

BACHELOR THESIS

CREATING A GOOGLE HOME SYSTEM AGENT TO REDUCE LONELINESS AMONG OLDER

ADULTS

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Abstract

This Graduation Project describes the process of creating an Agent for the Google Home to reduce loneliness among older adults. Social loneliness is a major problem within the elderly community nowadays, their social circle decreases while our society becomes more individualistic. By conducting a literature research, the main reasons for social loneliness were analysed as well as different possibilities and technologies to prevent them. The Google Home can be entirely steered by voice control, a new and innovative phenomenon that is easy in usage. Voice control has the possibilities for using the Google Home system were investigated using an online survey and semi-structured interviews. Based upon these findings, a prototype was designed for the Google Home. The Social Activity Agent stimulates elderly to be more socially active in Enschede by suggesting a variety of activities that can be done within their neighbourhood, reducing their social loneliness.

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1. Introduction

Loneliness is an unpleasant experience, encompassing a lack of certain relationships, which results in a decrease of well-being [1]. Weiss defines loneliness as 'A lack of human intimacy that is experienced by the individual as unpleasant' [2]. There are two types of loneliness: Emotional loneliness and Social loneliness. Emotional loneliness arises when someone misses having a strong intimate relationship, an emotional strong connection with a partner or (best) friend. This form of loneliness can only be resolved when this person takes on a new relationship or bond with a person [2], [3]. In social loneliness, someone misses having relationships with a bigger group of people surrounding oneself, like acquaintances, colleagues, neighbours or people with the same interest. Hence, social isolation is not necessarily negative since time spent by one's self can be enjoyable as well as productive [2], [3]. Social loneliness can only be solved by creating new bonds via for example a work or a sports club.

Loneliness causes suffering to people at any age. This research will focus on older adults, persons from 65 years old and above, addressed in this paper as elderly. The amount of elderly, has been increasing over the past few decades. In 2017, 3.2 million people in the Netherlands were 65 years or older, around 18% of the total Dutch population. It is said that this will increase towards 26% in 2040 [4].

A study conducted by the University of California, San Francisco stated that especially elderly can be a victim of loneliness [5]. In 2016, more than 40% of the elderly between 65 - 74, more than 50% of the elderly between 75 - 84, and more than 60% of the elderly older than 85 were lonely [4]. In general, loneliness frequently results in a decrease in well-being. Causing implications in quality of life, physical and mental health, and mortality [6]. This can for example be in the form of a depression, sleeping problems or disturbed appetite [7]. Latent causes are hospitalization and placement in nursing homes. Pathological consequences can be found in people who develop certain personality and adaptational disorders [7]. This can be in the form of alcohol overconsumption, loss of self-esteem, extreme forms of anxiety, powerlessness and stress [3], [7]. Especially elderly with no children at all or relatives have more difficulty finding joy in their life [2], for them the loss of a relative can be a constant source of grief over many years. This can result in relying very heavily on activities such as watching television and reading to make time pass faster [2]. In a more extreme case when one has a considerable bad health in combination with loneliness, estrangement from society and culture can be an outcome [7]. In numbers, elderly who reported themselves as lonely have a 59% greater risk of decline, and a 45% greater risk of death [6].

So how is the phenomenon 'loneliness' provoked amongst the elderly and which factors need to be taken into consideration? Dahlberg et al. [6] state that factors associated towards loneliness can be divided into 3 different groups.

- 1. Socio-demographic factors
- 2. Social factors
- 3. Health related factors

Among socio-demographic factors one can think of the characteristics of a population. E.g. age, gender, education and income. As already stated before, especially elderly can become the victim of loneliness [5]. According to a survey in both 1982 and 2005 in a Swedish population, almost half of the pensioners often feel lonely. Next to this, images that older people suffer from loneliness are often spread in the media [6]. Loneliness among elderly increases with age, adding to this fact that loneliness is also found more often in women than men [6].

Low socioeconomic status is another demographic fact that needs to be taken into consideration. Education and income can be used as indicators for this status [5]. People with a low income and education are more likely to be lonelier [8]. Hence, there are fewer possibilities for social participation and smaller social networks for these people [6]. Lower education means a lower income; a lower income means less money to spend. Money also plays a role in a way that it makes life for elderly much easier by being able to buy services that allow them to live in their own home, even when they experience physical difficulties. The 'poor' need to restrict themselves by limiting on certain social activities and expenses [9].

Among social factors one can think of e.g social contacts, marital status and social support. The Westerners, including the Dutch, have been living in gradually smaller households than in the past century. Family dilution will go on until 2035 in the Netherlands [8], with 2.1 persons per household and 3.5 million singles. Individualization has been growing, citizens rely less on traditional frameworks such as the church or traditions. Family dilution and individualization are both elements strengthening each other, contributing towards isolation for all of the generations, but especially for elderly [8]. The general senior citizen as we know nowadays is less likely to live in a big family and is more likely to have children and family living at a distance [10].

Research shows a strong association between marital status and loneliness. Widowhood can be of strong influence towards isolation [6] as well as living alone [11]. It is stated by van den Berg et al. [11] that elderly living in apartment complex are less lonely. Hence, people have fellow residents they can socialize with. Secondly van den Berg et al. stated that elderly living in rural areas also feel less lonely, stronger local networks exist here [11].

Aside from the fact that loneliness can cause health problems, health problems can also be the source of the loneliness [6]. People with a low physical functioning are more likely to experience loneliness, mobility difficulties can be a boundary for socialization [6]. Elderly will not go out of their house as much and getting somewhere becomes a difficult task. Psychological problems, such as depression and anxiety, have been found to be associated with higher levels of loneliness [6]. Chronical illnesses such as diabetes, arthritis, stroke, and neurological diseases are long-term. These illnesses make elderly highly dependent, even though the fact that this will increase human interaction with a nursing home or institutions, these living conditions cause likewise isolation and loneliness [3].

The objective of this thesis is to develop a system or application that will reduce the social loneliness among older adults. With the target group being older adults, persons from 65 years old and above, addressed in this paper as elderly. They suffer from social loneliness and are still living at home but might be in need for some extra care e.g. by Buurtzorg¹ or community nursing. **Research question:** *How can loneliness be reduced in the daily life of older adults using technology?*

¹ This Bachelor thesis is performed on behalf of Ecare Innovatie BV[12]. Ecare is a software company located in both Hengelo and Enschede. An example of a big partner of Ecare is Buurtzorg. The location in Enschede, Ecare Software BV is primarily focused on the development of software. Ecare Innovatie BV in Hengelo focuses more on different projects in the home care nursing community and works together with different partners towards solutions[12].

2. State of the Art

2.1 Related work

In this first part from the State of the Art research, related work considering the improvement of loneliness for elderly is investigated. So how can loneliness among elderly be reduced and which different approaches are used? These approaches will be divided into 3 different sub-categories: individual activities, social network and ICT usage.

Pettigrew and Robert [2] state that elderly see loneliness as a part of the aging process, but that individuals have some control over the extent to which they experience loneliness. Mir et al. [13] state that there is a strong correlation between the level of loneliness and the amount of daily activities. As the level of loneliness increases, they show lower levels of daily living.

2.1.1 Individual activities

Elderly try addressing loneliness by themselves with different approaches. The most used way is reading a lot, mostly books and sometimes also newspapers [2]. This is probably because of the fact that a lot of elderly are from the pre-television era. Reading allowed them to stay cognitively active while engaging in an enjoyable use of time. Reading is considered to be an active use of time, in such a way that it can be done during the day and in the evening [2]. Secondly, watching television is also an activity that is often done by elderly. Television is mostly watched in the evening, considering that the quality of evening-programs is the best [2]. A third activity that was mentioned is gardening. Gardening provides the elderly with a sense of functionality and purpose. Gardening offers physical and cognitive benefits, while at the same time being time-consuming. More than half of the elderly, who are able to do normal daily activities are independent [13].

2.1.2 Social Network

Family and friends

Especially relationships with children are of importance with feelings of loneliness [2]. When (grand)children are living far away or when they are often 'busy', loneliness can be a consequence of this. Friends are also seen as quite important, elderly seem to find it quite difficult to make new contacts. Hence, they often feel too old to establish new relationships and do not want to make the effort of looking for contact with others [2], [3]. To overcome the reluctance to seek company of peers, it could be beneficial to regularly provide information regarding the socializing opportunities available. Also volunteering can help to reduce loneliness. Elderly will be more physically, mentally and socially active and this will thus contribute to an improved health [2]. Encouraging elderly to engage in volunteer work has individual and social benefits that derive from the social interaction involved and the physical and cognitive requirements of the work [3].

Tilburg et al. [3] state that one way to improve loneliness among elderly is by social participation. With social participation, one is committing oneself to an organisation where oneself is a part of. This organisation can have a recreational purpose, for example a church or elderly union. A lot of elderly (78%) are a member of such an organization [3], with the biggest one being the church. Another majority is also a member of an elderly union. A smaller group of people are a member of an organization with a specific purpose, such as a music club or neighbourhood organization. Active members are members who go to gatherings, are a part of a commission within the organization or participate in the board. 33% of elderly are so called 'active members'. Almost half of the elderly under 75 are active in a recreational organization, but people above the age of 75 are much less active [3]. Food-related activities are often the center of social interactions. Food and beverage consumption is an activity that is considered fun and cosy for all age groups. It gives a particular purpose to meet with other people. Meals were always embedded in family life [2], giving the person the sense that things can be the same as they used to be. This can be especially important with for example holidays like Christmas.

A Dutch project that showed a significant reduce in loneliness is called 'Zin in vriendschap' [3], translated into English: 'Looking forward to friendship'. As stated before, having social contacts is quite important for elderly. However, because of retirement, friends that have passed away, and moving, not everyone has got a big social network. The course 'Zin in vriendschap' was set up for 55+ older women who wanted to acquire new friendships or to broaden existing friendships. Women often became older than men, making them the group that often loses their partner. The course consisted of 12 weekly meetings with 2 teachers. Via conversations, poems and stories different important characteristics of friendship were discussed e.g. Expectations of friendship, making new contacts and how to deepen existing friendships. Besides this, exercises were given to improve social skills. During the course, the participants indicated their relationships and the goals they wanted to achieve in these friendships. Resulting in a roadmap on how to get there. Six months after the course, there was a return meeting to see how everybody was doing with their goals. Two-thirds of the participants acquired new friendships, and more than half of the participants improved existing friendships. This resulted in new courses given to both men and women from 60 years or older.

Animal companionship

Another important factor to look at, is the use of pets. Mugford and M'Comisky [14] did a research among old-age pensioners living alone in an urban area, giving them budgerigars (bird species) randomly. The budgerigar owners were better off emotionally, had more friends, visitors and were more involved within the community [14]. A study, executed by Banks and Banks [14], concluded that Animal Assisted Therapy can effectively reduce the loneliness of residents in care facilities. Residents that were not able to have a pet, were in this way still able to enjoy their contact. Elderly who had a pet when they were younger, still had the desire of having a pet. Even if it was only for a small amount of time, being in the presence of a pet was statistically significant in reducing loneliness.

2.1.3 ICT usage

According to Fokkema and Steyaert [8], internet applications can benefit oneself to build up and to maintain a social network. Berg et al. [11] found that elderly using a tablet at least once a month are less lonely.

In the 2001 Seniorweb project 'Esc@pe' [3] chronically ill patients and handicapped elderly received a fixed cable connection, monitor, speakers and a printer. 15 Persons in total participated for 3 years, with the average age being 66 years old. At the start of the project they had 5 instruction lessons lasting 2 hours each on how to use the internet and e-mail. A volunteer from het Rode Kruis or de Zonnebloem [8] would lead the project, meeting every 2 to 3 weeks with the participant. With the help of the 'eenzaamheidsschaal' the elderly could indicate whether they felt lonely or not [8]. The 'eenzaamheidschaal' translated 'loneliness scale' exists out of 11 sayings which have to do with loneliness, with two examples of these sayings being; 'I miss people around me' and 'there is always someone to whom I can go to when I have personal problems'. Using these 11 sayings and whether the user agreed or not, indicated how lonely someone was. At the end of the project the loneliness among most of the participants was reduced. With 30% of the participants experiencing a strong reduction in loneliness [4]. Most participants acquired during the project more contact with other people, a better bond with the volunteer leading the project and more confidence. The elderly experiencing less loneliness were mostly higher educated, possibly since they are able to better understand the needed computer skills.

A study from Tsai et al. [15] researched a videoconference program intervention project. In this project nursing home residents received video conversation for five minutes a week with a close relative. The software used was either Skype or MSN. These conversations were held every week, for three months straight. The study demonstrated that the video conversation intervention provided the elderly nursing home residents with emotional and appraisal social support, alleviated their loneliness at one week and three months, and improved their depressive status at three months.

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2.2 Technology

In this second section, different technologies are investigated that could benefit the elderly. In order to have a guideline in searching for innovations, it was chosen to emphasize on social loneliness within the research. The following mentioned technologies often have a social and activating aspect that is directed towards the user.

2.2.1 Tinybot Tessa

Tinybot Tessa is a social robot that supports elderly with their daily structure [16]. The character has the shape of a planter. She gives spoken suggestions for activities and daily routines. The target group of this innovation is quite broad, consisting mostly out of elderly; people living alone, disabled people and people with a cognitive impairment.

The moments are set by Tessa's app, often managed by a family member or a caretaker. Advised is to set 6 - 8 messages a day [16], with 50% of these messages being functional and 50%

being social. It is important to consult with the resident how these moments will be planned and in what way. Playing music and the function called 'scripts' are additional features of Tessa. With scripts, the user can talk to Tessa and have a real conversation with the robot. This conversation is however, already programmed beforehand in the app. The reason why this robot is quite affordable, costing 1095 euro for 3 years [16], is because only the necessary tools for the robot to work are put in. Buurtzorg has delivered this robot to different people who were interested, 32 people were positive whereas 1 person was negative.



Figure 2: Technological used in Tinybot Tessa



Figure 1: Tinybot Tessa

2.2.2 ElliQ

ElliQ is a social robot especially designed for elderly. According to their website : *'to give them everything they need to stay sharp, connected and engaged* [17].' ElliQ consists of the robot itself and a tablet screen. ElliQ's features consist of: Video calls and messaging, cognitive simulation and games, music, photo's and video's, calendar and reminders, daily routine reminders and question and answer giving. The robot itself uses body language and gestures that provoke natural communication. ElliQ can be seen as a social companion, with lots of features to connect the user to the outside world. By using the internet, one can



Figure 3: ElliQ

be updated on the news but also Skype with for instance a loved one. There is no clear explanation considering the usage of ElliQ, so it is not exactly known how different features and the different parts of the robot are connected to each other. The downside of this robot is that it is quite expensive, costing 1500 US dollars for the use of one year [17].

2.2.3 Google Home

Google home is a brand of smart speakers developed by Google [18]. This device is not necessarily developed for elderly, but it provides certain smart features that could be beneficial in usage for elderly. Google home is connected with the software called Google Assistant. The software is available in over 30 languages, including Dutch. With the help of Google Assistant, users can talk to 'Google' and ask questions. The Google Assistant is connected with the internet through which it can find information for the user. Different features are e.g.: control the temperature in your house, set reminders to oneself, make hands-free calls, tell stories, set up daily routines and play your favorite music.



Figure 4: Google home

Next to the in-build and available apps of Google itself, there are a lot of third party extensions or 'Agents' available[19].

Interesting ones are:

- Todoist: Reminder application, which remembers you your schedule and important tasks. The user can set goals for itself and via visualizations see the progress.
- Spotify music: streaming service to listen to your favorite music
- FitStar Personal Trainer: gives different workouts to do at home.
- Dialogflow: Building a conversational experience supported by machine learning.

A normal Google Home is priced at 149 Euro [20] in the Netherlands and a Google Home mini is priced at 59 Euro [21].

2.2.4 De Gezelschapp

De Gezelschapp is an application that activates elderly who live in social isolation and brings them together. They are guided and supported by a personal welfare coach [22]. This application makes is possible for the elderly to come in contact with each other. On a personal profile the elderly can put their interests. Based on these interests, an offer of activities and services is shown. Via the app, the user can assign itself to an activity. Next to that participants are matched, they can become friends on the app and potential relationships can be formed. Welfare coaches are informed with the users information, so that they can see which kind of support each user needs. Via different channels, mostly via messaging, they can activate and stimulate the users to look for social contacts via the app.

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Figure 5: Messaging interface de Gezelschapp



Figure 6: Friend interface de Gezelschapp

2.2.5 Goal Island Exploration

Roessingh Research and Development is a Dutch institute focusing their research and projects on revalidation and chronic illnesses. Their activity coach [23] is an application that tracks your daily activity. By looking at the daily physical activity, the user can get an insight in it's own behaviour. When the user concludes that he does not have enough daily exercise, he can improve oneself. The activity coach gives real-time feedback and messages the user if the application thinks that the user can work out more. A downside of this application is that the user also needs to wear a fitbit or similar device in order to work. As an extension on the application, users can download the app GOAL Island Exploration [24]. When achieving your daily activity, puzzles are released in a tropical island game with a total of 7 checkpoints. When successfully completed, additional GOAL coins are released.



Figure 7: Activity Coach



Figure 8: GOAL Island Exploration

2.2.6 Amazon's Echo

Amazon's Echo is like the Google Home a smart speaker, developed by Amazon [25]. Amazon's Echo is connected with the Amazon's Alexa personal assistant software. It is the same principle as with the Google Home, users can ask their questions or wishes and the Echo will do as they wish. The Echo provides comparable features; you can play music, set reminders, ask questions and steer different devices from your home. A downside from the Amazons Echo is that the Alexa software is currently only available in four languages: English, French, German and Japanese. The Amazon's Echo (2nd generation) is currently priced at 93 Euro and the smaller version Amazon's Echo Dot is priced at 37 Euro [25].



Figure 9: Amazon's Echo

2.2.7 Apple HomePod

Apples HomePod is another smart speaker, working on Apple's assistant software Siri [26]. This innovation works in the same way as the Google Home and Amazon's Echo. Users can ask questions, play music and set for example reminders. The device itself is only compatible with Apple's own iOS system, so users can only use it when they connected to Iphones and Apple watches. Siri works in 20 languages, including Dutch. Services which are not from Apple do not work on this HomePod e.g. streaming Spotify and watching Netflix on a Samsung tv does not work. The Apple Homepod is priced at 379 Euro [27].



Figure 10: Apple's HomePod

2.2.8 Table of Comparison

Table 1	Tinybot Tessa[16]	ElliQ[17]	Smart speakers * [18, 25, 26]	De Gezelschapp[22]	Goals Island Exploration [23]
Target group	Mostly elderly living alone, the disabled and people with a cognitive impairment	Elderly	Consumer product; home- owners.	Seniors living in isolation	Users that want to track their activity, in the possession of a Fitbit
User amount	Two if the app is managed by a caretaker/family member. One if the app is managed by the user itself	One	Depends on people living/working in its environment	One	One
Main features	Social robot – Messaging: social and functional	Video calls and messaging, cognitive simulation and games, curated music and videos, photo sharing, calendar and reminders, news and weather, daily routine reminders, question and answer	Most basic ones: Weather forecast, play music, set reminders, set timers, ask for information considering daily activities, news, jokes and stories.	Try to make users attend activities and connect the users with each other.	Shows the user its amount of daily activity. User can compare the required amount of activity with its own amount of activity via visualizations.
Level of difficulty In usage	Simple to use with the app, messages are set beforehand. Can be difficult if the senior needs to do this by himself.	Difficult to say, no clear instructions or manual available.	Simple for the basic features, in case of using the Google Home simply say 'Hey Google'. For extensions more advanced connections maybe required before usage. Voice control can be a new innovation for elderly who find applications difficult in usage.	Simple layout	Simple
Costs	1095 Euro for 3 years, ± 365 Euro per year.	1500 US dollar for one year = ± 1322 Euro per year	See table 2	Unknown	Free, but Fitbit is required if not already owned.

Connection to Other Services	Is connected to the smartphone via the application. No other devices can be connected	Connected to the internet and 3 rd party extensions.	Connected to the internet and 3 rd party extensions. See table 2.	Application is accessible via the website and app on your smartphone. No further connections	Connected to the Fitbit and accessible via the application. No other
Privacy	Certrain Data from the users is gathered in order for the Tinybot to work, all according to the Dutch law	ElliQ is the only one that can access the gathered data	Gathers personal data**, after agreed to according to EU law.	Closed community, only accessible for the users.	Gathers personal data**, after agreed to according to EU law.

Table 1: Comparison of characteristics of the researched technologies

* Google Home, Amazon's Echo and Apple HomePod.

** Common Data that is gathered via applications are for example location, access to contact, access to photos and preferences.

Table 2	Google Home (Google Assistant)	Amazon's Echo (Alexa)	Apple's HomePod (Siri)
General knowledge	Good	Medium	Limited
Language interaction	Good	Medium	Limited
Number of languages	Over 30 languages (Dutch and English)	4 languages (English, no Dutch)	20 languages (Dutch and English)
Price	159 Euro	93 Euro	379 Euro
Platform compatibility	Android and iOS	Android and iOS	iOS
Bluetooth	Yes	Yes	No
Connection to 3 rd party services	Yes, 150+ applications.	Yes, 7000+ applications.	No, Only Apple devices
Music	3 rd party services like Spotify	3 rd party services like Spotify	Only AppleMusic
Calling via the speaker	Possible	Possible	Not possible

Table 2: Comparison of smart assistant speakers

References: [20], [25], [27], [28].

2.3 General Conclusion

As stated in the Introduction, factors causing loneliness can be divided into 3 different groups:

- 1. Socio-demographic factors
- 2. Social Factors
- 3. Health related factors

For this thesis, it was chosen to focus on the social factors causing loneliness and improving these. Both the client and Buurtzorg were asked which of these 3 groups are of most importance considering this research. To both parties, there was no clear difference of importance when looking at the factors. All of these factors are different per user. In the literature research of the State of the Art - Related work, most examples of interventions to improve loneliness were related with social factors . This is the main reason for emphasizing on this factor group.

In the State of the Art - Related work, different approaches on how loneliness can be improved are investigated. Firstly, individual activities are considered. The three most mentioned activities where reading, watching television and gardening. Secondly, the role of the social network and its interventions are explained. Family and friends play a large role when it comes to one's social network. Elderly often find it difficult to establish new relationships. Food related activities, like Christmas, are considered special occasions to share with family and friends. Voluntarily work, regularly provided information on activities and social participation in an organisation are possibilities to broaden one's social network.

A successful Dutch project in improving friendship is 'Zin in vriendschap', different exercises to participants helped them to focus on strengthening existing bonds and establishing new relationships with people. Animals are also a way of social bonding. Pets like dogs, birds and cats can be used in therapy and owned by the elderly in order to feel less lonely. Lastly, ICT usage was investigated. Technology that is connected to the Internet can help the user to build up and maintain a social network. Two successful programs on ICT usage with elderly are 'Esc@pe' and the videoconference program intervention project. In the first project, participants are given basic computer lessons on how to use the internet and e-mail. In the second project, elderly are given the opportunity to Skype with a close relative every week.

In the last part from the State of the Art - Technology, different technological approaches that could benefit the lonely elderly are investigated and its most important features are explained. With the help of the table of comparison (Table 1), these different technologies are compared. Not all of the innovations were targeted especially at elderly. Tinybot Tessa, ElliQ and de Gezelschapp were designed for elderly, the smart speakers and Goals Island Exploration were made for the general public. It was possible for all of the technologies to be used by only one person. The most important features of social interaction were messaging, music, reminders, activating activities and features which enabled the user to contact other persons. Hence, these features are all correlated with the daily activities from the user. All of the technologies were quite simple to use; Especially the smart speakers can be easy in usage for seniors, since only voice control is needed. For the Tinybot Tessa it can become difficult if the user has to set the messages themselves. There was no clarity for the use of ElliQ in this case. The costs for the different technologies range greatly. The social robots, Tinybot Tessa and ElliQ were the most expensive. The smart speakers had a quite considerable price, de Gezelschapp and Activity coach are free to download in the app store. All of the innovations were connected to the internet in order to function. The apps and Tinybot Tessa need to be handled via a smartphone, for ElliQ and the smart speakers this is not needed.

In order to get a better view on the differences between the smart speakers, these were compared with each other in a second table (table 2). Google Home is the best in general knowledge and language interaction, which is of great importance when interacting with the user. The Google Assistant and Siri are both available in a great range of languages. Amazon's Echo is the cheapest one available on the market and has the biggest connection to 3rd party services, with over 7000+ applications. Both Google Home and Amazon's Echo are compatible with Android and iOS. The use of the Apple HomePod is inconvenient for people who do not own a great range of Apple products and services, since this smart speaker only works on Apple services and technology.

2.3.1 Study Objective

The target group for this research are older adults, persons from 65 years old and above, addressed in this paper as elderly. They suffer from social loneliness and are still living independently at home but might be in need for some extra care e.g. by Buurtzorg or community nursing. The study objective of this Bachelor project it to reduce loneliness among older adults. The focus will lie on activating the user and social interaction by means of technology. The starting point for this thesis will be the Google Home System. The State of the Art has shown that Google Home is most convenient in usage compared to Amazon's Echo and Apple's Homepod. The Google Home can be entirely steered by voice control, a new and innovative phenomenon that is easy in usage. Voice control has the possibility to take away the threshold of using 'new' technology from the elderly. Therefore, the aim of this research is to develop an application that uses 'voice control' in order to reduce loneliness, with the Google Home as a starting point. Next to that, Ecare is a partner from the Google, making it possible to look into the different possibilities and background from the Google Assistant.

Research Question: How can social loneliness be reduced in daily life of older adults living at home using the Google Home system?

Sub-questions:

- How do experts look at loneliness experienced by older adults? (Chapters 3 and 4)
- How do experts view the usage of the Google Home system? (Chapters 3 and 4)
- Which important features need to be taken into account when designing a system for the older adults? (Chapter 5)
- What are the requirements for such a system? (Chapter 5)
- What is a possible design for a Google Assistant steered system to reduce loneliness among older adults? (Chapter 6)

3. Method

In order to solve the study objective and come up with suitable prototype, more research is needed. In this section, the method used to solve the research question (as described in section 2.3.1) is explained. The research done can be divided into 2 different sections:

- 1. Online survey
- 2. Interviews employees Buurtzorg

Based upon the results of this research, choices will be made for the design of the prototype.

3.1 Online Survey

An online survey was conducted to get a better understanding of how experts view this subject.

3.1.1 Participants

The online survey was especially designed for people who work a lot with elderly or have a lot of elderly within their social circle. Loneliness can be a really sensitive subject towards the elderly, especially via an online survey. Secondly, not every elderly person uses a computer. Both of these reasons can lead to a bias within the research. Participants who work a lot with elderly or have a lot of elderly within their social circle can give insight into different solutions for loneliness and how they think elderly would respond to the use of the Google Home system.

Participants are divided into 3 different categories:

- 1. Community nurses/caretakers of elderly.
- 2. Caregiver, in Dutch called 'mantelzorger'.
- 3. Persons who have a lot of elderly in their social circle or family.

The online survey was open to all of the 3 different groups, distinction is made within the opening question. Based upon the 3 different groups, participants were guided through the questions. Participants were recruited via different channels; LinkedIn², Buurtzorgweb³ and Facebook⁴.

3.1.2 Procedure & Format

Via the different channels a message was sent. It consisted out of a small introduction, a link to the survey and a link to a website especially created for this Graduation Project. On the website, more detailed information about the research was present. Also in the survey itself information about the research was present. Also in the survey itself information about the research was present. The message can be found in Appendix A.

² Social platform for the working community

³ Communication platform from Buurtzorg

⁴ Social media platform

The online survey was made using Google Forms⁵, this is a tool made especially for making and analyzing online surveys. In order to fill in the survey, a browser and an internet connection were needed. The language used in the survey was Dutch.

The website was made using Google Sites⁶, a tool made for easily designing and publishing websites online. The survey was anonymous and could be filled out without email registration. The survey was online for a total of 3,5 weeks. The website was available in both Dutch and English.

3.1.3 Questions

There were a total of 18 questions, divided over 6 different sections. An explanation at the beginning of each section was given if needed. Section 1 - 3, consists of both multiple choice questions and open questions. Section 4 and 5 contained statements with which the participant could completely agree (5) or disagree (1), on a scale from 1 to 5. Section 6 starts off with a multiple choice question followed by an elaborate explanation of the Google Home system and ended with statements again. The layout for the questions can be found in Appendix B.

Based upon the introduction question, participants were divided into 3 different groups. These different groups were guided through the questions differently. Participants of group 1 were first sent to section 2: questions regarding their clients. Participants of group 2 were sent towards section 3: a more detailed question regarding the person they take care of. After these questions both group 1 and 2 were guided towards section 4, statements about loneliness. In case of group 3, participants were immediately guided towards the statements of loneliness. From this 4rd section on, all of the questions were the same.

The statements made within both sections 4 and 6, were based upon the 4 features that were found in the State of the Art - Technology. These 4 features can be used within the Google Home system and possibly lead to less loneliness among the elderly:

- 1. Social conversations
- 2. Being in contact with an acquaintance
- 3. Music
- 4. Activating reminders

⁵ Google Forms: <u>https://www.google.com/forms/about/</u>

⁶ Google Sites: <u>http://sites.google.com/</u>

3.2 Interviews Employees Buurtzorg

The interviews for the Buurtzorg employees focused on both loneliness and usage of speech technology.

3.2.1 Participants

Interviews were conducted with employees from Buurtzorg at the head office in Almelo. A total of 7 persons were interviewed. All of the participants worked closely with elderly in different ways or were a community nurse. The interviews allow for a more in-depth research compared to the online survey.

3.2.2 Procedure & Format

Employees at the head office of Buurtzorg in Almelo were asked if they wanted to participate in an interview concerning the usage of speech technology. When agreed to cooperate, the researcher and participant(s) proceeded the interview in a separate room. Most of the interviews were held with 2 participants at the same time. Before starting the interview, the participant was informed about the goal of the research and the fact that he or she could stop the interview at any moment. During the interview, an explanation about speech technology and Google Home were given. Every interview lasted about 15 minutes. All of the interviews were conducted in Dutch.

3.2.3 Questions

The questions for the interviews can be found in Appendix C. The questions had some overlap with the questions from the online interview. The interviews were semi-structured, follow-up questions could be asked depending on the expertise of the person and the course of the interview. During the interviews, a smartphone with the Google Assistant could be used to explain the concept, if the participant did not know about the Google Home. Answers to the questions were written down with the usage of keywords on a pre-made answer form.

3.3 Analysing the Results

In Chapter 4: Results, the results of the online survey and interviews will be analysed. The online survey consists of quantitative data, with the exception being the two open questions which will be analysed in a qualitative way. The interviews consist out of qualitative data.

3.3.1 Survey

The quantitative data, so the closed questions were analysed using the tools in Google Forms, Google Spreadsheets⁷ and Excel (Microsoft Office 365). Multiple choice questions were analysed using pie charts. Statements were examined using bar charts, comparing the different groups and looking at the average opinion from participants. Open questions, the qualitative data, was studied using a wordcloud.

⁷ Google Spreadsheets: <u>https://www.google.nl/intl/nl/sheets/about/</u>

3.3.2 Interviews

The answers written down in keywords were analysed and compared with each other, the most important findings are summarized in section 4.

3.4 Ethical approval

The Ethics Committee EEMCS from the University of Twente gave approval for conducting both the online survey and interviews. Permission was given based upon the layout of the online surveys, interviews, website and their own checklist.

4. Results

In this section, the results of the research are analysed. Firstly, the results of the online survey are discussed. Secondly the results of the interviews with Buurtzorg employees are addressed.

4.1 Online Survey

The online survey was open for 3,5 weeks, with a total of 151 respondents. Closed questions are analysed in a quantitative way, by making use of graphs and charts, whereas open questions will be analysed in a qualitative way, using more abstract analysing tools like word clouds.

In section 1, respondents were divided into 3 different groups:

- 1. Community nurses/caretakers of elderly.
- 2. Caregiver, in Dutch called 'mantelzorger'.
- 3. Persons who have a lot of elderly in their social circle or family.



The division of the participants can be seen in the pie chart below:

Group 1 had 122 respondents, group 2 had 8 respondents and group 3 had 21 respondents. The reason for the big amount of respondents in group 1 is that BuurtzorgWeb contributed the most in getting the amount of responses. BuurtzorgWeb is a social platform especially designed for community caretakers, explaining why group 1 is the biggest. When analysing the results, it has to be kept in mind that group 1

explaining why group 1 is the biggest. When analysing the results, it has to be ke consists of the biggest group of respondents and thus counts the heaviest.

Elderly and Loneliness



In section 2 and 3, group 1 and 2 were both asked whether their clients/patients experienced loneliness and to what extent.

Chart 2: Loneliness experienced among clients from group 1



Chart 3: Loneliness experienced among patients from group 2

It can be seen in both pie chart 2 and 3 that community nurses and caregivers indeed think that their clients or patient is lonely. Most clients from community nurses tend to experience loneliness. Not one community nurse thought that their clients did not experience loneliness. The majority of caregivers except for one person stated that their patient indeed experienced loneliness sometimes or often.

Group 1 and 2 were both asked what the main reasons for experiencing loneliness are. All of the reasons were labeled and sorted on frequency. The reasons given are converted into a wordcloud⁸. The size of the words depends on the frequency that a reason has been mentioned.



(Wordcloud) Table 3: Reasons for Ioneliness

The top 3 reasons are:

- 1. Decreased mobility
- 2. Small social network
- 3. Family and friends passed away

Statements different possibilities reducing loneliness

In section 4, all of the groups were guided through statements about the different possibilities reducing loneliness. These statements were based upon the possibilities of the Google Home system:

- 1. Social conversations
- 2. Being in contact with an acquaintance
- 3. Music
- 4. Activating reminders

All of the statements could be answered on a scale from 1 to 5; 1 = totally disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = totally agree. Statements are analysed using bar charts, visualising all of the 3 groups and the average opinion.

⁸ WordItOut: <u>https://worditout.com/word-cloud/create</u>

Chart 4 shows whether respondents think if having conversations helps with reducing loneliness. The average opinion from all of the participants agrees (51%) or totally agrees (29,80%) with the fact that social conversations help. Both group 2 and 3 show no participants being neutral or disagreeing, whereas a small amount of group 1 does, disagree is 2,46% and neutral is 21,3% in this case. Group 2 has a rather high percentage (75%) in the agree option compared with group 1 and 3. Most respondents from group 3 totally agree (71,4%) with this opinion.



Most of the respondents are neutral (45%) or they agree (35,1%) with the statement that music can lead to less loneliness, which can be seen in chart 5. Only a small amount of participants think that this has no effect, totally disagree is 1,3% and disagree is 9,3%. Group 2 stays neutral (50%) or agrees (50%).



Chart 5: Statement listening to music

The majority of respondents think that activating reminders can help, 49% is on the agreeing side, this can be seen in chart 6 below. Group 2 is rather positive about this opportunity with 75% agreeing and 25% totally agreeing. Group 1 and Group 3 tend to be a bit more scattered, with also having participants disagreeing (8,20% group 1 and 4,76% group 3) or totally disagreeing (1,64% group 1 and 4,76% group 3), but with the majority nevertheless on the positive or neutral side .



In chart 7 can be seen that most of the respondents agree (37,70%) or totally agree (27,20%) with the fact that elderly meeting each other can be a solution, the other part stays neutral (29,80%). Group 2 tends to agree (75%) or totally agree (25%). Group 1 and 3 are more evenly spread.



Elderly and Technology

Usage of technology can be more difficult for elderly than younger generations. They often do not have much experience with the more advanced technologies coming into the market every year. Considering this fact, it had to be reviewed whether the usage of technologies is possible and to what extent in section 5 of the online survey.

Chart 8 suggests that the respondents think that the target group does not know how to use technology, on average only 9,90% agrees and 0.7% totally agrees. Looking at this statement, all 3 of the groups tend to be in sink by giving the same answers.



On the other hand, also quite a large group thinks that the usage of technology can be explained (chart 9) to elderly with on average 39,10% of the participants agreeing and 11,90% totally agreeing. Group 3 tends to be more positive than group 1 and 2, with 42,86% of the respondents totally agreeing. Nevertheless, from group 1, 39,10% agrees. Group 2 is more mixed with both 37,50% disagreeing and agreeing, 25% is neutral in this case.



In summary, chart 8 and 9 show some interesting findings. Elderly nowadays do not always know how to use technology. On the other hand, simple technology can be well explained to elderly, if they are open for it. e.g. the usage of a television or the computer.

Voice Controlled Systems

In the last section of the survey (section 6), participants were introduced with voice controlled systems and the Google Home. At first, participants were asked whether they knew voice controlled systems like the Google Home, after this question a brief explanation was given with corresponding pictures and youtube video.

Almost 75% of the respondents knew the Google Home system and 34,40% was experienced in using it (chart 10). The Google Home system is available on the Dutch market since october 2018 and available in America since november 2016, meaning that the popularity of this system grows rapidly.



It can be seen in chart 11 that the biggest part of respondents stays rather neutral (40,40%) about the elderly being able to using the Google Home system, but also a sizeable part agrees (37,10%). 15,20% Of the respondents disagrees and thinks that it could be hard for elderly to use. Group 3 differs big from group 1 and 2 in totally agreeing with 23,80%. The biggest part of group 2 (50%) is on the agreeing side, whereas group 1 is more neutral (44,26%).



Statement usage of the Google Home The Google Home is addressed in the following questions as a 'social assistant'. The next statement can be directly linked to the statement of chart 4: Elderly can become less lonely by having social conversations. In this case, the user would have a social conversation with a Google Home system (chart 12). On average, the majority is either neutral (44,40%) or agreeing (29,10%). With all of the groups being rather spread out over the different possibilities. An important finding is that in statement 4 respondents were much more positive, being almost all on the agreeing or totally agreeing side. Talking to a computer instead of a human is thus perceived more critical.



Calling a relative via a social assistant (chart 13) can be linked with both statement 4 and 12, a big part of the respondents seem to agree with this statement (55%). Respondents from group 2 either agree (37,50%), totally agree(25%) or disagree (37,50%), with not one respondent being neutral. This statement was set up to see whether there is a big difference in human to computer contact and human to human contact. Comparing this outcome to the previous statement, it can be concluded that human to human contact is preferred.


The following statement (Chart 14) can be linked directly to the statement from chart 5, elderly can become less lonely by listening to music. The majority of the respondents agrees (45,70%), they think that listening to music via a social assistant can work. Surprisingly, more respondents agree with statement 14 than statement 5, they think that the Google Home can have added value in this case.



Chart 15 can be directly compared with chart 6. The majority of the participants is either on the neutral (42,40%) or agreeing side (34,40%). Group 1 and 3 are both quite in sync with each other, but group 3 is more positive with 19,05% of the participants totally agreeing. Compared to statement 6, respondents are more on the neutral side using active reminders in combination with the Google Home system.



A concluding statement about the general opinion of using a speech system (Chart 16) shows that respondents are quite positive with 45% of the respondents agreeing. Respondents consider the Google Home system to have a good chance in reducing loneliness among elderly, if executed correctly.



4.2 Interview Employees Buurtzorg

The interviews held with employees from Buurtzorg can be divided into 3 different themes:

- 1. Elderly and Loneliness
- 2. Elderly and Technology
- 3. Elderly and Speech Technology.

Within each section, questions were asked related to the themes, these questions can be found in Appendix C. Depending on the interview, follow-up questions could be asked. Answers were written down as keywords in an answer key, these keywords were analysed for the results.

Elderly and Loneliness

All of the interviewees had the feeling that clients from Buurtzorg experience loneliness. Reasons mentioned for this loneliness are: Elderly....

- Do not take initiative.
- Isolate themselves.
- Have a lesser mobility.
- May suffer from psychological difficulties.
- Have a small social circle, family visits less often and family is busy (Individualism).
- Do not have enough volunteers.

Interviewees had the opinion that reducing loneliness has to come from two sides, namely the person themselves but also society. Elderly find it difficult to seek activities to do or go to for example a daycare, they do not want to bother others with their problems. On the other hand, our individualising society is more and more focused on oneself. This makes people care more about themselves, often forgetting people surrounding them and in this case the elderly.

Next to this, the ICT department of Buurtzorg mentioned that they were at that moment busy analysing data conducted through the Buurtzorg Databases. Findings showed that loneliness is indeed one of the big struggles that elderly face. Loneliness can however be different per type of neighbourhood. For example in a big city, life is more busy and people are busier with their own lives than in a rural area where people tend to look after each other more.

Elderly and Technology

According to the interviewees, using technology can be quite hard for elderly. But they make use of simple technologies like for example the television. Especially really advanced and complicated systems are difficult for them to use. One interviewee mentioned that: *'The usage of an Ipad is really accessible, no remote control is needed'*. She wanted to make clear that technology that looks complicated to use often scares elderly. Technology usage should be kept simple for elderly and easily explainable. Two interviewees also mentioned the fact that some elderly are low literate and cannot understand long difficult sentences. Texts should be kept brief and simple to follow.

Voice controlled systems

Most of the interviewees had heard of a voice controlled systems like the Google Assistant or Siri. The Google Home system was considered to be useful, if the user would be guided or 'steered' via questions in the right way. The user should be interested in usage of such a system and the system should be specific enough to be interesting for elderly. The Google Home has the potential to make the world of these people a bit bigger, by connecting them to services.

The last question of the interview asked how they think the Google Home could be implemented. This resulted in different opinions and ideas, a mini-brainstorm:

- Trying to prevent loneliness by analysing the mood or mindful state of a client.
- Elderly often get into a social isolation, it is quite hard for them to think solution oriented. Having more social contact is definitely the way to get out of this isolation. Social conversations are possible with the Google Home system. These conversations should be able to go in-depth.
- Let elderly get in touch with each other, there used to be a social map for elderly in some regions. Find a way to get them connected, via for example the usage of the Google Home and activities to do.
- Having an animal over can brighten up the day of the elderly. Maybe there is something possible with pets.

5. Ideation

In the ideation phase, a final concept idea will be generated. The results of the conducted research will be key points in coming up with a final idea and prototype. The specification is also processed within this section.

5.1 The Google Home as a social assistant

5.1.1 Possibilities according to the research

The features that enable the possibility for a reduce in social loneliness and that were used as key points in the interviews and online survey are:

- Social conversations
- Being in contact with an acquaintance
- Music
- Activating reminders

Respondents of the online survey and interviewees felt that having social conversations is key in reducing loneliness among elderly. Activating reminders and elderly meeting with each other were both seen as components that could be beneficial for the elderly. Not much elderly make use of technology, nevertheless the majority agreed that simple technology can be explained to elderly. This also includes the Google Home system.

Using the Google Home system was seen as a good possibility, but certain aspects have to be taken into account while using this system. The system should guide the user. Questions asked by the Google Home system have to 'steer' the users. Next to this, if text is displayed in some way, this should be kept brief and simple. Some elderly are low literate, meaning that having to read long sentences can be extremely difficult for them.

Having social conversations is possible with the Google Home system. Respondents were rather neutral about having social conversations with a Google Home system, but having social conversations/participation **with the help** of the Google Home system was viewed as much more effective. Next to this, the usage of activating reminders can also be considered a good possibility. The usage of music without the Google Home system was not seen as an improvement on the loneliness of elderly, but in combination with the Google Home system it did. Interviewees found that possibly the Google Home could be used to let elderly connect with each other.

5.1.2 Having a conversation with the Google Home

In this paragraph, the usage of the Google Home system is explained. By saying 'Hey, Google', the Google Home is activated. After this, a question can be asked. This can for example be 'What is the weather like today?'. When the user wants to make a call for an agent, he can simply say: 'Hey Google, talk to... *name of agent*'. Albert Heijn has for example got their own shopping agent: 'Hey Google, talk to *Appie.'* The conversation with the specific agent will be started.

A conversation with the Google Assistant is ended when you don't respond anymore, tell Google 'Thank you' or 'I'm done'. The user cannot have a conversation with the Google Home if he is making a phone call or if timers are going off. The microphone of the Google Home stays open for 8 seconds in order for the user to respond. If there are multiple people in one room, everybody can participate in the conversation.

Considering the privacy issues of the user, the Google Home will only listen to the conversation that the user is holding when he says 'Hey Google'. Users are not overheard and their privacy is protected according to the Dutch law. Next to this, there is a microphone mute button so that the Google Home can be put on standby.





5.2 Concept

5.2.1 Concept idea

Based upon the State of the Art and the outcomes from the research, a concept idea was generated. The final conceptual idea is based upon 2 different aspects:

- Social conversations
- Activation

Social conversations

Within the research, the importance of social contact for lonely elderly came forward. Conversations are a form of interaction that could provoke social feelings. Social conversations can be held between the Google Home system and its user. The downside of this is that these will stay rather simple and plain, whereas human conversations can go much more into-depth. Social conversations between humans would have a much bigger impact and give a person the feeling that they have someone to talk to. Socialisation is possible when people are brought together or when someone gets to know new people.

Activation

The State of the Art related work states that doing activities, especially activities involving multiple people, helps in reducing loneliness. Activating reminders can be used in two ways. Reminding the user of its already made appointment, for example going to the hairdresser or dentist. Secondly, activating reminders can suggest activities to do. The user can for example get the suggestion to do some groceries or go out for a walk. Within the online research, using activating reminders in daily life was seen as a quite successful possibility. Interviewees thought that this aspect could be used to bring elderly together in the form of activities.

The final conceptual idea is to combine these two aspects and create a Social Activity Agent. This Agent connects elderly by making them attend activities they enjoy. By asking the user questions, suggestions for activities within the neighbourhood can be made. Attending these activities enhances social participation, eventually leading to a bigger social circle. See also figure 12 below.

Figure 12 : Final concept idea



5.2.2 Requirements

Taking into consideration the results from the research and the most important aspects that came forward, requirements are set up for the prototype to be made. These requirements are prioritized using the MoSCoW method.

Must	The prototype cannot work without these features
Usertest	Must be easy to understand, by guiding the users using the right questions.
	Must have a backend database of activities especially for elderly in the neighborhood of Enschede.
	Must take into consideration the location of the user, this takes into account the mobility of the user.
Should	Important aspects but not vital
Usertest	Should be able to understand the preferences from the user, resulting into better suggestions for activities to do
Usertest	Should have an inviting and welcoming tone while speaking towards the user.
	Information put into the database should be reliable and correct
Could	Nice to have
	Could be able to work with an agenda application, showing a visual change when an activity is planned.
Won't	Aspects that can be given up on
	Also be able to work in Dutch

Table 4: Requirements

5.3 Target group

5.3.1 Decreasing mobility

In both the introduction and State of the Art the target group was described as follows; The target group for this research are older adults, persons from 65 years old and above, who suffer from social loneliness. They are addressed in this paper as elderly. The target group is still living independently at home, but they might be in need for some extra care by for example a community nurse.

Reviewing the online survey and interviews, some important aspects need to be taken into account regarding the current target group. One of the top reasons for loneliness among elderly is their decreasing mobility. Therefore activities suggested should not be too far away from their homes. These activities are preferably easily accessible via public transport or from a reasonable walking distance away.

5.3.2 Neighbourhood

ICT-professionals from Buurtzorg made clear during the interviews that someone's surroundings also contribute greatly in preventing loneliness. In the Netherlands there are 9 different types of neighbourhoods [29]. This thesis will focus on the city of Enschede. Enschede can be seen as a small city, small cities exists out of two types of neighbourhoods: small-town neighbourhoods and green small-town neighbourhoods. Green small-town neighbourhoods are especially prone to loneliness. This is why green small-town neighbourhoods are the target neighbourhood for these studies. These neighbourhoods lie on the outskirts of a city.

In green small-town neighbourhoods the population composition is diverse, the risk exists that there is less involvement between residents. This influences the social cohesion. More social cohesion can affect residents health in a positive way. Het Rijksinstituut voor Volksgezondheid en Milieu [29] advises two interventions for this type of neighbourhood:

- 1. Signaling: Make others aware of vulnerable residents
- 2. Activities: Interventions making residents meet with each other by doing activities together.

 \rightarrow The prototype focuses on intervention 2: activities.

5.3.3 Personas

Personas can give a better understanding and insight into the chosen target group. In this section two personas are portrayed: Gerrit van Dijk and Sarah de Groot.



Figure 13: Persona 1 Gerrit van Dijk⁹

⁹ UXPressia: <u>https://uxpressia.com/</u>

NAME

Sarah De Groot



Figure 14: Persona 2 Sarah de Groot

5.3.4 User Scenarios

User scenarios can give a better insight into the main purpose and usage of a system. A scenario can be seen as an explicit representation of a hypothetical use situation. Two different scenarios will be written, for the two different personas.

Scenarios are written based upon 5 aspects:

- 1. People (user)
- 2. Context (setting)
- 3. Goal
- 4. User action
- 5. Event + (re)action

Walking club Ambulare

It is a regular tuesday, Gerrit is at his home in the Wooldrik neighbourhood in Enschede. In the weekends, Gerrit often has enough plans to keep himself busy, he often goes to the soccer field to watch the game of his grandson. During weekdays, Gerrit enjoys watching some television and go outside to the park. But today he is quite bored, he wants to get in touch with other people and do an activity together. He used to do a lot of activities together with his wife, but unfortunately she died a few years ago. Gerrit got the Google Home from his son as a present last week, hence Gerrit can now listen to music and get daily information more easily. Gerrit knows that the Google Home has free access to so called 'Agents'. He was tipped by an acquaintance about the function of the Social Activity Agent. Gerrit starts talking to his Google Home and asks for the Social Activity Agent. Based upon the conversation with Gerrit and his location, the Social Activity Agent suggests a few activities that Gerrit can do in the neighbourhood within a group. Since Gerrit enjoys walking, he chooses to join a session from the local Walking Club Ambulare. After participating in the first session, Gerrit decides to join the session on tuesday weekly. He gets in touch with multiple persons, with whom he becomes acquainted.

People	Gerrit van Dijk
Context	He is at his own home
Goal	Get in touch with other people do an activity together, using the Google Home's Social Activity Agent
User action	Having a conversation with the Google Home
Event + Action	The Social Activity Agent suggest activities for Gerrit to do, based upon the conversation and Gerrits location. Gerrit decides to join the walking session.

Table 5: Scenario Gerrit van Dijk

Drawing Club Creativiteit

It is a friday morning, almost weekend in Enschede. Sarah is at her home in Deppenbroek, sitting in the living room. Petra visited Sarah last week with her daughter, they talked about all of the things that happened that week while drinking some wine on the terrace. Sarah always enjoys these visits. Her other daughter Anne will probably meet with her next month, since she was to come all the way from Amsterdam with her children and husband. Today Sarah is feeling empty inside, she has not talked to a single person for a few days. She already walked her dog and cleaned her house. Sarah would like to get out of the house, try out something new. Sarah asked her Google Home for advice on what to do, the Google Home system suggested Sarah to talk to the Social Activity Agent. The Social Activity Agent advised Sarah to try out knitting, painting or drawing classes. Since Sarah really enjoys painting, she immediately became enthusiastic about trying drawing classes. Apparently Drawing Club Creativiteit was right around the corner, offering classes for beginners but also more experienced drawers. Sarah signs up for a beginners course on monday evenings. At Creativiteit she met some other ladies interested in both drawing and painting, with whom she sometimes has a cup of coffee in the afternoon.

People	Sarah de Groot		
Context	She is sitting in her living room, after having finished all of her chores.		
Goal	Getting out of her house, trying out something new		
User action	Talking to Social Activity Agent from the Google Home, asking for advice on what to do.		
Event + Action	The Social Activity Agent finds some interesting courses in the neighbourhood for Sarah, she decides to try out the drawing beginners course.		

Table 6: Scenario Sarah de Groot

6. Prototype Realisation

6.1 Programs and applications

At first, the different possibilities using DialogFlow were investigated, creating a realistic picture of what can and cannot be done with the Google Home system. Dialogflow is a relatively new program, created for the usage of the Google Assistant.

6.1.1 Dialogflow

In order to produce an application or so called 'Agent' for the Google Assistant software, the program Dialogflow¹⁰ is used. Dialogflow is a program especially designed to build conversational experiences using machine learning. By giving example phrases and sentences, parameters can be built that can then be recognized by using speech e.g dates and places. Dialogflow is especially designed for the infrastructure from Google and the Google Assistant. The program can be connected with different API's and 3rd party services like for example Google Maps, Facebook Messenger and Twitter. Key to using Dialogflow is producing a clear scenario or flowchart, consisting out of all the different questions that can be asked and follow-up actions from the Google Assistant. Dialogflow makes use of the following elements¹¹:

- **Invocation:** The invocation kicks off the experience with the agent in a conversational manner. Just like saying 'Hello, how are you?' to for example a friend.
- Intent: An intent can be seen as a function that Dialogflow executes when it is invoked by one of the defined terms in the console. In Javascript you have a function, in Dialogflow you make an intent.
- User says: By providing Dialogflow with different training sentences, an intent is triggered.
- **Context:** This is used to reference to the parameter values at the user moves between different intents throughout the conversation.
- **Fulfillment:** When a fulfillment request is added to an intention, Dialogflow will execute the rest of the intention within a programmed node.js environment. The programming language used within the node.js environment is Javascript. Dialogflow can make contact with for example Databases, Facebook and other API's by using Javascript.
- Action and parameters: In this section usable parameters can be created that are used in for example the fulfillment section.
- **Response:** The answer that will be given to the user.

See figure 15 below: This is an example¹² of an intent to make an appointment in an bikeshop.

¹⁰ Dialogflow: <u>https://dialogflow.com/</u>

¹¹ Only the features used for the prototype are explained

¹² Created by Mirel Nijhuis

Dialogriow					
MarysBikeShop (own 👻 🔅	Contexts 📀		~		
💬 Intents 🛛 🕂	Events 😧		~		
R Entities +	Training phrases 🕜	Search training	g phrases 🔍 🔨		
4 Fulfillment	99 Add user expression				
🗘 Integrations	95 I'd like to get my bike fixed, I have a mountain bike that needs servicing,				
G Training	95 I need to fix my bike today.				
History	I need to make an appointment at 3 PM today.				
Analytics	Can i schedule service for 4 HM tomotrow? Can you fix my road bike?				
Prebuilt Agents	95 My bike is broken.				
	55 Can I set up an appointment for noon on Friday?				
Small Talk	Can I set up an appointment for noon on Friday? Make Appointment		SAVE		
Dialogflow MarysBikeShop (own *	Can I set up an appointment for noon on Friday? Make Appointment Can you fix my road bike? My bike is broken.		SAVE		
Small Talk Dialogflow MarysBikeShop (own * Intents +	 Can I set up an appointment for noon on Friday? Make Appointment Can you fix my road bike? My bike is broken. Can I set up an appointment for noon on Friday? 		SAVE		
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Pialogflow	Make Appointment save
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Intents + Image: Entities + Knowledge (beta) + Image: Fulfillment + Integrations - Training - History - Analytics - Prebuilt Agents - Small Talk -	Text response 1 Got it. I have your appointment scheduled on \$date at \$time. See you soon. Good-bye. 2 Enter a text response variant Image: Contract of the set of t
Pialogflow	4 Fulfillment
MarysBikeShop (own 🌣 en + E Intents +	Inline Editor (Powered by Cloud Functions for Firebase) ENABLED Build and manage fulfillment directly in Dialogflow via Cloud Functions for Firebase. Docs Docs
Entities	index.js package.json
	<pre>31 email: serviceAccount.client_email, 32 key: serviceAccount.private_key, 33 scopes: 'https://www.googleapis.com/auth/calendar' 34 b);</pre>
 Training History Analytics Prebuilt Agents 	<pre>35 36 const calendar = google.calendar('v3'); 37 process.env.DEBUG = 'dialogflow:debug'; // enables lib debugging statements 38 39 const timeZone = 'Europe/Amsterdam'; // Change it to your time zone 40 const timeZoneOffset = '+02:00'; // Change it to your time zone offset 41 42 * View execution logs in the Firebase console Last deployed on 05/31/2019 16:38 DEPLOY</pre>
Small Talk	

Figure 15: Example Appointment Intent within Dialogflow

6.1.2 Firebase Realtime Database

Firebase Realtime Database¹³ provides the possibility to store data between multiple users online. This makes it possible to connect the database to multiple devices, services or applications. In this case Dialogflow. Realtime means that when the data is updated, the connected services immediately have access to this data. The data is stored within JSON format. Via the fulfillment section of Dialogflow, the database is accessed with the use of programmed code in Javascript. See figure 16 below for an example of stored data within the Database.

Lasks
DMqnng42htcn4RFvYdLjQNQLvD02
Figure 16: Example

Figure 16: Example Data stored within Firebase

6.1.3 Google Calendar API

The Google Calendar API¹⁴ enables the user to make a connection between a public or private Google Calendar. If a private calendar is authorized within Dialogflows fulfillment section, data can be stored from Dialogflow within the Google Calendar.

6.1.4 Connection between programs

To get a better understanding of the connection between Dialogflow, Firebase and the Google Calendar API, please look at figure 17 below.

¹³ Firebase: <u>https://firebase.google.com/docs/database/</u>

¹⁴ Google Calendar: <u>https://developers.google.com/calendar/</u>



Figure 17: Connection Dialogflow - Google Calendar - Firebase

6.2 Development

6.2.1 Activities Elderly Enschede

Based upon the different possibilities of activities to do for elderly in Enschede, a prototype can be built. It became clear that there is not one central place for all of the activities that elderly can do in Enschede. There is not one central website or database available. Information is gathered from different local websites: Avelijn [30], Wijkwijzer Enschede [31], Aqua Vitaal [32], 55+ Enschede [33] and AlifaWelzijnOuderen [34].

Based upon this information 3 groups of activities were made:

- 1. Hobby
- 2. Sports
- 3. Food

6.2.2 Conversational Scenario

The language in which the prototype works is English. English has been chosen over the Dutch language because the speech recognition and pronunciation in English are currently much further developed compared to Dutch within the Google Home.

With the 3 different groups in mind, a conversational scenario was written, see charts 17 and 18 below. At first the user is welcomed by the agent. The user is asked whether he wants to plan an activity to do. The user has the possibility to choose between 3 different choices: 1. Hobby, 2. Sports and 3. Food.

When option 1 is chosen, a distinction is made between creative activities and games. After choosing, suggestions for activities are given.

When option 2 is chosen, a distinction is made between doings sports outside and inside. After choosing between outside and inside, different possibilities are given. Option 3 immediately leads to two different options.

When the user has chosen an activity that he wants to do, the agent will ask in which part of Enschede he wants to do this activity. Taking into account the mobility of the user is one of the key points regarding the research conducted while designing the prototype. By dividing Enschede into 4 parts (North, East, West and South), the activity will be close by and will not take long to reach. With the chosen activity and location, information is retrieved from the database. The agent will provide the user with the location of the activity and the time at which the activity is held. The center of Enschede is not included in the different options, the amount of activities there was niet sufficient enough to be included within the database. Next to this, the neighbourhoods where most elderly live are on the outskirts of Enschede, these are the so called green small-town neighbourhoods on which the agent is focused (Chapter 5).

Lastly the agent provides the user with the possibility to put the activity in its personal agenda. The date at which the user wants to join the activity is asked and the time at which he wants to leave the house. By putting it in the agenda of the user, there is also a visual representation available of his appointment on the smartphone, computer or tablet. Next to this, the Google Home will be able to actively remind the user about the activity.

Adding Suggestion Chips

Since the Agent can also be used on the Google Assistant software for smartphones, suggestion chips are added. These chips 'suggest' possible answers for the user, by giving a visual representation. In a conversation with the Google Assistant, the user can than simply select this answer on his smartphone. This can be easier for some users, it is of course also possible to tell or type the answer. See figure 18 below.





55

Chart 18: Scenario flowchart part 2

It seems that you do did not find a suitable activity for yourself yet. How about trying again?



Figure 18: Suggestion Chips

6.2.3 Creating the database

The following activities are put into the database:

- Hobby Creative: painting, needlework and singing
- Hobby Games: cards, billiards and bingo
- Sports outside: walking and cycling
- Sports inside: gym and swimming
- Food: having lunch or dinner.

These activities are chosen based upon their availability in Enschede and popularity in general [30], [31], [32], [33], [34]. Next to this, all of these activities are free or cost only a small amount of money. No activities are put in that are expensive since not everybody can afford these. Per option a maximum of 3 activities is present. Suggesting 4 or 5 activities gives an overwhelming feeling, especially for the elderly, therefore the amount of choices has been kept limited and clear.

The database is programmed in .json format using Notepad++¹⁵. Each activity consists of the following structure in the database:

Activity North Northtime Northlocation West Westlocation Westtime East East Eastlocation Easttime South Southlocation Southtime

Under 'North', 'West, 'East' and 'South' the information regarding the activity can be found. This database is uploaded in the Firebase realtime database.

¹⁵ Notepad++: <u>https://notepad-plus-plus.org/download/v7.7.html</u>

	T. 6	
2	ф. '	'activities" : {
4	•	"painting" : {
18	•	"Painting" : {
19		"North" : "The Liberein has got a paintingclub every mondaymorning at 9:30. The adress is Lijsterstraat 30.",
20		"Northlocation" : "Lijsterstraat 30",
21		"Northtime" : "9:30",
22		"West": "In playground Bruggert there is a painting and drawingclub every wednesday from 10:00 - 11:30. The adress is P. de Moulijnstraat 20.",
23		"Westlocation": "P. de Moulijnstraat 20",
24		"Westtime": "10:00 - 11:30".
25		"East": "The Liberein has got a paintingclub every mondaymorning at 9:30. The adress is Lijsterstraat 30.",
26		"Eastlocation": "Lijsterstraat 30".
27		"Easttime": "9:30".
28		"South": "In carecenter the Posten there are drawing and paintinglessons every thursday from 14:00 - 16:00. The adress is De Posten 135.".
29		"Southlocation": "De Posten 135".
30		"Southtime": "14:00 - 16:00"
31		
32		"paint" : {
46	-	"Paint" : {
60		"needlework" : f
74		"Needlework" : 🕻
88		"Singing" : {
102		"singing" : {
116	•	"Sing" : {
130	<u> </u>	"sing" : {
144		"billiards" : {

Figure 19 : Example activity in database

6.2.4 Programming

The following intents (functions) are present in Dialogflow in order for the agent to work:

- Fallback: Works if an unclear answer is given
- Welcome: Agent introduces itself
- Activity-yes: user agreed to work with the agent
- Activity-no: user does not want to work with the agent
- Activity: User has chosen an activity to do, information will be gathered from the database
- Activity-deny: The user does not want to do one of the suggested activities
- Hobby-choice: Agent lets the user choose between creative activities and games
- *Hobby-creative:* Suggestions are made for creative activities

- *Hobby-games:* Suggestions are made for games to do in Enschede
- Sports-choice: Agent lets the user choose between sports inside or outside
- Sports-inside: Suggestions are made for sports inside
- *Sports-outside:* Suggestions are made for sports outside
- Food: Suggestions are made for food
- *Booking:* Agent puts the activity in the users calendar
- *Booking-no:* User does not want to put it in its calendar.
- Bye: Ends the conversation

The activity and booking intent are the two functions that stand in connection with the fulfillment section. The Activity intent retrieves the data about the different activities that are held in Enschede. The Booking intent converts the time and date to the Google private calendar of the user. This code can be found in Appendix D.

6.3 User example case

In Chapter 5 (Ideation), 2 personas and user scenarios were created. In this user example case the usage of the prototype is explained with the help of the persona Gerrit van Dijk. Because the Google Home system makes use of only speech and can thus not be documented, the case is shown on the Google Assistant extension which is available on the smartphone.

Short recap: Gerrit lives in the Wooldrik neighbourhood in Enschede, which is located in the East. Gerrit enjoys being active and going outside. His wife had died, this caused Gerrit to become quite isolated and dependent on itself for going out of the house.

Alright. Getting the test version of my test app.Hil I am the Social Activity Agent. Would you like to plan an activity for you to do together?	That sounds great! There are a lot of different options to do for elderly in Enschede. What kind of activity would you like to do? Please choose one of the following options: 1.Hobby, 2. Sports, or 3. Food.
Ves please That sounds great! There are a lot of different options to do for elderly in Enschede. What kind of activity would you like to do? Please choose one of the following options: 1.Hobby, 2. Sports, or 3. Food.	I choose option 2. Sports I Choose option 2. Sports I Choose option 2. Sports active. Keep in mind that for this option you need to have a good mobility. Do you enjoy doing sports outside or do you prefer doing sports inside?
Suggested input	
1. Hobby 2. Sports 3. Food	Suggested input
cancel	Outside Inside cancel
Input 	Input Try typing or saying "Talk to my test $\varepsilon \Psi$

Figure 20: Introduction agent

The agent introduces itself and asks whether Gerrit would like to plan an activity. Gerrit is offered 3 different kinds of activities to do. He can choose between: Hobby, Sports or Food. Since Gerrit is quite active he chooses the sports option. He is made aware of the fact that he needs to have a good mobility for this option. The agent asks whether he wants to do sports outside or inside.

Doings sports is fun and it lets you stay av in mind that for this option you need to ha mobility. Do you want to do sports outside	stive. Keep ive a good e or inside?	I suggest the following activities for you to do: walking or cycling. Which one of these would you like to do?
I love being	g outside 📃	Walking
 I suggest the following activities for you walking or cycling. Which one of these w to do? 	to do: ould you like ৰ)	In which part of Enschede would you like to do this activity? Please choose between North, East, West and South.
Suggested input		Suggested input
Walking Cycling cancel		cancel
Input	iy Agent". 🎐 🕅	put • • Try typing or saying "Talk to Social Activity Agent". • •

Figure 21: Choosing an activity

Gerrit really enjoys going outside to get some fresh air, he often goes to the park. In the Google Assistant application the user also gets to see suggestion chips and can choose to tap these instead of typing or telling the answer. The agent suggest him to go walking or cycling. Gerrit would like to go walking with others.

 In which part of Enschede would you like to do this activity? Please choose between North, East, West and South. 	The NIVON walking club walks together every fridaymorning from 9:30 - 11:30. The adress is Dotterbloemstraat 120. Would you like me to put this activity in your agenda?		
East East East East East East East East	Yes please At which date do you want to go there?		
Suggested input cancel	Suggested input cancel		
Input	Input		

Figure 22: Getting information and the possibility to add the activity to the Google Calendar

Since Gerrit lives in het Wooldrik, which is located in the East he chooses to attend an activity in this neighbourhood. The agent provides Gerrit with information about this activity in the neighbourhood. Lastly he gets the option to put the activity in his calendar application. Gerrit thinks this is a good idea.

At which date do you want to go there?	And at what time do you want to leave from home?
On friday the 21st of June	9:15 AM 📟
And at what time do you want to leave from home?	 Got it. I have your activity scheduled on Friday, June 21 at 9 AM. I hope you will have fun!
Suggested input cancel	Suggested input
Input	Input Input Imput Try typing or saying "Talk to my test a Up to my test and the my te

Figure 23: Making a calendar appointment

The agent asks when Gerrit wants to go to the activity and at what time he wants to leave home. Since the activity is quite nearby he decides to leave 15 minutes in advance.

The activity is added to Gerrit's calendar and he will be reminded by the Google Home system. He can ask Google himself for his appointments but Google will also tell him his upcoming appointments every morning, reminding him actively.

> Figure 24 : Calendar appointment

Today		Day Month		C +		
June 2019						
S	М	Т	W	Т	F	S
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	1	2	3	4	5	б
Friday, June 21, 2019						
9:15 AM Activity Calendar Walking						

7. Evaluation

7.1 Elderly Assessment Usability Google Home System

In order to see whether elderly would be able to make use the simple functions of the Google Home system, an assessment was done in an elderly community center from Amstelring Dagbesteding in Hoofddorp. The Google Home system was presented and its basic features were explained. The interview focused on usability of the Google Home system, not loneliness itself.

7.1.1 Participants

Interviews were conducted at the community center Duycker in Hoofddorp. The interviewees were al 65+ and they lived independently in the neighbourhood. The researcher had permission from Amstelring Dagbesteding to conduct these interviews. A total of six participants were interviewed.

7.1.2 Procedure & Format

Persons participating in the activity were asked if they wanted to participate in the interview. When agreed to cooperate, the researcher and participant(s) proceeded the interview in a private setting. Before starting the interview, the participant was informed about the goal of the research and the fact that he or she could stop the interview at any moment. During the interview, an explanation about the Google Home and a Demo were given. Questions regarding the usability of the Google Home were asked. The participants had the possibility to try out the Google Home for themselves. Every interview lasted for about 20 minutes. All of the interviews were conducted in Dutch.

7.1.3 Questions

The questions and explanations for the interviews can be found in Appendix E. The interviews were semi-structured, follow-up questions could be asked, depending on the participant and the course of the interview. Answers to the questions were written down with the usage of keywords on a pre-made answer form.

7.1.4 Results

Technology

All of the participants were in the possession of a smartphone and they mainly used it to stay in contact with their family and friends. They did this via applications like Whatsapp and Facebook or by old fashioned calling and texting.

Four out of the six participants knew the Google Assistant, Google Home or Siri. All of the participants tried out the possibilities of the Google Assistant and were enthusiastic about the different possibilities. Opinions on the usage of the system deviated, whether someone would use the Google Home really depends on the person themselves. Some of the participants were really interested in new gadgets and the latest technology, whereas others were not. Two participants thought that it really depends on whether someone has children or not. Having children means being exposed to the newest technology and applications, which can provoke more interest.

Activities

Participants felt that attending interesting activities in their neighbourhoods can be quite hard, since there is not one clear overview. In this regard the created prototype could really be beneficial for them. Besides the prototype, also a website with a clear overview of all the available activities in Enschede should be launched.

Participants really enjoyed activities which involved food and music, since these kinds of activities give of a welcoming feeling to them. Going to activities alone can be a boundary for some elderly. Several participants attended the activity with a close friend, but there were also participants who attended the activity alone and established new contacts. The prototype is designed for users who are at ease with going alone to an activity. In order to include others who are finding it more difficult to go by themselves to an activity, the Agent could give users the suggestion to invite an acquaintance.

The idea of an Agent that helps elderly attend activities and get in touch with others, appealed to the participants. They had the opinion that, if performed correctly, the Agent could make it easier for them to get to know about the activities in their neighbourhood. Whether the participants would use it again really depended on the type of person, half of the participants thought they would like to try it out.

7.2 Functional User Testing Prototype

7.2.1 Participants

The functional user test has been conducted with participants from different ages who are fluent in English. The language in which the prototype works is in English. English has been chosen over the Dutch language because the speech recognition and pronunciation in English are currently much further developed compared to Dutch in the Google Home system. There were a total of 24 user testers. The user testers can be divided into 3 different age groups: 18 - 29 years old (group 1), 30 - 59 years old (group 2) and 60+ (group 3) years old. This distinction in age has been made in order to see whether there is a clear difference in functional usage between youngsters and elderly.

7.2.2 Procedure & Format

Participants were guided to a room were the set-up was present. Before starting the interview, the participant was informed about the fact that he or she could stop the user-test at any moment. Firstly, the main purpose of the prototype and research were explained. An explanation was given on how the prototype works and how to use it. Participants were given the task to make use of the Social Activity Agent and schedule an activity to do. After finishing the task, they were asked to fill out a question form regarding the task they just completed.

7.2.3 Questions

Questions asked during the user test can be found in Appendix F. Participants were provided with a Dutch questionform.

7.2.4 Results

The functional user tests were performed with a total of 24 persons. Group 1, 18 to 29 years old consisted out of 12 participants. Group 2, 30 to 60 years old existed out of 8 participants. And lastly group 3, 60+ years old contained 4 participants. Participants were retrieved from the researchers social circle and at Ecare Innovatie.

The majority (83,33%) of the participants knew the Google Home system or a similar system, see Chart 19 below. In group 1 and 2 almost all of the participants knew the Google Home system, whereas in group 3 this was more divided with 50% knowing the system and 50% not knowing the system.



Most of the participants seem to agree (54,20%) or totally agree (33,33%) with the fact that the Agent has got an inviting tone of speaking. Only a few participants were neutral about this statement and none were disagreeing. Especially group 3 totally agrees (50%) more than the other two groups.



All of the participants found the questions easy to understand with 54,20% totally agreeing and 41,70% agreeing, see chart 21 below. Group 2 and 3 both agree stronger than group 1 with this statement.



Participants found that the questions were quite easy to understand, in addition they also thought that the questions were structured in a logical way. 79,20 % of the participants totally agrees with this and 20,80 % agrees with this statement.



The majority of the participants found that it was clear what kind of answer was expected from them to give to the Google Home, 29,20% of the participants agrees and 48,80% totally agrees. However the majority of group 1 had a neutral opinion towards this statement (41,70%), younger participants seemed to be less patient with waiting until the Google Home had completely finished speaking, this might contribute to this result, see chart 23 below.



The activities present in the database are based upon its popularity and availability within Enschede, for now the amount of activities has been kept limited to two or three per suggestion. Chart 24 shows that the biggest part of participants agrees (45,80%) or totally agrees (46%) with this statement. Group 3 found the best fitting activities with 100% totally agreeing. One participant from group 2 disagrees and one participant from group 1 stays neutral about this statement.



The larger part of participants thought that the span of the conversation was good (70,80%), this can be seen in Chart 25. There were however also some participants that thought that the conversation took to long (25%), both group 1 (41,70% long) and 3 (25% too long) made this clear. A reason for this could be the fact that if an activity or location is pronounced wrong, the participants need to answer these two questions again. The same goes for telling the date and time of the activity.



23 Out of 24 participants managed to choose an activity and receive information about the activity from the database. 24 out of 24 participants managed to put the activity in the Google Calendar. All of the participants can thus be actively reminded of their appointment by the Google Home System.

Mistakes made during the usertesting according to the users:

- 'Google Home did not recognize the time that I gave.'
- 'I talked too fast'.
- 'I did not pronounce my answers clear enough, the Google Home could therefore not retrieve the correct information.'
- 'I am not used to telling the time with AM and PM.'
- 'I gave the wrong kind of answer.'
- 'I was too slow with answering.'
- 'I was too fast with answering.'

When an error occurred participants often talked too fast or they did not pronounce a word correctly. Likewise, some participants were too fast with answering, when the Google Home was still talking to them. Using a Google Home system more often can give users more experience in talking to the Google Home, overcoming these mistakes.

Sometimes an answer was given in a correct formulation but one that the Google Home system did not recognize, this caused the Google Home to ask the participant to answer the same question again. The more the Agent is used, the less these errors will occur. All of the logs and errors can be reviewed, making it able to keep on improving the system.

Positive comments about the agent:

- 'Choosing an answer was really easy.'
- 'I liked that the Agent gave different options to choose from.'
- 'The agent helped me in choosing a cool activity.'
- 'Interesting to check this technology out!'
- 'I should use this technology more.'

Especially older participants who did not know about the Google Home before were often surprised about the possibilities of the technology. They found the technology really innovative and easy to use, therefore they wanted to make use of it more often.

Tips given by participants for the development of the agent:

- 'Put more activities in there.'
- 'Include an option in the Agent for repeating a question.'
- 'The Twentse accent can be tough to work on the Google Home.'
- 'Develop a Dutch version of the Agent.'
- 'Put the given activity information also in the Google Calendar.'

The given information about the activity should also be put into the Google Calendar, right now only the name of the activity is displayed. It has to be possible to look up the information about the activity in the Google Calendar.

Information was given about the time and location of an event, but some participants did not remember these correctly. In the current prototype it is not possible to let the Agent repeat a question or answer, this can be a great addition to the Agent e.g. if the user did not understand the question correctly or if the users want to hear the information over again.

Hopefully in the near future also the Dutch language will get an upgrade, right now the English language is in the second version whereas the Dutch language is still in its starting version. This will make it possible to also create the current prototype in Dutch and maybe even in a local accent like Twents.

7.3 Requirement Analysis

In chapter 5, Ideation. A list of requirements for the prototype was set up. Considering the outcome from the prototype and user testing, the initial requirements will be reviewed.

Must	The prototype cannot work without these features	Outcome:
	Must be easy to understand, by guiding the users using the right questions.	\checkmark
→	User tests proved that the participants thought that the questions were easy to understand	
	Must have a backend database of activities especially for elderly in the neighbourhood of Enschede.	\checkmark
→	The prototype is connected to a realtime database that includes information from activities for elderly within Enschede	
	Must take into consideration the location of the user, this takes into account the mobility of the user.	\checkmark
→	The Agent asks the users were in Enschede they want to do an activity. This can be made even more precise by using for example GPS.	
Should	Important aspects but not vital	Outcome:
	Should be able to understand the preferences from the user, resulting into better suggestions for activities to do.	\checkmark
→	 Preferences from the users are filtered upon choices they make by answering the Agent. The 3 main types of activities are 1. Hobby: Creative activities and games 2. Sports: Both outside and inside 3. Food A possible option for the future is using a algorithm which predicts 	
	suitable activities based upon the users preferences.	
	Should have an inviting and welcoming tone while speaking towards the user.	\checkmark
→	User tests proved that the participants thought the tone of speaking was inviting.	
	Information put into the database should be reliable and correct	\checkmark
→ 	Information present is checked and put into the database. Right now this is done manually from various sources. Others can also add their activities within the 'general database' of Enschede, these new activities should also be checked beforehand.	•
Could	Nice to have	Outcome:

Could be able to work with an agenda application, showing a visual change when an activity is planned.	\checkmark
Users are able to put their chosen activity within the Google Calendar. The Google Home system is able to actively remind them beforehand of their activity. Users tests showed that information present within the database should also be added within the appointment, including the location and time.	
Aspects that can be given up on	
Also be able to work in Dutch	Х
The English language is much further developed within current speech technology, therefore the prototype was first build in English. For the development of another agent completely in Dutch, more time was needed. This is preferably done when the Dutch	
	Could be able to work with an agenda application, showing a visual change when an activity is planned. Users are able to put their chosen activity within the Google Calendar. The Google Home system is able to actively remind them beforehand of their activity. Users tests showed that information present within the database should also be added within the appointment, including the location and time. Aspects that can be given up on Also be able to work in Dutch The English language is much further developed within current speech technology, therefore the prototype was first build in English. For the development of another agent completely in Dutch, more time was needed. This is preferably done when the Dutch

Table 7: Requirements Analysis
7.4 Ethical risk sweeping

A product or service must be ethically justified. Ethical risk sweeping is therefore important before a product or service is launched upon the market. Assuming that this system will be used within multiple cities, different ethical risks can be identified:

1. **Trust:** The technology used should evoke trust between the user and the product. Since the technology will be talking back to the user, elderly might become frightened. This cannot happen, the product should evoke positivity. Especially using technology can be hard for elderly, they should be willing to use the design and feel at ease with the product.

Solution: The conversation should be designed in such a way that the system is inviting to use. Hence the usage of words and phrases has to be welcoming, friendly and positive. The designer should put oneself in the shoes of the user and design the conversation in such a way that the user feels that the Social Activity Agent can be trusted. (See Chapter 6 for the dialog)

2. Access for every person: Nobody is the same, everybody has got their own norms and values. The product must be accessible for every senior user. From every ethnicity, all religions and different cultures.

Solution: The database should include activities that are accessible for all people. So different religious activities, different cultural activities and a great variety of creative and sports activities to choose from. No people will be left out. (See Chapter 6 for the variety of activities)

3. **Database information:** Information that is put within the database should be reliable. No fake activities or events should be present. Fake data can mislead the user, making him unwilling to use the system again.

Solution: Before an activity can be definitely added within the database, the activity needs to be checked on reliability. One person or employee must receive this important task, with the result being that all of this data is correct.

4. **Privacy**: Data gathered by conversations held between the user and the Google Home should be protected. Personal information will be shared between product and user. This information should be held save, making the elderly willing to use this product and making them eager to talk.

Solution: Information about preferences and location needs to be gathered in order for this system to work. The personal data of the user has to be stored in order with the Dutch law, meaning that it cannot be shared with others and only used if it is needed by the system. The personal data will be protected from danger in this way.

7.5 Discussion

The goal of this project was to reduce social loneliness in daily life of older adults living at home using the Google Home system. This has been conducted in a step-by-step approach, which led to a final design. The project had some implications which need to be discussed.

A State of the Art research and literature review led to the choice of the Google Home system as main technology to use. Research was needed, expert guidance gave a better understanding of loneliness within the elderly community and the usage of the Google Home system. The online survey was answered by 151 respondents, these respondents were divided within 3 different groups. Group 1 (Community nurses) had 122 respondents, group 2 (caregivers) had 8 respondents and group 3 (respondents with elderly in their social circle) had 21 respondents. The reason for this big difference is the fact that BuurtzorgWeb helped in getting the most responses, making this group count the heaviest within the results. A follow-up research could be conducted, which also gets more input from the other two groups via different channels with more into-depth questions.

All of the groups thought that social conversations are needed in order to reduce loneliness, but group 3 was more positive about this thought. It could be that group 1 and 2 are more critical when talking about loneliness, since they actually work with elderly themselves whereas group 3 spends less time with the elderly. Having a social conversation with the Google Assistant was perceived rather neutral, respondents were not sure if this was the best solution, group 3 was however more on the agreeing side than the other two groups. This can again be the cause of group 3 not really working together with the elderly, making them a bit less critical when giving an answer. When asked whether a user would feel less lonely by calling through a social assistant, the average response was absolute, human to human contact is preferred over human to computer contact. In this case however, group 2 was more critical with also a few respondents disagreeing. A possible explanation for this result is that group 2, the caregivers, spend more time one on one with a client. Meaning that their answer is based upon one client's personality.

The results of the online survey and interviews were used as a base for the Ideation and Realisation phase. By connecting the two ideas of social conversations and activation the concept of the Social Activity Agent was created. The decreasing mobility and type of neighbourhood needed to be taken into account. This has been done by asking the user in which part of Enschede they want to conduct the activity: North, East, West or South. For a small town like Enschede it works, however for a big city e.g Amsterdam or Rotterdam this would not work. There the town would have to be split in more areas. Suggestions based upon location (GPS) would be a great solution for this.

Scenario writing and iteration lead to the final conversational scenario. The construction of the Database was conducted with the conversational scenario in mind. Activities were chosen upon popularity and availability in Enschede. This could mean that some activities were not taken into account because they were only given in certain parts of Enschede . In a second version of the prototype, a bigger variety of

activities should be present.

The elderly assessment and functional user testing gave a good understanding of the current status of the prototype. Whether someone would use the Social Activity Agent really depends on the kind of person, some elderly are more interested in technology and gadgets than others. Next to this, going to an activity can be quite tough for some elderly. Possibly the Agent can suggest the user to take a close relative or friend with them.

Overall the results from the user tests were positive, meaning that almost all of the requirements were met except for the Dutch version of the Agent. A bias within the user testing was the fact that some participants pronounced their answers in English not accurately enough. This resulted in the Agent repeating the questions. Next to this, a few correct formulations were not immediately recognized by the Agent. The more the Agent is used within the future, the less these errors will occur. All of the logs and errors can be reviewed, making it possible to keep improving the system. Definitely an option for repeating an answer should be implemented, so that users are able to listen to something over again. Lastly, within the Google Calendar appointment the information present within the database has to be added, making it possible for the users to read the activity information again if needed.

7.5.1 Limitations within the studies

There have been a few constraints within the research, target group and prototype. As mentioned earlier, the amount of respondents within the research was unevenly distributed. This made the average opinion very heavily depend on group 1, the community nurses. For the interviews, only 7 employees were questioned. A general result could be generated, but their personal opinion can be heavily dependent upon personal opinions. The same thing can be said about the elderly assessment, only 6 persons were interviewed in this case. A bigger sample size could have given a better overview of the current situation, this was however not possible due to time constraints.

The research was based upon the most used features of the Google Home system. Other not so well known features could also have led to a final concept for the prototype, but in a completely different way. Other less well-known features can be explored and possibly be implemented, leading to a better Agent. During the realisation of the realtime database, it became clear that there is not one general overview present of the different activities that can be done within Enschede. The researcher therefore created the database herself based upon the conversational scenario, availability of activities within the different neighbourhoods and their overall popularity. This can also be a real big problem for elderly trying to find activities which they can attend in Enschede.

As discussed within the Prototype Realisation, another great possibility is to use the Social Activity Agent on a smartphone or tablet. Users can read what the Agent will be saying, this might be easier in usage than the Google Home. Thereby, there are also suggesting cards available for the users. It was not possible to user test this possibility within the functional user testing due to time constraints, a bigger sample is needed.

8. Conclusion

Older adults and loneliness was the starting theme chosen for this Graduation project. By conducting a literature research, two different types of loneliness were investigated. Also reasons for loneliness and possible consequences were explored. The choice was made to focus the studies on social loneliness, since the social circle of elderly becomes gradually smaller as they become older. With the help of a State of the Art investigation looking into different technologies, the Google Home System proved to be suitable and innovative in usage. Therefore it was decided to create a Google Home System Agent to reduce loneliness among older adults.

Research was needed to get a better insight in the needs of older adults in regard to loneliness and the Google Home system. An online survey was held and interviews were conducted with Buurtzorg employees. This resulted into a final concept, the Social Activity Agent. An Agent especially designed to activate and connect elderly by planning activities together. Personas and user scenarios gave insight into the target group and their requirements.

A working prototype was realised. This prototype can suggest a variety of activities to do for older adults within Enschede, based upon their interest and location. Afterwards the chosen activity can be put into the Google Calendar. By doing so, the Google Home can actively remind the user of its appointment. It can be concluded that the created prototype can bring older adults together in a social atmosphere, reducing their social loneliness.

8.1 Recommendations for future research

Based upon the discussion and the studies as a whole, several recommendations for future research can be made. A second round of user testing can be conducted, in these user tests both the Google Home and Google Assistant will be tested to see whether one of these options is preferred over the other by users. When the Dutch language gets an upgrade within the Google Home system, there definitely has to come a Dutch version of the Social Activity Agent. Talking in one's mother language will always be favored over a second language.

The elderly assessment and user tests gave different options for improvements. Participants made clear during the interviews that finding an overview of all the activities within their neighbourhood is really hard. This has also been experienced by the researcher within the Realisation phase, a database has been created based upon various resources. The current database could also be published upon a website, making it easier for elderly to find activities which they like. The second thing that came up within the elderly assessment is the fact that some elderly find it difficult to attend an activity by themselves, the Social Activity Agent could give the suggestion to attend the activity with a close friend or relative. This will make it easier for the user to join an activity and socialise with other people.

The functional user testing showed several opportunities for improvement. The information that is present within the database should also be added within the Google Calendar appointment. By doing so, the user can at any time have access to the right information and location of the event. A second improvement that can be realised is the possibility to let the Agent repeat the given information or answer. Sometimes the user will not hear an answer given correctly, making it difficult to continue with the conversation.

When the Social Activity Agent is developed for a city bigger than Enschede, e.g. Rotterdam or Amsterdam. A better option for determining the location of the user has to be implemented. The location based upon the GPS location of the user seems to be the most convenient option. By implementing the GPS location of the user, also a question within the conversation can be taken out. Next to this, the activities within the database have to be expanded. The Social Activity Agent can then make more suitable and interesting suggestions of activities for the user to do.

The Social Activity Agents suggestions can be based upon the interests and personality from the user. The possibilities for development of a recommendation engine, steered by a machine learning algorithm, can be explored. More suitable suggestions for activities will be given, making the probability of the user attending an activity bigger. Lastly, the possibility of linking users can be explored. When users live within the same neighbourhood and their interests are alike they can be paired up by the Social Activity Agent. The Agent can suggest for them to attend an activity together or they could meet up for a drink in their neighbourhood, eventually becoming acquainted with one another .

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10. Appendices

10.1 Appendix A: Explanations in Online Survey

Introduction

Dear Reader,

This online survey is meant for a research project concerning social loneliness within the elderly community. The goal of this research is to see how technology can be used to reduce this loneliness. This research is conducted at the University of Twente in collaboration with Ecare Innovatie B.V. For a more elaborated explanation please visit:

<u>https://sites.google.com/student.utwente.nl/thesis-mirel-nijhuis/nl</u> For contact you can approach Mirel Nihuis (<u>m.f.nijhuis@student.utwente.nl</u>)

This survey is completely anonymous and will only be used for scientific purposes. The survey has got in total 18 questions, from which 2 are open. At the bottom of the screen, your progress can be seen. Filling this out will take less than 10 minutes. You can decide at every moment to quit with the questions. Thank you in advance for filling this out!

Explanation Voice controlled systems

A voice controlled system is a system that is controlled by the use of speech. Popular examples of voice controlled systems are the Google Home and Amazon's Alexa. These speakers often stand in a central space like living room or kitchen. Popular functions of such systems are asking for information, listening music, calling and reminding functions. Controlling such a system happen by asking a question. Simple examples of questions are: 'What will be weather by today?' or 'Can you play this song?'. The development of this technology goes really fast and it is already possible to have whole conversations. Such a system could be used as a 'social assistant'. The technology is easily usable and really accesible. It is not needed to use a laptop or smartphone to control the system. For my research I want to look into the different possibilities of using a 'social assistant' in reducing loneliness, conversations are a form of interaction that can evoke social feelings.

Youtube video link: https://www.youtube.com/watch?v=5bYSX2C4aWc

Picture:



10.2 Appendix B: Questions Online Survey

Question:	Participant Groups:			Explanation:
	1. Community nurse/caretaker			MC = multiple choice
	2. Caregiver ('mantelzorger')			ST = statement on a scale from 1 – 5.
	3. Elderly in social circle			With 1 being completely disagree and 5
				being completely agree
	1	2	3	
1) Introduction				
1. In which way are you concerned	Х	х	Х	MP, used to divide the different
with the elderly (65+)?				participant groups.
2) Elderly and Loneliness				
2.1 Do you have the feeling that a	Х			MP, get insight in whether caretakers
number of your clients experiences				have clients who experience loneliness.
loneliness?				
2.2 If so, what are the main reasons	Х			Open, get insight into the different
for this loneliness?				reasons for loneliness
2.3 How many of your clients make	х			MP, see how many elderly make use of a
use of a mobile phone?				technology used by the majority of
				people.
2.4 What kind of mobile phone do	Х			MP, see which kind of phone elderly use
your clients have?				most.
3) Elderly and Loneliness				
3.1 Does the person that you take care		Х		MP, see if the person they take care of
of experience loneliness?				experiences loneliness
3.2 If so, what is the reason for this		х		Open, get insight into the different
loneliness?				reasons for loneliness
4) Statements Elderly and Loneliness				
4. Elderly can feel less lonely by having	Х	Х	Х	ST, see in what way the participant group
social conversations.				thinks loneliness can be reduced.
5. Elderly can feel less lonely by	Х	Х	Х	ST, see in what way the participant group
listening to music.				thinks loneliness can be reduced.
6. Elderly can feel less lonely by an	Х	Х	Х	ST, see in what way the participant group
active reminder.				thinks loneliness can be reduced.
7. Elderly have to meet with each	Х	х	Х	ST, see in what way the participant group
other in order to feel less lonely				thinks loneliness can be reduced.
5) Statements Elderly and Technology				
8. Elderly make use of technology and	Х	х	Х	ST, see if the participant groups thinks
know how to cope with this				that elderly make use of technology
9. The usage of simple technology can	Х	х	Х	ST, see if the participant group thinks
be explained to elderly				technology can be explained to elderly
6) Voice controlled systems				
10. Have you ever heard of voice	Х	Х	Х	MP, see how many know the Google
controlled systems like the Google				Home.
Home/Google assistant?				
11. Elderly could use this system after	Х	Х	Х	ST, see if the participant group thinks the
a simple explanation				Google Home system can be used by
				elderly.

12. Elderly can feel less lonely after talking to a 'social assistant'.	X	X	X	ST, see in what way the participant group thinks the Google Home can be used to reduce loneliness
13. Elderly can feel less lonely through calling with a relative via a 'social assistant'.	x	x	x	ST, see in what way the participant group thinks the Google Home can be used to reduce loneliness
14. By giving their music preference to a 'social assistant' and listening to music, elderly can feel less lonely.	X	X	X	ST, see in what way the participant group thinks the Google Home can be used to reduce loneliness
15. If a 'social assistant' gives active reminders, elderly can feel less lonely	X	X	X	ST, see in what way the participant group thinks the Google Home can be used to reduce loneliness
16. The usage of a speech system can make elderly feel less lonely	X	x	x	ST, see how the participant group views the usage of this system.
17. Do you have any tips or suggestions that can help me with this research?	X	Х	X	Open, let people make suggestions in what needs to be taken into consideration with this research.

10.3 Appendix C: Questions Interview Buurtzorg Employees

Question:	Explanation: All of the interview questions were open in order to get the participants own view on the question or statement.
1) Elderly and Loneliness	
1 Do you have the feeling that a number of your clients experiences loneliness?	Get insight in whether caretakers have clients who experience loneliness.
2 If so, what are the main reasons for this loneliness?	Get insight into the different reasons for loneliness
3. How can loneliness be reduced according to you?	See in what way the participant group thinks loneliness can be reduced.
2) Statements Elderly and Technology	
4. Elderly make use of technology and know how to cope with this	See if the participant groups thinks that elderly make use of technology
5. The usage of simple technology can be explained to elderly	See if the participant group thinks technology can be explained to elderly
3) Voice controlled systems	
6. Have you ever heard of voice controlled systems like the Google Home/Google assistant?	See how many of the participants know the Google Home.
7. Elderly could use this system after a simple explanation	See if the participant group thinks the Google Home system can be used by elderly.
8. How do you think such a system could be used in order to reduce loneliness for the elderly?	See in what way the participant group thinks loneliness can be reduced using the Google Home.

10.4 Appendix D: Fulfillment Code

```
'use strict';
const functions = require('firebase-functions');
const {google} = require('googleapis'); //agenda
const {WebhookClient} = require('dialogflow-fulfillment');
//initialize DB function
const admin = require('firebase-admin');
admin.initializeApp({
  credential: admin.credential.applicationDefault(),
  databaseURL: 'ws://socialactivityagent2-waipnf.firebaseio.com/'
  } );
//Agenda
// Enter your calendar ID and service account JSON below.
const calendarId =
'tcoge07ucda3vhgor4anpc6h1k@group.calendar.google.com'; // Example:
6ujc6j6rgfk02cp02vg6h38cs0@group.calendar.google.com
const serviceAccount = {
  "type": "service account",
  "project id": "ut-mirel",
  "private key id": "e2e884a3b610020df33ea53bd103c5faf5d623df",
  "private key": "----BEGIN PRIVATE
KEY----\nMIIEvQIBADANBgkqhkiG9w0BAQEFAASCBKcwggSjAgEAAoIBAQDYwO+atKe
NfvI/\nDBjIYwMDCRWyQq/q3hy2oBOXWP+bqxHSwsS0zWXQbuLV+0/JaN314L9yyysj23
+I\nZBBPb9UUsW1GETjPiOAGMga8x+A5tfGGoKidZ9EKxwfJ307xF2O9XypABQkmbL45\
n1jJCKnOIabiPh9M3EbFC/saX2ubmEZ9afDPcNP2t00t7h0udQeFXUx9lu1MzCHlL\nLP
RsWVKhkOHUyOSd6JUhqYr2zPeHep1NoStahP4Eu2y7t6aB5zze2F18VfJUx3Ou\naQj5x
NVnAZuogw1mIk9x2g/t+hqfKaTO4tsEUzcC/v4/rDWNtbl1kB8WeW8ClInc\nZypCM7ix
AgMBAAECggEAKyN4/GoMd8uGZHhgnU8hXBMMi6IclW03OzyQMZy/oIhz\nP2ZOlmpTo2B
SSoKeHkh99m/QwoS/dP8801Wp711kR95JEHsgeqNz7J+7ugowrOOy\nalgivtMY5mN2wB
luvWppihi81Kl76PcXA/VGoucGf+WEmyJN7eWaSSpiNXpWXn7Q\n7faFaMbkL0DSdKJSt
2TSJ3f43N0afMT4qzz6XpvzM35ZPN7JPnIX+ambtlr0WmCO\nHmRS4hiJ+VN8w7XiFXWK
rmAVnlFETA1NPNFCFU8tel11kk5ekdd9RqQ76tVzexUm\nPVDCrTUPktjbqstVIah4Po+
xGrroyV5/4qaPig7f7QKBgQD6kjf3xIjvVKO0G1yq\nPDfxBhuOk2E6adwVf/OFvw7hTX
i8ZyybOmM5mqpxNW6SSmQIVOjwKR9OBe0Hpogv\nNEAw9H4PJECCXK5pPqWNAE0ufTYys
N6cpJDb0UYdidKDQ0fHku9PEk0PqvPN3/Fq\nhpZaHZ+QhGCTha/zVcPFybMcjQKBgQDd
cyZrPZIjq5XdCc1doxfBVZYkSt4K1WHY\nXogwQaPi/pkcWe3VrFScSVnv1nHiyn9qLkm
tO3yt3RFy4a5l32t8UioY93TCNHfz\niNAK6Cf5tX+IhBlrfK5dZup/a57S9ehYN7yIRV
iJlrbOqGsVl0zylKqrVAqEXtBW\ndd43PirttQKBqQCizGV4oUSm2sMRvcVTBZUDEAjPd
YnyPd00StGZ0CyGzaLoJdCh\neioFvyuGKkUQ3yxnDWPaxZ0FQGxkUBqjMLuUEwXkKJWR
```

```
HU5kKs08/Lkov017XdcE\nxxcm+q0ne+q+SHRWqmzhXu6aq20sGxfrMk51dlG5v4hP0Mq
kvVBZLVcl8QKBgBBD\nXaXwjqP5/PaPurpOuPbk3zLpIKdxBk+KmbvZhjysb/gqDpJrpo
cXx/gaKqD6OCNH\nJPgI714hZx+lvVYT82Pc8OSGf9enXMvQ116FsDHhh20yLl+7d166q
SwUbkSV9KtN\n5JWpahgormI88ihSxT7ndfZApJoVkH1ZCKnL8gElAoGAGyxR4OSDwcNy
uuPLAUvD\nbw5JveFHRmrOrsmtPXlY9akGSbpJiLK7CNSWFj91lRwTG2doWRpEi4qW5fU
uBsUK\nsUjPi9h2E3GUcqi0Fg4HJW2HAfe0tdstdWbe3xaeSAqQ/7SCFeqKBFK14U7lDy
p8\n2cDwu9oVXpgFqN9Ii0JIb6o=\n----END PRIVATE KEY-----\n",
  "client email":
"bike-shop-calendar@ut-mirel.iam.gserviceaccount.com",
  "client id": "116475044198310272793",
  "auth uri": "https://accounts.google.com/o/oauth2/auth",
  "token uri": "https://oauth2.googleapis.com/token",
  "auth provider x509 cert url":
"https://www.googleapis.com/oauth2/v1/certs",
  "client x509 cert url":
"https://www.googleapis.com/robot/v1/metadata/x509/bike-shop-calendar
%40ut-mirel.iam.gserviceaccount.com"
}
; // The JSON object looks like: { "type": "service account", ... }
// Set up Google Calendar service account credentials
const serviceAccountAuth = new google.auth.JWT({
  email: serviceAccount.client email,
 key: serviceAccount.private key,
 scopes: 'https://www.googleapis.com/auth/calendar'
});
const calendar = google.calendar('v3');
process.env.DEBUG = 'dialogflow:debug'; // enables lib debugging
statements
const timeZone = 'Europe/Amsterdam'; // Change it to your time zone
const timeZoneOffset = '+02:00';
                                        // Change it to your time
zone offset
//var time;
exports.dialogflowFirebaseFulfillment =
functions.https.onRequest((request, response) => {
 const agent = new WebhookClient({ request, response });
const activityName = agent.parameters.activityName;
 var location = agent.parameters.location;
```

```
//var time = agent.parameters.time;
```

```
//agent.parameters.time = '15:00';
  //agent.add(agent.parameters.time + "\n \n test?");
// admin.database().ref().once("value").then((snapshot) => {
  // time = snapshot.child('activities/' + activityName +
'/Northtime').val();
 // });
 // agent.parameters.time = time;
  function handleData(agent) {
    return admin.database().ref().once("value").then((snapshot) => {
      if(location == 'North' || location == 'north') {
       var activityInfo = snapshot.child('activities/' + activityName
+ '/North').val();
       agent.add(activityInfo + "\n \n Would you like me to put his
activity in your agenda?");
      }
     if(location == 'West' || location == 'west'){
       var activityWest = snapshot.child('activities/' + activityName
+ '/West').val();
       agent.add(activityWest + "\n \n Would you like me to put this
activity in your agenda?");
     1
       if(location == 'East' || location == 'east') {
       var activityEast = snapshot.child('activities/' + activityName
+ '/East').val();
       agent.add(activityEast + "\n \n Would you like me to put this
activity in your agenda? ");
      }
      if(location == 'South' || location == 'south'){
       var activitySouth = snapshot.child('activities/' +
activityName + '/South').val();
       agent.add(activitySouth + "\n \n Would you like me to put
this activity in your agenda?");
      1
       if(location != 'South' && location !='south' && location !=
'West' && location != 'west' && location !='East'&& location !=
'east' && location != 'North' && location != 'north' ){
```

```
agent.add("It seems that you did not choose a correct
location, please try again by telling me the activity you want to
do.");
     }
    });
    }
   function makeAppointment (agent) {
    // Use the Dialogflow's date and time parameters to create
Javascript Date instances, 'dateTimeStart' and 'dateTimeEnd',
    // which are used to specify the appointment's time.
   const appointmentDuration = 1;// Define the length of the
appointment to be one hour.
   const dateTimeStart = convertParametersDate(agent.parameters.date,
agent.parameters.time);
   const dateTimeEnd = addHours(dateTimeStart, appointmentDuration);
   const appointmentTimeString = getLocaleTimeString(dateTimeStart);
   const appointmentDateString = getLocaleDateString(dateTimeStart);
   //Check the availability of the time slot and set up an
appointment if the time slot is available on the calendar
    return createCalendarEvent(dateTimeStart, dateTimeEnd).then(() =>
{
     agent.add(`Got it. I have your activity scheduled on
${appointmentDateString} at ${appointmentTimeString}. I hope you will
have fun!`);
    }).catch(() => {
    agent.add(`Sorry, it seems you already have other plans on
${appointmentDateString} at ${appointmentTimeString}. Maybe try
another day. `);
    });
  }
  let intentMap = new Map();
  intentMap.set('activity', handleData);
   intentMap.set('booking', makeAppointment);
  agent.handleRequest(intentMap);
});
function createCalendarEvent (dateTimeStart, dateTimeEnd) {
  return new Promise((resolve, reject) => {
```

```
calendar.events.list({ // List all events in the specified time
period
      auth: serviceAccountAuth,
      calendarId: calendarId,
      timeMin: dateTimeStart.toISOString(),
      timeMax: dateTimeEnd.toISOString()
    }, (err, calendarResponse) => {
      // Check if there exists any event on the calendar given the
specified the time period
      if (err || calendarResponse.data.items.length > 0) {
        reject(err || new Error('Requested time conflicts with
another appointment'));
      } else {
        // Create an event for the requested time period
        calendar.events.insert({ auth: serviceAccountAuth,
          calendarId: calendarId,
          resource: {summary: 'Activity',
            start: {dateTime: dateTimeStart},
            end: {dateTime: dateTimeEnd} }
        }, (err, event) => {
          if (err !== null) reject(err); else resolve(event);
        }
        );
      }
    });
  });
}
// A helper function that receives Dialogflow's 'date' and 'time'
parameters and creates a Date instance.
function convertParametersDate(date, time) {
  if (date.indexOf('T') > 0 && time.indexOf('T') > 0)
     return new Date(Date.parse(date.split('T')[0] + 'T' +
time.split('T')[1].split('-')[0] + timeZoneOffset));
  else
    return new Date(Date.parse(date + 'T' + time + timeZoneOffset));
}
// A helper function that adds the integer value of 'hoursToAdd' to
the Date instance 'dateObj' and returns a new Data instance.
function addHours(dateObj, hoursToAdd) {
  return new Date(new Date(dateObj).setHours(dateObj.getHours() +
```

```
hoursToAdd));
```

}

// A helper function that converts the Date instance 'dateObj' into a
string that represents this time in English.
function getLocaleTimeString(dateObj){
 return dateObj.toLocaleTimeString('en-US', { hour: 'numeric',
 hour12: true, timeZone: timeZone });
}
// A helper function that converts the Date instance 'dateObj' into a
string that represents this date in English.
function getLocaleDateString(dateObj){
 return dateObj.toLocaleDateString('en-US', { weekday: 'long',

```
return dateObj.toLocaleDateString('en-US', { weekday: 'long',
month: 'long', day: 'numeric', timeZone: timeZone });
}
```

10.5 Appendix E: Questions Elderly Assessment

Demo Google Home:

I am looking into the usage of the Google Home system for elderly. The Google Home system is a digital assistant connected to the internet. The Google Home reacts on spoken commands by saying 'Hey, Google...'

'Hey Google, how will the weather be today?'

'Hey Google, how old is Mark Rutte?'

You can make a shopping list, play music, ask for the weather, hear the local news and set reminders for yourself.

Explanation Idea Prototype

I am designing an application to use for the Google Home which proposes activities for elderly to do in the neighbourhood. It is hard to find an overview of all the activities to do in the neighbourhood, this is why I want to link a database to the Google Home. Via talking to the Google Home suggestions are made for activities that elderly can do. Its main purpose is to activate people and let people connect with one another.

Question:	Explanation:
1) Technology Usage	
1 De veu melke use of technology in deily life og e	Open see whether elderly make indeed usage of simple
1. Do you make use of technology in daily life, e.g. a	Open, see whether elderly make indeed usage of simple
television or a radio?	technology in daily life
2. Have you ever heard of speech technology?	Open, see whether elderly know anything about speech
	technology.
2) Google Home	
3. Would you like to try out this technology? Give people	See if the participant would like to make use of the
the chance to make use of the Google Home.	technology.
4. How does the participant react to the Google Home	See the reaction of the participant.
system?	
5. What do you think of this technology? Is it easy for you	Open, ask for the opinion of the participants.
to use?	
6. Would you make usage of this technology if you had	Open, would participants make usage of the Google
access to it? In what way?	Home system?
7. What do you think of the idea for the prototype? Would	Open, see how elderly think of the idea.
is make it easier for you to do some activities?	

10.6 Appendix F: Questions User Testing

Question:	Explanation: YN = Yes/No question with possibility to comment O = Open question ST = statement on a scale from 1 – 5. With 1 being completely disagree and 5 being completely agree
1) General information	
1 What is your age?	O get to know the age of the participant
2. What is your gender?	O get to know the gender of the participant.
3. Did you hear from the Google home/Google Assistant before?	O, See whether participants heard from the Google Home/Google Assistant before.
2) Statements	
4. The tone of speaking was inviting	ST, see if the participants think the sentences were inviting to listen to.
5. The questions were easy to understand	ST, see if the participants think the questions were easy to understand.
6. The questions were structured in a logical way.	ST, see if the participants think the questions were structures in a logical way
7. It was clear what kind of answer was expected from me	ST, see if the participants think that the questions in such a way that it was clear what kind of answer they needed to give.
8. An activity has been proposed to me which I find interesting.	ST, see if the participants think that the activities proposed were interesting
9. The span of the conversation was exactly good.	ST, see if the participants think the time the conversation took was right
3) Fulfillment	
10. Did you succeed in choosing an activity and receiving information about this activity?	YN, did the participants succeed in choosing an activity.
11. Did you succeed in adding the activity to the Google Calendar?	YN, did the participants succeed in adding the activity to the Google Calendar.
12. Were there any errors during your conversation?	YN, see whether the participants experienced any errors during the conversation.
13. Do you have any tips for my further research?	O, ask for tips.