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Smart Homes for Impairments

Authors:

Andreas VALEGÅRD

Daniel TIBBING

Martin BJÖRLING

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1 Introduction

There are a lot of possible ways today to solve problems for impaired people. There are a myriad of different tools available, some better and some worse.

The history has shown that there are several ways to create aids for impairments. Not all of them are good, but some are better than others. There are also some gadgets that we today take for granted, that has been developed from impairment aids, such as the remote control.

Still today, many aids that reach the market are still not very thought through, and can be improved. Or they only address one type of impairment, which can actually make it harder to use for people with and impairment outside the intended target group.

The goal of this report is to describe a solution that could have a major possible impact for a person who has one or several impairments. We will try to suggest a system that has good solutions not only for one type of impairment but several. The solution we will discuss is how the smart home can help different types of impairments.

2 Background

First we have to define what a smart home is. We have not been able to find a definition of what a smart home actually is. If we search Wikipedia for smart homes, we find the article about home automation [1] and if we search for it on Google, we find pages both for smart homes and intelligent homes.

The Swedish site *Smarthome.se* [2] has the following text:

‘... we tie together all of the home’s features enabling all controlled from a single remote as well as portable embedded in the wall or why not control your home via the internet or mobile phone wherever you are.’

We have a very similar look on how we will use the term in this report, but we will also specify the usage a little bit. In our smart home, we will look at the smart home from a view where you can steer many of the features in the home from an app in a tablet or smartphone. We will use the tablet since it easily can be carried around, and if you are in a wheelchair, we can actually make some holder for the tablet, so the user doesn’t have to carry it in his or her hands all the time.

3 Existing solutions

A lot of the existing smart home solutions with a universal design perspective do not have the same view of “smart homes” as we do. In those homes it is the design that is regarded as smart, in a more physical way, whereas in our solution the home has some technical features that you are able to control by yourself.

Livable Homes [4] has a checklist of things that should be considered when designing one of these "physical" smart homes. In this list they mention things like:

‘Provide at least one no-step entrance to the home which may be accomplished with careful grading of the walkway run.’

‘Bathtub to have non-slip bottom, and a 24" minimum full length seated drying space alongside when possible.’

Of course these are good and valid considerations, but as we mentioned before we are thinking of a more technical solution. If we instead of looking at smart homes in a universal design perspective and look at just smart homes, there are more solutions, which also are more relevant for us.

Smarthome.se [2] lists some features that would be interesting to integrate in our system. Some of the most exciting features are electronically controlled cupboards, ability to control different kitchen appliances and possibility to control the lighting in the home.

4 Our solution

We are planning on creating a smart home system in form of an iOS or Android application. We chose this because smartphones and tablets are very common and therefore not very stigmatized, at the same time it is also something that can be used for more things than our smart home app. As discussed above there already exists a lot of different solutions of smart homes, however, our solution is directly focused for people with impairments. Our goal is to, even though directed towards people with impairments, make the app attractive for everyone to use and want and thereby further reducing stigmatization.

4.1 Online account

Our idea is that an account is created online so the information and steering of the house can be done not only when you are at home but also when you are away. This also mean that it is easy to add more and new devices, without having to set everything up from the start again. This is also useful in cases where the device has to be replaced for any reason, such as theft, the device breaks or the user just wants a new one.

In the online account the user can choose which functions he or she wants to have in the app. The user can also configure the different functions to fit his or her needs. There can be many things that can be altered using the online account. The difficulty with having many features and systems is that inexperienced users may have some problem with setting up the system. We will discuss this later in the report.

4.2 Scalability

The main challenge will be to keep the interface of our app simple while still allowing the app to be easily customizable and powerful. One thing that is very important is simplicity. The system has to be simple enough so that it would

be attractive to use. If the system has too many unnecessary functions it will be cluttered and very difficult to use.

The solution to this is to make the system scalable. In the online account, the user chooses which functions he or she needs, and then configure them according to need. This way, the users doesn't have to have all the possible functions when they probably won't need them. This reduces the cluttering and helps the system feel much more usable.

We will below discuss how we think our app can simplify the lives of people impairments in general and people with different areas of impairments.

5 General perspective

There are many solutions that can benefit everyone. First of all, these solutions target many different impairments at the same time. It means that these solutions are "essentially "good for everyone", it does not matter what kind of impairment the user has, it still help him or her a lot.

5.1 Raise the alarm

Something that even people without any impairs at all have problem remembering is whether you turned the stove of or not. Modern stoves have the ability to know if the stove is turned on or off, if there is something on the plate that is turned on. Some stoves may even know if the thing standing on the plate has something in it or if it's empty. This way, the system could raise the alarm, and the user can hear that something is wrong. The app could actually be integrated in a way so that the person can turn the stove on or off if the alarm is raised.

Another alarm that can be integrated is the fire alarm. There are already existing fire alarm systems that uses radio signals to raise the alarms in a whole building, and these systems can easily be adapted to the fire alarm. In this case and if there is the possibility to make a call from the device, the user could actually be helped to call the emergency services. If the alarm comes from another room than the room the user currently is in, the app should tell the user which room the alarm comes from.

5.2 Contact information

One thing that could be integrated which basically every user is having contact information with pictures. This way the user can easily use this information when he or she wants to contact a relative or friend. The app could also have integrated functions to call the person, send email or even start an online chat session using the device.

5.3 Shop groceries

Already quite popular today among people in general is the possibility to shop groceries online and then either pick them up at the store or have them delivered at home. There is a great possibility to have this implemented as a part of the app. The problem is that it needs to contact a store, which makes it dependent on some outside partner, and it may also be very limited when it comes to areas where it may be used. Many stores may not have a large delivery area.

6 Different impairment focuses

In this report, when it comes to functions for specific impairments, the focus lies on three different areas of impairments, namely blindness, dementia and wheelchair usage. Of course the system would be able to benefit users with other impairments than the one we focus on, and many other impairment areas could be implemented into the system. The reason that only three areas were chosen was because it would be too much for this project to think of all different areas. The selection of areas was because they felt most relevant.

The solutions below may seem to be aimed at a specific area of impairment. This is partly true, but all solutions below can be for all areas of impairment. Even though certain features might simplify daily life for people with certain impairments, everyone will be able to benefit from the solution.

7 The Blind Perspective

At the first look, it may seem as a blind person would have problem using a touch interface such as the ones on the devices that this system uses. As shown in a video by a blind person name Tommy Edison, this is not the case [3]. Different haptic and audio feedback would help a blind user to use the device almost the same way a seeing person would use it.

7.1 Audio feedback

The first of those systems consists of an audio feedback whenever the user makes a choice. This audio feedback could work very similar to a feedback shown in the video clip by Tommy Edison [3]. This video shows how he uses a iPhone and getting audio feedback from all the choices that he makes and the text he writes.

7.2 Haptic feedback

The app can also have some kind of haptic feedback. Almost all smartphones and tablets today have some kind of vibrating function built in. This vibrating function could be used to help the user determine when something was actually pressed.

7.3 Weather

One thing the system also could help the user us which weather it is outside. Since a blind person probably will not be able to determine which weather it is outside, the app could help warn the user if he or she is heading out and using the wrong kind of clothes for the weather. This system can both use information from some site on the internet, or some home weather station.

7.4 Lost and found

One thing that can be a major problem for blind people is when things aren't where they are expected to be. The things you most often hear people lose are keys or wallets, but many other things can be lost. Blind people may in general

be better in not losing things, since they are more dependent on things always being in the same place when not used. But we should not expect that blind people never loses anything. Here the app could have some “find item” function which the user can pre-program. The preprogrammed items then have some kind of small location device on them, so that the system can find them and tell the user where they are.

8 Wheelchair users

Depending on how mobile the person in the wheelchair is, there is a lot of space that in that person’s home not being used since it is beyond his or her reach. The app could help in many ways.

8.1 Device holder

The wheelchair could be fitted with a device holder so that the user could bring the app with him or her at all times. This holder would be designed so it can be retrofitted depending on which device the user choses. It would also be designed so that it fits all types of chairs, and the user can have the device at many positions depending on preference.

8.2 Moving utilities

Another thing that is hard when you are in a wheelchair is reaching everywhere in a home. The system could simplify this a lot, by adding functionality to raise and lower different parts of the home. The most apparent place where this could be done is the kitchen. Here you could be able to move the stove, cupboards, sinks and many other things, to reach more easily.

One huge benefit of being able to move utilities is that if two people are living together, the impaired person may feel much less dependent on the other person. This would hopefully remove some strain on many relationships. The downside to this is that it requires specific hardware to be developed and compatible with the application, but we don’t see it as an impossible goal to reach.

9 People with dementia

To design something to be used by people with dementia has some unique difficulties. It might be very hard, if not impossible, for a person with dementia to learn to use a new technical device. Therefore, our system has to be developed with this in mind and it has to, in some way, look, feel and work like a product they have always been used to [5].

9.1 Reminders

One of the possible supportive features for people with dementia is a reminder for, for instance, medication. This could be shown as a push notification on the device, with a vibration and a signal to alert to person.

This is a quite simple function. However, a person with dementia would probably not be able to configure the settings. To do this, he or she would need help from a relative or a carer.

9.2 Sensors on cupboards

One other supportive feature could be sensors on different things, cupboards for instance, communicating with our application. This could possibly help so that the person doesn't have to go through all cupboards to find something.

9.3 Lost and found

Another feature that is quite alike the sensor-thingy is the lost and found feature discussed earlier. This would help people with dementia too, since it is easy to forget where things are.

10 Setting up the system

As mentioned before, the system can be very hard to set up. Users that have a clear brain function and are already used to both devices with touch interfaces and using online tools, will probably not have much problem setting up the system. But this is not always the case. There could be conditions that have an impact on the brain such as dementia or Alzheimers disease. Or the user isn't very used to similar devices or doesn't feel comfortable in the beginning.

In these cases, a solution could be to get help from relatives or friends to do this. This way, the helping person could educate the user and help him or her get familiar and comfortable with the system. In some cases, the helper could also help setting up the whole system and the user only uses the device to steer the different functions that are chosen.

Another solution could be that the company selling the system could also offer help in setting up the online account, choosing and configuring functions, and educate the user in using the system.

11 The Money Problem

11.1 Developing

Developing the system would probably be a significant cost. There are several parts that has to be developed from the beginning. The app that is used on the device has to be developed, and it should be developed so that it works for most tablets today. This means that it has to be developed for Android, iOS, Windows Tablet and any other operating systems that might rise in popularity. The online account system would also have to be developed.

The different hardwares for the different functions may already be on the market in some form but it still have to be retrofitted to be able to use with the system as a whole. Depending on how easy it is to adapt the different hardware, it may cost more or less to do it.

11.2 Costs for users

Depending on which functions the user choose to have in the system, he or she would have to pay different amounts. There could be a base fee for the system software (app and online account), and then there would be different prices depending on which hardware needed. This could be a problem, since hardware may be very expensive, but it could also be that the user already would buy the hardware, and paying a small amount extra to have it integrated in the system would not be much of a problem.

12 The Future

As mentioned before, there are only three different areas of impairments mentioned in this report. But there are many other areas that would benefit from a system like this. Some of these areas could be hearing impairment, dyslexia or medical impairments. These are just examples. Other functions that could be included could be “Know your refrigerator”; the system helps the user knowing what he or she has in the refrigerator, what has to be refilled or if something is getting old, or “Steer electronics”; the user steers the TV, computer or other home electronic devices using the device.

13 Conclusion

This is something that would help people with impairments in their daily lives. It is also something that would help minimize stigmatization, since smart homes are something that is considered to be “in time”. One thing in particular that may help minimize stigmatization is the use of a regular tablet as the device for steering the system. Since very many people use tablets today, and it isn’t considered strange to have one, this will not be stigmatizing.

Scalability is also a very important concept in the system. There are very many possible functions depending on the users impairments and needs, and having them all at the same time in the system will make it very cluttered and hard to both learn and use. To make it usable and attractive, the system cannot be too cluttered and have a lot of functions unnecessary to the user. The solution is to make it scalable; the user can choose which functions he or she want to have in their particular home.

There are both general functions in the system, such as alarm systems, contact information and grocery shopping, and functions aimed at specific impairments such as blindness (audio/haptic feedback etc.), dementia (reminders, sensors, lost items) and wheelchair usage (moving utensils). Although there is some distinction between these though, it is important to remember that even though certain features might simplify daily life for people with certain impairments, everyone will be able to benefit from the solution.

The system may also be complicated to set up. There are several aspects that has to be overcome, such as the user feeling uncomfortable with new technology, unfamiliarity with the new devices or different impairments that makes it hard to set it up. The solution here is to either get help from relatives or friends, or that the company selling the system offers that help as well.

References

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