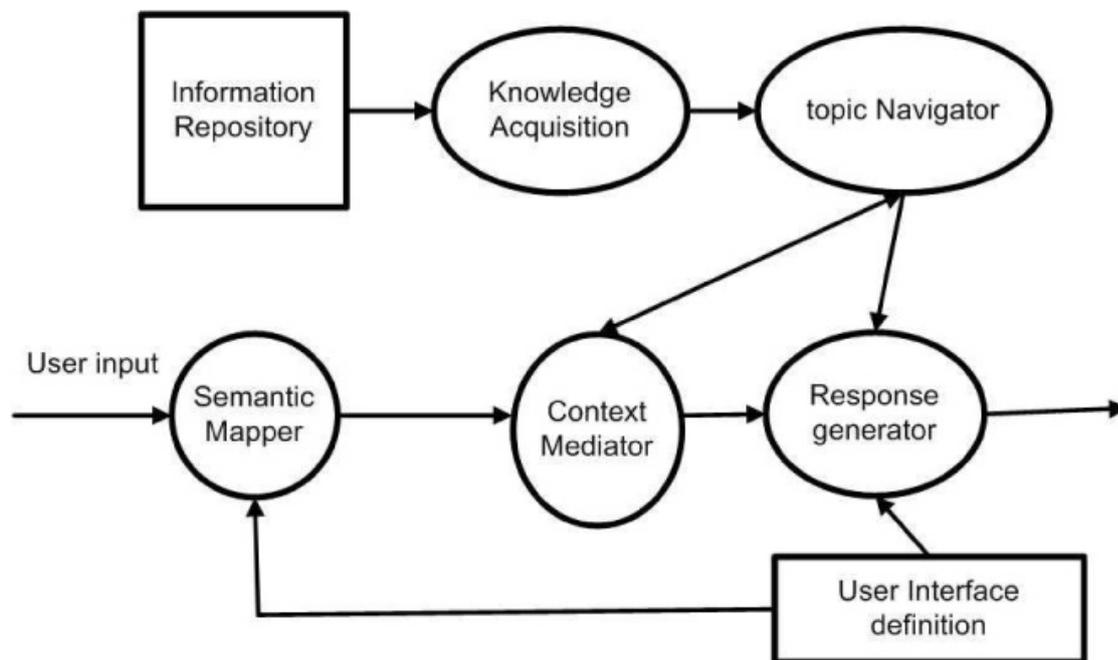


Figure 3.2: Design of the University FAQbot, which is a chatbot to answer student's questions about admission or courses. [13]

it changes complex grammatical forms into simpler ones. If conflicting semantic elements are detected the Context Mediator takes care of it. The Topic Navigator searches the Information Repository and the Response Generator handles the natural language output of the chatbot. The Information Repository is a collection of sets of patterns and templates.

With the above mentioned method two chatbots were implemented, that only differ in their knowledge databases. Table 3.1 and Table 3.2 show the results of the user tests. The tester seemed to be mostly satisfied by the answers of the chatbots.

| Conversation Context | Satisfactory | Unsatisfactory |
|----------------------|--------------|----------------|
| Admission info | 70% | 30% |
| Course info | 80% | 20% |
| Faculty info | 60% | 40% |

Table 3.1: results of user-testing of the UFAQBOT(REP) chatbot [13], left column: different topics the chatbot could be asked about, middle column: percentage of testers which were satisfied by the response of the chatbot, right column: percentage of testers which were not satisfied by the response of the chatbot

| Conversation Context | Satisfactory | Unsatisfactory |
|----------------------|--------------|----------------|
| Admission info | 60% | 40% |
| Course info | 60% | 40% |
| Faculty info | 50% | 50% |

Table 3.2: results of user-testing of the UFAQBOT(DOM ENG) chatbot [13], left column: different topics the chatbot could be asked about, middle column: percentage of testers which were satisfied by the response of the chatbot, right column: percentage of testers which were not satisfied by the response of the chatbot

Chatbots for Mediation Training

In [26] a digital role playing game was designed and implemented, that should enable students to learn how mediation of a conflict between two conversation partners works at best.

The implementation was made with Scenejo and AIML, Scenejo is a framework that enables two A.L.I.C.E. chatbots (chatbots created with AIML knowledge database) to talk with each other. It includes a software component called 'drama manager', that controls the conversational loops and turn taking. Furthermore authoring of the dialogues is supported by a graphical interface.

The design process started with the creation of debate scripts including a best case and a worst case of mediation. The debate scripts were analyzed mainly to find out if, when and why killer phrases occur and what effect they have on the further course of the debate. Furthermore the actors in the game (chatbots, who debate) should not only

have a simple stimulus/response functionality but also character features. In this case each chatbot was designed with a killer phrase level, which gets higher the more killer phrases occur during the debate. If a killer phrase occurs the player is able to act as a mediator through typing in a right sentence to the user chat field, which lowers the killer phrase level (cf. Figure 3.3). In the knowledge database of the chatbots every ut-

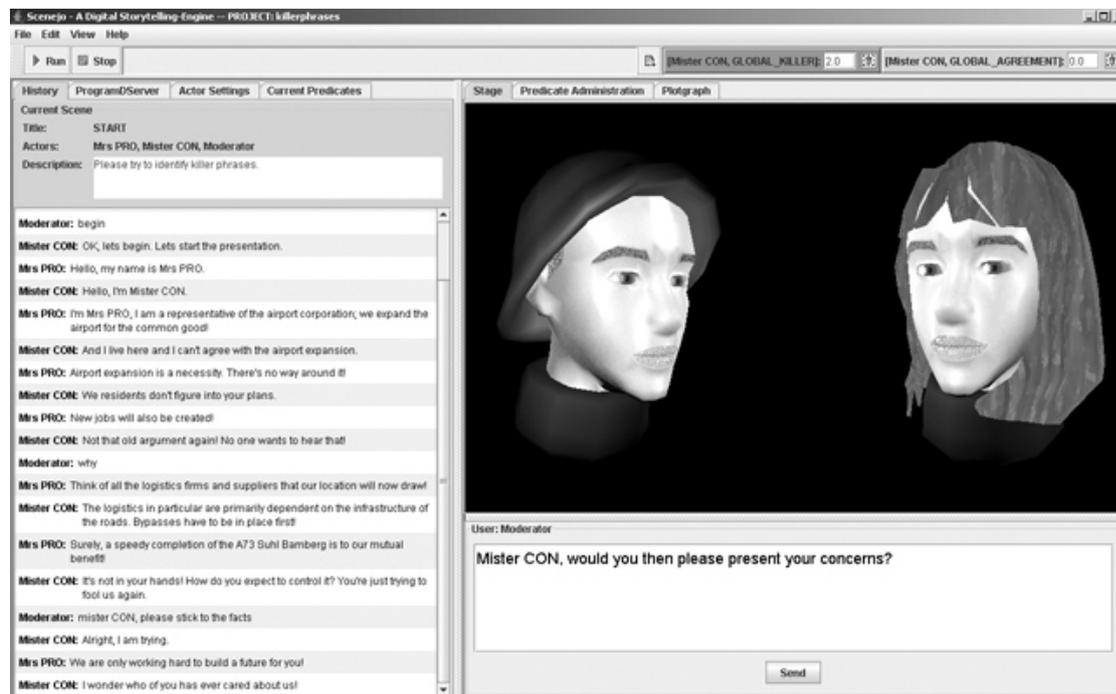


Figure 3.3: The Killer Phrase Game, where the player acts as an mediator for the two discussing chatbots, prototype interface running in the Scenejo Platform. [26]

terance was either classified as killer phrase or valid arguments. In the implementation two counters were used: One that determines the killer phrase level and one that counts the valid arguments, that only occur if the killer phrase level is sufficiently low. If one of the two counters reaches its previously defined maximum value the game ends either with an escalation or compromise of the two chatbots.

The user tests with the Killer Phrase Game prototype showed, that there are certain advantages and disadvantages in using a digital role-playing game instead of live role-playing games.

Advantages are on the one hand that it is easier to test boundaries within this setting than in a real social setting. On the other hand the technical setting allows more easily to control timing and pacing, for instance replay scenes, record scenes for later analyses or increase the occurrences of utterances per time unit to fake a stressful situation.

Disadvantages are that a simulation can never be as complex as a real situation. For example non-verbal cues like gestures or body language in general are not integrated in the design of the Killer Phrase Game. Furthermore the creation of a chatbot requires intensive interdisciplinary collaboration between domain experts and game developers to create the required dialogues and design them in a way so they can be used in a technical chatbot framework.

A Chat-bot that Simulates a Historical Figure

In [15] a chatbot was designed and implemented that simulates a historical figure. The designed application gives the user the possibility to get more information about a historical character by having a conversation with the chatbot.

The implementation was realized with ChatScript for the chatbot functions and Java Swing for the Graphical User Interface. ChatScript is a scripting language, which processes textual user input and outputs one or more responses.

The first step in this application is either to choose a historical personality from the predefined ones or choose a new one and provide the links for the website of the historical person on DBpedia (<http://dbpedia.org/NameOfHistoricalPerson> cf. [32]) and on Wikipedia.

To create facts related to a historical figure for the knowledge database of the chatbot, the information of the DBpedia site and Wikipedia site has to be extracted. Facts about the historical persons are extracted in triplets (subject, action/verb, object). In case of the DBpedia site it is possible to download the raw data in RDF format, which is easy to parse to the triplet presentation. Whereas the data of the Wikipedia site can only be downloaded as plain text. A Wikipedia article is usually divided into subchapters, this structure is good to identify facts and the topics they belong to. So first the information on Wikipedia was saved in a tree structure where each node represents a topic and contains the related text. But most of the extracted texts from DBpedia and Wikipedia are written in the third person form, therefore the texts have to be changed to first person form before they can be used for the chatbot.

After extracting all the data for the chatbot in the right form the data still has to be added to the knowledge database to design the behavior of the chatbot. As mentioned before ChatScript was used for implementation of the chatbot. ChatScript gives the possibility to store stimulus/response pairs inside rules. To structure the data one or more rules can be collected in topics. This is important because the answer to a user input may depend on the topic of the current conversation part. F.i. the simple question 'When?' may result in totally different answer depending of whether the current conversation part is about marriage or the last job or any other topic. Furthermore it is possible to define conditions inside a rule. Therefore the output not only depends on matched user input, but takes into account f.i. variable values, last topics chatted about, a.s.o.. This way the chatbot for example is able to notice that a question was asked twice and is able to react

differently on the second occurrence of the same user input.

In the conclusion it is mentioned that a chatbot could be an interesting alternative to existing methods of teaching history. One small drawback is that many of the rules for extracting knowledge in this project are mainly applicable to persons, with similar data - in this case military or political commanders, that have been involved in wars.

A Chatbot in a Social Network

In [24] a chatbot was implemented, that chats via a Twitter account with the users. Twitter seems to be a good choice, because a message sent over Twitter, called Tweet, has a maximal length of 140 signs. This improves the performance of the chatbot, because the processing of longer input would take more time. The implementation was realized with a web server with Internet access, PHP 5+, MySql and access keys to the Twitter API were used.

The algorithm consists of three parts: Message reception, Message processing, Generation of a suitable reply.

The message reception begins when a user sends a Tweet. As soon as the chatbot receives the Tweet punctuation marks and special characters are removed. After that the remaining text is changed either to upper or lower case, which is specified before. Furthermore it is verified if the Tweet was generated by the chatbot itself or if a previous Tweet of the chatbot was resent by another user. If this is the case the Tweet is rejected and not further processed.

Next the processed Tweet has to be matched against the database to generate a suitable reply. In the database three fields are stored for each possible input: 1. input words/phrases, 2. possible output reply divided by the separator sign '|', 3. a value for the relevance of coincidence. The third field for the relevance of coincidence should make it possible, if more than one possible reply is found to choose the one with higher relevance. But in [24] the search of a processed Tweet in the database stops as soon as the processed Tweet is matched positively towards an entry in the database. If a processed Tweet cannot be found in the database it is saved to add it later to the database with suitable replies.

If a matching database entry was found in the previous step, the resulting output is replied. To avoid that more Twitter users than the sender receive the Tweet, the sender's username is added to the beginning of the output reply. Furthermore the id of the received Tweet is stored, to hinder the chatbot from answering the same question twice.

Additionally the chatbot is able to start conversations with users. Therefore it has the ability to search user profiles with the Twitter search engine to find suitable users to talk to.

In this project three Twitter accounts were created: One for entertaining purposes and two for advertisement. Overall the chatbots showed a positive result and could start and

keep conversations with other users. But it is mentioned in [24] that many possibilities exist to improve chatbots. Besides working on phrase or word hierarchy, a method could be applied to involve more contextual information in the search of matching replies to make them even more suitable. Furthermore it is important to update the database consequently while the chatbot is in use.

Accessing the Information of a Learning System with a Chatbot

In [20] a chatbot was designed and implemented in the context of a learning system called INES. INES consists of three main parts: A Learning Management System (LMS), a Learning Content Management System (LCMS) and an Intelligent Tutoring System (ITS). The LMS manages the administration of different resources like students, administrators, activities, accesses, assessments, etc.. The LCMS enables the creation and management of educational contents. The ITS should support the students in their learning plans by tutoring.

To access the learning resources of INES the user communicates with the chatbot CHARLIE through natural language input. CHARLIE was implemented with ProgramD and AIML. The system contains a chatbot user interface, an interpreter and an AIML knowledge database, that are all integrated in INES (cf. Figure 3.4).

In the chatbot user interface the user can type her/his utterances. The utterances are preprocessed by an interpreter and searched in the AIML knowledge database to find a suitable answer. If the chatbot finds a matching entry in the knowledge database, the response can either be a textual response or a base instruction to search in INES. In case of a textual response it is directly used for output. Whereas the base instruction results in further processing of the user input in INES, which returns a response. The response of INES is then processed by the chatbot and is forwarded to the user. To administer the chatbot a management module is used. It is possible to select the set of AIML files, that should be used for the chatbot's AIML knowledge database. Furthermore the chatbot can be customized in two ways: One way is to predefine certain variables of the chatbot like name, age, gender, courses, a.s.o. It is also possible to choose a background image for the chat window.

As mentioned before resources, that are not in the AIML knowledge database can be searched in INES. This is basically a search for keywords in the user input, that are connected to certain resources in the system. For this reason the management module offers the possibility to add keywords to resources. The keywords can either be chosen manually or the open source linguistic analyzer FreeLing 1.5 can be used for automatic keyword creation.

Another important feature is the possibility of writing a test. It is possible to add ques-

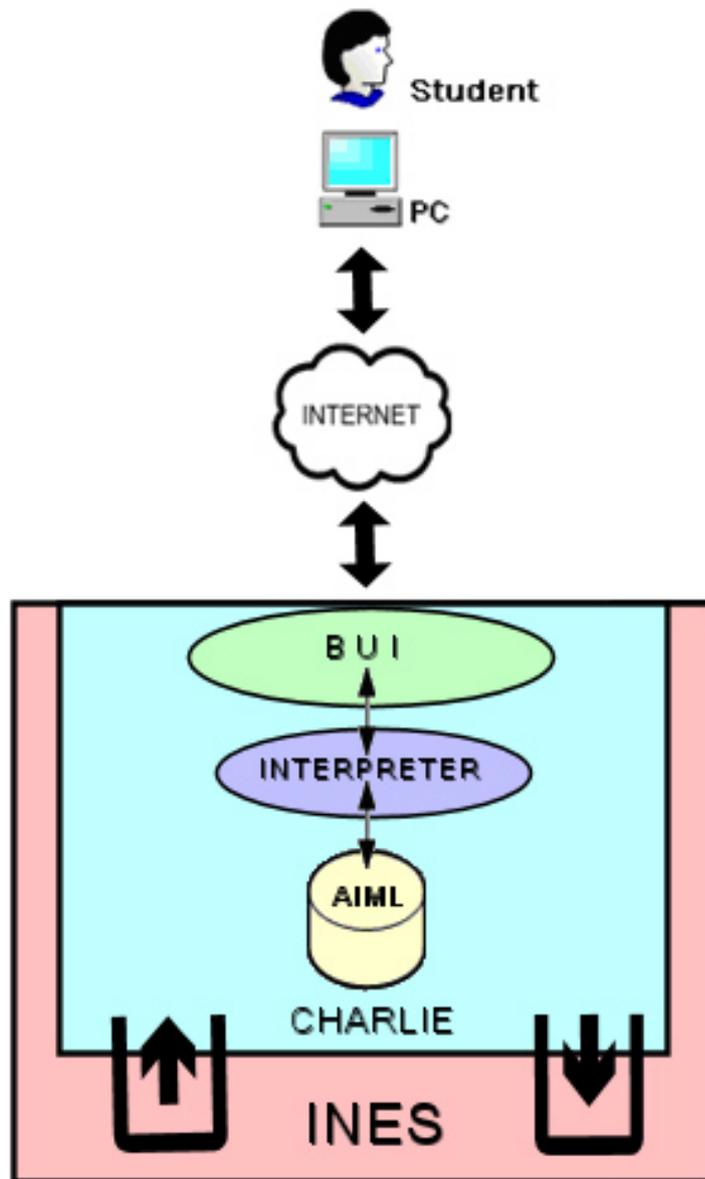


Figure 3.4: Architecture of the chatbot CHARLIE, which also uses information of the learning system INES to generate its responses. [20]

tions and possible answers to the resources of the system and collect them in tests afterwards. After that the user can then ask the chatbot for tests any time.

The conclusion shows that the system worked well, but also that there is a lot of potential in the improvement of chatbots through adding more semantic content to its

knowledge database.

Accessing the Information of an E-Government System with a Chatbot

In [18] a chatbot very similar to the one in [26] was designed and implemented. The chatbot is used as an interface to get access to underlying resources in the GIS based (Geographic Information System) intergrated in the E-Government system (IEGS).

The IESG is a J2EE application hosted on an IBM Websphere Application Server, and uses a DB2 backend. The chatbot was implemented as an external extension of IESG using a PHP-MySQL application, which uses ProgramE to match the user input against the AIML knowledge database.

The design of the chatbot here is very similar to the one in [26](cf. Figure 3.5). As in [26] the user is able to communicate with the chatbot through typing in a text box in the chatbot user interface. The user input is then preprocessed by removing all punctuations, split in two or more sentences and convert it to uppercase. The preprocessed user input is then matched against the AIML knowledge database, that either causes a direct response or further processing of the request in the IESG system.

The user input, that results in a response without a need to interact with the IESG, is called formal query. Whereas user input, that requires the IESG to create a response is called a business query. To identify which kind of user input is being processed ProgramE uses the AIML wildcard - pictured as '*' - in the pattern. For example the following AIML category includes a pattern with a wildcard.

```
<category>
  <pattern>Documentname- * </pattern>
  <template>
    You can find all details on Documentname-</star>
    by visiting this link <a target=''_new''
    href=''_some Weblink to Documentname-</star>''>
    Click Here</a>
  </template>
</category>
```

The system recognizes that this is a business query and uses the part of the user input, that is replaced by the wildcard in the pattern, to generate a request to the IESG. This way the answer of the chatbot contains a link to further resources in the IESG (cf. Figure 3.6). Because the IESG is built around a Geographic Information System the links created were not only used in the textual output of the chatbot, but also in an interactive map.

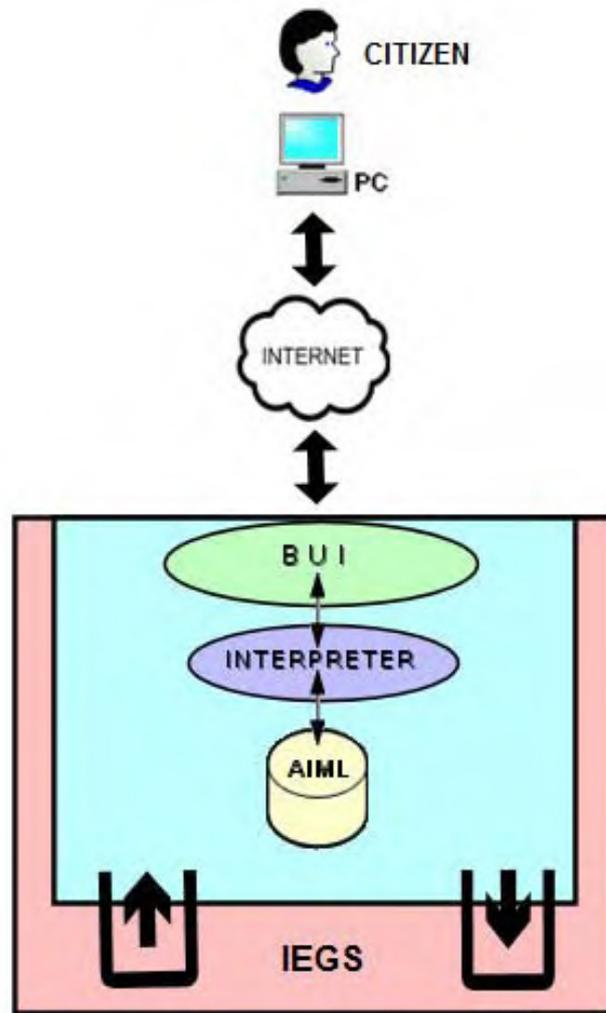


Figure 3.5: Architecture of a chatbot, which also uses information of the E-Government system and its underlying geographic information system (GIS) to generate its responses basic system architecture [18]

To give the chatbot a human like personality a persona-AIML architecture is used. The persona-AIML architecture consists of four components: Categories Base, Personality Component, Dialogue Log and Reasoning Component (cf. Figure 3.7). The Category Base contains the AIML categories, the Personality Component contains rules concerning the behaviour of the chatbot, the Dialogue Log contains the chat history and the Reasoning Component connects the information of the Category Base and the Personality Component and returns the response. The possibilities for administrators are equal

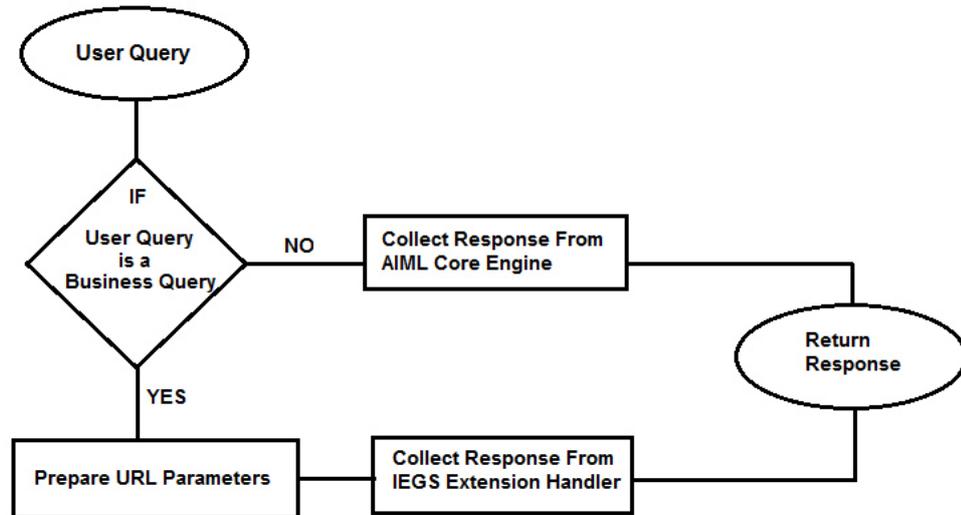


Figure 3.6: decision chart if the user query is a formal query or a business query. A business query is further processed in the E-Government system IESG to generate a response of the chatbot, a formal query can be answered with the usage of the AIML database, but doesn't need access to the IESG to generate a response for the user [18]

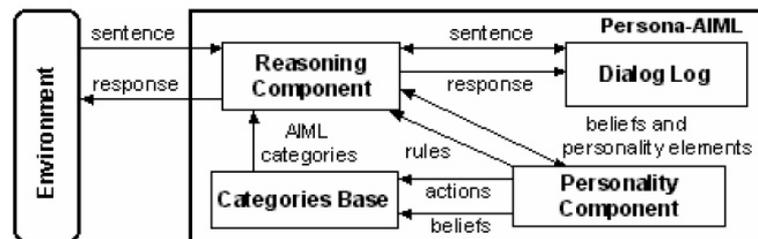


Figure 3.7: Persona AIML Architecture for the chatbot. The Category Base contains the AIML categories, the Personality Component contains rules concerning the behavior of the chatbot, the Dialogue Log contains the chat history and the Reasoning Component connects the information of the Category Base and the Personality Component and returns the response. [18]

to the ones in [20]. It is able to choose AIML files the chatbots uses, as well as adding additional information to personalize the chatbot like name, hobbies, interests, etc.. Furthermore the administrator is able to tag resources of the IESG with keywords, either manually or automatically with the linguistic analyser FreeLing 1.5.

But due to the limited size of the knowledge database of the chatbot, if a user input is used, which is not in the database a general answer is replied, for example a message

with a support email address.

Accessing the Information of a Bulletin Board System with a Chatbot

In [31] a chatbot was designed and implemented, which does not only use a predefined knowledge database with stimulus/response patterns. But also uses information found in the world wide web, to generate a suitable answer to the user input.

The chatbot was implemented in two ways, a standalone Java application and a chatbot which communicates by using Twitter. But both implementations are equal in respect to the methods used for chatbot creation. The chatbot knowledge database contains stimulus/response pairs and are processed with an extended ELIZA's template replying algorithm. ELIZA was the first chatbot system using templates for the generation of responses.

Similar to AIML it is possible with the ELIZA algorithm to use wildcards in the templates as a placeholder for an arbitrary word. This way one or more input of the user can be matched to a single template. For example the two sentences 'I like vegetables' and 'I like fruits' can be both matched to the single template 'I like %s', where the variable %s stands for the word used in user input. The output of this template can use the %s variable, for example the output could be 'Really, do you like %s?'

Futhermore the knowledge of the chatbot was extended through using information of a Bulletin Board System (BBS) named 2ch. The BBS is structured as follows: Categories represent the base topic. A category contains different boards, or subtopics, which contain one or more threads.

The information of every board is extracted for the knowledge database. Every sentence in board i is saved in set S_i . For production of an answer a part of the input is searched in the sets and one set of all the matches found is chosen randomly. If a user has chatted with the chatbot before, information about his interests is saved in his profile. This information is used to choose the most suitable sets for the user's interests, which leads to better answers for the user.

A Chatbot used as an Intelligent Tutoring System

In [21] a chat agent was designed and implemented to answer student's queries. The chat agent is supposed to give the students the feeling to talk to a real human tutor.

The system architecture consists of a chat agent interface, through which the students can enter their questions, a module to process the queries and outputs an answer, which after that is sent to a Text-To-Speech converter, which delivers the answer to the student (cf. Figure 3.8). First the student's query is processed in the Tokenizer, which divides the student's query into a set of words. Afterwards the output of the Tokenizer is passed

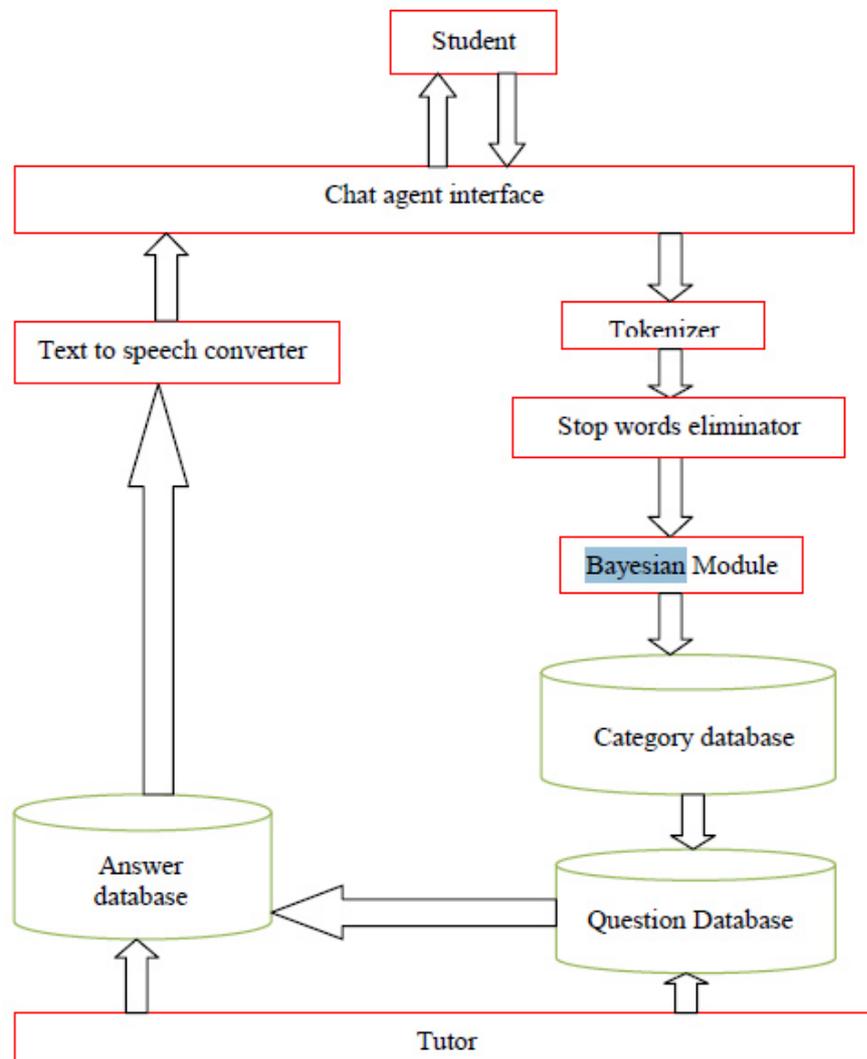


Figure 3.8: Architecture of the question answering system working with a chatbot, which serves as a tutor [21]

to a stop words eliminator. The stop words eliminator deletes all words, which are not relevant for the search of a matching answer to the student's query. Stop words are articles, prepositions, auxiliary words and the like.

After that the remaining set of words is sent to the Bayesian module, which searches for the category most suitable to the set of words to narrow down the search space for the answer. The knowledge database in this project is not a single entity, but is built

of three database categories. The first database is a category database, which contains different available topics. For each topic in the category database a question database is generated and for each query in the question database an answer is saved in the answer database. A human tutor administers the system and cares for the maintenance. The tutor is able to add new queries to the database and correct existing ones. Through this the tutor is able to learn more about the students' need and is also able to identify main issues relevant to students.

The system was tested in two configurations: One uses a single topic and therefore the knowledge database consists of one question and one answer database. The single topic chat agent could answer the students' questions most of the time. The second configuration uses three topics in the category database and matching question and answer databases. The main drawback of this method was that the system administrator had to define which words match to which category. If the matching was not done correctly the resulting answers of the chat agent may not be the one of the right topic.

A Web-Based Chatbot for Textual or Spoken Input

In [9] a chatbot was designed and implemented, which allows textual or spoken input and is accessible by using a website. The system architecture is built of three main components: server, client and knowledge acquisition. An Apache webserver hosts the website, which has the chatbot Java Applet integrated. A MySQL database was used to store the website files and the files for the AIML knowledge database of the chatbot.

Due to the limited size of the knowledge database a meaningful conversation with a chatbot may end, because the user might choose statements, which are not in the knowledge database. To decrease the statements, which are not in the knowledge database, a knowledge acquisition module was used. If a phrase, question or statement of the user is not found in the knowledge database a general statement or a topic change statement is responded by the chatbot. Afterwards the phrase, question or statement of the user is preprocessed and assigned to a third party expert system, named the 'Ultimate Research Assistant' (cf. Figure 3.9).

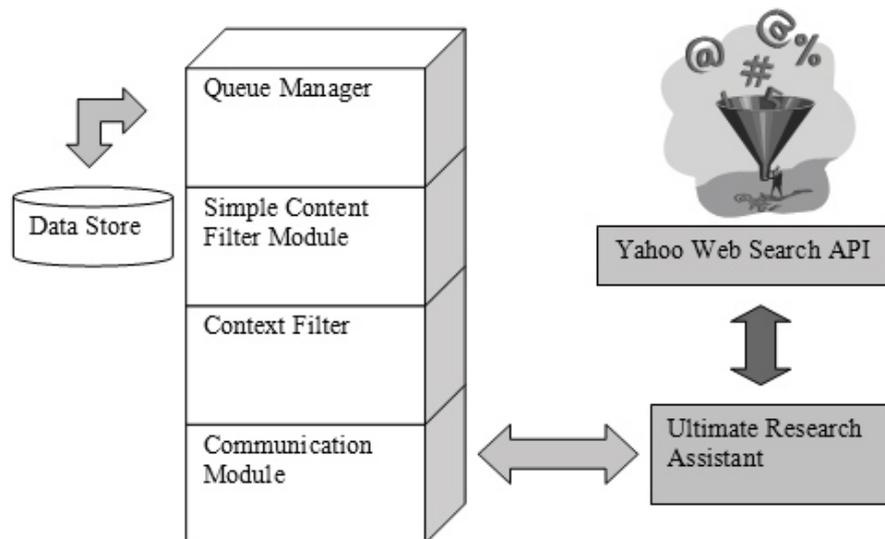


Figure 3.9: Content request using the Ultimate Research Assistant, if the response for the user input could not be found in the AIML database [9]

3.2 Discussion of the Development of Chatbots

As the chatbot projects described in this chapter show, there are many possibilities to use chatbots for different purposes. A chatbot offers more new natural interaction possibilities for informational systems. For example in [20], [18], [31] the chatbots enable the access to online resources by natural language input as well as to previously collected and formatted information in the knowledge database of the chatbot. Whereas in [15], [24], [26], [21], [13], [9] and [5] the chatbots relied only on collected information, which was added to the knowledge database of the chatbots before.

Although the chatbots in the above mentioned projects serve quite different purposes, the development process of a chatbot without access to online resources includes three major parts:

1. Collect the information, which should be made available to the user by a conversation with the chatbot.
2. The collected information has to be processed into a suitable structure for the knowledge database of the chatbot.
3. Define how a stimulus by the user is processed to get the most suitable response from the chatbot.

The collected information represents the knowledge of the chatbot, therefore it is important that the collected information is suitable for the purpose of the chatbot. For example a chatbot, which represents a real human being, needs a lot of personal information, whereas a chatbot, which should serve as a tutor, will be more focused on the facts the tutor is trying to teach than his personality.

After all the information needed first is collected, the obtained data has to be formatted for the knowledge database of the chatbot. Mostly this is done by defining stimulus/response pairs, that means extract pieces of the collected information, define keywords or statements to which that piece of information is a suitable response. Furthermore to make the responses of the chatbot more suitable to the context of the conversation in this moment, the stimulus/response pairs have to be grouped into topics. Thus a stimulus can be in the knowledge database more than once, because every occurrence of it is in a different topic. Most of the projects described above use AIML for the knowledge database. Due to its easy structure it is easily applicable. Furthermore the possibilities to set topics or variables in the '<think>' tag enable to give the chatbot some personality features. ChatScript is also easy to use and gives similar possibilities to add personality features, but also gives possibilities to set up rules to be able to interpret the user's input better than with AIML.

After the information is stored in the knowledge database of the chatbot, a program is needed to process the user inputs (stimuli) and search for the best matching response in the knowledge database. Individually programmed designs of chatbot systems have the advantage that the developers are free to choose the features or attributes they want to. But the development of a chatbot system from the scratch takes more effort (for example chatbot in [21]). In the above described projects for example in [18] and [26] the chatbot systems were built around an already existing information system.

Overall chatbots with text based input seem to have one major problem: The knowledge database is limited and the dialogue with the user may fail, because the user input cannot be matched to knowledge database entry. A possible solution would be providing possible user inputs to avoid that the user enters a statement, which cannot be interpreted by the chatbot.

'Do I Know You?' Game Conception

The original idea for the 'Do I Know You?' game came from Lorraine Hopping Egan, a game designer, author and writer (cf. [10]). The idea of the game was to create a click and point 'Do I Know You?' game, where the player gets to know Jane and helps her to get home. Jane is a relative of Lorraine Hopping Egan, she is 96 years old and suffers from dementia. Jane has a very colorful past, she worked as a researcher, writer and diplomat. She has always been very career oriented, but she also has a compassionate side. She has always loved cats and has saved some alley cat's life. I want to thank Lorraine Hopping Egan at this place for providing all the biographical information about Jane, including images and documents of Jane. The first 'Do I Know You?' game idea was to travel along with Jane and talk to her in the game. As my project partner Sebastian Czekierski-Werner, B.Sc. and me are computer science students and the production of the graphics for the original game idea would require a graphics designer, the idea was not to travel literally in a graphical environment, but in the mind of Jane.

Another source of the game idea was the 'Lebensnetz' project (cf. [6]). In the 'Lebensnetz' project a game was developed to enable persons to do reminiscence work in a joyful way.

4.1 First Design Meeting

In the first meeting with the advisors, the idea of the 'Do I Know You?' game was presented to us, and we were eager to begin to develop the 'Do I Know You?' game. At first we discussed the above mentioned issue, that realizing the idea to travel along with Jane in a graphical environment is not possible due to limited resources in this project. Therefore the aim of the 'Do I Know You?' game 'help her to get home' may not be suitable for the game in this way. Furthermore the basic elements of the 'Do I Know

You?’ game were discussed. The game should contain a chatbot, which represents Jane, and minigames using the images or answers of Jane. The design of the chatbot will be the focus of this work, whereas the game design and the implementation of the minigames is discussed in the thesis of Sebastian Czekierski-Werner, B.Sc.. One day later Sebastian Czekierski-Werner, B.Sc. and I chatted with Lorraine Hopping Egan and Jane, who were in New York in Jane’s apartment, via video stream. This gave us the possibility to get a feeling for Jane - who she is and what characterizes her. Afterwards the first prototypes of the chatbot Jane was implemented (cf. Figure 4.1).

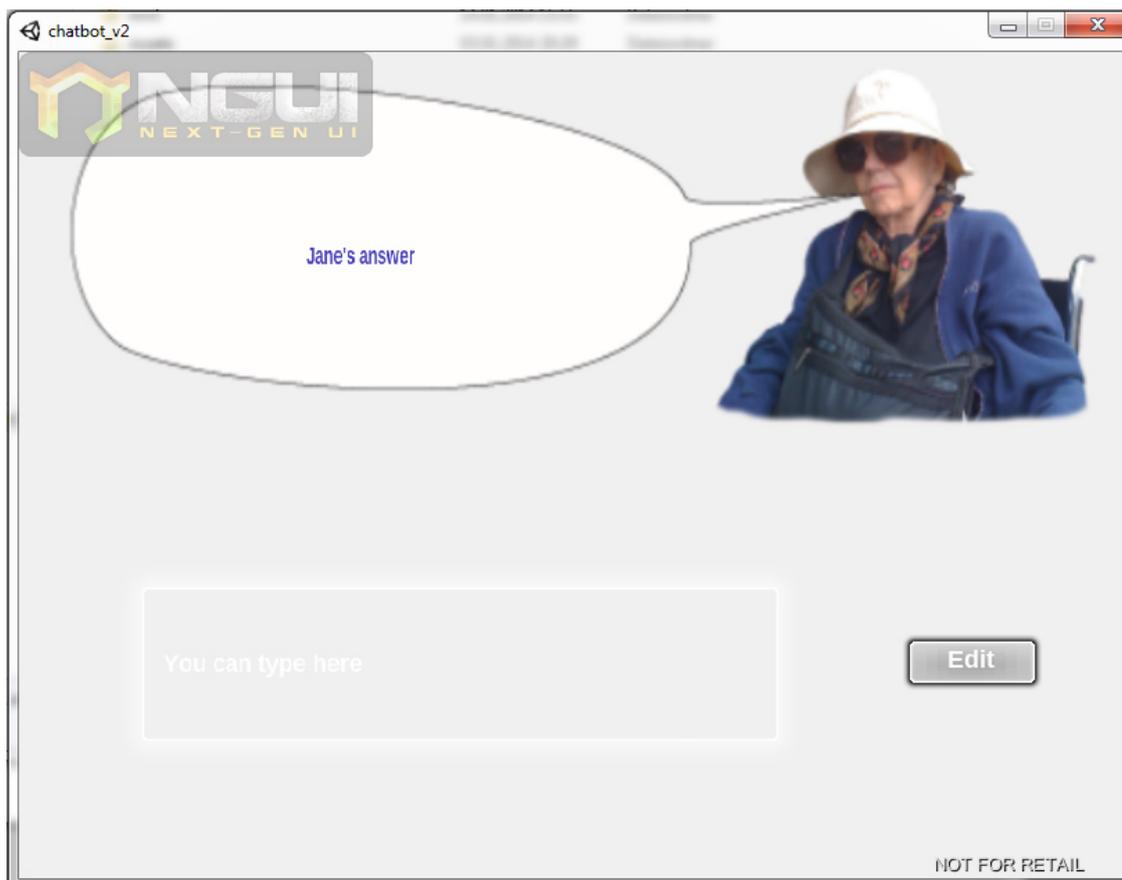


Figure 4.1: Sketch for the first prototype of chatbot Jane

4.2 Second Design Meeting

The second design meeting took place at the Institut of Design and Assessment of Technology at the Human Computer Interaction group. After the presentation of the basic

design idea, the aim of the game was discussed. The aim of the original game idea was to help Jane to get home by traveling with Jane through a game world. As our new game idea didn't include much graphic interface elements (like a whole game world), the idea came up that the definition of home can be seen less literally. What would it be like if home is not her actual address in the game world, but the presence of cats means home to Jane. Thus the player might be fooled at the beginning of the game, when chatbot Jane's statement is: 'Excuse me, could you help me to get home?'. Because the aim of the game is not to bring her home literally, but to talk to the chatbot Jane and explore her life even though the answers of chatbot Jane may be confusing due to her dementia. Furthermore the literature research revealed, that developing an all-knowing chatbot, which is able to answer appropriately to any statement of the player, is impossible. Due to the limited size of the knowledge database and the impossibility to add any possible player input with a matching response to the knowledge database, the dialogue with the chatbot may fail, because the player might not type in statements the chatbot knows. This might lead to an unsatisfying experience for the player, but this could be avoided by the use of a predefined input set as proposed in [5]. The interaction of the player with the chatbot is choosing one of the already provided inputs instead of typing in any statement. The disadvantage of this method is that the player has not only to read and understand the statements of chatbot Jane but also the input statements (cf. Figure 4.2). As the 'Do I Know You?' game should create awareness for the symptoms of dementia, using whole sentences as possible inputs might draw the attention of the player as well to the user inputs as to the statements of Jane. To put the focus on the statements of chatbot Jane the idea arose that possible inputs are a set of keywords rather than whole sentences. Thus the time, the player reads the input possibilities, reduces and the player is able to concentrate more on the statements of chatbot Jane.

It was also discussed that it would be interesting to have the possibility to play with different characters. For example the player could be a relative of Jane, a caretaker or any other person. The characters would differ in the input possibilities they offer to the user. But the development of different player identities and their technical realization would have exceeded the available resources of this project.

4.3 Prototype of the 'Do I Know You?' game

The prototype of the 'Do I Know You?' game was developed by Sebastian Czekierski-Werner, B.Sc. and Daniela Ramsauer, B.Sc. The implementation and design of the chatbot was developed by Daniela Ramsauer, B.Sc. and the game design by Sebastian Czekierski-Werner, B.Sc.

For the implementation we used the free versions of Unity [28] and NGUI: Next-Gen



Figure 4.2: Sketch for the second prototype of chatbot Jane

UI kit [16]. We decided to use Unity as we were already familiar to this game development framework. As we already knew that creating a 2D game, especially a Unity GUI, is very extensive and the offered features might include some bugs you have to deal with, we decided to use the NGUI: Next-Gen UI kit. We already knew the NGUI: Next-Gen UI kit, because it was used in the 'Lebensnetz' project. We found out that it a good alternative to the Unity GUI functionality, which enabled us to develop the GUI more efficiently. The implementation of the chatbot is based on the 'AIMLBot (Program#)' [29].

The main aim of the game was that the player gets to know the symptoms of dementia. Therefore we decided that it is not necessary to give them any kind of score, but let the gaining of knowledge about the symptoms of dementia be the reward for the player. The 'Do I Know You?' game begins with an introduction screen, followed by the main screen, which consists of a chatbot interface, an inventory and a smartphone. While playing the game the player can also use the documents in the inventory and play dif-

ferent minigames.

Introduction Screen

At the beginning of the game the player finds an introduction screen (cf. Figure 4.3). The screen tells the player about the initial situation of chatbot Jane (in the following

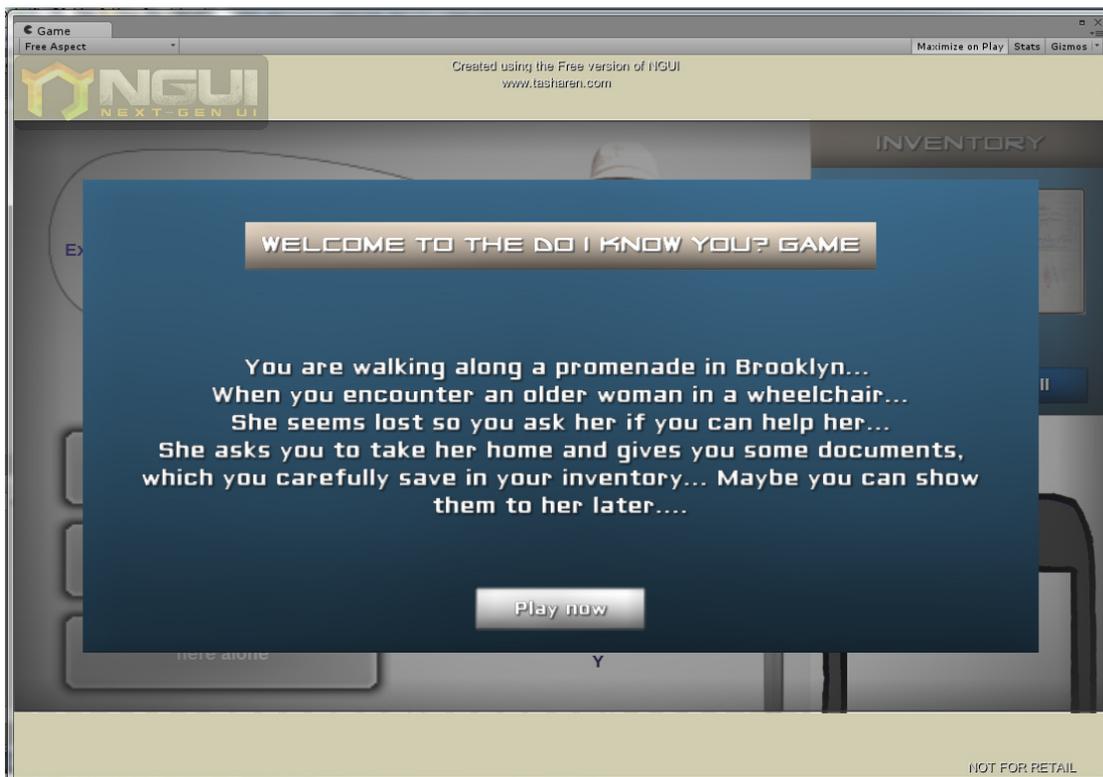


Figure 4.3: Introduction Screen of the 'Do I Know You?' game

called Jane). Jane sits in her wheelchair on a promenade in Brooklyn. She seems to be lost and asks you to take her home. We decided not to mention that Jane has dementia, to give the player the possibility to find it out on his/her own. Furthermore a hint is given to the player, that he/she will get some documents from Jane, which are stored in the inventory and that they can be shown to Jane later.

This introduction should motivate the player to engage in a conversation with Jane and arouse interest to get to know who Jane is. During the conversation the player should use the obtained documents to influence the course of the conversation.

Chatbot

The main screen of the game consists of a chatbot interface, a small inventory and a smartphone (cf. Figure 4.4). In this section the chatbot interface and its functions are

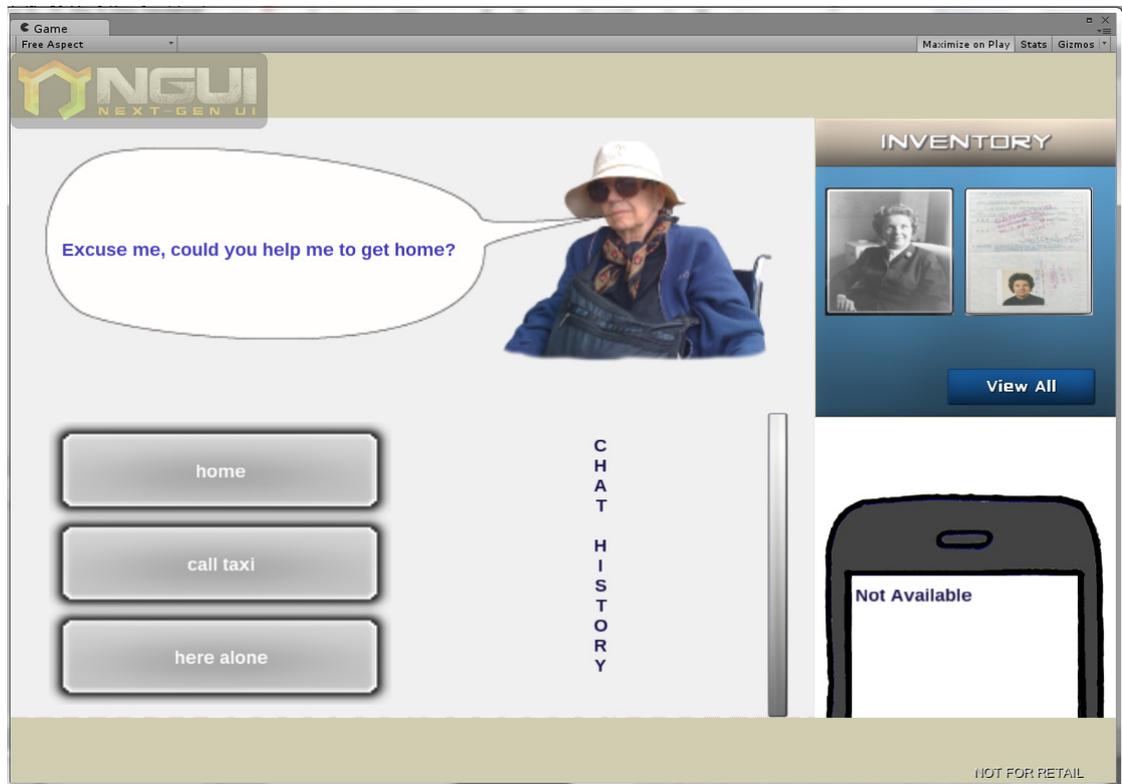


Figure 4.4: Main screen of the 'Do I Know You?' game

explained in detail. There are two ways for the player to interact with the chatbot: The first is to press one of the three input buttons and Jane answers according to the input keyword of the pressed button. The second one is to show documents to Jane, which also leads to a response from Jane and may cause a time shift in Jane's mind.

Three input buttons were used to avoid, that the player has to type in the right questions/statements from scratch. On the one hand this could lead to an input the chatbot cannot answer. On the other hand the player might spend too much time in thinking about what to type and might get demotivated. Furthermore a chat history is integrated in the chatbot interface, which shows the already used input buttons and the responses given by Jane (cf. Figure 4.5).

The first thing Jane says in the game is 'Excuse me, could you help me to get home?'. This should deceive the player, because he/she may think the aim of the game is to bring her home literally.

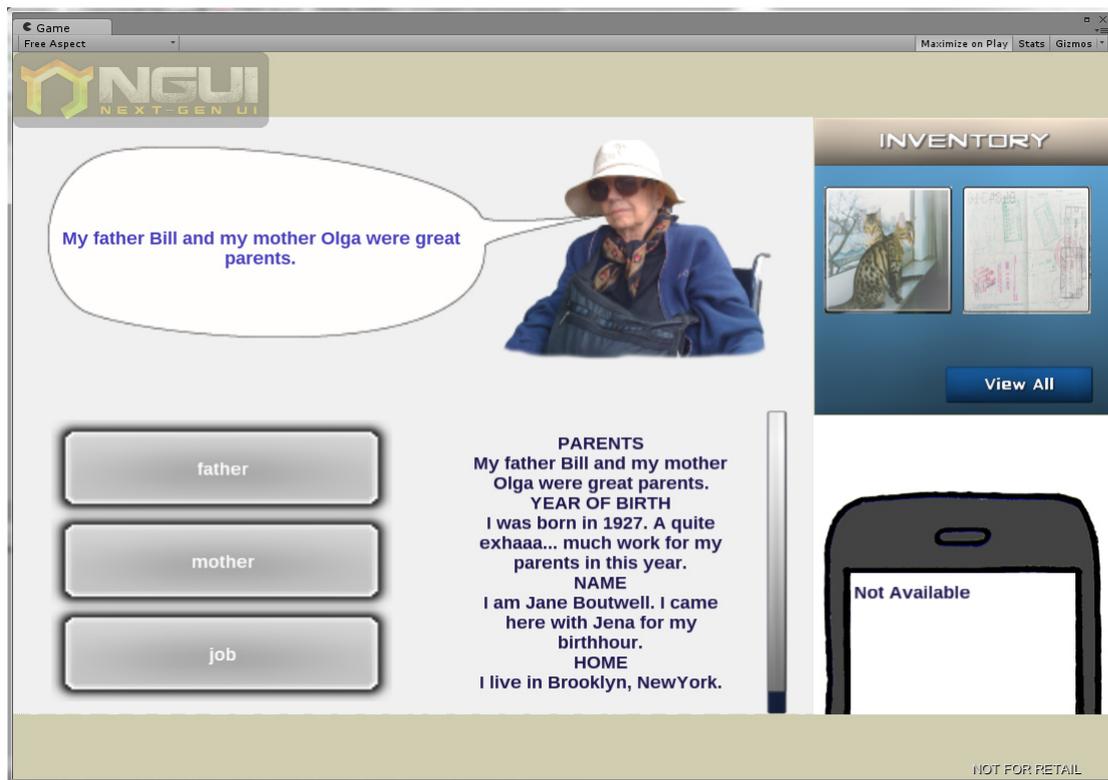


Figure 4.5: Main screen of the 'Do I Know You?' game with chat history

While playing the game the player is engaged in a conversation with Jane. By pressing an input button he gets a textual response of Jane. But sometimes if the player presses the right button, the player obtains Jane's confidence and she gives him/her a document. This document is added to the inventory and can be used to show it to Jane by dragging and dropping it from the inventory to Jane (cf. Figure 4.6).



Figure 4.6: Show a document of the inventory to Jane via drag and drop in the 'Do I Know You?' game

Depending on the document shown to Jane, she tells the player more about it. And some documents even may make Jane thinking she is living in the period when the picture was taken. Whereas showing other documents can bring Jane back to the present. As described in the chapter dementia (cf. chapter 2), reminiscence therapy uses documents like pictures, photographs or the like to improve the well being of dementia patients. In the case shown in Figure 4.6 the player shows a photograph of Jane, when she lived in Trieste. Jane's answer 'That's me. Why is it so cold, usually it's warmer here in Trieste' lets the player know that this statement cannot be true, because he/she learned in the introduction screen, that Jane is living in Brooklyn, New York. Furthermore the way Jane looks changes during the game as she shifts in time mentally - she gets a blurry, sepia brown look (cf. Figure 4.7).

As mentioned in the chapter dementia (cf. chapter 2) people with dementia seem to be confused about the time or place they live in. Therefore a counter was implemented that lets Jane shift in time every thirty seconds. The player gets to know that something happened, because Jane gets that blurry, sepia brown look and the input keyword options change. By reading the statements the player should find out, that Jane thinks she is living in the past and ideally also in which period of her life she thinks to be. To find out in which period she thinks to be, the player also can watch the smartphone, which



Figure 4.7: Jane’s look in the 'Do I Know You?' game if she thinks she is in the past

will be described in the smartphone section.

Inventory

The inventory is used to store the documents the player gets from Jane. The inventory enables the player to show documents to Jane and take a more detailed look to the obtained documents. In the 'Do I Know You?' game the inventory is displayed in two views: The small view is integrated in the upper right corner of the main screen (cf. Figure 4.4), whereas the large view of the inventory is placed in an additional window. In the small view of the inventory the latest two documents are displayed and can be shown to Jane by dragging and dropping it on Jane. After pressing the 'View All' button in the small view of the inventory the large view opens. After clicking a document in the inventory, further buttons are revealed in the lower right corner of the large image view (cf. Figure 4.8). The pressing of the 'View Image' button opens the detail view for single documents (cf. Figure 4.9). The pressing of the 'Show Jane' button shows the selected document to Jane like the dragging and dropping in the main screen of the 'Do I Know You?' game. The pressing of the 'Cancel' button closes the large view of

the inventory and the main screen is shown.



Figure 4.8: Large view of the inventory after clicking an image in this view of the inventory in the 'Do I Know You?' game

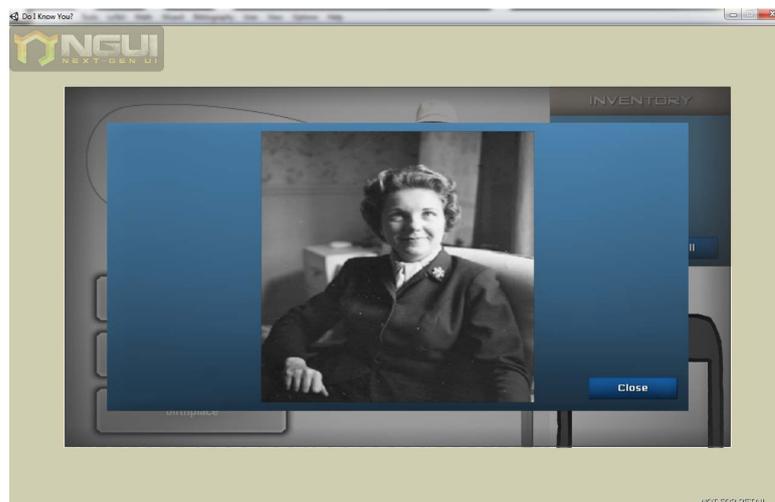


Figure 4.9: Detail view of a document in the inventory in the 'Do I Know You?' game

Smartphone

At the lower right corner of the main screen a smartphone is located. When Jane shifts in time to a former period of her life information is shown on the screen of the smartphone.

This information is about topics, which indicate the period of Jane's life, where she shifted to.

In its initial state the smart phone is not visible entirely (cf. Figure 4.10). A click on the smartphone shifts it upwards and the player can read the whole information, another click on the phone shifts it downwards again (cf. Figure 4.11).



Figure 4.10: Main screen of the 'Do I Know You?' game with partly visible smartphone

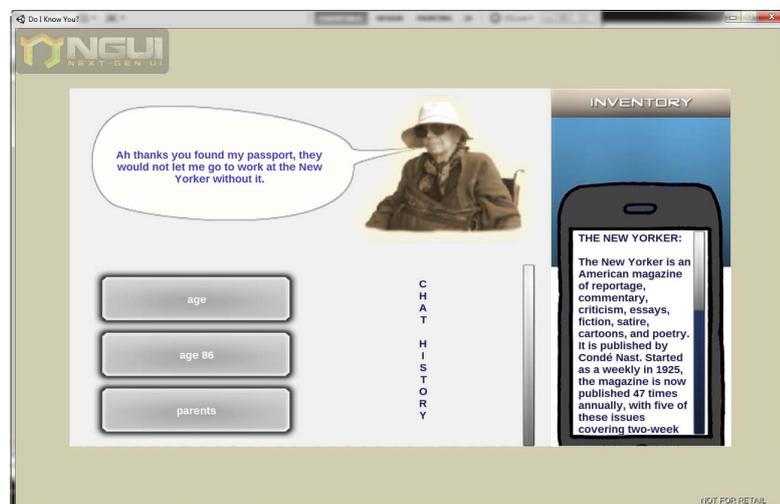


Figure 4.11: Main screen of the 'Do I Know You?' game with the entirely visible smartphone

Minigames

Several minigames were implemented to add some variety to the 'Do I Know You?' game to make the whole game more entertaining.

Another reason for the integration of minigames was to search for a joyful way for the player to interact with the obtained documents as well as with the textual output of Jane.

As mentioned several minigames were implemented and tested with rapid prototyping. For example a minigame was implemented, where the aim was to find Jane on a photograph within a group of 20 people. But tests have shown, that the game did not bring as much fun as expected.

Whereas other minigames turned out to be a better choice - these were 'Guess the Word', 'Turn the Pieces' and 'Rotate the Cubes'.

Guess the Word

In the 'Guess the Word' minigame the player has to guess which word Jane intended to say. For example if Jane says 'I live in Orange Street. I came here to ce...ce...celebrat my birthday.', she wanted to say celebrate instead of 'ce...ce...celebrat'.

Figure 4.12 shows another example, where Jane wanted to say exhausting instead of 'exhaaa...'. The letters of the word looked for move around in the 'Guess the Word' minigame and the player has to click the letters in the right order to complete the game and return to the main screen of the 'Do I Know You?' game.

The game is started, when Jane uses a wrong word, which she has not used before.

Turn the Pieces

The idea for the 'Turn the Pieces' minigame was influenced by Assassin's creed [11]. In this minigame a document is torn into ring-shaped pieces and every piece except the center piece gets randomly rotated.

The player can select a piece by using the up and down arrow keys. Once a piece is selected it can be rotated with the left and right arrow keys. If all pieces are aligned rightly the player receives a success message and can return to the main screen of the 'Do I Know You?' game by clicking the 'ok' button. Figure 4.13 shows an example of the 'Turn the Pieces' minigame. The game is implemented for two documents - when the player obtains one of them the 'Turn the Pieces' minigame is started.



Figure 4.12: Guess the Word minigame in the 'Do I Know You?' game



Figure 4.13: Turn the Pieces minigame in the 'Do I Know You?' game

Rotate the Cubes

In the 'Rotate the Cubes' minigame a document is torn into nine square pieces. Each piece is attached to one side of a cube, then the cubes are rotated. Figure 4.14 shows a screen shot of the 'Rotate the Cubes' minigames. The player can select a cube by navigating to it with the arrow keys and select/unselect it with the space key. If a cube is

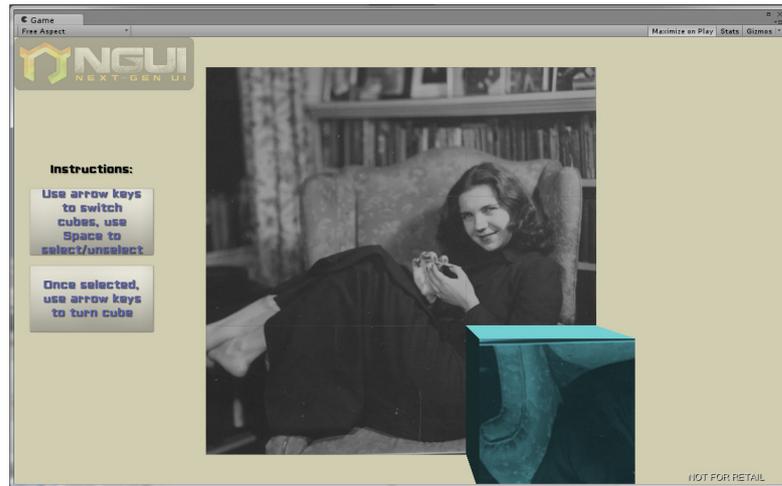


Figure 4.14: Rotate the Cubes minigame in the 'Do I Know You?' game

selected it can be rotated by using the arrow keys. Once all cubes are rotated rightly the document turns to be entirely visible again. The player gets a success message and can return to the main screen of the 'Do I Know You?' game by clicking the 'ok' button. The 'Rotate the Cubes' game is implemented for two documents - the game is started, when the player gets one of them.

Ending

The end of the game is reached when the player spent six minutes in the main screen of the 'Do I Know You?' game. As mentioned before in section 'Second Design Meeting' the first statement of Jane 'Excuse me, could you help me to get home?' should intrigue the player. When the game ends an endscreen is displayed (cf. Figure 4.15), which tells the player what 'home' really means to Jane.

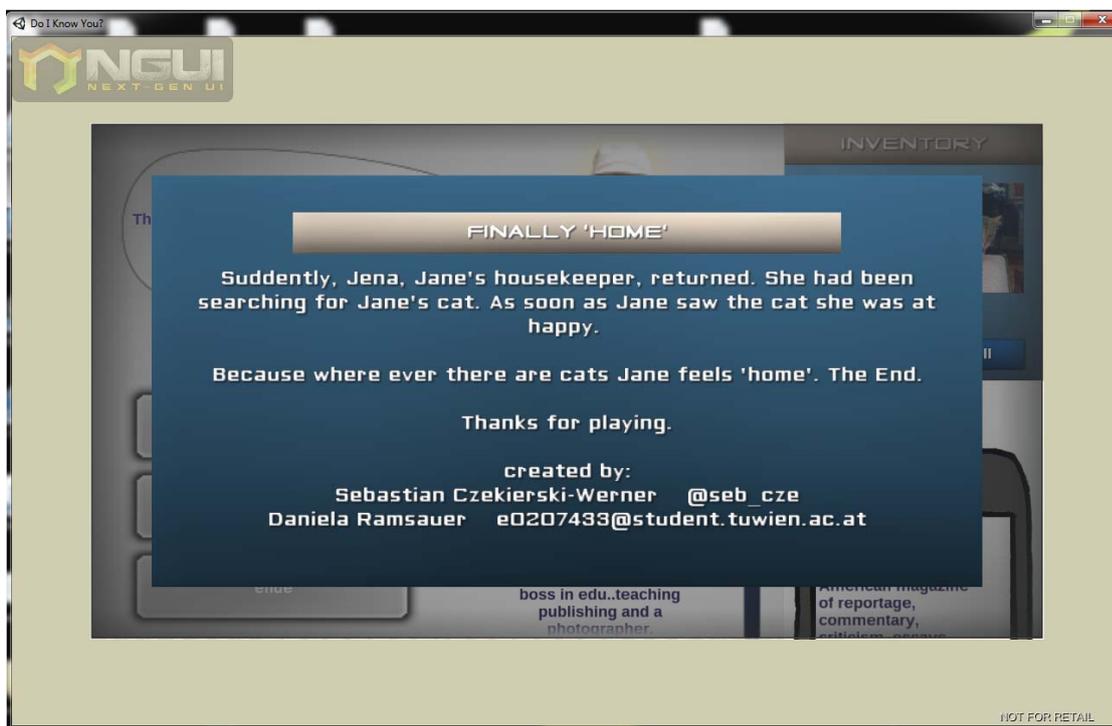


Figure 4.15: Endscreen of the 'Do I Know You?' game

Chatbot Development

As mentioned in the Prototype section the implementation was done with free versions of Unity [28] and NGUI: Next-Gen UI kit [16]. For the chatbot functionality the `c#` chatbot library [29] was used. The development of the chatbot begins with collecting of information about Jane: facts about her life, her personality, and the like. The information is structured in stimulus/response pairs, which are used to create dialogue variants. Afterwards the stimulus/response pairs are added to the knowledge database of the chatbot in AIML. Furthermore the `c#` chatbot library [29] was extended to process the AIML files according to our purposes.

5.1 Creation of the Content for the Knowledge Database

As already mentioned earlier biographical information about Jane was already available. To get a glance of her personality we also tried to talk to Jane by a video chat, which was difficult due to her progressed dementia. But we could take a look at her apartment in New York, which contains a lot of memorabilia, and Lorraine explained a lot to us. Based on all the information already obtained, the data needed to be processed to the right format for the chatbot knowledge database. The knowledge database is written in AIML, which basically consists of stimulus response pairs. The first step is to extract keywords and possible answers and bring them in AIML format. In this case this was a two step procedure: First keywords and possible answers were saved into a `*.csv` file. Afterwards it is processed by a Java program and saved as an `*.aiml` file. The time a user may chat with chatbot Jane is limited to six minutes, because more chat time would require more personal resources to fill the knowledge database of the chatbot as are currently available in this project. For example if a player takes 1 second to decide which

input keyword option he/she chooses and 2 seconds to read chatbot Jane's answer, already 120 stimulus response pairs are needed in the database for a dialogue, which lasts six minutes length. This example does not consider that the player has the possibility to choose from different input keyword options. Taking into account the three input keyword options 360 stimulus/response pairs would be necessary. Furthermore the player should not be bored by getting the same input keyword options and thus also the same responses from chatbot Jane again and again.

Technically there would be the possibility to add more than one possible answer to each keyword/set of keywords. The following code example returns randomly one of the phrases within the tag if the player input is 'Hello'.

```
<category>
  <pattern>HELLO</pattern>
  <template>
    <random>
<li>Hi, how are you</li>
<li>Nice to meet you</li>
<li>Hello</li>
    </random>
  </template>
</category>
```

But this possibility complicates the design of the dialogues. After defining possible chatbot answers and input keywords, it has to be defined which input keyword options are offered to the player after an answer of chatbot Jane. Or generally it has to be decided in which state of the conversation which keywords should be offered as input options. As the dialogue should imitate a real conversation the input keyword options have to fit thematically to the previous answer of chatbot Jane. And whatever input keyword the player chooses, in the end the sum of all chosen input keywords and answers of chatbot Jane should result in a coherent dialogue. The coherence of the dialogue should only be broken by the modeled symptoms of dementia of chatbot Jane.

5.2 Dialogue design

As mentioned in chapter 3 creating an all knowing chatbot, which is able to give a suitable answer for every user statement, is impossible. This would require to anticipate every possible statement in every possible context and their answers. As proposed in [5] this problem can be solved by offering the user a predefined set of input options. Therefore in the 'Do I Know You?' game the player chooses one of three input keyword options as stimulus to chatbot Jane, which answers with a matching response found in

the knowledge database. This procedure avoids that the player enters a statement, which chatbot Jane cannot answer, because it is not saved in the knowledge database. Furthermore predefined input keyword options make it easier to control the conversation flow and assure that the answer of chatbot Jane also fits in the current context of the conversation. For example: If the player enters the stimulus 'Who?' a suitable answer strongly depends on the previous output sentence of chatbot Jane.

But offering three input keyword options to the player not only requires to match one stimulus to a matching response, but also the opposite - matching responses to possible following input keyword options. It has to be defined which input keywords can be chosen in a certain state of the dialogue, or which input keywords are available after having got a certain response. A challenge in defining input keyword options for the player is that no matter which input the user chooses the result has to be a coherent conversation. A first idea was to create the dialogue design manually from scratch. The dialogue design process was similar as described in [5]. First objective knowledge or facts about Jane's life were collected and a closer look to Jane's personality was done with the help of Lorraine Hopping Egan. After processing the obtained information and adding it to the knowledge base of chatbot Jane, a first dialogue was created. The process of dialogue development was pretty straight forward: As the stimulus/response pattern were already saved in the knowledge database, the task was to bring stimulus/response patterns in a right order, to create the feeling of a real conversation (cf. Figure 5.1). Breaks in the conversation may occur, but these breaks should be due to symptoms of dementia of the chatbot. So the stimulus the user enters should always match thematically to the previous statement of the chatbot, whereas the response of the chatbot may be totally or partly unsuitable due to symptoms of dementia.

As mentioned before due to the limited resources in this project the dialogue length was limited to about six minutes. Assuming that the user needs about three seconds to read the chatbot's answer and choose an input keyword option, it requires about 120 stimulus/response pairs to create a dialogue, which lasts six minutes. The time a user needs to choose a input keyword option may vary a lot, because of different length of the statements of the chatbot and the resulting varying reading time. Furthermore the decision process and time may vary a lot depending on the user.

After creating a first ideal dialogue with 120 stimulus/response pairs of the knowledge database, further variants of the dialogue had to be developed. After processing the obtained information of Jane, the knowledge database of the chatbot contained about 360 stimulus/response pairs. Furthermore it has to be decided how many input keyword options the user should get after a statement of the chatbot. In the 'Do I Know You?' game the user should get the possibility to choose of three input keyword options (cf. Figure 5.2). But why only three input keyword options or not just two? The decision to offer three input keyword options was based on two considerations: The first was -

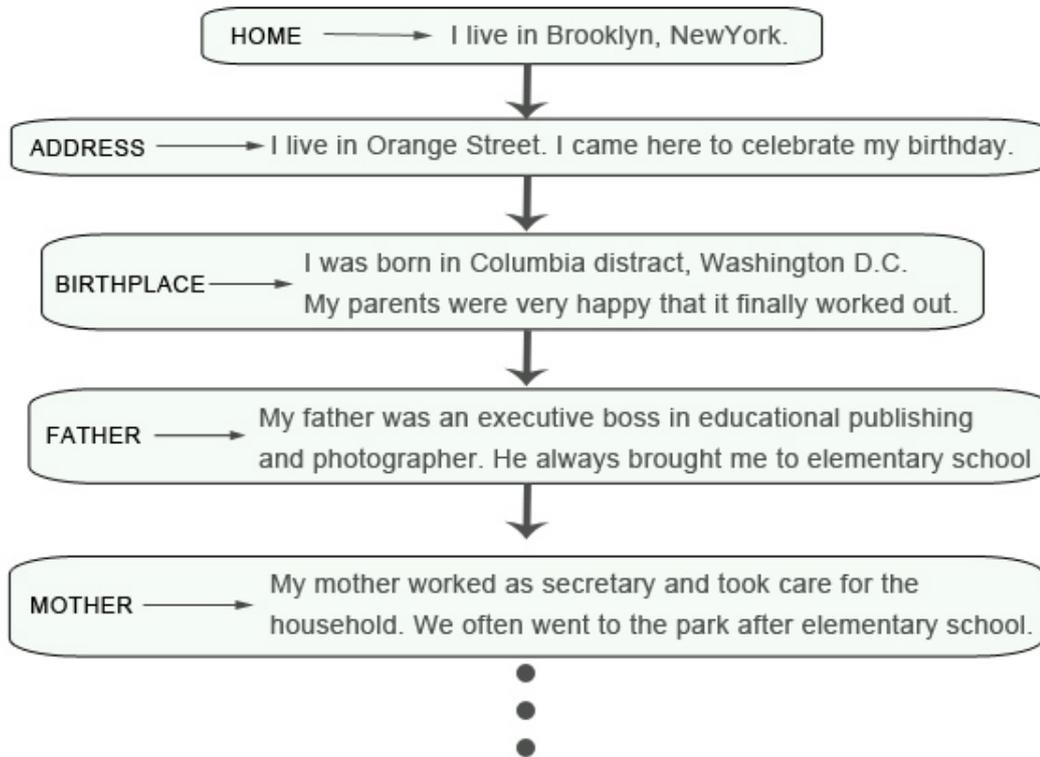


Figure 5.1: beginning of the first created dialogue for the 'Do I Know You?' game

taking two input keyword options or less would limit the user too much in controlling the course of the conversation. The second was - taking more input keyword options would focus the user's attention too much on the choosing of input keyword options rather than on the chatbot's statements.

To create the dialogue variants a tree structure seemed to be suitable to represent the possible dialogues. But the main problem in this method of dialogue creation is that the chat tree gets very big and it gets difficult to maintain the overview of the single conversation paths. If every conversation path consists of two 120 stimulus/response pairs, the chat tree has a length of 120. Considering that every response results in three input keyword options, the chat tree contains three to the power of one hundred and twenty end nodes. This also means that in the end there are three to the power of one hundred and twenty dialogue variants. Furthermore in one dialogue every keyword should only occur once, because repeating keywords, which lead to the same responses, might hinder the user from getting more diverse information from Jane. It would be necessary to create three to the power of one hundred and twenty dialogues. To be sure to avoid repetition of input words one has to consider firstly to travel along each dialogue path

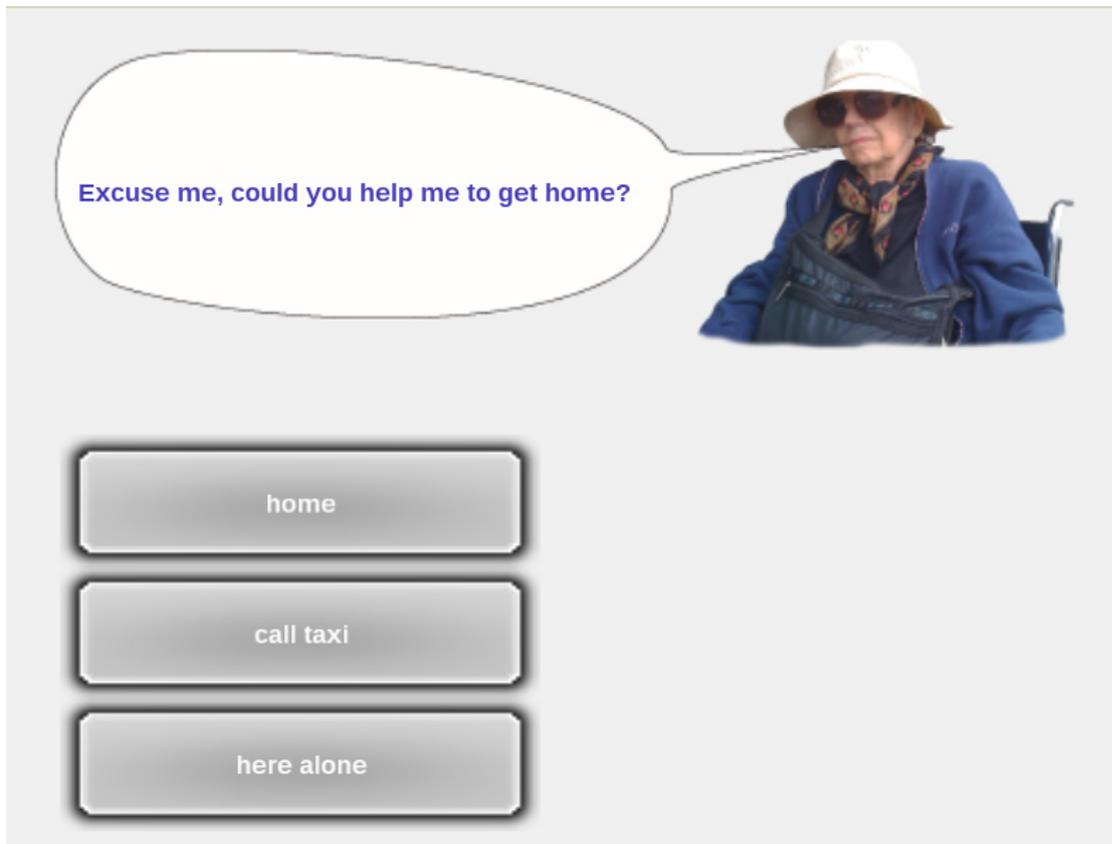


Figure 5.2: chatbot interface with three input keyword options

and check if every stimulus/response pairs is present only once, and secondly if there are repetitions within the choosable, but not chosen, input keyword options (cf. Figure 5.3). Another approach considered is the usage of AIML to choose suitable input keywords to every possible response of the chatbot. In the knowledge database of a chatbot usually only stimulus/response pairs are saved, where the stimulus is an input of the user and the response is the answer of the chatbot. In this project a possibility to define input keyword options, which are displayed after a response, is to use AIML the other way around. The response of the chatbot is taken as a stimulus and results in an output, that contains the three input keyword options. The following lines of code show how this could be realized technically with using AIML:

```
<category>
  <pattern>I LIVE IN BROOKLYN NEWYORK</pattern>
  <template>address#here alone#call taxi</template>
</category>
```

The processing of 'I LIVE IN BROOKLYN NEWYORK' leads to the response 'address#here alone#call taxi'. The '#' sign in the code above is used as a dividing sign to enable automatic processing of the response to insert the three input keyword options in the chatbot interface. The main drawback in this method is that input keywords and their matching responses might repeat involuntary depending on which input keywords the user chooses. In a worst case scenario a conversation might consist of the same repeating shorter dialogues due to the limited size of the knowledge database.

Inspired by the method used in [21] another approach considered was to assign different probabilities to the input keywords depending on the statement of the chatbot. The first step is to define suitable input keywords for every output sentence in the database and assign a probability how well they match to the response.

In Table 5.1 an example for the initial statement of the chatbot is given. After a statement of the chatbot the three input keywords with the highest probability are chosen and their probability is set to zero. This method should avoid that the same input key-

| response | matching input words | probability |
|---|----------------------|-------------|
| Excuse me, could you help me to get home? | home | 1.0 |
| | call taxi | 1.0 |
| | here alone | 1.0 |
| | address | 0.9 |
| | name | 0.9 |
| | Jena | 0.9 |
| | birthday | 0.9 |
| | year of birth | 0.8 |
| | birthplace | 0.8 |
| | age | 0.8 |
| | siblings | 0.8 |
| | parents | 0.7 |
| | father | 0.7 |
| | mother | 0.7 |
| | job | 0.6 |

Table 5.1: left column: first statement of the chatbot; middle column: matching input keyword options, which can follow after the statement of the chatbot; right column: assigned probabilities, which define how well an input keyword matches to the statement

words are presented to the player more than once. But due to the limited resources in this project, the knowledge database may be sufficient for developing a functional prototype, but does not contain enough matching input keywords for each output sentence. As Table 5.1 shows some input words do not match to the statement of the chatbot. For example 'Jena' and the input keywords afterwards cause a break in the conversation,

because they do not refer to the previous statement of the chatbot in any way.

As the aim of this work is to implement a functional prototype to test, if a serious game like the 'Do I Know You?' game can be used to let the player get to know symptoms of dementia in a playful way. And at the same time the 'Do I Know You?' game offers a testing environment, which enables the user to practice talking to a demented person. The advantage of talking to a chatbot instead of talking with a real human being suffering from dementia is that there is no risk of making a real human being feel bad by saying something wrong.

To get a fully functional prototype of the 'Do I Know You?' game despite a limited size of the database, the stimulus/response pairs in the knowledge database have to be ordered and adjusted in the following way:

1. Divide the stimulus/response pairs in blocks of three
2. Arrange the blocks of three into an order in a way, that following input keywords match to the responses of the previous block.

The knowledge database is supposed to contain stimulus/response pairs, where the responses contain information of a certain aspect in Jane's life from childhood until now. In the 'Do I Know You?' game the player 'travels' with Jane through her whole life and gets to know her hobbies, jobs, personality and the like. Thus the second step mentioned above - to arrange the blocks of three - is very important to obtain a dialogue with a coherent story. It also includes a correction of the responses in the database. Figure 5.4 shows an example of the iterative process of correcting or extending the responses in a way they match better to the following input keywords offered to the player.

5.3 Make the Chatbot demented

After a basic chatbot knowledge database file has been created, the symptoms of dementia are not yet reflected in the behavior of chatbot Jane. As described in the chapter dementia (cf. chapter 2) symptoms of dementia are losing the ability to remember newly learned information, disorientation, mood and behavior changes and deepening confusion about events, time and place. As the disease progresses there will occur - unfounded suspicions about family, friends and professional caregivers, more serious memory loss and behavior changes and difficulties with speaking, swallowing and walking. [22]

The speech of demented persons is influenced by memory problems, which lead to certain compensation strategies. [14, 25, 27] If a word can not be remembered, compensation strategies are for example the replacement of words by words of the same category, circumlocutions or apparently invented words.

Furthermore the speech of demented persons can be marked by confabulation. [27] Dementia patients may also have problems in paying attention to the interlocutor. [25] As the disease progresses demented persons often seem to shift in time, they seem to live in the past and also think sometimes that they are in another (former) period of their life. [22]

The replacements of words of the same category was done by replacing words with replacing words in the responses of chatbot Jane in the knowledge database files. For example the word 'cat' was replaced by the word 'tiger'. In Table 5.2 examples for the replacement of words from the same category are shown.

| output Sentence | replaced word from the same category | intended word |
|--|---|----------------------|
| Oh I remember Giselda and Venus my c.. tigers. | tigers | cats |
| I was born on 27th November in 19...mmmmh-hhh... When I was a ch...chi... younger my parents gave great parties on my birthday with all my friends | younger | child |
| I went to University of Wisconsin in Madison.I studied hi..hissss... the past. | past | history |
| I hated the job there. I did not study for years for getting a party assassi... helper. | helper | assistant |
| I had two c..c.. Kittens. | Kittens | cats |
| As a diplomat you network a lot, get in contact with lots of people, meetings, make invastat.. questions about people you are going to meet. | questions | investigations |
| I always go there on weekends. My father built a cott... house there on Fire Island. | house | cottage |

Table 5.2: examples for word replacements with words from the same category in the responses of the chatbot

Also the invention of new words could be simulated in the responses of the chatbot in the knowledge database straight forward by replacing existing words with invented ones. In Table 5.3 examples for the invented words are shown.

Furthermore words in the knowledge database were replaced by circumlocutions (cf. Table 5.4). To represent the speech of a demented person general word-finding pauses were integrated in the responses of chatbot Jane (cf. Table 5.5). Beside symptoms

| output Sentence | invented word | intended word |
|---|----------------------|----------------------|
| I live in Orange Street. I came here to ce...ce...celabrat my birthday. | celabrat | celebrate |
| He was a very good business man. His March of Time newsreels created a sensation and won an Academy Award. He also piblushed magazines – Time, Fortune, Life, and Sports Illustrated. I went out with friends and listened to sounds. | piblushed | published |
| I worked in Trieste for the Foreign Service in 19...when The Tournament of Roses Parade becomes the first event tvsised nationally in color. | tvsised | televised |
| I lived in a realy nice flat with a balcony in the center. It was quite big as I lived there just with my Knatens. It was in the Via Ponde....Ponga.. Pnodares. | Pnodares | Pondares |
| I lived in a realy nice flat with a balcony in the center. It was quite big as I lived there just with my Knatens. It was in the Via Ponde....Ponga.. Pnodares. | Knatens | Kittens |
| As usually hihi I worked 10 hours a day, well most of the time. But sometimes I found the time go to the opera or to go out with my celloagues/pupils | celloagues | colleagues |
| He was a italian composer of operas in the 19th century. I love MabCathOtello. | MabCathOtello | Mac Beth, Otello |

Table 5.3: examples for invented words in the responses of chatbot Jane

regarding the speech of demented persons, sometimes demented persons also seem to shift in time. It can happen that they think they are living in another former period of their life. During the conversation with chatbot Jane in the 'Do I Know You?' game its responses should also indicate that chatbot Jane seems to live in the past.

As the design of the character of current state-of-the-art chatbots do not include the design of a demented personality, a new method was needed to implement a chatbot, which shifts in time. As mentioned in [5] in AIML the 'topic' tag can be used to structure the dialogue to choose available questions of a predefined question set.

For example the 'topic' tag can be used to define responses to stimuli only if the conversation with the chatbot is about the previously set topic. A topic can be set if a certain stimulus was entered by the user. The following code shows an example of a stimulus/response pair in the AIML database where a topic is set:

```

<category>
  <pattern>highschool</pattern>
  <template>
    <think><set name="topic">HIGHSCHOOL</set></think>
    I went to Columbia highschool
  </template>
</category>

```

After the user entered the Stimulus 'highschool', he/she gets the response 'I went to Columbia highschool'. At the same time the topic 'HIGHSCHOOL' is set 'in the chatbot's mind'. This influences the responses to following stimuli: In the AIML file a different response can be defined for the same stimulus depending on the topic set or not set. The following code shows, how two different responses can be defined for the same stimulus in AIML depending on the topic set:

```

<topic name="HIGHSCHOOL">
<category>
  <pattern>favorite teacher</pattern>
  <template>I liked best Mrs. Tornshire</template>
</category>
</topic>
<category>
  <pattern>favorite teacher</pattern>
  <template>
    I liked best my history professor at university
  </template>
</category>

```

In the code above the answer to the stimulus 'favorite teacher' is 'I liked best Mrs. Tornshire', if the topic with the name 'HIGHSCHOOL' is set. If no topic is set the response to this stimulus is 'I liked best my history professor at university'.

In the 'Do I Know You?' game a counter is implemented, that evokes a time shift in Jane's mind every thirty seconds. Five different topics Jane can shift to were defined. 'CBS', 'DIPLOMAT', 'MARCHOFTIME', 'NEWYORKER' and 'NOW': For every topic an AIML file with stimulus/response pairs was generated. The topics represent the different phases of Jane's life and were defined according to the jobs she has had in her life and a general topic 'NOW'. The responses in the topics 'CBS', 'DIPLOMAT', 'MARCHOFTIME' and 'NEWYORKER' indicate that Jane thinks she is living in another period of her life than she actually is. The topic 'NOW' represents the state of Jane's mind, where she knows what time and place she lives in.

But timeshifts can also be evoked by showing a certain document to Jane by dragging

| outputSentence |
|---|
| I resigned in 195...when situation comedy I Love Lucy premiered on CBS. I worked there as a researcher afterwards. |
| A quite exhaaa... much work for my parents in this year I were not allowed to go out. Just when i was a debla...debli... I danced at the prom. |
| My care..ceerar work as a writer has always been very important to me. Because of my bach..boc.. finished studies I could work at Henry Luce's 'March of Time' as a researcher. |
| I interviewed famous people, went along on a narcotics shift with po... uniform people, covered the transit strike and I found stories wherever I went. |

Table 5.4: examples for circumlocutions in the responses of chatbot Jane, if she doesn't remember a word

| output Sentence |
|---|
| I liked to listen to classical music, esp...espa... operas. |
| I lived with my parents in college and they didn't like an...aimag.. cats. |
| From time to time I visited my parents in Was.. D.C., but I couldn't effort to go abroad. |
| I worked at the CBS as a researcher in 195... the early 50s. |
| grad....graaa. No I don't have graa... |

Table 5.5: examples for word finding pauses in the responses of chatbot Jane

and dropping in on her or pressing the 'View Image' button in the large view of the inventory. Technically this was realized by defining a textual stimulus (the name of the document) for every receivable document. When the document is shown to Jane this textual stimulus is assigned to the chatbot program and it outputs an textual response and sets the previously defined topic of the document.

5.4 Modification of the chatbot library

The chatbot library already offers a functionality to set a topic. It works with the AIML 'think' tag, the following lines of code show an example of a stimulus/response pair defined in a category with the usage of the 'think' tag:

```
<category>
  <pattern>setTopicCBS</pattern>
  <template>
    <think><set name="topic">CBS</set></think>
  </template>
</category>
```

After the stimulus 'setTopicCBS' was assigned to the chatbot program, the actual topic is saved in the actual settings of the chatbot. The chatbot library offers a method to request the actual topic in the file 'User.cs':

```
public string Topic{
get
{
return this.Predicates.grabSetting("topic");
}
}
```

The set topic can be requested by the following lines of code:

```
Bot myBot = new Bot();
User myUser = new User("consoleUser", myBot);
string input = "The stimulus for the chatbot";
Request r = new Request(input, myUser, myBot);
Result res = myBot.Chat(r);
string topicSet = res.user.Topic;
```

First the 'Bot' object and the 'User' object have to be initialized and the stimulus for the chatbot has to be defined. After this a new 'Request' object and a 'Result' object is initialized. Then the actually set topic can be read from the 'Result' object.

In the 'Do I Know You?' game not only the actual topic should be saved, but also the documents, which the player gets from Jane. This could be realized by adding a new variable to the settings of the chatbot, which can be accessed through adding the following lines of code in the file 'User.cs':

```
public string Document{
get
{
return this.Predicates.grabSetting("document");
}
}
```

In the AIML files single documents can be set, if a certain stimulus was passed to the chatbot, as follows:

```
<category><pattern>HOME</pattern>
<template>
<think>
<set name="document">PJanecatsportrait</set>
```

```
</think>
I live in Brooklyn, NewYork
</template>
</category>
```

'PJanecatportrait' is the name of a document, which is saved in the 'Assets' folder of the Unity project of the 'Do I Know You?' game. In the 'Do I Know You?' game the obtained documents get saved in an array, which represents the contents of the inventory.

The described method was also used to save wrong words Jane said. The 'Guess the Word' minigame is started as soon as a new wrong word is saved in the variable 'DementedWord' of the chatbot settings. It can be read by 'res.user.DementedWord' like the actual topic or the latest received document. The AIML code to save a wrong word is as follows:

```
<category><pattern>NAME</pattern>
<template>
<think><set name="DementedWord">birthday#birthhour</set>
</think>
I am Jane Boutwell. I came here with Jena for my birthhour.
</template>
</category>
```

The parameters needed for the 'Guess the Word' game are the wrong words and the correct words, which Jane intended to say. Therefore the variable 'DementedWord' stores the string 'birthday#birthhour', which already includes the faulty word and the correct word divided by the '#' symbol.

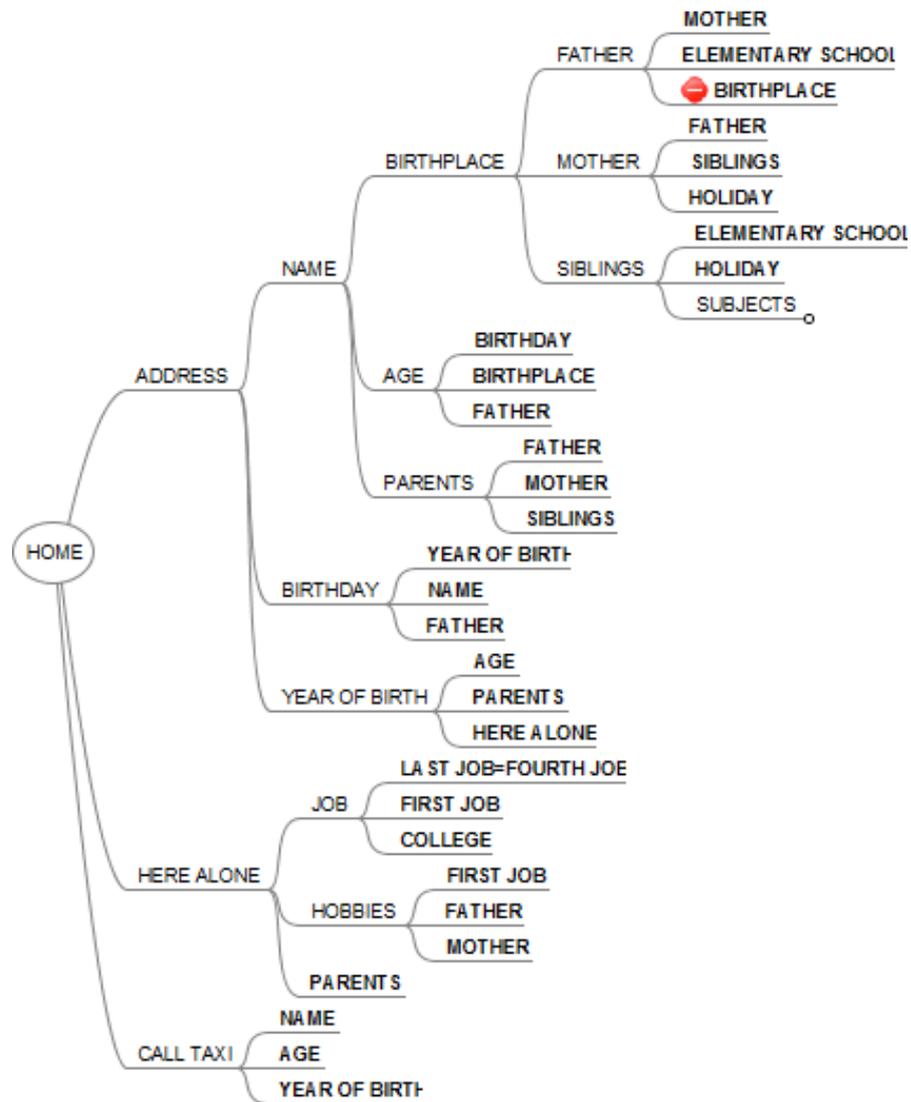


Figure 5.3: Small part of a tree representation of input keyword options for the 'Do I Know You?' game. For example if the user chooses 'ADDRESS' of the three input keyword options 'ADDRESS', 'HERE ALONE' and 'CALL TAXI', the next eligible input keyword options are 'NAME', 'BIRTHDAY' and 'YEAR OF BIRTH'. The red circular stop sign means that this input keyword was already used earlier in the conversation

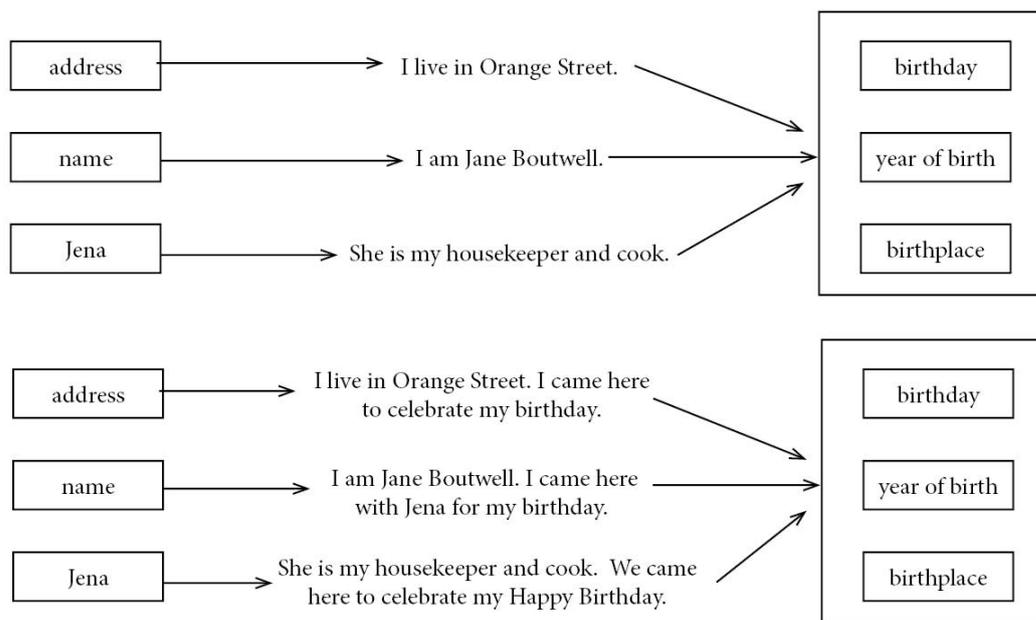


Figure 5.4: top: three input keywords the original responses and the following choosable input keywords (no matter which of the three responses was the output of the chatbot); bottom: three input keyword options and the corrected responses match better to the following input keyword options

Analysis of Symptoms of Dementia in a Dialogue of the 'Do I Know You?' game

In the chapter 5 it is described how the chatbot and its knowledge database was designed and implemented. In this chapter a possible dialogue variant of the 'Do I Know You?' game is analyzed. The dialogue was generated by playing the 'Do I Know You?' game. The input keywords - chosen by the player - and the matching responses of chatbot Jane were saved in table 6.1 in the order they appeared in the 'Do I Know You?' game.

In table 6.1 the left most column shows the chronological order of the input/answer pairs.

The middle columns show input keywords - chosen by the player - and the matching responses of chatbot Jane.

The right most column shows the time period chatbot Jane thinks she is at this moment: NOW means that she aware of the time and place she is right now. MARCHOFTIME, CBS, DIPLOMAT and NEWYORKER means that Jane thinks that she is in the past. MARCHOFTIME stands for the time period from 1950 to 1951, when she was working for the 'March of Time'. CBS stands for Columbia Broadcasting System and the time period from 1951-1953, when she was working there. DIPLOMAT stands for the time period from 1954 to 1956, when Jane was working as a diplomat in Trieste. NEWYORKER stands for the time period from 1956 to 1992, when she was working for the New Yorker magazine;

In the responses of chatbot Jane in table 6.1 boldfaced words/phrases are used to indicate word errors typical for demented persons like word replacements with words from the same category, invented words, circumlocutions or word finding pauses; italic typefaces

in the responses of chatbot Jane indicate that the statement is not true either because Jane thinks she is in another time period or her statement is marked by confabulation.

| no. | input keyword | Jane's response | time period Jane thinks she is in that moment |
|-----|--------------------|---|---|
| 1 | home | I live in Brooklyn, NewYork. | NOW |
| 2 | name | I am Jane Boutwell. I came here with Jena for my birthhour . | NOW |
| 3 | birthday | I was born on 27th November in 19...mm-mmhhhh... When I was a ch...chi...younger my parents gave great parties on my birthday with all my friends. | NOW |
| 4 | age | I am 86 years old. | NOW |
| 5 | father | My father was an execu... boss in educational publishing and photographer. He always brought me to elementary school. | NOW |
| 6 | elementary school | I went to elementary school in Columbia. | NOW |
| 7 | school uniform | When I was in elementary school girls wore dresses or skirts with blouses and boys were dressed in shorts or knickers.In highschool I could cho..chuss.take want I want. | NOW |
| 8 | highschool | I went to Western High School in Washington, DC. | NOW |
| 9 | parents | <i>My father Bill and my mother Olga are great parents. But I haven't heard from them for a long time. Maybe I should call them, but I don't find their telephone number.</i> | MARCHOFTIME |
| 10 | mother | <i>My mother works as secr...secertary.. and cares for the household. We often went to the pa...</i> | MARCHOFTIME |
| 11 | first job | <i>I am working for Henry Luce's 'March of Time' as a researcher.</i> | MARCHOFTIME |
| 12 | like March of Time | No not really. I didn't study for years for getting a party assisss... helper . | MARCHOFTIME |

| | | | |
|----|----------------------|---|-------------|
| 13 | working times | I begin at 8 in the morning, and mostly I finish at 7 p.m.. Often there's hardly time for lo..lu... food. | MARCHOFTIME |
| 14 | pet | I have Mini and Cinderella. | MARCHOFTIME |
| 15 | second job | <i>I just began working...</i> | MARCHOFTIME |
| 16 | age 86 | <i>My grandmother was that old, when she died in 1945.</i> | NEWYORKER |
| 17 | holiday | I always go to the Saltaire with Giselda and Daisy on weekends. | NEWYORKER |
| 18 | abroad holiday | Every summer I go to Europe. Last summer I went to Trieste, it looked really do...di..other , than I rrr...roomi...rem... than picture in my had. | NEWYORKER |
| 19 | first job | My first job was right after college at Henry Luce's 'March of Time' as a researcher. | NEWYORKER |
| 20 | liked March of Time | I hated the job there. I didn't study for years for getting a party assassi... helper. | NEWYORKER |
| 21 | how long at MOT | I worked there for one year. | NEWYORKER |
| 22 | salary March of Time | It was my first job so I didn't earn that much. But I had a good life. I lived with my Kittens. | NEWYORKER |
| 23 | go out highschool | I were not allowed to go out. Just when i was a debla...debli... I danced at the prom. | NOW |
| 24 | college | I went to University of Wisconsin in Madison.I studied hi..hissss... the past. | NOW |
| 25 | study finished | Yes I finished with a Bachelor in History. | NOW |
| 26 | college parties | I did not go out a lot at college. I was a very ambit... I always studied a lot , just my mother forced me sometimes to go to society parties... | NOW |
| 27 | first job | My first job was right after college at Henry Luce's 'March of Time' as a researcher. | NOW |

| | | | |
|----|---------------------|---|----------|
| 28 | Henry Luce | He was a very good business man. His March of Time newsreels created a sensation and won an Academy Award. He also publi... made magazines: Time, Fortune, Life, and Sports Illustrated. | NOW |
| 29 | parents | <i>My father Bill and my mother Olga are great parents.</i> | DIPLOMAT |
| 30 | holiday | I didn' t have lot of time, but I made many short trips on weekends and went to many cities in Europe. | DIPLOMAT |
| 31 | abroad holiday | <i>Abroad? Well yes. I am already abroad I am from NewYork and we are in Italy.</i> | DIPLOMAT |
| 32 | first job | My first job was right after college at Henry Luce's 'March of Time' as a researcher. | DIPLOMAT |
| 33 | Henry Luce | He was a very good business man. His March of Time newsreels created a sensation and won an Academy Award. He also published magazines - Time, Fortune, Life, and Sports Illustrated – were the most popular and profitable periodicals in America. | DIPLOMAT |
| 34 | how long at MOT | I worked there for one year. | DIPLOMAT |
| 35 | name Kittens MOT | Their names were Mini and Cinderella. | DIPLOMAT |
| 36 | pets March of Time | I had two c..c.. Kittens . One day callege at work asked if I could take them for two weeks, but they stayed. | NOW |
| 37 | holiday first job | From time to time I visited my parents in Was.. D.C. , but I couldn't effort to go abroad. | NOW |
| 38 | second job | I worked at the CBS as a researcher in 195... the early 50s. | NOW |
| 39 | What job at CBS | At first I was hired to research historical themes. But in the end this was the smallest part of my work. Most of the time I had to teach young men how to do the research. | NOW |

| | | | |
|----|----------------------|---|-------------|
| 40 | working times CBS | As usually hihi I worked 10 hours a day, well most of the time. But sometimes I found the time go to the opera or to go out with my celloagues/pupils . | NOW |
| 41 | hobbies CBS | I went out with friends and listened to sounds. | NOW |
| 42 | music CBS | I listened mostly to classical music like operas, but sometimes I went to Jazz clubs. | NOW |
| 43 | third job | <i>I just began my first job.</i> | MARCHOFTIME |
| 44 | job foreign service | I never worked for the Foreign Service. | MARCHOFTIME |
| 45 | how long at NY | I came to New York right after I graduated in 1949. | MARCHOFTIME |
| 46 | when retired | <i>I will retire in about 40 years, but I don't look forward to that. I like to work, even though right now it's not my dream job.</i> | MARCHOFTIME |
| 47 | hobbies | I like to listen to music, especially operas and play with my Kittens . | MARCHOFTIME |
| 48 | go out | I like to go on parties or social events. | MARCHOFTIME |
| 49 | liked CBS | I liked it better than the job at March of Times and I earned a little bit more. | DIPLOMAT |
| 50 | music CBS | I mostly listened to classical music like operas, but sometimes I went to Jazz clubs. | DIPLOMAT |
| 51 | jazz clubs | Well not often, but once my colleagues and I were going out. In the end we decided to see what this Jazz is we heard of. | DIPLOMAT |
| 52 | job foreign service | <i>I work as a diplomat.</i> | DIPLOMAT |
| 53 | address diplomat | I live in a really nice flat with a balcony in the center. It was quite big as I lived there just with my Knatens . It was in the Via Ponde....Ponga.. Pnodares . | DIPLOMAT |
| 54 | diplomat | As a diplomat you network a lot, get in contact with lots of people, meetings, make invastat.. questions about people you are going to meet. | NOW |

| | | | |
|----|------------------------|---|-----------|
| 55 | pets third job | I saved two street Knatens . I named them Huge and Pogo. They were quite wild, they used my furniture like a cat scratchy . But as they grew older they wound down. | NOW |
| 56 | Knatens | <i>Hmmm...Ahh Mr. Knatens he was a working colleague at the New Yorker, yes I remember.</i> | NOW |
| 57 | last job | My last job was at the New Yorker magazine. I worked there as a writer. | NOW |
| 58 | What job at New Yorker | I wrote about a lot of things, made some interviews with fam.... well known persons. | NOW |
| 59 | stories at New Yorker | I wrote the Talk of the Town. I wrote about Javier Pereira, preserve, delicate,... | NOW |
| 60 | parents | <i>My father Bill and my mother Olga are great parents. But I haven't heard from them for a long time. Maybe I should call them, but I don't find their telephone number.</i> | CBS |
| 61 | mother | <i>My mother works as secr...secertary.. and cares for the household. We often went to the pa...</i> | CBS |
| 62 | favorite city | I liked Rome most. Rome is great cultural city. Also the remains of ancient Rome were impr.ess.. fascinating . | CBS |
| 63 | first job | My first job was right after college at Henry Luce's 'March of Time' as a researcher. | CBS |
| 64 | liked march of time | I hated the job there. I didn't study for years for getting a party assassi... helper . | CBS |
| 65 | salary march of time | It was my first job so I didn't earn that much. But I had a good life. I lived with my Kittens . | CBS |
| 66 | second job | <i>I work at the CBS as a researcher.</i> | CBS |
| 67 | pets CBS | I had my c...c...ca...caties Mini and Cinderella. | NEWYORKER |

| | | | |
|----|------------------|--|-----------|
| 68 | how long at CBS | <i>I worked there for one year, but then I got a really good offer from the CIA, ähhh to be a spy. Ups I shouldn't tell you that.</i> | NEWYORKER |
| 69 | opera CBS | My favorite operas have been written by italian composers, like Verdi. It always is so glamerous. But also Porgy and Bess from Gershwin imperssed me much. | NEWYORKER |
| 70 | third job | I have worked in Trieste for the Foreign Service since 1954. | NEWYORKER |
| 71 | address diplomat | I live in a realy nice flat with a balcony in the center. It was quite big as I lived there just with my Knatens . It was in the Via Ponde....Ponga.. Pnodares . | NEWYORKER |
| 72 | pets trieste | I saved two street cats. I named them Huge and Pogo. They are quite wild, they use my furniture like a cat scratchy . | NEWYORKER |
| 73 | fourth job | <i>I am working as a writer at the New Yorker.</i> | NEWYORKER |
| 74 | what writer | I wrote about a lot of things, made some interviews with fam.... well known persons. | NEWYORKER |

Table 6.1: a possible dialogue of the 'Do I Know You?' game; the left most column shows the chronological order of the input/answer pairs; the middle columns show input keywords chosen by the player and the matching repsonses of chatbot Jane; the right most column shows the time period chatbot Jane thinks she is at this moment: NOW = present, MARCHOFTIME = 1950-1951, CBS = 1951-1953, DIPLOMAT = 1954-1956, NEWYORKER = 1956-1992; boldfaced words/phrases in the responses of chatbot Jane are used to indicate word errors typical for demented persons like word replacements with words from the same category, invented words, circumlocutions or word finding pauses; italic typefaces in the responses of chatbot Jane indicate that the statement is not true either because Jane thinks she is in another time period or her statement is marked by confabulation

As described in chapter 2 characteristics related to the speech of demented persons are word replacements with words from the same category, circumlocutions, invented words and word finding pauses.

In the following the response with the number x is called 'response in line x' (x is a digit from 1 to 74).

For example in table 6.1 in the response in line 2 the word 'birthhour' appears, where chatbot Jane replaced the word 'day' (in birthday) with the word 'hour' from the same

category. Table 6.2 shows examples of these word replacements in the responses of chatbot Jane.

| no. | Jane's response | word Jane intended to say | replaced word from same category used by Jane |
|-----|---|---------------------------|---|
| 2 | I am Jane Boutwell. I came here with Jena for my birthhour . | birthhour | birthday |
| 3 | I was born on 27th November in 19...mm-mmhhhh... When I was a ch...chi... younger my parents gave great parties on my birthday with all my friends. | child | younger |
| 7 | When I was in elementary school girls wore dresses or skirts with blouses and boys were dressed in shorts or knickers. In highschool I could cho..chusss.take want I want. | choose | take |
| 12 | No not really. I didn't study for years for getting a party assiss... helper . | assistant | helper |
| 13 | I begin at 8 in the morning, and mostly I finish at 7 p.m.. Often there's hardly time for lo..lu... food . | lunch | food |
| 18 | Every summer I go to Europe. Last summer I went to Trieste, it looked really do...di..other , than I rrr...roomi...rem... than picture in my had. | different | other |
| 20 | I hated the job there. I didn't study for years for getting a party assassi... helper . | assistant | helper |
| 24 | I went to University of Wisconsin in Madison. I studied hi..hissss... the past . | history | past |
| 28 | He was a very good business man. His March of Time newsreels created a sensation and won an Academy Award. He also publi... made magazines: Time, Fortune, Life, and Sports Illustrated. | published | made |
| 36 | I had two c..c.. Kittens . One day callege at work asked if I could take them for two weeks, but they stayed. | cat | Kittens |

| | | | |
|----|--|----------------|-------------|
| 40 | As usually hihi I worked 10 hours a day, well most of the time. But sometimes I found the time go to the opera or to go out with my celloagues/pupils . | colleagues | pupils |
| 47 | I like to listen to music, especially operas and play with my Kittens . | cats | Kittens |
| 54 | As a diplomat you network a lot, get in contact with lots of people, meetings, make invastat.. questions about people you are going to meet. | investigations | questions |
| 62 | I liked Rome most. Rome is great cultural city. Also the remains of ancient Rome were impr..ess.. fascinating . | impressive | fascinating |
| 64 | I hated the job there. I didn't study for years for getting a party assassi... helper . | assistant | helper |

Table 6.2: responses of chatbot Jane in the dialogue (cf. table 6.1) of the 'Do I Know You?' game, which contain a replacement of words intended to say by chatbot Jane with words from the same category: the left most column transport the chronological order like in table 6.1; the second column from the left contains responses of chatbot Jane; the two right most columns shows the word chatbot Jane intended to say and the word she replaced it with

Furthermore the speech of demented persons is characterized by word finding pauses, where they try to find a word or fact they want to use in a sentence. Also words can be misspelled by demented persons due to memory problems. For example the response in line 3 contains a word finding pause, when Jane says '19...mmmmhhhh...' she can't remember the exact date. Table 6.3 shows examples for word finding pauses and misspelled words due to memory problems.

| no. | Jane's response |
|-----|---|
| 3 | I was born on 27th November in 19...mmmmhhhh... When I was a ch...chi... younger my parents gave great parties on my birthday with all my friends. |
| 5 | My father was an execu... boss in educational publishing and photographer. He always brought me to elementary school. |
| 10 | My mother works as secr...secrertary.. and cares for the household. We often went to the pa... |
| 36 | I had two c..c.. Kittens. One day calleoge at work asked if I could take them for two weeks, but they stayed. |

| | |
|----|---|
| 37 | From time to time I visited my parents in Was.. D.C. , but I couldn't effort to go abroad. |
| 40 | As usually hihi I worked 10 hours a day, well most of the time. But sometimes I found the time go to the opera or to go out with my celloagues/pupils . |
| 53 | I live in a realy nice flat with a balcony in the center. It was quite big as I lived there just with my Knatens. It was in the Via Ponde...Ponga.. Pnodares . |
| 61 | My mother works as secr...secertary.. and cares for the household. We often went to the pa... |
| 69 | My favorite operas have been written by italian composers, like Verdi. It always is so glamerous. But also Porgy and Bess from Gershwin imperssed me much. |
| 71 | I live in a realy nice flat with a balcony in the center. It was quite big as I lived there just with my Knatens. It was in the Via Ponde...Ponga.. Pnodares . |

Table 6.3: responses of the dialogue shown in table 6.1, which contain a word finding pause or a misspelled word; the left column shows the chronological order of the response in the dialogue like in table 6.1; boldfaced letter mark the place of a word finding pause or misspelled word

Moreover the speech of demented persons is characterized by circumlocutions if they can't remember a word. For example the response in line 18 contains the phrase 'than I rrr...roomi...rem... than picture in my had'. Chatbot Jane wants to say 'than I remember...' but instead paraphrases it with the circumlocution 'than picture in my had'. Table 6.4 shows examples for circumlocutions in the responses of chatbot Jane.

| no. | Jane's response |
|-----|---|
| 38 | I worked at the CBS as a researcher in 195... the early 50s . |
| 58 | I wrote about a lot of things, made some interviews with fam.... well known persons. |
| 74 | I wrote about a lot of things, made some interviews with fam.... well known persons. |

Table 6.4: responses of the dialogue shown in table 6.1, which contain circumlocutions for not remembered words; the left column shows the chronological order of the response in the dialogue like in table 6.1; boldfaced letter mark the place of a circumlocution

Also the speech of demented persons is characterized by invented words. For example the response in line 53 contains the word 'Knatens' instead of the word cats. Table 6.5 shows examples for invented words in the responses of chatbot Jane.

| no. | Jane's response |
|-----|---|
| 53 | I live in a really nice flat with a balcony in the center. It was quite big as I lived there just with my Knatens . It was in the Via Ponde....Ponga.. Pnodares. |
| 55 | I saved two street Knatens . I named them Huge and Pogo. They were quite wild, they used my furniture like a cat scratchy . But as they grew older they wound down. |
| 67 | I had my c...c...ca...caties Mini and Cinderella. |
| 71 | I live in a really nice flat with a balcony in the center. It was quite big as I lived there just with my Knatens . It was in the Via Ponde....Ponga.. Pnodares. |
| 72 | I saved two street cats. I named them Huge and Pogo. They are quite wild, they use my furniture like a cat scratchy . |

Table 6.5: right column: responses of the dialogue shown in table 6.1, which contain an invented word. Boldfaced letter mark the place of a invented word. left column: chronological order of the response in the dialogue like in table 6.1

A frequent symptom of demented persons is that they seem to shift in time. They sometimes are not aware of the time and place they are living in right now. They may think that they are currently in another time period of their lives. As described in chapter 4 in section 4.3 chatbot Jane switches into another time period of her life every thirty seconds or if the player shows her the right image. The changing of the time period - Jane thinks she's in - was represented in the 'Do I Know You?' game by a sudden change of the input keyword options in the user interface. In the 'Do I Know You?' game usually the input keyword options only change if the player presses one of the input keyword option buttons.

Table 6.6 shows examples for the change of input keyword options in the same 'Do I Know You?' game as used for table 6.1.

The first line of the first column from the left shows the time period chatbot Jane thinks she is in, the following lines contain the input keyword options presented to the player in the first moment; The second column contains the input keyword options, which would follow after the player chose one of the previous input keyword options and chatbot Jane wouldn't switch in time. The first line of the third column shows the time period chatbot Jane switched to and the following input keyword options (no matter if one of the previous input keyword options was chosen by player or not). The time periods Jane may think she is in are NOW = present, MARCHOFTIME = 1950-1951, CBS = 1951-1953, DIPLOMAT = 1954-1956, NEWYORKER = 1956-1992 according to the jobs she had in her life.

| input keyword options presented to the player at first | following input keyword options which would be presented to the player if Jane wouldn't switch in time | following input keyword options presented to the player |
|--|---|---|
| <p>NOW</p> <ul style="list-style-type: none"> ● highschool subjects ● highschool ● favorite teacher high-school | <p>NOW</p> <ul style="list-style-type: none"> ● favorite subjects high-school ● sports highschool ● hobbies highschool | <p>MARCHOFTIME</p> <ul style="list-style-type: none"> ● age ● age86 ● parents |
| <p>MARCHOFTIME</p> <ul style="list-style-type: none"> ● second job ● flat ● CBS | <p>MARCHOFTIME</p> <ul style="list-style-type: none"> ● what research at CBS ● liked CBS ● working times CBS | <p>NEWYORKER</p> <ul style="list-style-type: none"> ● age ● age86 ● parents |
| <p>NEWYORKER</p> <ul style="list-style-type: none"> ● salary March of Time ● name kittens MOT ● flat first job | <p>NEWYORKER</p> <ul style="list-style-type: none"> ● second job ● CBS ● what research at CBS | <p>NOW</p> <ul style="list-style-type: none"> ● swimming team ● swimming style ● go out highschool |
| <p>NOW</p> <ul style="list-style-type: none"> ● Henry Luce ● March of Time ● what research | <p>NOW</p> <ul style="list-style-type: none"> ● liked March of Time ● how long at March of Time ● working times | <p>DIPLOMAT</p> <ul style="list-style-type: none"> ● age ● age86 ● parents |
| <p>DIPLOMAT</p> <ul style="list-style-type: none"> ● name Kittens MOT ● salary March of Time ● flat first | <p>DIPLOMAT</p> <ul style="list-style-type: none"> ● second job ● CBS ● what research at CBS | <p>NOW</p> <ul style="list-style-type: none"> ● when March of Time ● pets March of Time ● salary March of Time |
| <p>NOW</p> | <p>NOW</p> | <p>MARCHOFTIME</p> |

| | | |
|---|---|--|
| <ul style="list-style-type: none"> • music CBS • Jazz clubs • opera CBS | <ul style="list-style-type: none"> • third job • worked abroad • after CBS | <ul style="list-style-type: none"> • how long at CBS • foreign service • third job |
| <p>MARCHOFTIME</p> <ul style="list-style-type: none"> • go out • Venus • here alone | <p>MARCHOFTIME</p> <ul style="list-style-type: none"> • live alone • why go out • career important | <p>DIPLOMAT</p> <ul style="list-style-type: none"> • liked CBS • working times CBS • pets CBS |
| <p>DIPLOMAT</p> <ul style="list-style-type: none"> • address diplomat • working time diplomat • go out | <p>DIPLOMAT</p> <ul style="list-style-type: none"> • Knatens • pets Trieste • street cats | <p>NOW</p> <ul style="list-style-type: none"> • job foreign service • diplomat • working time third job |
| <p>NOW</p> <ul style="list-style-type: none"> • stories at New Yorker • Mr. Shawn • go out New Yorker | <p>NOW</p> <ul style="list-style-type: none"> • Javier Pereira • preserve • delicate | <p>CBS</p> <ul style="list-style-type: none"> • age • age86 • parents |
| <p>CBS</p> <ul style="list-style-type: none"> • second job • name kittens mot • flat first job | <p>CBS</p> <ul style="list-style-type: none"> • CBS • what research at CBS • liked CBS | <p>NEWYORKER</p> <ul style="list-style-type: none"> • liked CBS • working times CBS • pets CBS |

Table 6.6: In the 'Do I Know You?' game chatbot Jane begins to think that she is in another period of her life than she thought in the moment before, in the following called Jane switches in time. This is represented by changing the input keyword options electable for the player. The first line of the first column from the left shows the time period chatbot Jane thinks she is in and the input keyword options presented to the player in the first moment; the second column contains the input keyword options, which would follow after the player chose one of the previous input keyword options and chatbot Jane wouldn't switch in time. The first line of the third column shows the time period chatbot Jane switched to and the following input keyword options (no matter if one of the previous input keyword options was chosen by player or not). The time periods Jane may think she is in are NOW = present, MARCHOFTIME = 1950-1951, CBS = 1951-1953, DIPLOMAT = 1954-1956, NEWYORKER = 1956-1992.

Furthermore textual hints were given to the player, table 6.7 shows responses in the dialogue shown in table 6.1, where the player might suspect that this statement can't be entirely true. For example the player might already know her age from former responses and then read the response, where Jane talks about her parents as they are still alive. The player might consider that it is not very likely that the parents of such an old lady are still alive. Or the player might get suspicious, when Jane tells him that she was working as a spy for the CIA. Also the remaining responses about her jobs indicate that they might not be true, for example when Jane says: "I just began working".

| no. | input keyword | Jane's response | time period Jane thinks she is in that moment |
|-----|---------------------|--|---|
| 9 | parents | My father Bill and my mother Olga are great parents. But I haven't heard from them for a long time. Maybe I should call them, but I don't find their telephone number. | MARCHOFTIME |
| 10 | mother | My mother works as secr...secertary.. and cares for the household. We often went to the pa... | MARCHOFTIME |
| 11 | first job | I am working for Henry Luce's 'March of Time' as a researcher. | MARCHOFTIME |
| 15 | second job | I just began working... | MARCHOFTIME |
| 29 | parents | My father Bill and my mother Olga are great parents. | DIPLOMAT |
| 31 | abroad holiday | Abroad? Well yes. I am already abroad I am from NewYork and we are in Italy. | DIPLOMAT |
| 43 | third job | I just began my first job. | MARCHOFTIME |
| 44 | job foreign service | I never worked for the Foreign Service. | MARCHOFTIME |
| 52 | job foreign service | I work as a diplomat. | DIPLOMAT |
| 56 | Knatens | Hmmm...Ahh Mr. Knatens he was a working college at the New Yorker, yes I remember. | NOW |
| 60 | parents | My father Bill and my mother Olga are great parents. But I haven't heard from them for a long time. Maybe I should call them, but I don't find their telephone number. | CBS |

| | | | |
|----|-----------------|--|-----------|
| 61 | mother | My mother works as secr...secertary.. and cares for the household. We often went to the pa... | CBS |
| 66 | second job | I work at the CBS as a researcher. | CBS |
| 68 | how long at CBS | I worked there for one year, but then I got a really good offer from the CIA, ähhh to be a spy. Ups I shouldn't tell you that. | NEWYORKER |
| 73 | fourth job | I am working as a writer at the New Yorker. | NEWYORKER |

Table 6.7: hints in the responses of chatbot Jane in the dialogue shown in table 6.1 that she doesn't remember everything rightly; the left most column shows the chronological order of the input/answer pairs analogous to table 6.1; the middle columns show input keywords chosen by the player and the matching responses of chatbot Jane; the right most column shows the time period chatbot Jane thinks she is at this moment: NOW = present, MARCHOFTIME = 1950-1951, CBS = 1951-1953, DIPLOMAT = 1954-1956, NEWYORKER = 1956-1992

CHAPTER 7

Evaluation

The prototype of the 'Do I Know You?' game was evaluated using expert reviews done by computer science students attending the "Exploratives Design" course at the Technical University Vienna.

As a small introduction about the background and core concepts of the 'Do I Know You?' game were presented to the students. The introduction did not include an explanation of how the interactions in the 'Do I Know You?' game work, because it was important to get to know, if it is possible to make the interactions intuitively understandable with some hints in the beginning of the game. The 'Do I Know You?' game prototypes for Windows and OS X could be downloaded by the students by a provided link to an online repository.

The students were asked to play the 'Do I Know You?' game and fill out a questionnaire, which consists of twelve questions and an additional section for comments. The questions were mostly formulated as open questions to get rich answers and a detailed feedback.

The questionnaire is about how interesting and enjoyable playing the 'Do I Know You?' game was and if the students learned something about Jane and dementia. The questionnaire can be found in Appendix A.

7.1 Results of the Expert Reviews

23 students made an expert review of the 'Do I Know You?' game. In this section the answers to the questionnaire will be summarized and discussed. 52% of the students don't know a person with dementia and 48% do. The questionnaire and the answers of

the students can be found in Appendix B.

The first question is what Jane's speech characterizes. Most of the students recognized that Jane has problems with remembering some words correctly. The students noticed that Jane stutters, forgets words or doesn't know how to spell them. One student for example wrote:

"Jane's missing some words and/or doesn't know how to correctly spell them. Therefore she's stuttering and rephrasing her words, which can be hard to understand."

Two students realized that Jane seems to be confused about time and place:

"She sometimes loses focus or does not know where/when she is."

"She seems to forget some simple words, but she can say what she means with different words. Also, I had the feeling that she mixes up what was happening and what is happening in the present."

Furthermore students wrote that "she talks about the old time, she mixes up stuff" or "it seems she loses track of what we talked about, when there are too long gaps in the communication".

The second question is what they know about Jane's life. The answers revealed that after playing the 'Do I Know You?' game all the players could remember some facts about Jane's life like her jobs, her pets and the like.

The answers to the third question, which was about how well they know Jane, showed quite different answers. Some students wrote that they know Jane pretty well, whereas others stated that they don't have the feeling that they know Jane. At least all knew her a little bit and quite well regarding the aspect of time they spent with Jane.

The answers to the fourth question 'What happens to Jane, if she blurs out?' revealed that some students did not notice the blurring at first or at all. The blurring of Jane was a visualization if Jane switched to an earlier period of her life. Two students recognized that the blurring means a change of time or topic. Others assumed that the blurring of Jane is combined with appearance of wrong words in Jane's responses or other reasons.

The fifth question is, how they liked the interaction with the chatbot. The answers to this question were quite diverse. Some of the students liked the interaction with the chatbot. But some of them also mentioned, that they had to play the 'Do I Know You?' game a second time to understand the interactions completely.

Some students were confused, because the input keyword options switched after thirty seconds. This feature should help the player to notice that Jane switches in time, but sometimes it was identified as bug by the students.

The sixth question is, what for are the images in the inventory. All students found out that they can show a picture to Jane either via large inventory screen or small inventory in the main screen. Nearly all of them found out that they can get additional information from Jane by showing an image to her. Showing an image to Jane not only causes an additional response, but can also cause a time switch. Two students assumed that the topic is changed, when the player shows an image to Jane.

The seventh question was about how interesting the students found the 'Do I Know You?' game. On the one hand students answered that they find the idea of the 'Do I Know You?' game very interesting and that they were curious to find out facts about Jane's life. For example one student wrote:

"I enjoyed the explorative parts of the game, where you could have a look at the inventory items and ask Jane questions."

On the other hand students stated that it was not very interesting for them to play the game. But some of them mentioned, that this is because they do not like the genre of the game or that they do not think the topic can be presented well within a game. For example one student wrote: "Not really interesting. To be honest, if this hadn't been an assignment I wouldn't have played the game. But this isn't necessarily your fault. Any game where the goal is to get to know a character has the same problem: I'm just not really interested in other people."

The eighth question is, how enjoyable the game is. Some of the students wrote the game is not very enjoyable for different reasons. Some did not like that they had to read a lot in the game, and others missed the excitement in the game. Some students stated that they would have preferred having an aim in the game and some reward system how close you are to it. Overall they found it an interesting project and one student wrote:

"Takes a bit to orientate in the game, but nice to play."

The answers to the ninth question 'How did you like the minigames?' are quite different: On the one hand students wrote that the minigames were too easy and one student thought they were unnecessary anyway. But others enjoyed playing the minigames and one student wrote:

"They are a nice break from the wall of text the game offers otherwise." Some of them only liked the minigames partly, for example the 'Word Puzzle' game was too easy for some students, but others liked it:

"It was really cool and challenging to find the right word.!"

The tenth question is about if and how they would like to change the game. The answers to this question revealed that some students missed a reward system in the game

like getting points for finding clues. Others mentioned that the graphical user interface is not suitable for the scenery of the 'Do I Know You?' game. Furthermore it was mentioned, that it would be interesting to be able to influence the course of the conversation more and add more story branches. Thus the conversation would differ from former conversations every time the game is replayed.

The eleventh question asks, if the students learned something new about dementia. Nearly all of the students stated, that they have not learned something new.

In the answers to the additional remarks/comments section in the questionnaire it was mentioned that the graphical user interface should be redesigned to give the game a more familiar look like in the answers to the tenth question 'What would you change about the game?'. Some of the students wrote that it would be interesting to have more options for conversation. One student wrote that it might be helpful to give a more detailed introduction in the beginning.

7.2 Discussion

The results of the expert reviews show, that the 'Do I Know You?' game was perceived as an interesting opportunity to transport knowledge about dementia.

In the 'Do I Know You?' game Jane's speech was characterized by the symptoms of dementia. She cannot remember certain words, which results in stuttering, replacements of words from the same category, remembering words wrongly, which leads to misspelled words or invention of new words. Most of the students recognized the verbal symptoms of Jane well, they mentioned that Jane stutters, forgets words and tries to paraphrase them.

Even though the students seemed to recognize the verbal symptoms of Jane's speech very well, nearly all of them mentioned, that they haven't learned something new about dementia. This might have two reasons: On the one hand they may already have known before about this kind of symptoms of dementia, on the other hand they may not have identified it as a symptom of dementia, because forgetting words is not only a matter of demented persons. Also normally elder people and even some younger ones can be forgetful and do not remember words and try to paraphrase them. As stated in [36] most people do not know the difference between behavior related to normal aging and early stages of dementia.

After playing the 'Do I Know You?' game all the students remembered some facts about Jane, whereas the answers how well they know Jane differed. The reason for this might be that it strongly depends on a person's character and attitude, what is needed to know another human being. Some of the students wrote that they got to know Jane well

in particular regarding the aspect of the little time they 'spent' with her. Whereas others wrote that they just know some facts about Jane, but this is not enough for knowing a person.

In the 'Do I Know You?' game the conversation with chatbot Jane works with input buttons labeled with keywords, which represent a question about a topic. Most of the students had no problems understanding the keywords or that they serve - if pressed - as questions to Jane, but a few mentioned that they were confused sometimes, because they did not understand what the keywords should mean.

The time switches of Jane in the 'Do I Know You?' game were presented by the changing of the input buttons and the changing of Jane's look in the game (Jane gets blurred). Even though some students recognized, that the changing of the input buttons could mean a topic switch, because Jane loses track of the conversation, many of them thought it could be a bug.

The blurring of Jane's picture in the game as a representation for a mental journey to the past was not recognized by most of the students. It turned out that if they mentioned the changing of Jane's look, it was not obvious to them why this happened. The smartphone in the game shows information on the period Jane thinks she is in, but most of the students did not recognize the connection between the smartphone and the time switches.

The feedback for the minigames have shown, that balancing the degree of difficulty is very hard for an audience with different skills and knowledge. Some of the students found that the minigames were interesting and the game gathers momentum, whereas others considered them as too easy or missed the opportunity to fail in a game. Furthermore it was criticized that there is no possibility to quit the minigames without quitting the whole game.

Another issue mentioned in the answers of the students is, that nearly all of the students found out intuitively which kind of interactions like 'showing a picture to Jane' or 'chat with Jane through input buttons' are available in the game and how to use them. But a few students wrote that the possible interactions in the 'Do I Know You?' game could not be recognized intuitively, when playing the game the first time and that an additional tutorial in the beginning of the game would be helpful.

Furthermore some students missed a reward system in the game, which shows the player how close (or far) he/she is from the aim of the game.

Some answers of the expert reviews also revealed that the graphical user interface should have a more consistent look. Also the colors and fonts used in the game were considered as too cold for a game, which should arouse empathy for demented persons.

Conclusio

The expert reviews have shown that the 'Do I Know You?' game is an interesting project with a lot of potential for further development. A main research question of this work was, if a chatbot integrated in a serious game is a good opportunity to transport knowledge about the symptoms of dementia.

The evaluation of the prototype of the 'Do I Know You?' game has shown, that the verbal symptoms could be presented well and were recognized by most of the participants of the expert reviews. They noted that Jane stutters, has difficulties to remember words and tries to paraphrase them - sometimes with success, sometimes without.

Another symptom of dementia modeled in the game was that demented persons sometimes lose the track and think they are in the past. Or they remember things from their past, but believe they are happening right now.

In the 'Do I Know You?' game, when Jane thinks she is living in the past, the input keyword options in the main screen change. Furthermore the image of Jane in the main screen gets sepia brown and blurred. And also the text on the smartphone screen gives information about the topic of the period, Jane thinks she is living in. The expert reviews revealed that some students recognized that changing of the input buttons is symbolic for the loss of track of the conversation by Jane. But some thought also this could be a bug.

As the above mentioned hints for time switches in the game did not work for most of the students, the time switches should be presented more clearly. The blurring of Jane in the main screen of the 'Do I Know You?' game seems to be hardly recognizable for the players. Therefore it would be necessary to visualize the changing of Jane's look more eye-catchingly for example with an animation, which draws the attention of the player to Jane's image. Furthermore in the 'Do I Know You?' game textual hints were

given in some responses of Jane that she thinks she's in the past. The reason why most of the students did not notice the time switches might also be that these hints were not included in all responses of Jane, when she thinks she is in the past. Thus if the player chooses input keyword options, which do not result in a response with a hint for the time switch of Jane, she/he cannot notice them because of the hints in the responses. A solution to the not recognizing of the time switches of Jane could be to focus more on the hints in the responses of Jane and neglect the sudden change of the input buttons. To realize this the structure of the knowledge database of the chatbot has to be adjusted. In the prototype of the 'Do I Know You?' game the knowledge database consists of a single AIML file with stimulus/response patterns for each time period Jane can think she is living in. Furthermore the knowledge database contains a list of input keywords for each period Jane may think she is in, which defines when in which conversation state, which input keyword options are displayed.

To represent time switches in an adequate way, the knowledge database has to be extended and restructured. Instead of using five different lists for defining the possible input buttons, one list is entirely sufficient. To assure that there are enough input keywords for six minutes chat time, this new list must contain as much input keywords as the five single lists.

Afterwards the input keywords, which serve as stimuli, and the matching responses have to be added to the AIML files. For every input keyword five responses have to be created, because the response should differ depending on the period, where Jane thinks she is living.

Another important issues in developing chatbots is to make the player believe to talk to a real person. It is important that the 'character' of the chatbot is believable and the conversation with it feels naturally. To achieve this it is important to design the character first. In this work the character did not have to be designed from scratch, but information about a real person was collected.

Most of the participants of the expert reviews got to know Jane pretty well during playing the 'Do I Know You?' game, even considering the short time they chatted with her. Although the 'Do I Know You?' game was interesting for most participants of the expert reviews, some wrote that they were missing some variability in the game referring to the chat options. A reason for this is that for the prototype the input keyword options were static. If the game was played a second time, the possible input keywords are still the same as in the first game. For future work it would be necessary to add variability to the input keyword options, thus the player gets more options to influence the course of the conversation. This would require to extend the knowledge database and add more stimulus/ response pairs to it and as described in section 'Chatbot Development' in Table 5.1. Input keyword options offered to the player would differ depending on what input keyword options the player has chosen. Thus the player could influence the course

of the conversation.

Furthermore in a future version of the game it would be nice to be able to talk with different persons. In this way the attention of the players might be prolonged and it gives also the possibility to show chatbots, which represent persons with different subtypes of dementia. Even though, as mentioned in the chapter dementia (cf. chapter 2), the different subtypes of dementia are sometimes indistinguishable without neuroimaging.

To increase the variability in the game also video and audio files could be added to the documents. Furthermore it would be desirable to give the player the opportunity to listen to Jane by letting her speak the sentences rather than only display them in textual form within a speech bubble.

The expert reviews have shown, that the minigames were appreciated as a variety to the game play. For future work it would be certainly possible to make them even better by fixing visual bugs like text, which does not fit in its surrounding box, and giving the players the possibility to quit the minigames if wanted. Furthermore more different minigames would add more variety to the gameplay.

Another issue mentioned in the expert reviews was the graphical user interface. For a final version of the game it would be necessary to redesign it to give it a warmer and more attractive look. Also the different parts of the game should have a consistent look.

The 'Do I Know You?' game project was an interesting opportunity to do research on the potentials of chatbots to transport knowledge about the symptoms of dementia. And - as a matter of fact - the prototype of the 'Do I Know You?' game has shown that there is a great potential in transporting knowledge about the symptoms of dementia with a chatbot.

Bibliography

- [1] ALICE A.I. FOUNDATION. Alicebot <http://www.alicebot.org/>. Accessed: 03-20-2014.
- [2] Sharon Ash, Corey McMillan, Rachel G Gross, Philip Cook, Delani Gunawardena, Brianna Morgan, Ashley Boller, Andrew Siderowf, and Murray Grossman. Impairments of speech fluency in Lewy body spectrum disorder., journal = *Brain and language*, volume = 120, pages = 290–302, year = 2012.
- [3] Silvia Bagnoli, Ylenia Failli, Irene Piaceri, Valentina Rinnoci, Valentina Bessi, Andrea Tedde, Benedetta Nacmias, and Sandro Sorbi. Suitability of neuropsychological tests in patients with vascular dementia (VaD)., journal = *Journal of the neurological sciences*, volume = 322, pages = 41–5, year = 2012.
- [4] Almuth Berg, Katharina Sadowski, Melanie Beyrodt, Stephanie Hanns, Markus Zimmermann, Gero Langer, Christiane Becker, and L. Snoezelen, structured reminiscence therapy and 10-minutes activation in long term care residents with dementia (WISDE): study protocol of a cluster randomized controlled trial. *BMC geriatrics*, 10:5, 2010.
- [5] Cordula Boden, Jessika Fischer, Kathrin Herbig, and Ulrike Spierling. Citizentalk: Application of chatbot infotainment to e-democracy. In *Technologies for Interactive Digital Storytelling and Entertainment*. Springer Berlin Heidelberg, Deutschland, 2006.
- [6] Heinrich Hoffer (Alters und Sozialforscher Projektinitiator) Ovos media ÖPIA Plansinn TU Wien Caritas Wien, Fh Campus Wien. <http://lebensnetz.at/>. Accessed: 2014-28-05.
- [7] Maria Cotelli, Rosa Manenti, and Orazio Zanetti. Reminiscence therapy in dementia: a review. *Maturitas*, 72:203–5, 2012.
- [8] Dr Maëlenn Guerchet, Dr Matthew Prina, and Prof. Martin Prince. *Policy Brief for Heads of Government: The Global Impact of Dementia 2013–2050*. Alzheimer’s Disease International (ADI), London, December 2013.

- [9] S. J. du Preez, M. Lall, and S. Sinha. An intelligent web-based voice chat bot. In *IEEE EUROCON 2009*, pages 386–391. IEEE, 2009.
- [10] Lorraine Hopping Egan. <http://www.hoppingfun.com/>. Accessed: 2014-18-05.
- [11] Ubisoft Entertainment. Assassin’s creed ii. <http://assassinscreed.ubi.com/en-us/games/assassins-creed-2/index.aspx>. Accessed: 2014-18-05.
- [12] Förstl Hans and Wallesch Claus-Werner. *Demenzen*. Thieme, Stuttgart [u.a.], 2., aktual edition, 2012.
- [13] S Ghose and J J Barua. Toward the implementation of a topic specific dialogue based natural language chatbot as an undergraduate advisor. In *Informatics, Electronics Vision (ICIEV), 2013 International Conference on*, pages 1–5, 2013.
- [14] Murray Grossman, Brigitte Stemmer, and Harry A. Whitaker. Language in dementia. In *Handbook of the Neuroscience of Language*, pages 279–288. Elsevier, 2008.
- [15] Emanuela Haller and Traian Rebedea. Designing a Chat-bot that Simulates an Historical Figure, booktitle = 19th International Conference on Control Systems and Computer Science, pages = 582–589, publisher = IEEE, year = 2013.
- [16] Tasharen Entertainment Inc. http://www.tasharen.com/?page_id=140. Accessed: 2014-16-05.
- [17] Hugh Loebner. Loebner Prize Homepage <http://www.loebner.net/Prizef/loebner-prize.html>. Accessed: 03-20-2014.
- [18] R. P. Mahapatra, Naresh Sharma, Aakash Trivedi, and Chitransh Aman. Adding interactive interface to E-Government systems using AIML based chatterbots. In *2012 CSI Sixth International Conference on Software Engineering (CONSEG)*, pages 1–6. IEEE, 2012.
- [19] Lotte Meteyard, Emma Quain, and Karalyn Patterson. Ever decreasing circles: Speech production in semantic dementia, journal = Cortex, year = 2013.
- [20] Fernando A. Mikic, Juan C. Burguillo, Martin Llamas, Daniel A. Rodriguez, and Eduardo Rodriguez. CHARLIE: An AIML-based chatterbot which works as an interface among INES and humans. In *2009 EAEEIE Annual Conference*, pages 1–6. IEEE, 2009.
- [21] M. Niranjan, M. S. Saipreethy, and T. Gireesh Kumar. An intelligent question answering conversational agent using naive bayesian classifier. In *2012 IEEE International Conference on Technology Enhanced Education (ICTEE)*, pages 1–5. IEEE, 2012.

- [22] Alzheimer's Association National Office. What is Alzheimer http://www.alz.org/alzheimers_disease_what_is_alzheimers.asp. Accessed: 01.02.2014.
- [23] Okumura Yumiko; Tanimukai. Effects of short-term reminiscence therapy on elderly with dementia: A comparison with everyday conversation approaches. *Psychogeriatrics*, Vol.8(3):pp.124–133, 2008.
- [24] SM Rodrigo and JGF Abraham. Development and Implementation of a Chat Bot in a Social Network, booktitle = Information Technology: New Generations (ITNG), 2012 Ninth International Conference on, pages = 751–755, year = 2012, address = Las Vegas, NV.
- [25] Marc Rousseaux, Amandine Sève, Marion Vallet, Florence Pasquier, and Marie Anne Mackowiak-Cordoliani. An analysis of communication in conversation in patients with dementia. *Neuropsychologia*, 48(13):3884–3890, 2010.
- [26] Ulrike Spierling. 'Killer Phrases': Design Steps for a Game with Digital Role-Playing Agents. In *Transactions on Edutainment I*, pages pp 150–161. Springer Berlin Heidelberg, Berlin, Heidelberg, 2008.
- [27] Larry R. Squire, S. Kemper, and L.J.P. Altmann. Dementia and Language. In *Encyclopedia of Neuroscience*, pages 409–414. Elsevier Academic Press, Waltham, Massachusetts, 2009.
- [28] Unity Technologies. <https://unity3d.com/unity>. Accessed: 2014-16-05.
- [29] Nicholas Tollervey. <http://sourceforge.net/p/aimlbot/code/head/tree/tags/2.0/aimlbot/aimlbot/>. Accessed: 2014-16-05.
- [30] A.M. Turing. Computing Machinery and Intelligence, journal = MIND A QUARTERLY REVIEW OF PSYCHOLOGY AND PHILOSOPHY, volume = VOL. LIX. , pages = 433–460, year = 1950.
- [31] Miki Ueno, Naoki Mori, and Keinosuke Matsumoto. On novel chatterbot system by means of web information. In *Eighth International Conference on Fuzzy Systems and Knowledge Discovery (FSKD)*, pages 1391–1395. IEEE, 2011.
- [32] Freie Universität Berlin Universität Leipzig and OpenLink Software. <http://wiki.dbpedia.org>. Accessed: 2014-18-05.
- [33] Elina Vuorinen, Matti Laine, and Juha Rinne Pulssin. Common Pattern of Language Impairment in Vascular Dementia and in Alzheimer Disease., journal = Alzheimer Disease and Associated Disorders, volume = 14, pages = 81–86, year = 2000.

- [34] Jing-Jy Wang. Group reminiscence therapy for cognitive and affective function of demented elderly in Taiwan., journal = *International journal of geriatric psychiatry*, volume = 22, pages = 1235–40, year = 2007.
- [35] Robert T Woods, Errollyn Bruce, Rhiannon T Edwards, Barry Hounsome, John Keady, Esme D Moniz-Cook, Martin Orrell, and Ian T Russell. Reminiscence groups for people with dementia and their family carers: pragmatic eight-centre randomised trial of joint reminiscence and maintenance versus usual treatment: a protocol. *Trials*, 10:64, 2009.
- [36] World Health Organization and Alzheimer’s Disease International. *Dementia: a public health priority*. WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland (tel.: +41 22 791 3264; fax: +41 22 791 4857; e-mail: bookorders@who.int, 2012.
- [37] OOSAWA M. ITO S. & YAMAGUCHI H. YAMAGAMI, T. Effect of activity reminiscence therapy as brain-activating rehabilitation for elderly people with and without dementia. *Psychogeriatrics*, 7:69–75, 2007.

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Questionnaire

A.1 Do I Know You? Game

The 'Do I Know You?' game prototype was developed by Sebastian Czekierski-Werner and Daniela Ramsauer as part of their master thesis on raising awareness of dementia with serious games. The purpose of the game is for players to develop empathy and an understanding for people with memory loss.

In order to see if we achieved our goal, we would be very interested in hearing what you think of our prototype and we hope to gain valuable feedback on things we need to work on or change and how we can provide a better experience. After playing the game, please answer following questions:

What characterizes Jane's speech?

What do you know about Jane's life?

How well do you know Jane?

What happens to Jane, if she blurs out?

How did you like the interaction with the Janechatbot?

What are the images in the inventory for?

How interesting was the game for you?

How enjoyable was the game for you?

How did you like the mini games?

What would you change about the game?

Did you learn anything new about dementia you didn't know before?

Have you ever known anyone with dementia?

Additional Remarks, Comments:

Expert Reviews

B.1 Answers to the Questionnaire

What characterizes Jane's speech?

1. When she speaks she always tells stories from her past.
2. A little bit shy
3. Do you mean the wrong spelled words? I think that's because of the dementia? The sentences she speaks are also quite short.
4. She seems to jump between topics. She uses elaborate sentences, but suddenly can't remember simple words. It seems she loses track of what we talked about, when there are too long gaps in the communication.
5. I never heard her speak.
6. Lack of expression, she forgets words.
7. Jane's missing some words and/or doesn't know how to correctly spell them. Therefore she's stuttering and rephrasing her words, which can be hard to understand.
8. She's got some serious speech problems like stuttering, maybe it's one side effect of dementia (I'm not very familiar with this topic). She's describing her past very precisely.
9. Jane does remember the meaning of words and knows how to use them, but sometimes forgets how to spell them properly. Early onset of semantic dementia?
10. She forgets words sometimes. She talks about the old time, she mixes up stuff.
11. Sometimes she forgets words and wants to paraphrase them but forgets those too. Then a minigame is started where you have to guess the word.
12. No focus on topic and just wanted to continue talking!
13. She really likes to talk about her experiences in Life and is happy to share them. She is very convinced about what she is saying. So I think she knows about her condition

but maybe doesn't understand how serious it is.

14. She's often referring to past events that seemed to have an influence to her life. She's uncertain about some words and confuses them. Also, she reveals a lot of personal information to a stranger.

15. Forgets words, likes to tell stories of her life, does not ask questions

16. Disconnected sentences, a few words were not understandable. But overall she was clearly understandable

17. Often switches between different contexts and topics; can't remember words; has some topics that help her remember related things; switches letters;

18. She sometimes loses focus or does not know where/when she is.

19. I didn't have much time to speak to her. I started the game by carefully exploring all the documents she gave me. When I was finished I had an info text at my phone about the New York Times (?) and didn't know what I should do with this information. When I finally wanted to speak to her the given answers didn't make any sense. We hardly had any time to talk (I think it were only three sentences) and then the game was already over. I didn't notice anything about her speech.

20. I would say she speaks rather clearly for a person suffering dementia

21. She stutters at some words and forgot how to spell them

22. stuttering

23. She seems to forget some simple words, but she can say what she means with different words. Also, I had the feeling that she mixes up what was happening and what is happening in the present.

What do you know about Jane's life?

1. She attended college.

2. Her first job was at Henry Luce's. She lives in Brooklyn, New York, Orange Street. She was born on 27th November. She has no brother and no sister. She lives in Brooklyn. Her grandmother was 86 years old when she died. Her father was a photographer. The names of her parents were Bill and Olga and her favorite city is Prague.!

3. I know a lot of different facts but it was quite hard to keep the big picture of her life because of so much text. But during the game I learned a lot about her life.

4. She worked at a radio station and at a magazine. She always worked hard, but her efforts weren't appreciated as much as she would like – she often had to do secretary jobs, although she was much more qualified. She had two cats, had no siblings and her parents were abroad a lot (I think).

5. She is 86 years old. She has problems with pronouncing some words. She lives in Orange street, she has a cat. She came to celebrate her birthday with her housekeeper and cook

6. Some facts about her working life, her journeys, parents, ...
7. She is talking mainly about the past and gives a lot of information about the past – about her family, her jobs, and so on... Also she gives very detailed and specific information about events and things that happened.
8. She had some pets, she feels like home where ever cats appear, she was a researcher, she has a housekeeper Jena, ...
9. Age 86, worked at CBS and the New Yorker, likes cats, parents (father was called Bill) were working a lot, thus no siblings.
10. She worked at Henry Luce as a researcher, but she did more of organize parties (10h/day?) than she did actual research. She has a housekeeper (warden?) named Jane. And she doesn't really mind giving strangers her papers... She wouldn't tell me her age, but she told me that she was born in 1927. No siblings. Her grandmother died in 1945. She was born in Columbia "distract" [sic!]. She lives at "Orange Street". Apparently her favorite traveling goals were in Europe. (Austria, Germany, Italy) But now she can't afford to travel anymore. And a lot of other stuff..
11. She is an older woman (I think she said she's 86 years old) with two cats. She worked a couple (4?) of different jobs. The first one was at a radio station; the second was in research where she mostly had to teach other people. She's an only child. She often says she hasn't talked to her parents in a while, but I suspect they are dead already and she can't remember due to her dementia. Her Father once built a cottage on Fire Island. She also said she worked as a spy for the CIA once.
12. She is 86! Used to travel a lot, worked in a newspaper agency. She loved pets and has already two cats.
13. She is retired. Was working as a Journalist/for a TV Station. Her father was a successful businessman. Went to school in Columbia, Washington. She loves cats
14. She was working as a researcher at CBS, but I couldn't figure any details and left some questions. However, she didn't enjoy working in that position. Her parents had a hard time raising her and she likes cats.
15. Worked at CBS, liked sports at High-school, wanted to become a writer, loves cats, has a cat named Cinderella, has a cat which is grey-striped and one which is spotted like a cow, was not allowed to go out in High-school only as a debutant, liked to listen to operas (especially Italian operas as they the most emotional ones), likes Jazz
16. She worked for CBS as a researcher. She liked to you out with her fellow journalists. She had a cat. She lives in New York. She liked to travel.
17. Worked at CBS, likes European cities, has no money for travelling, often thinks on her parents that are likely dead but does not know, was good looking in early days; studied history
18. She did work for a newspaper, but got offered a job by the CIA. Her Father was a teacher. She grew up in Washington, was in Italy when she was younger and lives in New York now. She has no siblings.

19. According to her documents she used to work as a researcher in the past. But since she was born in 1927 she must be in retirement by now. She needs a wheelchair and glasses. She likes cats and has some of them at home.
20. She worked as a researcher, went to elementary school in columbia. Has cats. Was enthusiastic when entering a new job.
21. When I met her, she came here to celebrate her birthday. She forgets some stuff, but then second time she remembers them again. (See visited cities, she didn't mention vienna first time) She was raised in Columbia and loves cats. She was born in 1927.
22. repeatedly went to Europe, not always sure, an document that she's a researcher
23. I do know things about her cats, about some of her different jobs in which she was working really hard. I also know about her bachelor degree in history. She also told me about a job at the CIA, but I don't believe her. Then I also learned some things about her family and about her cats, as well as her holiday trips.

How well do you know Jane?

1. I know stuff about her past put I don't know Jane very well.
2. Not very well. But she told the most important facts about her life.!
3. I think you really be able to understand what kind of person she is. The game simulates a conversation in real life really good.
4. I seem to only know the surface a bit. Mots of the time when I tried to find out more details about her, she switched topics, so I only gasped a little of her personality.
5. I know her 10 minutes.
6. Quite well regarding the aspect of time.
7. This is quite a difficult question. In general Jane gives a lot of information about her life, which assembles a good picture of her personality. But information about her near past is completely missing.
8. Information about family, her jobs and if she liked them, about her pets, . . .
9. Sure there is much more to learn about her, at this point i am not sure if she is a real life person or just a fictional character. I was rather surprised that the game ended so spontaneously.
10. I have no idea.
11. Not all that well. This stems from three different reasons. First, whenever her dementia strikes there's a distinct possibility of me remembering false information. Second, the things I ask and the things she answers aren't always related. For example when asked about her age she says that her grandmother died at age 86 (or was it 87?). Third, the options that were offered often were about things I didn't care about, like the boss she had on her first job.
12. Not that much! Just know about her as she said about herself! (above info)

13. A bit. I got to know quite some details about her life but these were just glimpses and sometimes a bit out of context.
14. She revealed many details of her life but there's still some distance. The fact that the game confronts you with more or less static text doesn't enforce a strong relationship.
15. Not very well her, but some things about her life and history
16. Hard to say. You grow a certain empathy mainly because of the pictures in the inventory. But its really hard to grow a relationship to her because the displayed image of her. A image of old women with a gigantic speech bubble just look strange and doesn't give a feeling of atmosphere.
17. Not really well, just some key facts of her life; but also some more personal facts like her kittens
18. Reading a few loose facts from a persons life does not make me know her at all.
19. Not well at all. I only read some basic information in her documents and know about her cats because of the ending. I didn't get anything out of our conversation, because it was too short and after a short time period the possible answers alwas changed to something that didn't make any sense.
20. Not well I guess
21. Very, because she was telling me a lot of her life.
22. Not at all, I got some informations from ger but i am not sure if I did understand her correctly or if she's even telling the truth
23. I think she did tell me much about her life, but more about her work than her free-time.

What happens to Jane, if she blurs out?

1. Then she forgets a word and a mini game opens.
2. She uses other words with the same ore similar meaning.!
3. That's something I didn't recognize the first time I played the game. Even now it's not really clear to me what happens.
4. First I didn't realize any connection between my actions in game and what happened to her image (especially because I went to the inventory straight away, and she faded while I was there, and afterwards I was confused a little bit). After the half of the first game (I played a second round), It occurred to me, that that's when she looses track of the conversation we had, because at the same time when she blurred, the conversation options went back to earlier "story-branches".
5. She cannot pronounce some words or she cannot give them proper name.
6. Lack of expression, she forgets words and confuses past with present.
7. If Jane blurs out, the subject (and options) of the conversation changes to something else. Also additional information becomes available on the phone. [However, it took

me a while to figure out that “blurs out” is literally blurring out of Janes image]

8. She remembers things when I’m showing pictures of her past to her.

9. I don’t understand the question.

10. I’m not sure, but when Jane “blurs out” (the color of the image fades, and there’s a shiny ring around it?), there seems to be a new “state-the-fact” message on the cell-phone. For whatever reason. I can’t tell at which context these messages appear, nor why or when they are disappearing again (seems to be timed).

11. I didn’t notice while playing the game, but now that you mention it it probably signals that her dementia is acting up and her answers aren’t accurate during this time. To clarify, I did notice that sometimes her image gets a sepia filter but it seemed random and unimportant. She still had problems remembering some words even when the sepia filter wasn’t in place.

12. Probably will be lost.

13. She seems very confused because she knows what she wants to say but doesn’t know HOW.

14. I didn’t notice that.

15. She mixes up letters

16. I don’t understand what is meant by that.

17. Cant remember words

18. She forgets how to pronounce words and only speaks words that sound alike or mean something partially similar.

19. She didn’t blur out when I first played the game.I played it a second time to answer this question (and a few of the following), but I didn’t notice anything that generally happened to her. I think with “blur out” you mean the change to mini game mode. This mostly came up, when she had troubles finding the right words, but also when she gave me a photograph to repair, which are quite different things.

20. Didn’t happen? Or do you mean the end of the game? At the end her nurse is coming back home.

21. She stutters

22. changing color

23. I didn’t look at that at first, but now that I read this question. I actually didn’t pay attention about that too much, so I can’t tell you.

How did you like the interaction with the Jane chatbot?

1. At the first-time playing the game I didn’t know what to do and was confused about what to do with the Inventory and the Smartphone till the game said it is over. The next few times playing the game was a little more interesting cause I found out how to get some information about Jane and got to play some mini games. The controls in the mini

- games felt a little bit slow in reaction. All in all it felt weird playing this game.
2. At the beginning it was a little bit confusing because the questions for Jane changed too quickly. But after a few minutes and some interactions it worked very well.!
 3. There were a few bugs in the game. The chat options changed after a few seconds without any user interaction. So I wasn't able to choose the button I wanted to. But anyway, it's a nice idea.
 4. I first disliked how I was forced to be fast with next questions to not "lose the conversation", but felt like this is an interesting little insight how a conversation with someone with dementia is like. See my answer to the question "How interesting was the game for you" for details.
 5. Did not understand it.
 6. Sometimes incoherent and a few of the selectable sentences are not easy to understand (too short, too little information).
 7. It's kind of awkward – the time-based (?) changes in conversation options makes it hard to get into a conversation flow. Sometimes you want to know more about a topic and it's suddenly gone.
 8. It's too static. I wish there were more options to make this unidirectional communication more thrilling.
 9. Was ok, not really feeling like having a talk with a real life person.
 10. To be honest, the game was heavily bugged, I wasn't really able to play it properly, not on Windows 8 nor Mac OS X. For instance the topics I could talk about with Jane would change randomly (seemed as if they would change in a certain time interval - why?). Also, just because she "spells" words wrong (which I am wondering - how can I "hear" her spelling words wrong when she's talking to me) why do I have to reassemble the words letter by letter? (e.g. "celebrat" - "celebrate")
 11. This is done pretty well. I didn't really have a problem with answers repeating themselves in my first game. In my second game the options given were often about things I already knew.
 12. It was a bit confusing for me! Took time to understand what is going on there!
 13. It was very confusing that the possible topics were changing automatically.
 14. I liked the "adventurous" touch of raising questions and digging into more details. However, it was difficult to uncover the supposed interaction. The chat options were formulated as keywords instead of full questions and I noticed that they changed from time to time (without a reason).
 15. Very well, allows to learn more about her life
 16. Very confusing. At first I did not understand what the pressable buttons meant I still don't quite understand what their purpose was. Usually in a scenario where you are confronted with a statement or question you assume that the available options would be some kind of answer to the question. But in many cases the clickable options had nothing to do with what Jane was saying. To me it was not clear at the beginning, that I would ask

her something about one of the things that were written on the buttons.

17. Not really – I often do not know what the words on the buttons should mean in the context.

18. I did not perceive it as a chat-like interaction. Pressing a button fires a quote. Having three buttons limits the interaction to pressing a button at random and reading the quote.

19. I didn't like it at all. When I first played the game, the switching of the answers seemed like a bug for me and I didn't realize at all that this was intentional. Even when I had a seemingly correct set of given answers I often didn't exactly know what one of the buttons means or why I should ask this. For example, I once had to option "Jena" even though this name hasn't been mentioned before and I have no idea what the answer "home" is meant to be when the question was something like "can you help me get home". Interacting with the chatbot mostly seemed completely random.

20. Somehow complicated; I didn't understand why the three choices are changing if you wait for some time.

21. I didn't like it. I would rather have real question or answer possibilities, and not only few words.

22. irritating that my chat options changed over time

23. I played the game 2 times. The first time, I at first had a look at the documents that she gave me. In the meanwhile the conversation options were changing I think. Therefore I think the conversation was then a bit misleading for me and I got a bit confused. The second time, I was concentrating only on the conversation options and went through a lot of them. This time it worked better for me and it was easier for me to follow Jane in the conversation.

What are the images in the inventory for?

1. The Pictures remember Jane of situations in her past. I can use them to start a conversation about things that she remembers when I show her a picture.

2. You can show them to Jane and gather additional informations from her.!

3. To show Jane some things from her life so that she can remember different things.

4. In the first round I played they confused me a little bit, because the chat jumped in the middle of a conversation – it seemed irrelevant to what pictures I showed Jane. It was unclear if that was a bug or intended. But the pictures seem to be there to trigger memories of Jane that gives us something to talk about. They seemed to be important memories of hers.

5. For triggering some memories.

6. To show them to Jane, to stimulate memory (memory aid)?

7. Basically those images can be shown to Jane in order to get information about the pictures. I think it might be even better to make it possible to change topics and give the

player conversation options linked to the shown image. If I show Jane a image and she tells me that it was taken the time she went to college, I want be able to ask her about this time.

8. For remembering Jane about her past and then she's telling you something about it.

9. For me they are vital to get a better impression of the person i am dealing with. Also, you can show them to Jane and she will tell you about them.

10. I think they are meant to get to know Jane better / talk to her about them. Problem is, this feature is also bugged. There are three buttons when you select an image. "Cancel", "Show Image" and "Show Jane". Well, as soon as you SELECT one of the items in the inventory, Jane will start to talk about this topic IMMEDIATELY (before you have the chance to select one of the three options mentioned, which will pop up AFTER you select an item). This greatly impacted my experience of the game, because I wasn't able to look at the items at will, because (after some time) I recognized, that my previous conversation with Jane was just wiped away. Also, if Jane doesn't have some kind of magical superpower, how is she able to know which picture/item I am going to look at by simply selecting it?

11. Some images get her to comment while other images just create a blank response. The main purpose seems to be the minigames you have to solve in order to get them.

12. Memorial photos

13. They gave the game a more personal touch and were drawing a different image of Jane in conctrary to the old, dement old lady we see in the beginning.

14. The inventory contained Jane's personal belongings. There was an ID and some photos. If you showed something to her, it helped her to remember some details.

15. To help Jane to find her memories.

16. As far as I have understood i was able to show her the pictures in order to get some kind of reaction. She might remember something. But that inventory never felt like a integral part of the game. It was there but i was never felt the need to do something with the items in the inventory.

17. To show jane, so she could remember something

18. Recalling memories.

19. I don't know. There is a possibility to show them to Jane, but I don't see any reason to do this, when my goal is just to bring her home. I don't see how old photographs of her and old documents are helpful in this task.

20. To get more topics to speak about with Jane (stimulate her long-term memory).

21. To show them to her. They let her remember a few things.

22. to read and eventually show to Jane

23. They are snapshots of Jane's life. I suppose, they help her to remember what her life was about. It also gives strangers some topics to talk about.

How interesting was the game for you?

1. At the moment when I found out how to get information about Jane it started to get more interesting but the peak of interest was reached within a short time.
2. The history of Jane was a little bit boring. Maybe something like „based on a true story“ or „based on a real person“ would be good for the story and the feeling of the user.!
3. It's definitely a nice idea because in real life it's maybe kind of hard or weird for anyone to talk to people who suffering from dementia. And in this game it's really normal and interesting to talk to Jane. Of course you have to read a lot – that could be a little boring after a bit of time.
4. It was a bit confusing (especially the first round), and it was a bit frustrating to be thrown out of a conversation that started to get interesting – I guess that's part of the purpose of the game though :) It occurred to me, that when I'm quicker at asking questions, it's less likely that Jane loses track of what we talked about, which felt unnecessarily stressful first, but at the end it managed to build a tension, because I had to be quick when reading, losing some details, but I could get deeper into the conversation instead, so it was an interesting tradeoff (quantity vs. quality). The inventory was more confusing than helpful/interesting, and I almost entirely ignored it in the second round I played.
5. Very interesting concept, but not challenging.
6. 6/10 points
7. The topic itself, raising awareness of dementia, is very interesting. However, I'm not sure that there are good ways to combine it with gameplay or reflect something like dementia by gameplay itself.
8. Not very interesting, because it wasn't my preferred game genre and I'm not a big fan of point and click adventures. The end of the game came up too suddenly. It's also possible to solve the game without reading the text, therefore I would suggest to ask the player questions about her past during the game session.
9. It was rather interesting, in the beginning I thought it is a game targeted at people suffering from dementia to train them to regain some of their cognitive power.
10. As I stated earlier, unfortunately I wasn't able to play the game properly, or the game's intention is to make the gamer feel him/herself demented, which worked quite good. Honestly, I really felt like I had no idea what was going on.
11. Not really interesting. To be honest, if this hadn't been an assignment I wouldn't have played the game. But this isn't necessarily your fault. Any game where the goal is to get to know a character has the same problem: I'm just not really interested in other people.
12. C+ , I did not reach to the end of the game and I could not understand what would be the end of that.
13. I was surprised by the perspective. Some aspects of dementia could be presented very well.

14. I enjoyed the explorative parts of the game, where you could have a look at the inventory items and ask Jane questions. The actual game parts, where you had to guess the right word and hit the letters were not very challenging. I could guess all words at the beginning and therefore it was less exciting to hit the letters. I guess it would have been fun if it makes a difference how/when you ask certain questions.
15. Nice to play and interesting, since it is not a typical game.
16. Hard to say. I was interested in the game while playing it. But primarily because I wanted to understand what was going on and to figure out how I can achieve the goal.
17. Not really interesting, repeating
18. Not so much. I did not see any goal nor incentive to play along. For me it was, as mentioned above, clicking buttons at random and being confronted with odd minigames.
19. Honestly I'm still not sure if I understand the intention your game. I expected Jane to be the one with dementia, but as I understand it now it's me who has problems memorizing what we were talking about. That was an interesting twist, but it worked only because I knew about the dementia setting before I even started the game. Playing the game as someone without this information I would only have thought it to be extremely buggy.
20. 3/5
21. Not really. I didn't like the interface, and the chatbot. As I mentioned before, I wished that there were full sentences and not only words. At the beginning of the game, when the lady asks "Excuse me, could you help me to get home?", you get the answer possibilities: "home" "call taxi" "here alone", and I was really confused and had no idea what I should do. It didn't feel like a conversation. Also I had no idea what some answer possibilities should mean, like "here alone", what should that mean? : 1) I am here alone with you, and will eat all your bananas! 2)-Are you all alone? So I can eat all your bananas?
22. I was curious at the beginning but I lost interest over time, because I had the impression that I could not influence the flow of the discussion.
23. It was not too interesting for me, but it was nice to have conversation options to choose from. The most interesting thing for me were the pictures and what Jane had to say about them.

How enjoyable was the game for you?

1. It felt some kind of weird playing the game.
2. It was okay. Not the best game I ever played but I played worse.!
3. The bug with the chat buttons was very disappointing, so it was very hard to enjoy the game on the prototype.

4. I have mixed feelings for the “story”/chat part of the game (see last question). What was really interesting about the game was that I felt a bit like having dementia myself. . . too long gaps in the conversation made it impossible for me to ask further details about what we were talking about. This kind of put ME in the role of having dementia instead of Jane; also the letter juggling mini game (and a little bit the cube game) felt like this too.
5. Not much, unfortunately, did not intuitively understand what was I supposed to do.
6. 4/10 points
7. Same reason as before: It is quite hard to develop enjoyable gameplay that reflects dementia. Currently the game is in a state where it is hard to tell if things that happen are actually planned that way or simply buggy. But I also have to admit, that serious games are not those kind of games I use to play.
8. Well, it was ok. There are better serious games out there, which are serious and exciting at the same time (Re-Mission f.i.). I’m missing the excitement part in this prototype, the seriousness is well done.
9. Not very, but i guess that is not the point of the game
10. I could imagine the game to be fun and informative, but as I mentioned, I was busy figuring out why certain things were happening in the game.
11. Not really enjoyable. It was a boring reading exercise.
12. The best part was the pictures puzzle.
13. It was interesting but to be honest not very exciting.
14. At the beginning it was motivating to uncover the inventory, ask some questions but it this gets repetitive.
15. Takes a bit to orientate in the game, but nice to play.
16. Unfortunately not very. At the beginning you get confronted with a splash screen that tells you something about the scenario. And then you are suddenly in the game without any explanation about the game mechanics. So the first few attempts you try to figure out how the game actually works and how you can achieve your goal. That is problem because you have a feeling like you could mess something up because you might take a wrong action, simply because you don’t understand how the game works.
17. It didn’t look like it would come to an end, so it was pretty soon annoying – no end in sight; did not even know if there would be an end. . .
18. As I could not identify the purpose/goal of the game, I did not really grasp what it was that I should play towards. Accomplishment/Reward scenarios work for me with games. I did miss that completely.
19. As said before in my first try I thought the game was buggy, I hardly had the opportunity to interact with Jane and I still don’t understand the conclusion. An important aspect of a good game is a goal and the way to reach this goal, but I didn’t see anything of that in this game. As I understand it, my goal is to bring Jane home, but then we speak about how old she is, where she worked, about her parents (why should we even

... and I don't see how this brings me any closer to my goal. I don't understand what the phone is for. I don't understand what I need the inventory for. I have to admit: I don't understand the game at all. Also, the interaction was not very intuitive since I had to use the keyboard for some minigames even though the main is played only by using the mouse.

20. 1/5

21. Same as above.

22. It was interesting with well chosen minigames

23. At first I didn't know what to do, so I had a look at the documents. I enjoyed combining the pictures with the statements of Jane more than the simple conversation on the main page.

How did you like the mini games?

1. The one where I had to click the letters in correct order was funny. The one where I had to rotate the cubes had a way to slow rotation-animation, all the time I had to wait for the cube to finish its rotation.

2. It was really cool and challenging to find the right word.!

3. I liked it! Anyway, there could be more different types of it in the game.

4. I most liked the cube puzzle game, because it twisted my brain a little. The rotate the image parts puzzle was the least enjoyable, also it seemed unrelated to the "main game". The guess the word puzzle was also nice, but it (as the other games) seemed to have no influence on the main chat. Something like that Jane told me more details when I helped putting a word together fast and she could focus more on the story instead of the missing word would be nice. They seem to demonstrate different aspects of what a person with dementia suffers from.

5. -

6. Quite easy, just the one with the cubes/image puzzle was not clear to understand at the beginning. I'd say, it'd be more fascinating, if the player can lose not just win.

7. After a few seconds it is clear how the different mini games work - from this moment on it's not really challenging and therefore rather time-stretching than improving the game. Maybe more different mini game types could freshen it up.

8. They are easy to understand and not too hard, which is a good point in the game. Serious games shouldn't be as hard as Super Hexagon, therefore they are very suitable for that game.

9. The controls of the rotating cubes game was very counter intuitive to me. There was a bug with the first game where you had to get the spelling right, it would not take any input.

10. The spelling minigame kind of feels like it tries to teach me how to spell words

correctly. The minigame where you had to turn some circles to form a picture was ok. I saw another minigame with 9 blocks, but I wasn't able to play it, 'cause it was simply broken. Also, there is a) no way to fail at those mini games (no wrong letters to be picked for example), and b) no way to skip these minigames (after the 7th time spelling "celebrate my birthday", this can be a bit of annoying).

11. They are a nice break from the wall of text the game offers otherwise.

12. The finding words (No) Photo puzzle (Yes)

13. They are not very original.

14. The difficulty level is very low, so it got annoying.

15. They are nice. Letter catching is okay, finding the picture was more fun

16. The game with the flying letters was annoying. The game with the circular image was ok but very easy. The game with the rotatable cubes was actually quite interesting and fun.

17. There was no challenge in them.

18. The minigames are of that kind that kids play in kindergarden or groundschool. Solving little puzzles or classic "hangman". The third time the "hangman" lettercloud came along I started to get annoyed. Adding no option to escape the minigame is highly problematic. Forcing the user to play along is a no-go for a minigame.

19. In my first try, there were no mini games. I had to play again to see them. I liked the puzzle mini game with the cubes, because there I had to think in three dimensions, which made it much more difficult than the ring puzzle or the word puzzle. These other two puzzles were too easy since there was no time limitation and one could simply try clicking all the letters or turning a ring around until the result fits.

20. the puzzle was nice. word game was rather annoying because the result was obvious on first sign, nevertheless it took a long time to finish

21. I wished that there would have been more of them, they brought some variety to the game. Still the mini games were pretty easy to solve, maybe too easy.

22. I enjoyed the minigames

23. I think they are not necessary. Actually I they were a distraction for me.

What would you change about the game?

1. I would have liked some advice what the Smartphone is for, I was wondering the whole first time playing the game.

2. I would definitely update the interface. It looks a litte bit outdated and gives a odd feeling to the player.!

3. Of course, as often in a prototype, there are several technical issues that have to be fixed. Maybe more different types of mini games would be nice.

4. The first round was confusing, and I think mostly because I went straight into the

inventory. I would let Jane start the conversation and only give photos/ items a little later. First I didn't realize, what the "show jane" option meant, because it jumped back into the main screen and I didn't realize I triggered a response from Jane. I would change it so the two options "view" and "ask Jane about" pop up as I click the image, each having a transition to the caused action.

5. Give it more challenge.

6. More enjoyable mini games and maybe give the cellphone more features? Because right now it displays just a few details/information nothing really important for the game imho.

7. At this point it's hard to tell if some things like the inventory are planned this way or buggy. So there are a lot of things that could be improved or explained better at the beginning (randomly changing subjects, the information shown on the phone, etc.) I also would change the graphical style of the game, the mixture of real pictures, drawings and clunky looking buttons isn't a good combinations – a consistent style would be way better.

8. Bring some dynamics into the game! The mini games are a good starting point for the dynamic factor of your game. Mix some words and let the user bring them into the right order, put in some secrets, do some audios or videos, let the user solve some puzzles (combine things in the inventory to gain new information. . .), and so on.

9. Please proofread the sentences in the game - lots of word order, grammar and spelling mistakes - e.g.: "... as soon as jane saw the cat she was at happy", "career improtant" A complete redesign of the GUI. Including real speech would be nice.

10. Removing the Bugs. I also didn't really understand the purpose of the cell-phone at first. I suppose it is there to state facts which Jane might be mixing up or provide some background information? Also, if you scroll down to the bottom of a "text-message" on the cell-phone, and later on a shorter message will pop up, you'll see a white screen at first, because the "scroll-state" seems to be saved (you'll have to click at the scrollbar again to see text).

11. Things that you should fix: Some way to restart the game would be nice. Especially when you finish the game. The first time I played I chose a resolution of 1920 x 1200 because that's my monitor's resolution. This resulted in the exit button being outside of the display. Having an exit button within the game would be appreciated. I played the game with two different resolutions and both times the text didn't align very well in the most frequent minigame where you have to click the letters in the right order. Textboxes overlapped and the wandering letters also moved through the textboxes. You should proofread the text. There are quite a lot of grammatical errors. When Jane talks it's not really important because it can just be interpreted as her way of speaking, but the narration should be corrected. When you receive a document there's a bug that you can just continue to choose text options. You still get the document, but you can skip the minigame that way. Other suggestions: My first game ended pretty suddenly when

we arrived at Jane's house and her caretaker came out to get her. I suggest giving some feedback to the player as to how close to her house we are. This can be something simple like her saying she recognises this place and we're getting closer to her home at some point.

12. Add Sounds maybe, more mini games

13. 1)Interesting Mini Games 2)The necessity of finding clues to bring her home would make the game more fun... like this its just a conversation-simulator

14. Personally, I'd concentrate on the explorative elements and leave out the mini game. It's exciting to talk to Jane and maybe it could be a fun game element to get more and more information out of her by asking the right questions. Therefore you would have to "understand" the mind of dement people. If this is already the case in the game, it would require more feedback (What went wrong? Why is she revealing more?).

15. More variable mini games (not always word guessing)

16. To me the main problem is that during the whole game there was no indication about how far i am or how well Im doing. I was not able to understand which questions to ask are the most effective. Choosing a question felt random.

17. Suddenly the game was over and I did not quite understand why. The options for the player should be clear formulated actions like „Ask here what she was working“ or „Ask her about her Pets“ and not just „work“ or „pet“. Simply the word „pet“ has no affordance character. The inventory felt not very useful. I don't feel like it helped me a lot in achieving my goal. I also did not understand why the mobile phone as there or how i can interact with it . Sometimes some kind of information would pop. The information displayed on the smartphone was very long and felt boring. After i've read the information on the phone I was not able how it should help me in achieving my goal. I personally would change the game completely around. I think it would be a much more interesting approach to be in the position of the person who has dementia. The player should solve tasks but only with a limited capacity of time or memory. Users should experience themselves how it feels to not be in control of their own actions.

18. Describe it first. Make a goal. The sentence in which the word in the mini-game occurs nearly not visible to me. It took a few mini-games with letter-clicking until I saw it on top of the playground.

19. GAMEPLAY i. Give the user a goal to work toward. Even if it is just a simple coin-reward system. ii. Let the game come to an end at some point. An accomplished level, mission, part or at least a final text passage that signals the user has seen most an can decide to play again at that point. iii. Give the user some tools to take action. Choosing one out of three buttons is not enough to catch attention. iv. Use full scentences for the interacion-buttons. "Holiday first job" is not something that anyone would say in a conversation. UI v. Kick the smartphone-metaphor out of the UI. It serves no purpose. vi. Avoid cutting/bleeding with the texts. Sometimes the instruction for the minigames is not fully visible, sometimes the textbubble is simply to small for the text. vii. Images

in the inventory do not seem to have the right proportions. viii. That the inventory can be used to further interact with the “chat-bot” is not really clear.

Make more clear what the game actually is about, what the goal is, how you reach it (or why you don't) and why you speak about random topics * Make mini games more appealing with time limits or scores * Make it completely playable with either keyboard or mouse alone * Make it more transparent what actually happens in the conversion, e.g. animate the possible answers when they change so people are able to see that this is a feature and not a bug.

20. It was not really clear what is actually happening. After finishing the game i guess it was a talk with Jane until we arrived at her apartment?

21. I would try to make it more understandable for the user.

22. trying to script/design/implement different discussions with Jane with different endings

23. I would remove the mini games or change them. The mini game with the word guessing was too simple for me and I didn't expect that I have to complete a picture puzzle in a game which is about dementia.

Did you learn anything new about dementia you didn't know before?

1. I didn't really learn something new about dementia, but I think I got a feeling like it must be if I had dementia.

2. No

3. Not really

4. One thing I think I learned is, that people with dementia have problems with visual thinking (that's at least my interpretation of the cube mini-game). Other than that not much, because my grandpa has dementia.

5. No

6. No

7. No

8. If stuttering or restraints in speech is a side effect of it, yes I do.

9. No, a detailed description follows in the next question.

10. That Dementia somehow gives you telepathic superpowers and lets you see in other people's inventory.

11. No

12. That a person who suffers from dementia cannot focus on a topic.

13. Not really

14. No

15. No
16. No
17. That she feels like home when a cat is nearby
18. No
19. No, I didn't learn anything in your game since I'm still not sure what it really was about.
20. I don't think so
21. No
22. No
23. Not really

Have you ever known anyone with dementia?

1. I had a Grandma who had dementia.
2. No
3. No
4. Yes, my grandpa.
5. Yes
6. No
7. Yes
8. No
9. I have done my civil service as a medic and continued volunteering for four years and came to talk to a quite a lot of people suffering from dementia. The severity of the cases varied from forgetting names and words to a complete loss of identity, orientation and perception. My grandmother was suffering from dementia too.
10. Yes
11. My grandma suffers from a severe case of dementia where she doesn't even recognize her own children anymore.
12. No
13. Yes. My Grandma.
14. Yes
15. No
16. Yes, I have a close Family member that suffers from very strong dementia for a some years now.
17. No
18. No
19. No
20. No personally
21. Not personally

22. Yes grandpa
23. Not personally I think. At least I would not have noticed.

Additional Remarks, Comments

1. -
2. -
3. A really nice idea – I think the atmosphere in the game could be a little nicer. The game is about a conversation with an old lady, it's familiar and nice. But the design and the colours are quite cold. Maybe in the future there could be different characters you can talk to.
4. I know this is a student project and the game has a demonstrative purpose, but a bit more polish in the UI work would have been nice – better transitions (like for the inventory as I mentioned above), or that I can't push things in the background unintentionally. Other than that it's definitely an interesting project. I like how the game kind of pushed me in the role of having dementia a bit – if you continue working on the project, enforcing that component more throughout the game would be cool.
5. -
6. -
7. I think if the graphical style gets cleaner and the user gets a bit more information what's going on (maybe as a tutorial), DoI Know You can be a quite interesting game.
8. Some typo mistakes (a / an (f.i. was an executive boss.., wahington (missing s for washington)) and the screen was too small for the text (in the mini games, where you have to complete the word).
9. I think there is another bug with the questions you can select to ask - if i waited for some time they changed (might be intentional too) End screen should not block everything out - make gathered information available to the player there is no way to leave the end screen Sometimes questions repeat themselves (meaning you can ask a question more than once) the design of the user interface is substandard - ok for a prototype, but for the final work of the master thesis disappointing.
10. I did this review after I played this game about 10 times. It was also necessary to play the game several times to figure out why certain things would happen for no obvious reason. The bugs I mentioned would need further testing to be confirmed for 100
11. Also, I can't really understand, what are these things that occasionally fly through the screen (into the inventory?) from left or right? The whole game seems to be time based (popping up of messages, subjects changing). Why? The last time I played, I tried on purpose: I didn't do a thing at all (!), and still text-messages were incoming, and topics were changing from the beginning on. Even Jane was picked up after a certain amount of time – game finished. Also: How can „I“ know about certain topics, if I don't

interact with Jane at all? From the beginning on, text-messages pop up, and topics start to change periodically. I would rather enjoy a game where I can explore new options to talk with Jane about because I asked her about „the right“ topics, not just some random options I can choose from, which will change after some time no matter what. This way the game very quickly ends in some „rapid-random-clicking-to-the-end“ gameplay.

12. I really did not get the point of that smartphone screen. Also most of older people who I saw till now they use just a simple phone with bigger keyboards.

13. Through some polishing I think the game could look nice and have definitive an informational impact.

14. Very interesting topic!

15. -

16. I think it is a very good idea to raise awareness about dementia but I think this is very tough task. Dementia is very serious matter and can be very tough subject for many people. Witnessing how a person changes over the years to somebody who is not recognizable anymore is a horrible thing. Although the game is a „serious game“, I don't think that it captures the seriousness of the topic. The game should really try to transport the feeling of helplessness, anxiety, disorientation. An other remark about the visuals of the game. I understand that this is only a prototype but I do feel like the visual esthetics of the game create no atmosphere. When I've read in Intro that I would be on a bridge in Brooklyn i have expected a dark scenery. But the interface had no visual appeal or speech to it. The game just did not get me on a emotional level. I hope, I was not to harsh with my critique. I wish the best luck with the project.

17. As noted, some more information in the beginning would be cool and to know what is the goal of the game.

18. I apologize for a critique that may sound harsh to you, but I do feel the need to write freely and honestly about what I see. In my eyes the game has a noble idea behind that carries it, but lacks of the necessary concept to keep the users attention. As I already stated above I think that any game needs some kind of mission, however simple it may be. Furthermore, I do not like the UI at all. Fonts, colors and interactions do not create a consistent look-and-feel, which in my opinion is paramount for games or any kind of entertainment media. Textbleeds and cutting should also not occur and can be seen fairly problematic, since the interactions are mainly based on text. The minigames did annoy me, since it is not possible to quit them without quitting the game. The fact that a total of three minigames has to be played repeatedly is something that does not help the gameplay either. On a more technical level I do not see the need to implement such a game with Unity in combination with a UI component. A web-based approach, using JQuery/JQuery UI, would have sufficed for that purpose.

19. If I get it right that changing the possible answers after a short period of time is meant as a simulation of forgetting what we did talk about: I don't think that is a good representation at all. Knowing what people were saying (Jane's text is always shown in

your game) and not being able to give a correct answer is something completely different. I didn't feel like I didn't remember anything, instead I did feel like I couldn't speak properly although I knew exactly what Jane had said.

20. -

21. -

22. Improve the chatbot with different discussion branches, jane could unexpetedly jump from one branch to another. i wouls be interested to see if I can get a specific information out of her (trying to beat her dementia)

23. I think I would have enjoyed a mini game in which I would have to guess, if Jane is speaking the truth or not - so that I would have to decide if a statement is correct or not, based on the information I already have. For example I was very suspicious about her statement that she had worked for the CIA.