Project Report

Experts in Teamwork

TDT4850 - ICT- Enabled Social Innovation for Social Good

Group 1

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Chapter 1

Introduction

In this chapter, concepts such as the theme of the village, social innovation, Autism Spectrum Disorder or the Socratic platform will be explained, followed by the presentation of the challenges, the group expertise, the motivational factor and our contribution to the challenge selected.

1.1 ICT-Enabled Social Innovation for Social Good

In September 25th 2015, the United Nations created the New Sustainable Development Agenda, which targets the Sustainable Development Goals in a near future horizon of fifteen years. There are three complementary and inclusive factors that lead us to sustainable development: environmental, economic and social factor. The path towards sustainable development is understood as a process of meeting human development goals while sustaining the ability of natural systems to continue providing natural resources. It needs to be equitable, viable and bearable, and here is where the three factors mentioned before emerge.

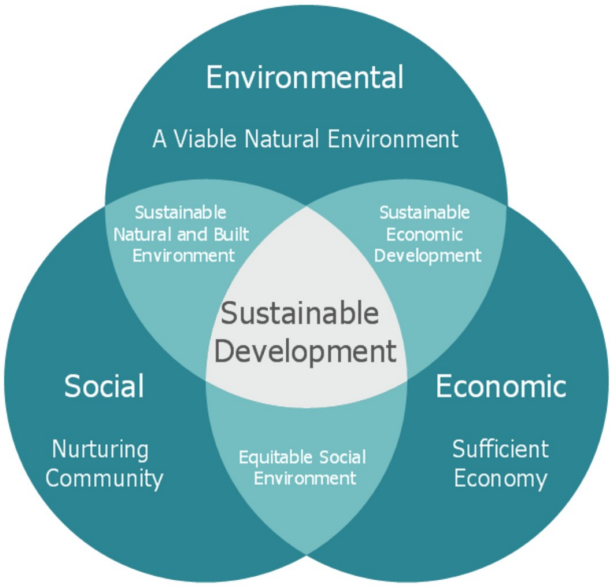

Figure 1.1: Sustainable development model (Nnamdi Azikiwe University CSD Diagram).

This project proposed for the village ICT-Enabled Social Innovation for Social Good is related with the last of these factors, which in the New Sustainable Development Agenda (UN, 2015) is included under the name "Ensure prosperity for all".

In this category it is possible to find four of the seventeen Sustainable Development Goals,

which are the follows:

1. SDG 3: Health and well-being
2. SDG 8: Decent work and economic growth
3. SDG 10: Reduce inequalities
4. SDG 11: Sustainable cities and communities

The aim of this EiT village is to collaboratively identify and propose specific innovative solutions for achieving the desired Sustainability Development Goals through ICT-enabled social innovation. In order to achieve the target of a social sustainable development this village will use Socratic, a social creative intelligence platform that fosters social innovation. (Socratic, 2016)

Talking about Social innovation means identifying a social problem through a systematic and sustainable approach and doing something positive about it. When it comes to sustainability these solutions are meant to work long term financially and with minimal impact on both the local and global environment and solve the problem not just for a short period but in a long term view. The root causes of problems should be treated instead of just treating the symptoms.

This year, the focus of the village for social innovation will be on people with Autism Spectrum Disorder (ASD).

1.1.1 Autism Spectrum Disorder

Autism is a neurodevelopmental condition which affects the brain's growth and development. It is a lifelong condition, with symptom that appear in early childhood. (Amaze, Shaping the future for Autism, 2017).

Individuals diagnosed with autism spectrum disorder present two types of symptoms: deficits in social communication and social interaction; and restricted, repetitive patterns of behaviour, interests or activities. Furthermore, some individuals also possess exceptional abilities and skills making them quite unique. Thus, some have strong visual skills, incredible tech skills, astonishing artistic abilities, an amazing facility for maths, problem solving or an unusual ability to understand and retain concrete concepts, rules, sequences and patterns.

Nowadays, many people with ASD struggle every day to interact in their social environment even if they have an average intelligence coefficient or above. Furthermore, they have a hard time adapting to the working community of modern day society. Not only is the competition for employment extremely tough, but also when finally employed it is hard to adapt to the work environment and get comfortable in all work situations. Especially people with ASD struggle with social interaction as they have a hard time picking up social clues, and change behaviour according to norms. However, recent research also shows that with earlier screenings and assistance, the life of people with ASD could improve (Socratic, 2017), and here is where the village intervene.

In this intensive three-week-village managed by the Faculty of Information Technology and Electrical Engineering in cooperation with NTNUs strategic research area Sustainability and SOCRATIC (NTNU, 2016), the students are split up in groups of five or six people, and each group is asked to propose a solution to help people with ASD using information and communications technology (ICT). These solutions are developed as a project and explained in detail in this project report.

1.2 Challenge and research questions

During the start-up of this village we were presented six existing challenges. Each team was asked to propose at least three ideas as a solution for the challenges they want to work with and the

idea that would receive best feedback among the stakeholders would be the one developed by each group. In our case, the chosen idea was a solution for challenge number 5: " Create solutions that help people affected by autism to better handle stress". In short, we proposed using emotion recognition technology for helping people with ASD in social situations. The main reason we suggested solutions to this challenge was that, not only it is hard for people with ASD to find work, but it is very hard for them to find work they are comfortable with and be able to hold on to. Stress management is key in order to make the workplace environment more comfortable, and this will benefit the employee by providing incentives to stay, and make the work easier to comprehend. With a tool to handle stress this can also make the employee more effective, and enable the person to do a better job. This might also strengthen the confidence in not risking losing the job. With this project, the first research question we want to answer in our project report is: How can information and communications technology (ICT) make social interactions easier for people with ASD? The second research question will be: How can emotion recognition technology help people with ASD manage stress in social interactions?

1.3 Group Expertise

Our group is composed by five people with different study backgrounds. The study programs represented in our group are Occupational Psychology, Childhood Studies, Sustainable Architecture, Computer Science and Political Science.

Bachelor's degree in Psychology and now ongoing master's degree in occupational psychology provides the tools and understanding from research, quantitative and qualitative methodologies, human communication and information processing and alike from psychology, and dynamics related to work environment and organizational functioning. The education also provides experience with working in teams, especially during the master's degree in occupational psychology where the courses were based on solving problems in workshops.

A background on Childhood Studies supplies knowledge and understanding on key sociological and psychological concepts focusing on its application to current social issues. Although specifically focused on children, the bringing together of perspectives from anthropology, sociology, history, and geography allows for a multi-disciplinary approach in research methodologies and fieldwork with the aim of critically examining social policies and bringing forward practical solutions to social problems.

A background in Architecture provides knowledge for creating spaces that satisfy the aesthetic, technical and functional needs while been environmentally sustainable. This kind of background also gives you crucial knowledge about teamwork and cooperation, problem solving and decision making abilities, leadership and all the technical knowledge related to computer tools for graphic design, technical drawing and media presentations.

The study of Computer Science at NTNU teaches how to create and work with many different software systems ranging from low level operating systems to high level pages using many different techniques from fields like information retrieval, artificial intelligence using specific development models like for example Scrum. Political Science provides the skills of source criticism, academic writing, and understanding of structures within government and needs and wishes of society. Understanding the needs of society is very useful in social innovation as it provides knowledge on what society benefits from, what government will appreciate and maybe also financially support.

Based on our interdisciplinary competences we have created a business plan, a prototype for an app and a marketing campaign. All the members of the team have contributed in all parts of the project, but with different main focuses. The computer science student was in charge of the programming and development of the app, as well as being a crucial consultant on what is

technically possible to do. The architecture student was in charge of the design, video presentation, gather input from the others and develop considering all needs. The occupational psychology student read up on, presented and implemented previous research of ASD people's understanding of emotions, and the issues linked with it. The student of childhood studies was in charge of presentations and marketing. Lastly the political science student was in charge of organizational structure, report writing and benefits for society. All members of our team have contributed with their individual education and interest, but everybody has also worked interdisciplinary, and challenged each other throughout the project. We have all engaged ourselves in the topic of the village, and worked hard for reaching our goals.

1.4 Motivation

Every individual has limitations in physical, social, and psychological capacities although it may be experienced in varying degrees. Persons diagnosed with Autism are particularly challenged since they have a higher degree of limitation in one or more of these capacities. Based on the information session on Autism provided by psychiatrist, Bernhard Weidle, we have inferred that for individuals in the upper end of the autistic spectrum Asperger's Syndrome can be highly functioning. However, they struggle with adapting socially.

This challenge on adapting to social situations was further described through the personal experiences of Mariana, an individual diagnosed with Asperger's in her late teens, and has struggled much in her social experiences until she was old enough to find ways and tools to be able to cope with social stress (an example of this is the use of a Walkman to block out noise and interactions around her). She has also recounted how it was difficult to adjust in a workplace and build social relations with her colleagues until she figured out a work schedule arrangement that allowed her to cope with these situations.

Our team strongly believes that this limitation does not have to hamper a person with Asperger's from having a more satisfying social life and meaningful social interactions. Mankind has developed so many kinds of technologies to address our various limitations. From simple tools to high-technology, we have developed into a stage where anything can be possible with the right research and political will to implement developments.

The motivation for our team is to take advantage of existing researches and technologies that may not be well explored as of the moment, but is available for development opportunities in order to address the needs of people with Autism by developing a technology that will hopefully aid them in social interactions and make social situations less stressful. We are aiming to produce a product that advocates for social integration and inclusion, and at the same time develop a technological concept from already existing, underexplored technologies available today.

1.5 Contribution

We want to contribute solving the challenge by creating an application for smart-glasses that work as a tool for recognizing emotions in facial expressions, to make social interaction less stressful for ASD people. Our contribution will make social interactions easier, and considering it is unavoidable in the workplace, we think that our product can make a difference in ASD people's everyday life.

1.6 Outline

The rest of our report is structured as followed. Firstly, we will provide a theoretical framework as a foundation for our product. Then, we will present our proposal for solving the challenge.

Subsequently, the methodology followed for developing the project will be explained. Later on, the findings from the project will be presented, just before the discussion about them. Finally, our conclusions about the final result of the project will be exposed.

Chapter 2

Background Theories and Related Work

2.1 ASD's characteristics and ICT

How does our application relate to the advancement in research on ASD and emotions? The next section will be the basis for how the feedback of emotions was displayed to the user (e.g.: should it be with colours or text? and how often should the view be updated?). To understand the actual usefulness of the available technology and how it could benefit people with ASD, we read several research on deficits in relation to perception of emotions in social situations. This way we could understand what attributes to focus on to help them interact with others and avoid social alienation.

The ability to recognize the emotional state of your interlocutor requires attention and focus on relevant facial features, which is a subconscious process. Avoiding eye-to-eye contact could be one of the underlying problems among individuals with Asperger's Syndrome (AS). Some studies have found evidence of a disposition to focus more on the lower part of the face (e.g. the mouth) in opposition to the higher parts (e.g. the eyes) (Grossman, Klin, Carter, & Volkmar, 2000; Klin, Jones, Schultz, Volkmar, & Cohen, 2002). Some suggests this could be an attentional strategy, rather than a difficulty apprehending the information (Lahaie et al., 2006; Van Der Geest, Kemner, Verbaten, & Van Engeland, 2002).

There is evidence that children with AS don't rely on either facial expressions or situational context on occasions where they are contradictory (Camras, 1986). Verbal intelligence has been found to be a significant predictor in decoding facial expressions of emotion, and that verbal understanding of emotions is likely to be a precondition to understand the expression of emotions across different modalities, like verbal content, prosody, body language and facial expression (Egan, 1989). There's evidence to suggest that AS is related to impaired face and affect matching relative to their performance on object matching, compared to normally developing peers (Braverman, Fein, Lucci, & Waterhouse, 1989). In Lindner og Rosén (2006) children with AS were tested on isolated modalities, and modalities in combination. AS children had more difficulty identifying emotions in the isolated modalities like static facial expression, dynamic facial expression, and prosody than typically developing children. But there was no significant difference in relation to decoding verbal content or combined modalities. The results in Grossman et al. (2000) indicated that children with AS are less likely to look for and spontaneously use facial cues of emotion in social interaction. They also found evidence that individuals with AS did worse on tasks that had mismatching words paired with facial expressions of emotion, which they suggest could indicate that they are "utilizing compensatory strategies, primarily verbal mediation, that may mask social

affective deficits under certain circumstances" (Grossman et al., 2000, p. 375).

2.2 Earlier use of ICT in relation to ASD

There exists validated computer-based interventions and tools to improve social skills in ASD individuals. One is an "avatar assistant" called FaceSay, which is an intervention using a computer-based social skills training program for children with ASD. It was tested on students with both low-functioning autism (LFA) and high-functioning autism (HFA), where they practiced attending to eye gaze, discriminating facial expressions and recognizing faces and emotions. LFA improved in emotion recognition and social interaction. HFA improved on facial recognition as well as the other two (Hopkins et al., 2011). Another example is FEFA - a computer based program for the training and testing of facial affect recognition developed at Center of Neurodevelopmental Disorders at Karolinska Institutet (KIND) (used in many different studies referenced to at http://ki.se/en/kind/fefa-a-computer-based-program-for-the-training-and-testing-of-facial-affect-recognition).

Chapter 3

Proposed Solution

In this chapter, our proposal for solving the challenge number 5 "Create solutions for people affected by Autism to better handle stress" will be exposed, including the explanation about the designing, technical details, business model and marketing campaign.

3.0.1 Description of the idea

The proposed solution is an expressions analyser app for smart glasses meant as a tool to make social interactions easier and less stressful for people with ASD. The main goals of the app is to help people with difficulties of recognizing emotions from voice or facial expressions better handle these situations and become more easily integrated in their social environment. This can be learned, for example, by observing which kind of comments trigger certain emotions over time and learning which actions trigger a positive or negative response. The app will detect emotions using either a camera, a microphone or both at the same time. It can be used both real-time and used for pre-recorded files. When an emotion is detected to be significant enough, a feedback will be displayed to the user. The way the software works is that it gives a value to all detectable emotion for each frame. This means several emotions may be significant at the same time. The group concluded that more than one emotion might be needed for providing a good feedback, but at the same time never more than two because that might cause confusion. Also the feedback should change the least possible to not take too much attention. Therefore, a continuously changing text value or a progress bar with many steps rejected. The final solution was to create three progress bars to make the feedback as stable as possible. Two progress bars might be relevant solution also, but might not be informative enough. These decisions were based on the psychological research mentioned in chapter 2.

The app will also include other features that will support the mentioned functions, which have its own subsection. In order to test the application, the group will develop an app for Android smart phones which could be part of the resulting product depending on the feedback from the target audience.

3.1 Value for the beneficiaries

The Emotiscan is a tool specially created for people with ASD to learn how to adapt in social situations, making easier for them to have a successful social life. This tool also helps them to relax during situations that are usually considered as stressful for them. By using the glasses, they have an easier social interaction so the listener can get more information about them than if them were not using the glasses.

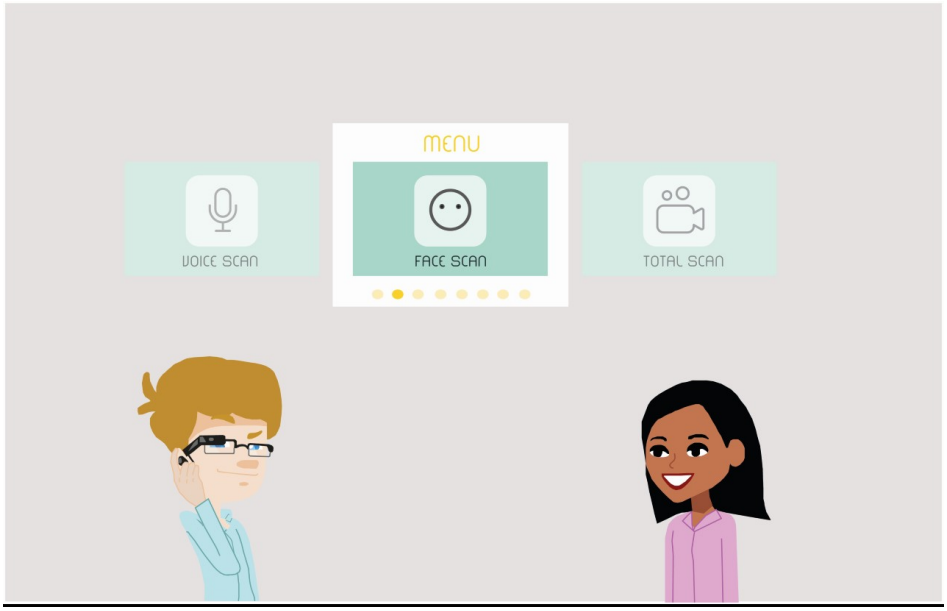

Figure 3.1: Design of the app menu in the smart glasses.

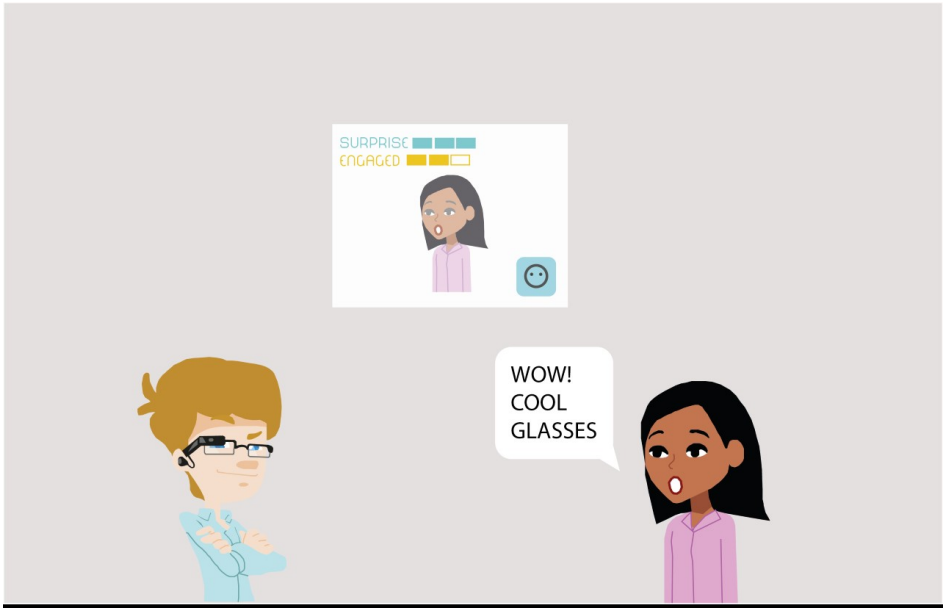

Figure 3.2: Design of the feedback received when social interaction occurs.

3.2 Impact on other stakeholders

This product will not only help people with Autism Spectrum Disorder but also will make easier for not ASD people to understand and better communicate with them. When it comes to the work environment, it also will help both employer and employee to adapt to work situations.

3.3 Technical aspects

Currently the most known developer of smart glasses might be Google, whose prototype was available for developers until recently. There are many companies that are working on their own version of smart glasses and most of them are likely to run android [1,2]. Due to this, the solution proposed by the group is firstly, to develop the application for the android operating system by using a phone or tablet for testing the app in order to develop it further. Because of the compatibility

between Google glasses and android phones most of the code that is used in the phone app can be moved to the glasses app (Figure 4). There are some components that will be directly transferable while others will need some customization before they can be used on the glasses. In Figure 4 a circle at the end of a line means that a component provides a services while the half circle embracing it is consuming the service. Most of the functionality in Android is the same across devices.

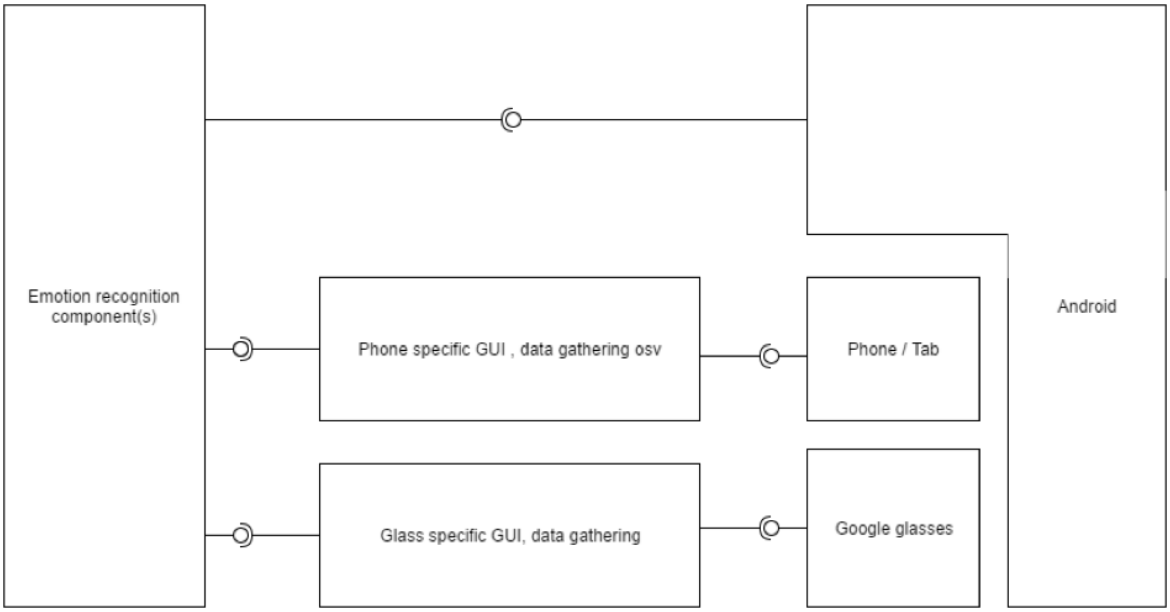

Figure 3.3: Compability of the different devices running Android.

3.4 Graphic design

Every commercial product needs an appealing appearance. Therefore, colours, typography and distribution of elements on the visual field are the most important factors during the design process of an app. People with ASD are more easily distracted than the rest of the people, hence, the icons and names associated with each function of the app must be as simple as possible, easy to understand and do not lead to second interpretations. Therefore, most of the icons used for the functions are the ones most commonly used in apps already available in the market. Thus, the icon for the preferences menu are three horizontal lines, the one for help is a question mark, the icon for the friends list is a person, for statistics is a graph, for the face scan is a face, for the voice scan a microphone, for both simultaneously a video camera and so on.

About the colours, the softer part of the pallet has been selected. Users have the option to change the colour themes of the application on their screens. These kind of colours are not that bright to be distracting but they are catchy enough to look fashionable and appealing.

Regarding to the distribution of the icons in the screen space, it has been carefully designed for making it easy to use by moving only one finger. The order of the icons has change from the first design of the menu screen to the final one. The face scan, voice scan a total scan functions have been placed on the lower part of the screen making it possible to reach them with the thumb finger, which makes less complicated to activate the main functions of the EmotiScan application. Besides, since in this preliminary version of the app it is needed to use the camera (since the real smart glasses are not reachable from our students' condition) it is very helpful as well to have the thumb near to it, in order to activate the camera or stop the scan process as soon as you want to.

Lastly, about the typography, between many of them available "La chata" has been selected. This typography is easy to read and with its soft strokes makes the app look friendly and reliable.

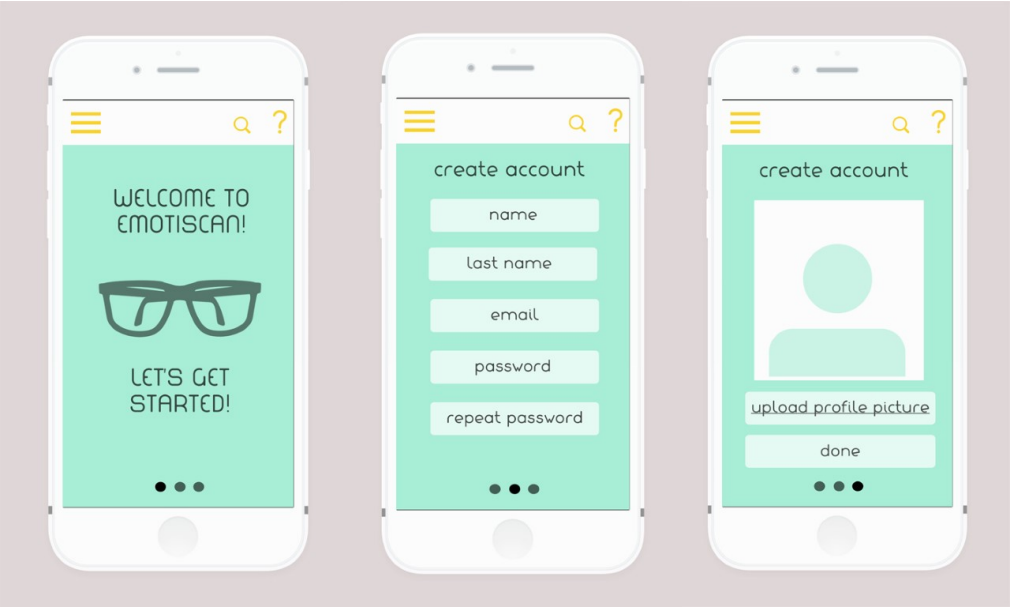

Figure 3.4: Design of the app's welcome screens in the smart phone.

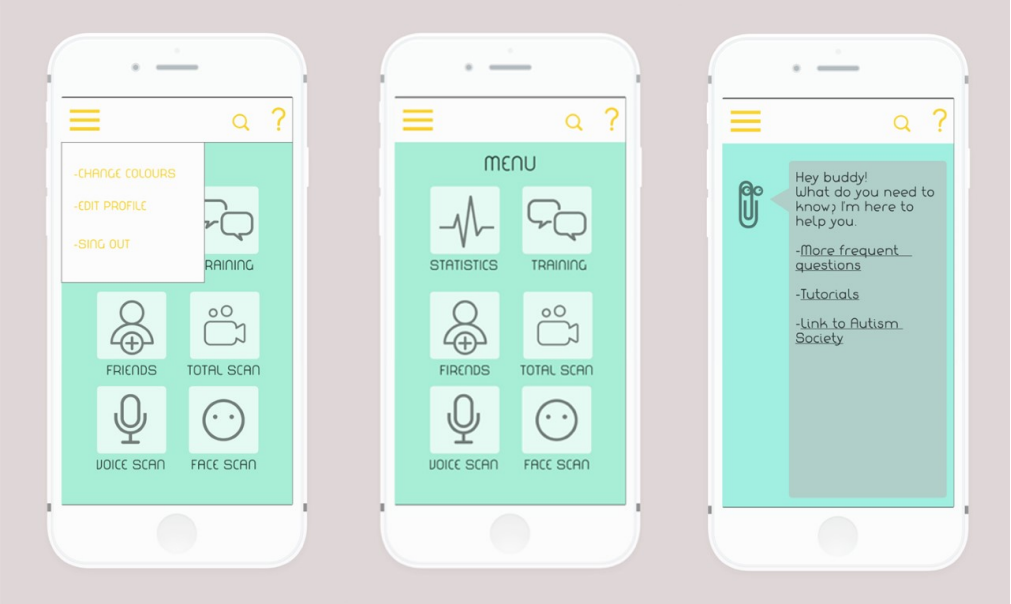

Figure 3.5: Design of the app's main menu in the smart phone.

To sum up, the graphic appearance of Emotiscan has been carefully designed to look appealing, not distracting and easy to understand.

3.5 Features of the Emotiscan app

This app can recognise up to nine different emotions, which are the follows: joy, sadness, anger, contempt, disgust, engagement, fear, surprise and valence.

To foster the target of a social environment in equitable conditions for all, the features of this app have been carefully selected in order to be complementary and helpful for people with ASD not only for an easier social interaction but also as an informative and training tool to help them improving in these stressful situations. Therefore, the main features that the final app contains are the follows:

- Face scan: this feature analyses the pictures taken with the video camera for facial features related to different emotions, and reports back the dominant emotion.
- Voice scan: analyses the tone and rhythm in speech associated with emotions. It works in the same way that the face scan.
- Total scan: a simultaneously combination of the two previous features.
- Friends: facial expressions depend on the person but also on the context. Therefore, this app also includes the option of accumulate specific information about the people the user interact more frequently with in order to make the feedback as accurate as possible. (e.g.: when your mother rise an eye brow means that she is mad at you).
- Statistics: this feature gathers data about the user' social interaction with the main purpose of keeping him/her permanently informed about his improvement in this field and to help him/her to keep in track.
- Training: with the purpose of helping the user to improve quicker and without needing real social interaction, the Emotiscan app also includes an interactive guessing game which consist in guessing the feelings just by looking to the facial expression or listening to the tone voice that appear in the game. It also includes a link to Social Guidebook^{TM} (project of group number 2) since we truly believe that his cooperation between both projects could be really fruitful for their users.

No two people on the autism spectrum are alike. All people on the autism spectrum are different and will experience autism in different ways. Due to this, the app also includes the possibility to change the colours of the different screens. In order to make it easier to use and understand, the app also count with a help button where you can search information about your particular doubts and a character in charge of communicating all the new information added to the data based system and giving the user vital information about the operation of the application.

3.6 A Sustainable Business Model

<table>
<tr><th>KEY PARTNERS</th><th>KEY ACTIVITIES</th><th>VALUE PROPOSITIONS</th><th>CUSTOMER RELATIONSHIPS</th><th>CUSTOMER SEGMENTS</th></tr>
<tr><td rowspan="2">1. Smart glasses developers
• Google
• Apple
• Other hardware suppliers for promotion
2. Augmate
• Device management solution
• Security
3. Social Guidebook Developers
• Cooperative agreement with group 4
• For more context</td><td>1. Develop application
2. Research
3. Set up partnerships
4. Get financing
5. Advertise
6. Get into an application store (Google Play)</td><td rowspan="2">1. Learning Tool
2. Social Aid
• Solves: social stress, communication problems
• We offer: emotion analyzer through face and voice scan
• Training
• Personalization
• Social context adjustments features
• Statistics

MINIMUM VIABLE PRODUCT:
• Phone application
• Face Scan
• Social guidebook</td><td>1. Autism Society
2. Early introductiom
3. Training
4. Government
5. Application updates based on feedback for development
6. Employers</td><td rowspan="2">1. Persons with ASD
2. Employers
3. Parents and family
4. Teachers
5. Doctors / Psychiatrists</td></tr>
<tr><td>KEY RESOURCES
1. Money
• Emotion and Voice Recognition Libraries
2. Researchers
3. Programmers
4. Market Analytics
5. Hardware</td><td>CHANNELS
1. Infiltrate Autism Society
2. Coordinate with the health sector
3. Public schools (high school) and parents
4. Government care center</td></tr>
<tr><td colspan="3">COST STRUCTURES
Resources:
1. Salaries and wages
2. Hardware (smart glasses)
3. Licenses
Activities:
1. Research
2. Advertisements
3. Application Development (conceptualization, design, programming, testing)</td><td colspan="2">REVENUE STREAMS
1. Free phone application (Freemium and In App Purchases)
2. Monthly subscription to glasses
3. Public funding / research funding
4. Entertainment application for generating income</td></tr>
</table>

Figure 3.6: Business plan.

The most important points of this business model is the potential partners, revenue streams and marketing. First of all, a partner with developers of Smart Glasses would be beneficiary as the goal is creating an app for their technology it requires using Smart Glasses to test the app and improve it. Partnering up with these developers might also provide some cheap advertisement as they also rely on apps being created to ensure their product remaining on the market. This way the partnership creates an interdependent relationship. Other partners important to get in touch with is group number two, the creators of The Social Guide Book. An agreement was made with them to give each other a good promotion spot in each other's apps. Because both group have the same narrow customer base, some cooperation in the beginning can be a nice jump start for both projects. The last of the most important partners are the Device Management Solution as they guide businesses in implementing software into hardware.

Let us look at revenue streams. Due to the glasses currently available are very expensive the group thought a subscription service would be the best pricing model in the start. Firstly, glasses are rented out, and when the user is done with them, they can be rented out to someone else. Re-use of technology is both cost-efficient and environmentally friendly. Applying for governmental funding is also crucial, as this innovation can be a benefit for society. Government supports projects that aim for inclusion, tailoring for vulnerable individuals, and integration. The final idea is to use the same emotion analyzation technology to create an entertainment app, and sell it for profits.

When it comes to marketing, this campaign focus on product display and demonstration. The intention is to ask the Autism Society in Trondheim for a promotion spot during their annual big event (General assembly, seminar, member meeting) to demonstrate our product. A booth will be set up outside the convention venue. The placement must be strategic so that people walking in and out of the seminar room have to pass it. The placement should be in the corridor between the entrance to the seminar room and the way out of the building. This way we assure visibility. Design should take into account visibility and appeal. It needs not only to be easy to see, but also raise curiosity and interest for people to approach and talk. This will be ensured by using the app colours (light green and black), and logo. A table is set up that is covered with the logo and colours. This way the booth looks more professional, instead of showing a simple conference table. Behind the booth there will be billboards with the app colours and pictures from the app, and of people wearing smart glasses. All the information will also will be provided in flyers. As we know that social interaction can be hard for ASD people, it is important to provide information in a written form so that they don't have to interact in order to get information. Next to the table there will be set up a station where smart glasses are secured through cables to the table. The idea is that people can try them out, and see for themselves how the app works, and try out the different features of it. The booth ought to be informative, but also interactive to give the best picture of the product. There will also be included a feedback form where people who have tried out the mobile application will be able to rate their satisfaction with the product, and also to provide suggestions and comments for further improvements that the developers can include in the application in the future.

When it comes to resources, several things are needed. First of all, staff is required to run the booth. This should be people with good marketing skills, communication skills, and really knows the customers and their needs. The second thing is a table for the booth. These can often be borrowed on location, depending on the venue, but arrangements must be made with the host. For creating a station for smart glasses a special table often seen in mobile phone stores is required. These tables have cables that connect to the product both to charge them, but also to prevent stealing, or people going far away with them. Security is important when using expensive technology.

When it comes to other materials, two large roll-up billboards or posters is needed. This is to provide visual information about the product. One of the posters should have the name,

EmotiScan, the app colours and a catchphrase like: “A must-have app for social interaction”. This is to underline what kind of business this is, and give information immediately that this is a tool in the shape of an app. On the other poster a high-resolution photo or animation of a person wearing the glasses and showing the feedback from the app is showing. A simple picture can explain the main feature of the app. These resources are expensive, and require funding. This needs to be budgeted for. The good thing is that all the equipment can be reused for other occasions. For example, the booth can be brought on a tour visiting companies that could be interested, business expos to reach even more companies, set up at the city hall to influence decisionmakers or schools to make teachers aware of the product.

Chapter 4

Methodology

4.1 The Socratic platform and methods

The Socratic platform became an essential and integrative part in the conceptualization and development of the team's project idea. Its initial use was for the team to access the challenges of our village. The challenge owners provided descriptions and other vital information necessary for the team to be able to generate ideas. Those ideas would be later developed and transformed into the solutions for the different challenges.

One main feature of the platform that became very useful in this process was the "social innovation spaces" where members can pitch in ideas. This allowed for an interactive and comprehensive repository where easy access to information and additional resources was available. The open sharing of all the ideas also helped the team to see a larger view of what the other teams in the village were working on, and this in turn proved to make way for teams to suggest on how to make ideas better and be able to connect projects together.

There were two methods found in the Socratic platform that were extremely helpful for our team during the generation of ideas. These two methods were the Brainstorming and Brain writing, and Mind Mapping. These were helpful because it allowed the members to throw in ideas and interconnect them. The platform then provided for specific spaces where members could describe the important aspects of the project such as Definition, Ideation, and Selection.

The Definition Section helped the team understand the goals of a particular challenge, as well as the specific needs of the challenge owners that needed to be addressed. In the Ideation Section, the team was able to respond to the challenges by posting a proposed idea with descriptions, value for beneficiaries, impact for stakeholders, and needed skills an resources. Filling in these sections aided in coming up with a structured planning of the project. The Selection Section was a designated space where the challenge owners could vote and provide feedback on the project ideas. However, this section was the least utilised part of the platform for our team since the comments and suggestions of the challenge owners were delivered to us through a different medium due to technical issues.

4.2 Initial Sketches

During the first stage of the design process is important that all the members of the group agree on the targets of the app, main functions and required components for its development. The team has determined the main purpose of the app which is to be able to scan facial expressions and identify the emotion associated to it. The main consideration that team has for the initial sketches is the main functionalities that the application will be able to do. We have decided that the facial scan

function was a central feature, but we also came up with the possibility of having a voice analysis feature as well. The first idea was to have them as separate functions but we have decided that there must also be an option of combining those two functions and so we have come up with the face with voice scan feature. Additionally, other suggestions came up such as adding a function where the user can keep information for particular individuals. This function was initially named "Contacts" but the team has decided to change it to "Friends" to give it a more personal feel. Also, functions for statistics and training was added as we thought it was useful for future references and for individuals to be able to learn about reading and identifying other people's emotions without necessarily interacting with people if they are not comfortable with it yet.

Thus, this first stage has been done by hand, using a SWOT analysis and sketching the ideas for its final appearance. This stage is of utmost importance since through it all the members of the group clarify their personal vision for the app and the expectations as to how it is going to perform. With the SWOT analysis and continued work on the project, the team implemented changes to the initial sketches.

4.3 Computer tools

Once the draft of the design is completed, it is necessary to translate that design to an computational language. In order to do that, the computer programs for graphic design and media presentations has been required. In order to create the vector illustrations, the main programs used are Photoshop and Illustrator, with the additional help of the online platform for vector illustration Noun Project.

Adobe Photoshop is a raster graphics editor developed and published by Adobe Systems for macOS and Windows. It can edit and compose raster images in multiple layers and supports masks, alpha compositing and several colour models including RGB, CMYK, Lab colour space, spot colour and duotone. Photoshop has vast support for graphic file formats but also uses its own PSD and PSB file formats which support all the aforementioned features. In addition to raster graphics, it has limited abilities to edit or render text, vector graphics (especially through clipping path), 3D graphics and video.

Adobe Illustrator is a vector graphics editor developed and marketed by Adobe Systems. While Photoshop is primarily geared toward digital photo manipulation and photorealistic styles of computer illustration, Illustrator provides results in the typesetting and logo graphic areas of design. It also includes a 3-dimensional capabilities allowing users to extrude or revolve shapes to create simple 3D objects. Its function Live Trace allows for the conversion of bitmap imagery into vector art.

Last but not least, in order to create the video presentation, the software used has been After Effects. It is a digital visual effects, motion graphics, and compositing application developed by Adobe Systems and used in the post-production process of filmmaking and television production. Among other things, After Effects can be used for keying, tracking, compositing and animation. It also functions as a very basic non-linear editor, audio editor and media transcoder.

4.4 Approach for doing emotion recognition

Before the EmotiScan idea was presented to the stakeholder the group had to make sure that it was actually possible to do it. Therefore, Sigurd did some quick research to find out if there was any SDK that could do this. Developing such a component would not have been applicable for this project because it would require knowledge in subfields like computer vision and interpretations of facial expressions. The group quickly found out that there were many libraries available for a

range of platforms and when presenting the idea to the challenge owners many of the results were included as examples.

When Sigurd started to look deeper at the different SDK's licenses and API's one them stood out as the easiest to use for testing in this project. Some of them required training sets to train the algorithms to get usable results while other required a relatively big financial commitment up front. The one the group chose also came with an Android SDK which made much easier to use in for example Google Glasses. A background from computer science also became handy when the group implemented a prototype app for android.

Chapter 5

Findings

Theory suggests that our application is customized to accommodate the specific characteristics of ASD individual's social behaviour and perception. In relation to the FaceScan, it's fitted to increase to which degree ASD individuals will make use of facial cues in social interaction, as well as working like a verbal mediator between facial cues and the combining of modalities to an interpretation of the emotional expression in that specific situation. This is understood as effective and relevant because of evidence of ASD individuals using verbal mediation as compensatory strategy and avoiding eye contact, or having impaired processing of emotions with isolated modalities. This could be related to speech as well, and is relevant for further development. Earlier use of ICT in relation to ASD has showed positive results in improving social skills and emotional recognition. How it could be integrated in outside support groups and research situations has yet to be discovered. This is what the application is trying explore, and our business plan and further development will try to answer such questions.

5.1 Feedback and experience from use

We developed a prototype of the application as well as an introductory/educational video on how it would be in use. This was presented to the challenge owners with individuals diagnosed with ASD present. The video was well received by the audience, with good feedback on the application's usefulness by the individuals with ASD. We also contacted an AS individual externally from the project to comment on our development and for considerations to take into account. The prototype was designed for mobile phones, but not intended for use before it could be customized for smart glasses. Some people expressed that the application could be useful as a standalone application for phones as well. In relation to this, and with more information, further more widespread testing of the mobile application will be considered.

Before such a product can be used to help people with ASD one must validate that the recognition of emotion is correct enough and that response times are so short that the product is valuable. The main testing group for this has been the team members. Because of limited time and resources, we only got to test one of the libraries that was available for emotion recognition. It was called Affdex and was created by a company called Affectiva. The software development kits offered recognition of nine different emotions in addition to some other features like age, ethnicity and gender. When displaying the values of the different emotions back to the user one have to choose what can be ignored and at which value one considers it not relevant anymore. Some emotions like engagement and valence often have a strong presence and should therefore be used to show the general attitude towards the situation, not as independent emotions. The application should be tuned to the specific usage context but right now it is oversensitive to specific emotions, and lacking sensitivity to others. To bring more facial cues into the calculation might be necessary, as

well as different libraries. The current application has not been deemed satisfactory in terms of the quality of feedback to the user, with one of the main problems being its calibration. Actual field testing and continuous adjustments are also preferable, but more resources are needed to make detailed and complex changes to the programming code.

Secondly, our next finding suggests that the app can help in several ways. First of all, ASD people can pick up social cues much more efficiently using the facial expressions technology. The app simply provides the user with information about emotions, and the person does not have to struggle with interpreting them himself. Instead energy can be used for responding rather than analysing. E-mail correspondence with the challenge owners has provided us with insight as to how well this app target the costumers. The challenge owners provided good feedback and underlined that this app could be useful for them, as social interaction would become less stressful. The feedback stressed that it is useful for people with normal or high cognitive capacity, but also for children as a learning tool. However, we will not have a clear picture of how well our app works for ASD people before we have tested it properly.

Chapter 6

Discussion

6.1 Theoretical Implications

People with ASD are very different from each other and have individual needs. This app is therefore maybe not useful for everybody. Many studies have found evidence of differences (see theory section) between AS individuals and individuals with normal development, but these results represent a statistical relevance, and is not applicable to each individual. In regards to the problems ASD individuals have in perception and emotional recognition described in the theory section. This application fills some the gaps in social interaction and perception. By giving feedback in text, and mediate different modalities to through verbal content, the application will create an effective connection between facial and vocal expressions and their related emotion. This will be communicated effectively in real time to the user, not demanding excessive attention, with the feedback being presented directly to the visual field. It will also direct the attention to the face and facilitate the users disposition to make use of this information and make further assumptions of how the different modalities relate to the verbal content, which relates to their higher functioning in combined modalities (facial expressions, prosody, and verbal content). The matching becomes to a higher degree spontaneous and effortless, and facilitate the verbal mediation used as a compensatory strategy for understanding emotions.

There's also been studies that have found impaired processing of basic emotions in speech, although there is too little evidence to make conclusions (Korpilahti et al., 2007; Lepistö et al., 2005). There is still an advantage incorporating speech in the analysis in so that it facilitates the possibility of combining modalities in perception, and using verbal content as a mediator in the same way as with facial expressions.

6.2 Practical Implications

Firstly, using the software requires a pair of smart glasses to run on. This has to be compatible with the operating system that the software is designed for, which in our case is Android. Nowadays, a pair of glasses are quite expensive. When the Google Glasses became available to the public they were priced around 1500$. Sony's version of smart glasses, which is called Smart Eye Glasses, are also available for the public and they cost 900$. However, the technology is still maturing and may become much cheaper with time. On the other hand, Google seem to be changing the target market from B2C (business to consumer) to B2B where the second business creates the specific application software, which they can sell afterwards to consumers. In other words, it might be much harder to get Google Glasses if Google does not decide to partner with you.

Secondly, wearing a pair of smart glasses might make the user stand out in a way that does not

make the social interaction better. The people who the app is used on should agree with being filmed or scanned, even though the glasses are not recording and the film will not be saved on the device. However, using them for a better understanding of social interactions and training purposes might be recommended. With commercialization of smart glasses and the probable lower pricing associated with it, the application can represent a more cost effective alternative to social skill group training (Olsson et al., 2016). Although social skill group training is to be considered a better and more rigorous intervention, many such models also requires a teams of clinicians and expertise on the specific field of study, parents involvement and so an established auxiliary system in their municipality to accommodate the need. This alternative, and an investment on it, can represent an effective way, with a lower threshold, of reaching out to AS individuals and give them much needed support in handling social interaction. This could further their social inclusion and development in relation to work possibilities, and in this way easier accessible aid programs could be advantageous.

6.3 Limitations

6.3.1 Use cases for the phone app

A plausible limitation of the phone app is that it cannot be used for analysing a video feed in real-time should not be used in social situations where the user is participating in the conversation. This is because it makes the interaction much harder if one of the interlocutors is focused on a phone screen.

6.3.2 Battery time of smart glasses

One of the main concerns of the Google glasses has been the battery time. In addition to this filming and analysing a video feed is a processor intensive task and will require much more battery than simply displaying information and notifications. This means that the use of the glasses in real time situations will be limited to short time periods. How long the battery will last is hard to say, but will depend on some of the configurations like how many emotions one is tracking and how many frames per second is that being analysed.

6.4 Future work

Future work will be related to future advancements in the field of ASD studies and development of new technologies. This would lead to further development and improvement on the existing functions, as well as adding functions that could improve the translation of features in the environment to accommodate AS individuals' perceptive skills.

6.5 Interdisciplinarity in the work

The specialization in different fields was evident, and in the project we made use of everyone's different perspectives and knowledge when designing and developing the application as well as how we approached the tasks as a team. Jakob with his experience in general, clinical and occupational psychology brought among other things concerns on how to approach the culture's understanding of diagnoses and what to take into account specific for ASD individuals. This was complimented in Marie's experience from childhood studies, on how we could account for different factors in individual development and environmental factors. Their complementary understanding made way for how the design which Marie worked with, and the technical details Sigurd was a specialist

on, could be adopted the service the needs we established as necessary to consider. The whole project needed to take society as a whole into account as well, and find realistically possible ways our ideas would be integrated into society, and what support we could find aid programs and societal structures to both integrate our solutions and accommodate ASD individuals in the best way possible. Oda, with her education in political science, was fitted to this task, and worked with the group as a whole to see how our ideas could be made possible. Marta was in charge of the designing part, from making the first sketches to the final prototype and the video presentation. In our teamwork everyone has used different tools on specific tasks related to their study, and used different macro structures to work with their fellow students to reach their goals. These different perspectives made it possible for us to adapt our work method to the wide range of tasks and concerns in a complex and multifaceted project as this.

Chapter 7

Conclusion

The development of the application has taken as many factors as possible into account, drawing from the experience of each member's field. The factors considered from theory on ASD, practical value in terms of usefulness and feedback, and the Lean business model all give support for the idea and prototype to be relevant for further development and testing. Research on perception impairment. There are limitations to consider regarding technical details since smart glasses are not available for testing, and limited resources has been available to test the application in natural settings. Through our interdisciplinary team having SCT in mind we have developed what could be a low threshold solution as an alternative or complementary to social skill groups. With the prototype functioning we have been able to receive early feedback and do testing, so that considerations and dysfunctional aspects has been mapped for further development.

The conceptualization and initial development of an application for smart glasses for individuals with ASD has been a collective effort from members of the team coming from different fields of expertise and personal backgrounds. Despite the diversity and differences, each member's prior knowledge and experience in their own fields have contributed to not only propose an idea but more importantly being able to produce an actual prototype of the application.

The team's accomplishment was possible because of a good balance of theoretical, technical, and aesthetic knowledge and skills from its members. The three members from the fields of Psychology, Political Science, and Childhood Studies have contributed largely in the organization and structuring of the project, ensuring that the ideas are grounded on existing theory and are responsive to the challenge of producing a sustainable solution to the challenge presented before them. The Computer Science student had the most valuable contribution of translating an idea into an actual product, showing not only the team but the rest of the village the boundless possibilities that a well-researched technology can contribute to society. Lastly, the Architecture student has provided the creative inputs on designs of the application that are not only aesthetically pleasing but also highly functional.

The intertwining of technology, theory, and design is representative of this team's project output. It has proven that these fields are not exclusive of each other, but rather complimentary of each other.

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