How to reduce the sedentary lifestyle of UT students through empathy and technology?

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Chapter 0: Abstract

This study will focus on how to alleviate sedentary lifestyle amongst University students through the use of empathy. Sedentary lifestyle is a form of lifestyle that does not require a lot of physical activities and most of the people practicing these forms of lifestyles tend to sit down a lot more than they should. This is an issue as sedentary lifestyle and a lack of physical activity is related to a variety of different health issues both physical and psychological. Because of this, it is important to increase the amount of physical activity for an individual and promote more active behaviour. Even walking would suffice to alleviate the issues regarding a sedentary lifestyle.

The root of the issue is that with the development of technology, most people have access to a variety of different distractions such as social media, video games and videos. The issue with these distractions is that the user is given instant gratification which thus make sedentary lifestyles feel more rewarding. Additionally, the issues regarding sedentary lifestyles are often overlooked as it is a long term issue and it is also just a risk which makes the drawback seemed less important. Another major issue is the lack of time management, University students tend to have a lot of work to do including deadlines, lectures, tutorials and exams. This may lead to a more sedentary lifestyle as students may feel like they are obligated to use their breaks more efficiently by working. Active lifestyles such as walking or going to the gym requires some energy, sometimes money and most importantly time. This makes active lifestyles appear less appealing to do especially for busy students.

To counteract this issue, the simplest solution is to make the active lifestyles more rewarding. By doing this, students would hopefully have something to gain by engaging in physical activity and they would feel secure that they are not wasting their time. As mentioned before students may feel guilty if they are not working during their free time. However, if they are rewarded for doing a certain action then they will feel less guilty into doing those activities. This is the same principle on why people are more willing to engage in distraction more so than doing active lifestyles. There are multiple ways in which to reward the users for engaging in a physical activity but the one chosen for this paper is through the use of empathy.

Empathy was chosen as it is a relatively effective way to give participants emotional support, increasing self motivation and also to reduce burnout or fatigue. Additionally empathy gives the participants some form of self reflection as well as giving them a sense of responsibility if done properly. All of this was considered as the main goal of the report is to make active lifestyle more rewarding rather than to give users an external reward for engaging in physical activity. This is an important distinction as the first example makes it so that the user enjoys participating in physical activity while the second example focuses more on rewarding them to do something that they may not take pleasure in doing.

Chapter 1

1.1 Introduction

Sedentary behaviour is a growing problem in the modern day as it has been the most common lifestyle for people in the working class and especially for those with a desk job. Sedentary lifestyle is a lifestyle that involves minimal physical activity and is usually associated with sitting behind desks. This is primarily due to the type of work associated with Universities where students are expected to sit behind their desks during lectures and work on a computer for their report or deliverables. This is also true in the case of most university students including the students studying in the University of Twente. Despite the lifestyle being a norm amongst universities, this lifestyle has been proven to correspond to a high risk of physical and psychological issues and it (Michie, 2002). Physical issues include a high risk of obesity, type 2 diabetes, stroke, certain types of cancer and cardiovascular diseases(Ford, Kohl, Mokdad, & Ajani, 2005; I.-M.; Lee et al., 2012, Owen et al., 2010) whereas mental issues include depression, stress and anxiety (Teychenne, 2015; Gibson, 2017). Most of these issues can be cured through exercising or even simple physical activities such as walking or standing.

Physical activity plays an important role in maintaining a healthy body as well as to improve mental well being. A study has shown that physical activity, relaxation and social interactions are effective for reducing stress and increasing general health (Deshpande, 2012; Hartfiel, Havenhand, Khalsa, Clarke & Krayer, 2011). The study also confirms that exercise doesn't have to be intense as walking, yoga and even meditating has been proven to reduce risks associated with sedentary behaviour. Brisk walking for 30 minutes has been known to significantly reduce the risks associated with a sedentary lifestyle (Haskell, 2007). Exercise has been acknowledged as an important part in people's physical health and yet a significant portion of the population still chooses to adopt a more sedentary lifestyle. There are many determinants for this behaviour including time constraints, cost (gym), stress, prioritization and energy among other things (World Health Organization, 2010) .

1.2 Situation

In many Universities, students have shown to adopt a more sedentary lifestyle due to the nature of their work. This often leads to a number of psychological stress and physical health issues amongst university students (Deshpande, 2012; Hartfiel, Havenhand, Khalsa, Clarke & Krayer, 2011). This may affect the overall productivity and quality of work for each student and it also increases the risk of students reaching burnout and fatigue. Healthy use of breaks has been shown to reduce a significant amount of stress when used properly. However studies have

shown that a large group of people tend to use their breaks with more sedentary based activities such as watching videos, playing games or looking through social media. In addition to this, research has shown that one of the biggest contributors to this behaviour is due to guilt of not working.

The main aim of this research project is to promote a healthier lifestyle among university students without forcing them to do so. This paper will focus more on persuading the students in the University of Twente to walk more and generally grow healthier habits. There are many ways to promote a healthier living but this paper will primarily focus on the concept of motivation and how to retain it. More specifically, the paper will explore the concept of empathy and how it can be used to motivate behavioral change.

1.3 Problem analysis

There are a number of determinants that make people more likely to adopt a sedentary lifestyle than an active one. One of the biggest contributors tend to be related by a single factor which is related to cost and return (Epstein, 1998, King et al., 2002, Owen et al., 2000). Costs can be described as any form of investment (time, money or effort) that someone has given to do a certain action. The theory suggests that any form of action should have an equally satisfying reward or results or else people would have no motivation to engage in the activity . This promotes a sedentary lifestyle as sitting down and multitasking on desktop gadgets (computer, phone, tablet etc) is relatively easy (low cost) while simultaneously rewarding (Epstein, 1998, King et al., 2002, Owen et al., 2000). Rewarding in the sense that it is fun or distracting and there are a lot of things a person can do.

Alternatively, walking outside requires more work with little to no direct payoffs as most of the benefits of walking can only be seen after a long period of time(Epstein, 1998, King et al., 2002, Owen et al., 2000). In addition to this mentality, external factors regarding consequence also pays a large role. Studies have shown that people prefer to stay near their desks so they can also remain productive or work instantly as soon as they are needed. A sense of fear is present that makes people feel guilty for taking breaks that are outside their working station (Epstein, Avrahami & Biehl, 2016).

1.4 Approach

There are a number of methods to reduce sedentary lifestyle or to promote an active lifestyle. However, this document will focus mostly on the use of empathy to promote a healthy lifestyle through exercising. The reason for this decision is because the use of empathy, particularly in the form of companionship, can have a significant change to how people perceive sports and their lifestyle in general.

There are multiple different kinds of sports, some are a lot more social than others. Several studies have shown that social support from teammates and partners have damper the effects of burnout and increase self-determination of motivation in sports (DeFreese J.D. & Smith, A. L., 2013; Pepping G.J and Timmermans E.J., 2012). Additionally, the study conducted by DeFreese J.D. also claims that perceived support from teammates is enough to motivate the athlete regardless if any actual social support was given. A study conducted by researchers at the University of Victoria have also shown that having a dog also has a positive correlation with increased physical activity. This is more likely due to the fact that pets give their owners some form of responsibility or obligation to take care of them (Rhodes R.E, Murray H., Temple V.A., Tuokko H. and Joan Wharf Higgins, 2012).

In conclusion, having some form of relationship or bond with someone or something can help reduce burnouts while simultaneously increasing personal motivation. This may help alleviate the issue with the cost and return mentality mentioned in the previous segment. This is because social support has proven to have the ability to lower the cost (reducing burnout and increasing personal motivation) and increases return (positive feedback from companion). In addition, certain relationships such as owner and pet also give a sense of responsibility that the owner has to fulfill. This gives another layer of motivation as even if the owner does not want to exercise, they might do so for the sake of their pets. The studies mentioned before also has proven that perceived social support also has a similar effect as when social support is actually given. This essentially means social support may not actually need to be present as long as the patient perceives or thinks that it is present. This means that an artificial agent may work better for this intervention as an artificial agent is able to give numerical feedback as well as scripted social support. In addition, an artificial agent can be in any shape or form such as a robotic dog that can interact with the physical world, a virtual pet on the user's phone or even a robot that gives advice during training.

1.5 Research Question

Main Research question:

How can a system that uses empathy help to create an active lifestyle?

Sub Questions:

1. To what extent can empathy be applied to motivate people to change their behaviour/habits?

2. How can technology evoke an emotional response from their user, enough to form empathy?

1.6 Challenges

The main challenge of this project is the idea of purposely designing a product that actively tries to form an empathetic bond with a user. Empathy is mainly used by two social, living beings regardless of race or species as a form of communication and bonding. This is shown by man's relationship with one another and even in pets or other animals they raised. As such it may be difficult to evoke this similar response to an object that has no "soul" but it is possible. Some examples include some people's behaviour and care towards valued personal items such as a car or an heirloom. However, most of these objects formed an emotional bond due to the individual's own beliefs and/or by accident/ circumstances. In other words, It may be difficult to evoke this emotional bond purposely. An object is also significantly less dynamic than an actual living being which makes it a lot harder to communicate as it is usually a one way communication (person to object). When it is hard to communicate, it is hard to empathize with and this forms a loop where communication requires empathy and empathy requires some form of communication. If the object gives some form of feedback (even if it is scripted) to the user then it might have a higher chance of forming an emotional bond.

In relation to the previous statement there are also other challenges related to the individual's belief. Some cultures may be more accepting than others (such as Japan) while others may disagree with it. The project will be conducted in the University of Twente, as such the users would most likely be of Dutch origin as more than 70% of the students are Dutch[1]. This may affect the project to a certain degree depending on how much the dutch culture views artificial beings. Additionally, there may be a difference in beliefs between the developer and the user in terms of what evokes an emotional attachment to non-living things. This may lead to a product that works for the developer and certain niches but lacks the mainstream appeal. This could be an issue as the product needs to appeal to as much people as possible within the UT.

Another challenge may relate to how people may perceive the agent as a toy or a game rather than a partner. This is because most people already knew that the artificial agent's responses are mostly scripted and therefore fake. As such, using the product (no matter what medium, physical or virtual) may appear as some form of escapism. This can cause a significant issue as this would mean that the product itself wouldn't be used much at all. Careful attention to design choices and implementation need to be considered in order for the intervention to work. Additionally most of these design choices would need to be experimented on to make the most effective design. This may be more difficult than simply creating a good design as societal expectations may impact the results regardless of the quality of the agent.

[1] https://www.utwente.nl/en/facts-and-figures/education/#key-figures

There are also fears and paranoia involving the monitoring of users through the use of robotics and applications into daily lives. Thus far, regardless of virtual or physical, the agent rely on certain sensors to measure the progress of the user. This can be seen as a form of an invasion of privacy by the people who issued the robot or application. Some people already have some issues regarding privacy and safety concerns of having a robot monitoring daily activities during work (Guizzo E., 2015). This is also applicable to virtual applications as there arguments which suggest that phones are already tracking people's activity. Adding a virtual agent (pet or not) does not dismiss the fact that data is taken (daily routine, GPS route and location, etc).

Chapter 2. State of the art

2.1. Literature Review

To design an intervention that promotes an active lifestyle, it is important to understand the determinants of a sedentary lifestyle. Understanding the factors that lead to a sedentary lifestyle would help create a better understanding of how the issue is formed and how it can be alleviated. Additionally, it is also important to understand how active lifestyles can be promoted. There has been plenty of studies and experiments regarding behavioral psychology specifically in the field of motivation and behavioral change.

2.1.1 Positive and Negative reinforcements

Positive and negative reinforcement in operant conditioning refers to the addition and subtraction (respectively) of a stimulus contingent on a behaviour that will encourage the behaviour in the future. For example: when a rat pushes a button and it gets food, the rat will associate the act of pushing the button with the reward. This makes the rat more motivated to push the button again in hopes of getting more reward (food). This is known as positive reinforcement as the rat is rewarded for its actions. Conversely, if the rat is electrocuted when he/she pressed the button then the rat will learn to associate the button with some form of punishment (Electrocution). This will ensure that the rodent would not press the button again to avoid getting punished. This is known as negative reinforcement as the rat is punished for doing a certain action. These principles can be applied to the current situation in a sense that positive reinforcement can be given to when the user engages in an active behaviour. Conversely a negative reinforcement can be applied when the user engages in a sedentary behaviour for too long.

A study by Justin Chumbley Suggests that positive reinforcement is more effective at inducing cooperation. The study states that negative reinforcements tend to cause some level of frustration where as positive reinforcement techniques are related to a willingness to continue and “return to play” (Chumbley et al., 2006). This essentially means that positive reinforcements can help people be more motivated to continue with the desired behaviour / intervention. Positive reinforcements can be in any shape as long as they empower the user in some way. This could be in the form of a physical reward, points or positive appraisal. In this intervention, empathy would be used to act as the “reward” for the user should they act in the desired behaviour. Additionally, negative reinforcements will not play a large role but it might play a small role in terms of guilt. Negative reinforcement can be used as long as it does not evoke a sense of fear and panic as it may cause some frustration from the user.

2.1.2 Intrinsic Motivation

Reinforcement contributes to intrinsic motivation but the two can be separate from one another. Most reinforcements (both positive and negative) are extrinsic rewards/compensation which is not the same as intrinsic motivation. Intrinsic motivation refers to the interest, enjoyment and or inherent satisfaction of doing the action itself (Lisa Legault, 2016). Extrinsic motivation on the other hand are mostly instrumental motivation and/or noninherent motivation (Lisa Legault, 2016). Extrinsic motivation essentially means that people would require an additional motive to do a certain behaviour independent of whether or not they enjoyed it.

2.1.3 Self determination theory

According to the Self-Determination Theory (Ryan R. M. & Deci, E. L., 2000), people have innate psychological needs for self motivation. The three main psychological needs according to Ryan & Deci are relatedness, competence and autonomy. Relatedness is the need to be connected with others as well as having a sense of belonging. Competence is the sense of mastering a certain skill or the ability to complete a certain action or activity with maximum efficiency. Autonomy is when one feels independent and in control of their own choices and decisions. It is important to note that competence would improve intrinsic motivation without some form of autonomy (Fisher,1978). All three factors play an important role in increasing a person's intrinsic motivation.

2.1.4 Basic needs (Based on research and context)

According to Albert Bandura (psychologist from Stanford university), perceived self efficacy refers to "how well one can execute courses of action required to deal with prospective situations" (Bandura, 1982). There has been a number of theories based on changing one's self efficacy but one of the most popular theories on the subject is the behavior change techniques by professor Susan Michie. Dr. Michie is a professor of health psychology and director of the centre for behaviour change and of the health psychology research group at University College London, UK. Behavioral change techniques (BCT) are theory-based methods for changing an individual's attitude (or self efficacy) through changing one or multiple psychological determinant of behaviour (Abraham & Michie, 2008). In most cases, many interventions employ a number of BCTs to increase the probability of success and increasing the patient's or user's perceived self efficacy.

Several BCTs will be used as a means to find relevant design techniques that promotes empathy for behavioral change. The lists of BCTs that seemed relevant to empathy in technology can be seen in table 1.

BCT No.	BCT	Description
3.1	Social support	Advise on, arrange or provide social support (e.g. from friends, relatives, colleagues,' buddies' or staff) or non-contingent praise or reward for performance of the behavior. It includes encouragement and counselling, but only when it is directed at the behavior
7.1	Prompts and Cues	Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behavior. The prompt or cue would normally occur at the time or place of performance
10.3	Social reward	Arrange verbal or non-verbal reward if and only if there has been effort and/or progress in performing the behavior
10.4	Social incentive	Inform that a verbal or non-verbal reward will be delivered if and only if there has been effort and/or progress in performing the behavior
14.1	Behaviour cost	Arrange for withdrawal of something valued if and only if an unwanted behavior is performed (includes 'Response cost').

Table 1: Behavioral Change techniques Based on Michie's 2013 BCT list (Michie et al, 2013)

Social support (BCT 3.1) is the main behavioral change technique of the intervention. By providing an exercise "buddy", the students should feel more motivated to initiate the active behavior. This is further supported by social reward (BCT 10.3) and social incentive (BCT 10.4) which suggests that a verbal (or non-verbal) positive social response (proud, joy, happiness etc) will be rewarded if there has been effort invested in performing the desired behaviour. Both forms of reward are related to positive reinforcement. Contrary to the previous techniques, behaviour cost (BCT 14.1) is a form of negative reinforcement which can be implemented through giving negative social feedback such as disappointment, sadness or anger. Prompts and cues (BCT 7.1) is mainly implemented as a means of scheduling and reminding the user about the desired behaviour. Simply by just adding the piece of technology in to the user's daily routine, they are more likely to initiate the desired behaviour. Additionally, if the technology itself is the social support, it may add additional cues and prompts suggesting that it wants to go for a walk or exercise. This raises the question on whether or not it is possible to form emotional connections to an artificial being.

Synthetic characters forming empathy

Artificial (fictional) characters are not entirely a foreign concept in human society as they appear in various forms of media such as video games, movies and/or books. To make a believable character, the character does not have to be real or alive rather it has to give the illusion of life under the users suspension of disbelief (Bates J., 1994). There are several factors that need to be taken into consideration when designing a believable character. One of the factors, autonomy, plays a large role in such an intervention as the believability of a robot relies heavily on its behaviour (Paiva A. et al., 2007). Autonomy is the freedom from external control and influence or in this case more specifically the ability to form its own actions and decisions. In this case, autonomy refers to the artificial intelligence of the robot: the more autonomous the machine, the more it will be able to react to its surroundings. The opposite of an autonomous robot is a scripted one. In this case, the more autonomous a robot becomes, the more believable it appears to the user given that it has a relatively decent AI (Paiva A. et al., 2007). Hence, an emotional bond should be easier if the robot is more autonomous as more interactions are made possible. However, a scripted robot can still form an emotional bond with the user but it depends heavily on the quality of the script it is given (Paiva A. et al., 2007). Additionally a scripted synthetic character is easier to appear more realistic and believable than an autonomous one (Paiva A. et al., 2007).

Another important factor is the robot's perceivable actions and it's expressivity. Expressivity is known to be one of the most difficult but most important features to have in making a believable character. According to Thomas and Johnston, animators from Disney, there are three important points when expressing emotions (Thomas F. & Johnston O., 1981):

1. The emotional state of the character must be clearly defined, in such a way that is undoubtedly perceived by the viewer;
2. The emotional state affects the reasoning process and consequences must be perceivably reflected in the actions of the characters;
3. The emotions can be accentuated or exaggerated, to clearly communicate to the viewer the emotional state of the character.

2.2. Background research

Physical robot pets or assistants

There have been a number of artificially intelligent robots that have been introduced into the market that were designed to form an emotional bond with their users. These examples have some similarities as well as some major differences with varying degrees of success. The two most prominent design choices revolve around the robot's functionality: assistant or pet. Both design choices will be examined.

2.2.1 Robot Assistants

Assistant robots tend to focus primarily on providing a good service over forming a bond with their users. However, some products have been made to specifically form emotional bonds with their user while simultaneously working as their assistant such as Jibo (image 1), the social robot for home. Jibo has many features regarding social interactions to make the robot appear more life-like such as the three motor body-design, microphone, cameras and speakers. Jibo was designed by Cynthis Breazeal who is known for her various projects regarding social robots. Some her past projects include Huggable (image 2), Kismet (image 3), Nexi (image 4) and Leonardo (image 5). According to Breazeal, one of the most important features Jibo needs to have is the speech recognition and synthesis. These features are important to Jibo because it also has to function as a digital assistant such as Amazon echo/alexa (figure 5). Due to the nature of Jibo's primary goal, which is to be a companion, this feature would need to be more natural than the current digital assistants on the market. This is an addition to the other services that most virtual assistants on the market already has to offer. Breazeal herself mentioned that in order for Jibo to succeed, it has to offer a mostly flawless user experience (Guizzo E., 2015). Jibo was one of the few artificial assistants on the market that directly aims to be a companion to the user rather than a simple virtual assistant.

Image 1: Jibo

Image 2: Huggable

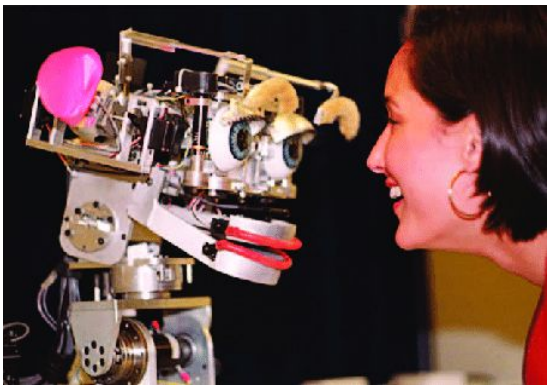


Image 3: Kismet

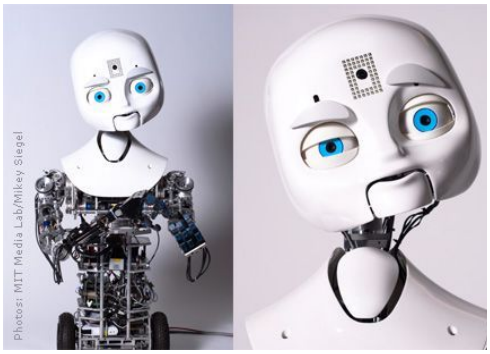


Image 4: Nexi

Image 5: Leonardo

To apply robot assistants specifically for the goal of the intervention, the robots could behave similarly to that of coaches instead of regular assistants to match the theme of health and sports. This gives a variety of opportunities for design especially in terms of giving feedback to the user. In terms of having a virtual interactivity, the voice interactivity (specifically the synthesis) could help increase the emotional bond between the user and the technology. This is because in addition to listening, the robot is now able to respond to their users via speakers emulating a conversation. This would also give another design opportunity to implement some form of character or behaviour into the robot. This is because in addition to expressions, the robot has a new medium to portray its “emotions” through voice synthesis. This can be done either by controlling the voice, tone or accent of the robot.

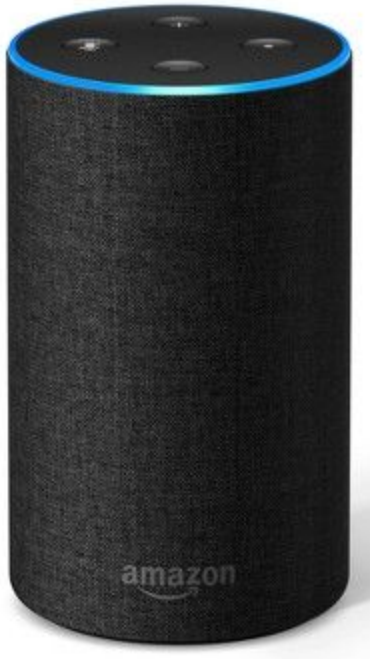


Image 6: Amazon echo / Alexa

These features gives the robot assistants an edge, but these features also have a number of drawbacks. One drawback is the fact that virtual assistants are mostly for practical use and not much seen as a companion. Although Jibo somehow manages to make it work, it does come at a cost. At launch, the product was incomplete as some features that the developer promised were not available at the time. This is because a significant amount of work was invested on making the Jibo feel life like rather than on making the product have as much features as possible. Because of this the product soon went out of business and all the Jibos had to shut down. This shows that a significant amount of development is required to make an artificial assistant. In addition to the basic AI, voice synthesis and speech recognition is also fairly difficult task to program.

2.2.2 Robot Pets

Another popular home robot design are the pet-based robots designed specifically to replace pets (or as a toy) such as the Sony Aibo (image 7) and Anki Vector (image 8). These robots generally offers less services but tend to be more expressive and interactive. The overall design of robot pets tend to vary significantly between different manufacturers but several sensors and key design choices are present in the design of most robot pets. Some common designs include the use of touch sensors to replicate petting, expressive eyes (usually a screen) and various sensors. Most of the sensors are used to make the robot more aware of its surroundings which allows it to interact with the physical world. More advanced robots tend to also utilize facial recognition to further enhance the robot's intelligence or personality. By adding facial recognition the device is able to be more responsive as well as more believable as it can distinguish its owners from different people.

Image 7: AIBO

Image 8: Anki Vector

One of the leading products in this field is the Sony Aibo (Image 7) which is designed specifically to emulate a puppy. The AIBO has motorized limbs that allows it to walk similarly to a puppy. Additionally it has motors on its tail, head, jaws and ears to exaggerate certain expressions similarly to how a regular dog behaves. All of this combined help the robot to move and behave like that of an actual dog. As for expressivity, the AIBO has LCD eyes that allows it to animate multiple expressions. Since the eye is the most expressive part of the face, this small addition helps increase the expressivity of the robot. The Anki vector employs a similar design

where by it has eyes displayed in a small monitor. This allows a wider range of expressivity due to the fact that it is easier to animate a virtual asset than it is to program and setup a motor on the eyelid. In addition, both the AIBO and the Anki Vector has small cameras that it uses for facial recognition and microphones for voice recognition and voice detection. This allows them to detect where the voices are coming from as well as recognizing who is communicating with them. This added another layer of believability in their designs as they now able to distinguish their owners from the environment and interact with them as a pet would. The product was so successful that there are several studies regarding their application in rehabilitation and children. A study found that children are able to form an emotional attachment to the robot puppy within a short period of time (Weiss A. et al., 2009).

Based on these products (Aibo and Anki vector), there are several key features that have shown to be effective design choices to increase the believity of the robots. These features can be seen in table 2:

No.	Feature	Description	Execution
1	Interactive	Inputs from the physical world including the user	Sensors: (Camera, touch sensor, gait sensor etc)
2	Well animated	Movement / animation creates behavior/ personality	Physical: Motors Virtual: Screen
3	Sufficiently AI	Personalization and individuality	Program specific behaviours based on the inputs from sensor or context
4	Expressive	Emotive, functions as a feedback	Animate eyes (screen)

Table 2: Key features of robotic pets

2.2.3 Virtual pets

Virtual pets function similarly to robotic pets except for the fact that they do not possess physical bodies. This means that virtual pets have very limited interaction with the physical world and therefore more limited possibilities to be more life-like. On the other hand virtual pets are much easier to construct than robotic pets and has the added benefit of being more expressive. This is because to visualize a certain behaviour, the designer could just animate the virtual pet's entire body instead of just relying on key expressive features (usually the eyes). In addition to a

more expressive design, visual pets are easier to animate as there are no complex calculations involved. For robotics some level of calculation is required to control the motors and where to place them to maximize the level of expressiveness while still looking natural. Some popular examples of virtual pets include the Tamagotchi (Image 9) and the Petz series (Image 10). Both games offers a similar gameplay whereby the user can adopt, feed, raise and breed the pet avatar enabling the users can form emotional bonds.

Image 9: Tamagotchi

Image 10: Petz (Dogz and Catz)

Research has shown that these games form emotional attachments through the use of an affective loop. Affective loops are a digital social interaction system that is able to elicit, detect and respond to the emotions of its users (Sundström P., 2005). This system dramatically increases the likelihood for the user to form an emotional bond to the virtual pet. However, research regarding another virtual pet game known as Nintendogs has shown that the attachment to and emotional engagement with a virtual pet is still not as effective as owning a real pet such as a dog or a cat (Chesney T. & Lawson S., 2007). There are several key concepts that helps increase the probability and intensity of emotional engagement between human and virtual agents. These concepts include attentional and emotional involvement (Peters C. et al., 2009), rapport (Huang L. et al., 2011), immersion (Wolf M. & Perron B., 2003), and empathy (Shamay-Tsoory S. et al. 2009). Unfortunately, there has been only a small number of research studies in the field of virtual agents concerning how affection and engagement is established (Lin C. et al., 2017).

Image 11: Tamagotchi forever app

Tamagotchi forever is a free application available for Android that continues the legacy of the original Tamagotchi toys. The Tamagotchi series is one of the leading icons in virtual pets. Although the original products were hardware, most of the appeal came in the form of the virtual pets that inhibits the physical console. The original game was simple: if the Tamagotchi is not taken care of it will die. In this latest version the Tamagotchi won't die but it does have a happiness meter. The new version of the tamagotchi franchise also made a number of changes to the original game to take full advantage of the fact that it is a mobile game. Since the new iteration exists inside a phone instead of its own small console as seen in image 8 several design changes were taken.

Firstly the application takes full advantage of the notification feed as a means for the tamagotchi itself to "speak". For example: "I am hungry please feed me" or "I need to go to the toilet". Using the notification under the tamagotchi's perspective makes the tamagotchi feel more life-like while simultaneously still functions as a reminder. The tamagotchi also requires some attention as the tamagotchi can't feed or sleep by itself which gives the users some sense of responsibility. For this application in particular there are no drawbacks to when the user fails to take care of the tamagotchi. The tamagotchi is just simply upset and the happiness meter goes down tremendously. The app also allows user to interact with the tamagotchi directly by means of petting. This is the only form of direct interaction the user can do with their tamagotchi and yet it seemed to be sufficient enough in making the tamagotchi feel more responsive and realistic. Another feature the tamagotchi app has is the ability to "evolve" the tamagotchis. This can only be done if the user manages to keep the application happy for an extended period of time.

2.2.4 Summary of State of the Art

There are reasonable arguments that suggests both robotic and virtual pets are able to form emotional bonds with their user. However, robotic assistants on the other hand have shown some difficulties in achieving the same level. This is partially due to how robotics assistants are viewed as practical products that should help the user more so than to be their companions. Robotic and virtual pets on the other hand are seen more for their companionship rather than for their practical use. Studies have shown that robotic pets have succeeded in forming emotional bonds with their users but still less so than their organic counterparts such as dogs and cats. Virtual pets have succeeded in a similar manner but to a lesser extent. Additionally, not enough studies were conducted for virtual pets in the domain of affection and engagement as of yet.

Due to these results, our intervention should focus more on a pet agent rather than an assistant. The intervention will focus on the design of the appearance and artificial intelligence of the artificial pet. Furthermore, some questionnaires or interviews may be required to analyse which medium might suit the intervention better: virtual or robotic. The primary research may also be beneficial in finding the specific determinants for a sedentary lifestyle amongst UT students.

Chapter 3. Ideation

3.1 Methodology

Brainstorming

The first step for creating the intervention is to brainstorm potential solutions to alleviate sedentary lifestyle and/or to promote an active lifestyle. The brainstorming phase will be separated into several different stages each more specific than the last. This is to help create a more specific and feasible project to finish within the limited amount of time without being too tunneled to only one possible solution.

User context analysis

After brainstorming, a user context analysis will be made to get a better understanding on what is needed and which features would go well to accommodate those needs. In addition, several design decisions may become more prevalent after a better understanding of the user needs and context. Because of this, the preliminary requirement can be made to help assist with designing relevant features for the final product.

Design

The design phase is used mainly to explore all the potential features the product could utilize in its design. All of the features made are based on the preliminary requirement or are present to enhance the probability of success. The design phase is essentially a more focused brainstorming session that further develops the project to make it more effective and concise in

its goals. However, most likely not all features would be developed due to time constraints and a limited experience.

Developing the project

To develop the project several development tools would be needed to create assets for different means. Regardless of whether or not the product will be hardware or software, some programming is involved. Regardless of what medium the project will take place, some time will be required to learn the basics of the IDE (integrated development environment) before actual development will take place. It is safe to assume that several prototypes will be made before the project is ready for user evaluation.

User evaluation

User evaluation is when the product is tested with the target group in mind and it is meant to gain as much feedback as possible. This feedback plays an important role in acknowledging the strengths and weaknesses of the project so that a better iteration could be made. At this point of the research the product must at least reach the preliminary requirements based from the user context analysis. User evaluation will be the final step in the project but the results might be important for future developments regarding the subject.

3.2 Stage 1 - General Brainstorming

Stage 1 will focus more on finding all the potential solutions to reducing sedentary lifestyles in the university. At this stage there are little to no boundaries on creating ideas for the intervention. The ideas will first be conceptualized and then categorized into one (or more) of the following categories:

3.2.1 Main Brainstorm

The brainstorm session for the graduation project was held together with another group that also tries to tackle the same issue of reducing sedentary lifestyle. The brainstorming focuses on coming up with as many ideas as possible as long as it can reduce sedentary lifestyle and increase the user's motivation for an active lifestyle. Once all the ideas were made they were separated and organized to one of eight different categories: Hobbies, Physical health, Lifestyle, Values, Environment, Social, Entertainment and Technology. Due to the fact that the ideas were made before organizing them into categories, some ideas might be applicable to more than one category. The outcome of the brainstorming process can be seen in image 12:

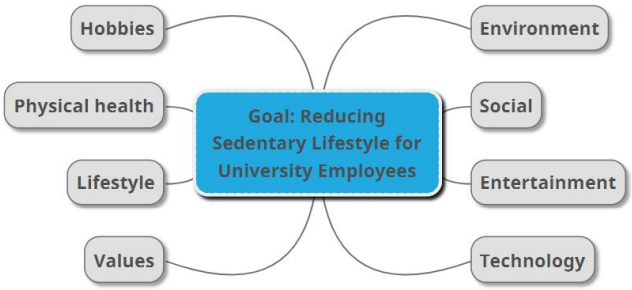
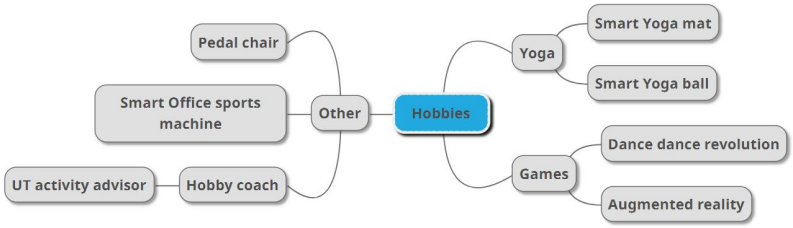


Image 12: Brainstorm web (continued below)

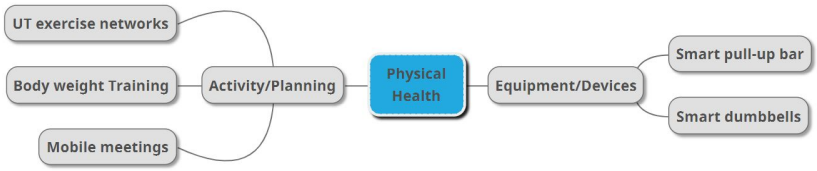
1. Hobbies

Hobbies are ideas that were primarily based on actions the user might potentially do in their spare time. As such ideas on this category often focus on small and/or fun activities that the user might do in their spare time already except with an active element.



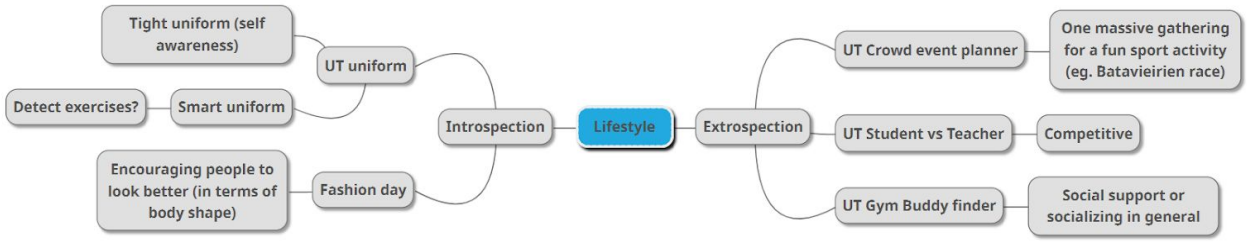
2. Physical health

Physical health are essentially ideas that focus more on enhancing existing sports equipment to make them much more effective at monitoring the user's progress. Due to the context of the intervention (limited to campus), only easy to set up or portable equipment were taken into consideration. Additionally planners for training regimes were also evaluated in this category.



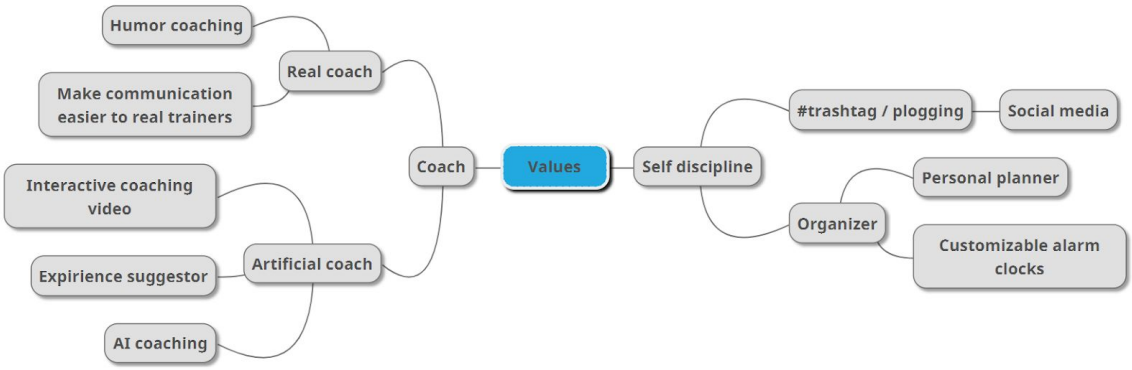
3. Lifestyle

Lifestyle ideas are mostly ideas that revolve around changing the environment and culture surrounding the user to promote a more active lifestyle. The lifestyle interventions are divided into two subcategories: introspection (self awareness) and extrospection (social awareness).



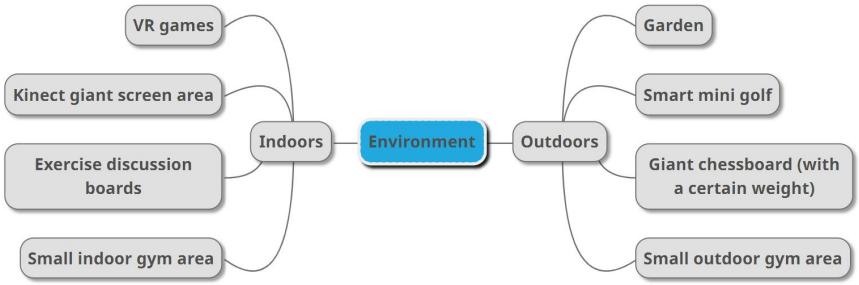
4. Values

Values focuses more on the user's beliefs and opinions as well as the opinion of an expert which in this scenario will be a coach. Value centered designs will focus primarily on the user's judgment (self discipline) or lack thereof (coaching).



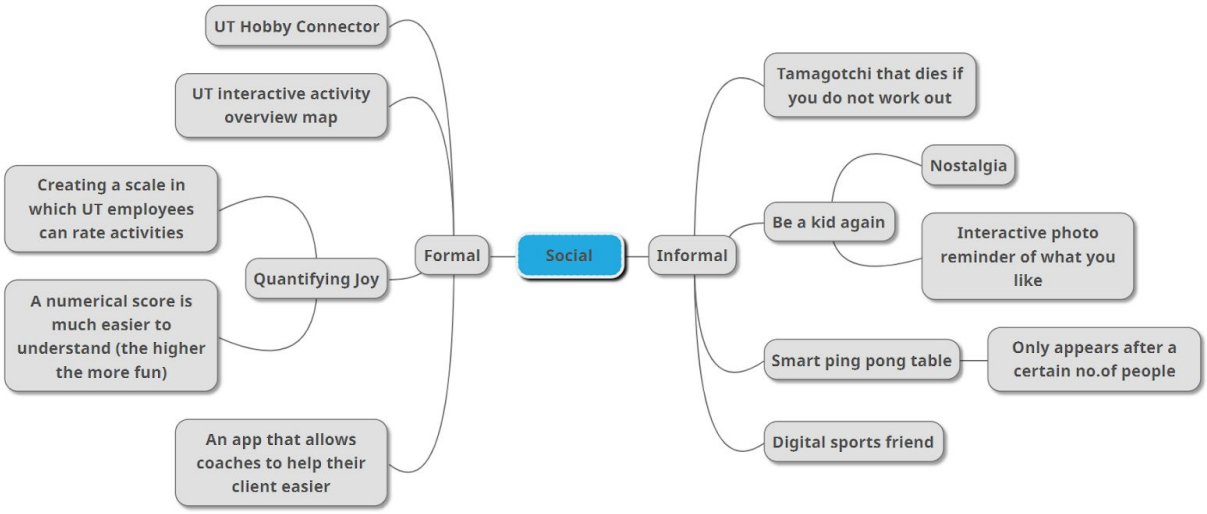
5. Environment

Environmental based ideas are mostly focused on creating cues in the environment to remind or motivate the user to engage in an active behaviour. Additionally, environmental based ideas can also evoke the need to be active by making the work out areas more accessible to the users.



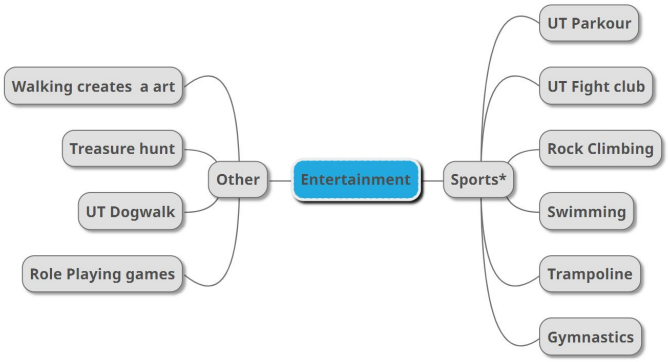
6. Social

Social intervention relies on the concept of social support as well as positive feedback from friends, family, pets or coaches. Additionally social interventions rely on social interactions to make most of the ideas work. Some ideas may also revolve around the concept of social interactions more so than actually engaging in social interactions such as the “be a kid again”. concept.



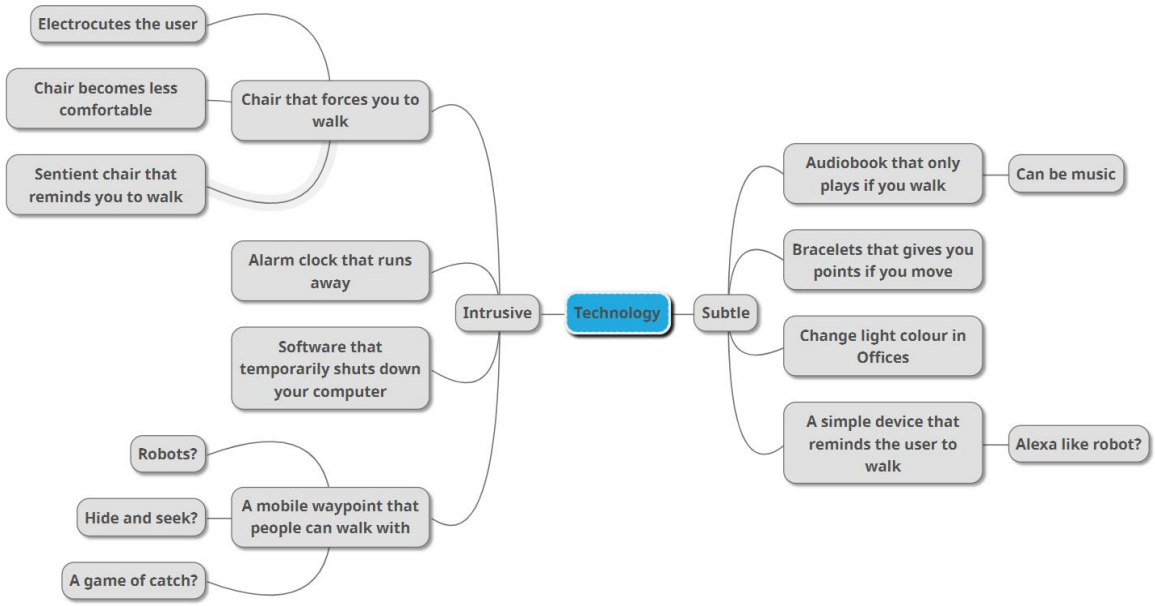
7. Entertainment

Entertainment focuses more on the idea of providing and organizing fun activities the users can enjoy while simultaneously encouraging an active behaviour. It is similar to hobby based ideas but instead of having the activities become a routine, entertainment based ideas aims to make the events as sparsely and dynamic as possible. The entertainment based ideas focuses more on trying to distract the user from physical fatigue by making them do something fun.



8. Technology

Technological interventions are solutions made by integrating technology to the user's daily routine. Alternatively these ideas are also based around the concept of integrating technology to enhance the experience of engaging in sports. Technological interventions can also provide cues in the environment that subtly or intrusively warn the user to take some exercise.



3.2.2 Top 5 features

There are plenty of ideas to based the intervention on. However, only five concepts will be developed or used as a base inspiration for the design of the final product. This is simply to make a product that focuses on one job but does it really well as opposed to a jack of all trades design. Additionally, one concept should be sufficient enough to motivate a person to become more active if it is designed correctly. The top five concepts will be chosen mostly based on the research that has been done thus far and the feasibility of the design. The top five concepts that this project will focus on are:

1. UT dog walk (Entertainment)
2. Tamagotchi that dies if you do not work out (Social)
3. Digital Sports friend (Social)
4. Bracelets that gives you points if you move (Technology)
5. Mobile waypoint that people can walk with (Technology)

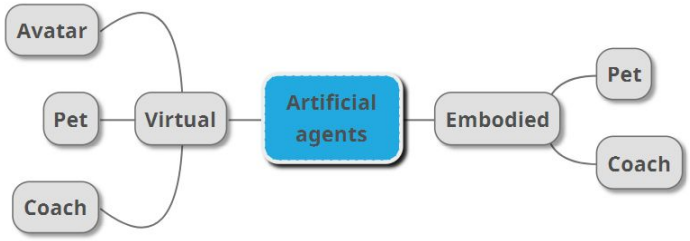
The reason why these top five concepts were chosen in particular is due to its heavy emphasis on positive reinforcement and social interactions. Research has stated that perceived social support is more than enough to reduce fatigue and improve self motivation. Additionally, positive reinforcement measures have been proven to be more effective at long term

commitment than negative reinforcement techniques. Despite this, by using social interactions, the top three chosen concept works can employ some form of negative feedback without the use of any punishment. For example: concept 1, 2 and 3 can have their partners become angry or disappointed at the user which could make them feel guilty. Unlike most direct means of punishment, guilt tends to be more centered around the person's sense of responsibility rather than to directly harm the user. This should reduce the amount of frustration experienced by the user when they are interacting with the final product. Concept 4 and 5 are mainly chosen due to their feasibility and importance in terms of progress tracking and guidance. Some form of numerical feedback such as the case with the bracelet (concept 4) can be added to help measure the progress of the user. The waypoint feature from concept 5 might be a fun method to guide users to certain location for exercising.

To combine all of the features mentioned above, the graduation project will be mostly related to the use of an artificial agent that functions as their user's exercise buddy. This concept is similar to the top 3 in terms of conceptualization but the other features can also be implemented. The point system from the 4th concept can be implemented in to the artificial agent either through a screen or the object itself. The 5th concept could be implemented by having the agent suggest routes and destinations the user can go to. By just walking to the destination, the user would already make some form of exercise.

3.3 Stage 2 - Empathy on artificial agents

A second brainstorm was required to know how the artificial agent can be presented to the user. This argument mainly covers 2 factors: 1. The medium in which the artificial agent will be portrayed and 2. The role of the artificial agent. The medium will focus on how the body and personality of the agent will be physically and/or visually built. For every possible concept it is important to know whether the agent would be virtual or physical as each medium has their own advantages and disadvantages. The role of the artificial agent focuses more on how the user will interact with the agent as well as how the agent will behave. Deciding the role of the agent will consequently affect the interactions and relationships between the user and the agent. There are 3 major ways in which the agent could play a role in this intervention: Avatar, Pet and Coach.



3.3.1 Concept ideas

T-Bo (Trash boy)

Image 13: T-Bo prototype

T-Bo is a robot assistant originally designed to resemble an office desk toy that will occasionally remind the user to take walks. After some development, the product was later changed to much more resemble a mascot that walks around the school. The idea was to have some form of robot that walks around the university that tries to recruit students and staff alike to join it on an adventure. It was originally planned to have multiple routes that changes every day to lead the participants to different paths and explore different parts of the university. The one shown in image 13 was a LoFi prototype of the final project and it can do so far as to move its mouth and makes sounds. This LoFi prototype is essentially a small trash can with a motor attached to its mouth and a speaker in its barrel to emulate speech and talking. The main inspiration for this robot is the HitchBot as seen in image 14. The hitch box is a solar powered robot that, as the name implies, hitch a ride from random people.

Image 14: HitchBot

The Hifi prototype would have the same design but bigger and have wheels on the bottom to make it move. The larger size was to make it more noticable and the motorized wheels were added to make it move on its own. This project was not too far from its development but several key features was already determined:

1. The robot has to be able to walk on its own
2. It must have a route to traverse around
3. It must grab the attention of the students
4. It has to give incentive for the participants

DogGo

DogGo is a small box shaped dog that the user can take to go for walks, the shell of the prototype can be seen in image 15. This project aims at providing the user with some form of responsibility by giving them a physical robot that behaves similarly to a puppy that needs to be taken care of. DogGo has a charging wheel on the bottom as well as some motorized wheels, a speaker, some sensors and a detachable stick. The User can play around with the DogGo as if it was a real pet, the DogGo will occasionally make sounds similar to that of a dog and it will move around in a variety of different patterns.

Image 15: DogGo

During scheduled times (around 12:30 to 14:00) or when the DogGo is at low battery, the dog will execute the “please walk me” protocol. The “please walk me” protocol is when the DogGo walks in a circle and makes a whimpering sound to get the attention of the user and make them feel sorry for it. The DogGo does not have a charger, the only way to charge it is to “walk” it by attaching the detachable stick on the roof of the device. Once attached, the user would have to take a walk and push the DogGo in a position similar to that of walking a dog or pushing a push toy (see image 16). The charging wheel will work as a main way to power the device, as such the DogGo can only be fed through walking.

Image 16: Push toy

Virtual pet application

Similar to the DogGo, this prototype features a pet that the user needs to take core of by walking. The only way to feed the application is by walking and the more walks the user take, the happier the virtual pet behaves. The virtual pet can be implemented in a device on its own or function similarly as a phone application. The main purpose of this prototype is to make the user feel sorry for the virtual pet, so much so that they are willing to sacrifice some of their time to take care of their virtual pet by walking. Alternatively when the user walks more than anticipated, the virtual pet would be happy and the positive reaction would hopefully act as a positive reinforcement for the user. Image 17 is a small prototype showcasing the layout of the user interface. The main inspiration for this project is the tamagotchi franchise as seen in image 18.

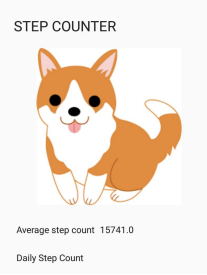


Image 17: virtual pet

Image 18: Tamagotchi

Both versions: the phone application model and the separate device model would utilize accelerometer to determine the amount of step count. The step count is the main method for the

virtual pet to track the user's progress throughout the day. The user can play around with the application: feeding, mini games and putting it to sleep etc. But when it's time to walk the user would be given a special animation where the pet wants to go for a walk. This animation will also trigger an alarm either through notifications (on the phone) or a vibrating motor and flashing leds (on seperate device). If the user continues to ignore the application, the virtual pet will become sad and make all of the interactive elements unusable until it gets proper exercise. Also the more the user ignore the application, the more unhealthy the pet will become.

Virtual coach application

This iteration is similar to the virtual pet but instead of a pet, it utilizes a virtual trainer as seen in image 19 that will give the user a variety of exercises for them to do. The core of this prototype is to provide the users with information on how to do certain exercises. The base premise for this prototype is that the users do not exercise as much as they don't know how to do so properly or within a short amount of time. The application will provide a variety of tutorials and exercises to give the user some ideas of what they can do. The tutorial comes with an animation starring the coach. The main appeal of the application is that the user is allowed to customize their coaches, giving them more personality and allowing the users some form of personalization.

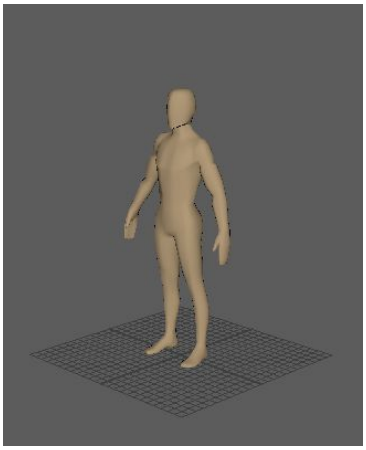


Image 19: virtual coach

The application would provide a variety of different exercises from simple sports or work exercises to more intense workouts the user can do in the gym. This prototype would only provide potential options and tutorials for the user without much sensors. Sensors would only be used for simple activities such as walking or doing push ups to make it more convenient for the user to track their progress. The virtual coach will teach and accompany the user through out their work out as well as tracking all of their activities throughout the week. In addition to those features, the coach will cheer the user on in an attempt to increase the user's motivation/morale.

Another iteration of the virtual coach is the virtual avatar which functions similarly to the virtual coach but instead of starring a different entity, the coach will reflect more of the user. Instead of acting as a teacher, the avatar would work as a companion that will accompany the user through out their work out. The more exercises the user commits, the healthier the avatar becomes as seen in image 20. This is a method in which the application gives the user some form of self reflection.

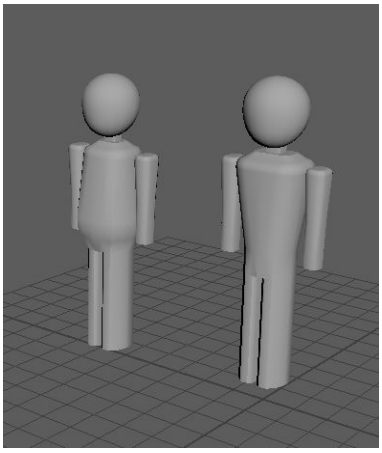


Image 20: virtual avatar unhealthy vs healthy

Virtual vs Embodied agents

Currently there are two different methods to create an artificial agent: a virtual agent and an embodied agent. Virtual agents are characters made in the virtual world whereas embodied objects often have a physical body the user can interact with. The decision to go for either one of these approaches will determine how the project will be executed. Regardless of choice, both options requires the use of empathy to reach their goal of motivating their users.

Virtual characters are much easier to animate and design as they do not have to concern much with sensors, industrial designs and motors. Animated characters tend to be more expressive than embodied characters as embodied characters such as robots require a lot of motors and pistons to portray emotions. This also leads to embodied agents costing a large amount of money to develop and consequently have high prices. Additionally embodied agents are exposed to novelty much more than virtual agents do. Virtual agents are also much easier to access as they can be placed on to the user's phone, tablet or any other portable technological devices. The only advantage embodied agents have over virtual one is in its ability to interact with the real world. Due to time constraints as well as the effectiveness of virtual agents in general, the artificial agent will take form in the virtual world.

Role of the agent

There are three distinct roles that the agent can play as: the pet or the coach. The pet approach is to give the user some form of responsibility as they will be given the task to take care of a pet. This can be implemented in a sense that the user has to walk their pet or reach a certain exercise related milestone to keep their artificial pet healthy/happy. The second approach, the coach, will function similarly to a tutorial video on exercising or an exercise advisory application. However, the major difference between this interpretation of the idea is the implementation of empathetic design features integrated in the interaction between user and product.

Out of all of these potential roles, the virtual pet approach will be taken as the main design choice as it is the easiest to implement and it is the more unique of the two digital solution. There are already plenty of coaching applications available on smartphones and making a physical, robotic coach might be considered to be overly ambitious. Additionally, to implement an avatar approach, a character creation tool would have to be developed in order for the whole system to succeed. Making an entire character creation tool requires a lot of assets and programming skills that the developer simply does not possess nor have time to do so. As such the virtual agent will play more as a pet in order to evoke some form of an empathetic bond.

3.4 Stage 3 - User needs

3.4.1 Stakeholders

The stakeholders can be divided into three categories; developers, end users and supervisors. The developers main role is to design and create the application itself using the research as the base of inspiration. The end users are the target group the application is meant to be used for. The supervisors are the people that assists the developers on decision making and guiding the developers are on the right direction as well as time.

Developers

The main goal of the developer is to create and document the application's development progress as well as the research behind the project. The developer is mainly concerned with how the final application will be developed and how effective it can be in practice. Additionally, the developer needs to ensure that the application can run as smoothly as possible without any bugs or issues. The developer is also responsible for how the final product will look and be presented to the target group. The developer will also be the one responsible for conducting user evaluation tests and keep the application updated based on the results of these tests. Conducting a user evaluation test would include:

1. Preparing a prototype that will be tested
2. Questions for the interview
3. Planning and conducting the interviews

Additional responsibilities the developers have to do include research and writing a report. This is so that other potential developers would be able to either assist in developing the project or continue the project once the current developer is finished. Because of this the developer also needs to provide some explanation of the code for the application by means of pseudo coding and referencing. The report would also note down the ideas behind the project as well as unfinished concept features. All of this combined would mean that the project must also be achievable by the developer within a given time frame. As such the application should not be too ambitious as it might not be feasible given the limited time frame.

Supervisors

The supervisors are mainly concerned with how well the developer implement the application to the topic at hand. Their main responsibility is to assist the developer in terms of writing the report and to keep the developer on the right track. The supervisors also provide support by offering solutions as well as providing connections for the developer. Supervisors also give advice on how to proceed with the development of the project. Supervisors are mainly concerned about the developers progress, deadlines and report. Hence, they are also concerned about the feasibility of the project which means they prefer the project to be smaller and more focused as it is the most realistic to finish within the given time frame.

Target group

The target group are mainly the UT students and they are mainly concerned with the overall effectiveness of the final product/application. The target group is the only group that is not associated with the development of the application directly outside of giving feedback. The target group played the most important role as the entire project will be based on the user's needs and wants. Although they are not the ones who develop the application, most of the application's design will be based on their needs as they are the ones that are going to utilize the product the most. Additionally, the target group will be the only stakeholder that does not care about the feasibility of the project as they care more about the quality of the final product/application rather than its development. As such they are more than likely to demand more features and services from the application.

Due to the differing interest of the developer and the target group, a PACT analysis will be made to understand the user context slightly better. This should give a more accurate representation of the user's needs and what features are more important. An expert interview will also be conducted for a better understanding on the subject of human and artificial agent relationships. A preliminary requirement will also be made from the PACT analysis and expert interviews to help summarize and outline design features that are most important to the application.

3.3.2 PACT - Analysis

People

The targeted demographic for this intervention is fairly broad considering University students can refer to people from different cultures, genders and generations. University students may also have a diverse set of interests based on the fact that there are many different faculties in the university. Speaking of the University, the University of Twente is a technical university. As such it is safe to assume that most of the students studying in the University are at the very least familiar with technology. Most of the organization in the University of Twente uses some form of application or website such as Canvas and Rooster. This shows that integrating technology to day to day life is not uncommon amongst UT students.

Activities

Most University of Twente students spend their time on their computers to either relax or work. During break time most students took advantage of their free time to eat lunch or socializing with other students. However, some students still work during breaks simply because they might need to work harder to meet a certain deadline or because they were still focused from the lesson prior to the break. In either case, most students remained stationary either because they are eating or working. Other potential causes of a sedentary behaviour might be caused by easily accessible entertainment from the internet such as video games, social media and videos.

Context

The University has a fairly large campus for the students to walk around, but most of the routes are simply there to get from one point to another. There is also no dedicated walking path except for some areas as most paths are shared with bike paths. This may not be a large issue but it does make jogging or recreational walking slightly uncomfortable and unsafe as there might be a risk of having an accident with a biker.

The University also offers a decent amount of clubs and activities as well as facilities to accommodate them. Some facilities are also accessible for individual use such as the gym, pool, running track and basketball court. The running track in particular has a small outdoor exercise area comprising of several gym equipment and space. In addition to all the facilities on campus, the university also allows students and staff free access to aquadrome and slagman (both swimming pools) given that they have a union card.

Technologies

Most university students are most likely familiar with the use of technology in their daily lives. However, other than a computer screen and laptops, one of the most common pieces of technology being used on a regular basis is the smartphone. Most of the University students would most likely have a smartphone in hand at all times as it is portable and it gives a variety of different services. Smartphones are also the main communication tool used for both in and out

of campus relations. In summary, smartphones are fairly important to have in University and most students are more than likely to use it on a day-to-day basis.

Rather than creating a separate piece of technology, it might be easier to just use the smartphone as a medium for the intervention. This is because most UT students already integrated their smartphones in to their daily routine either professionally or for personal use. Utilizing smartphones would alleviate the need for the UT student to integrate something new into their lifestyle. In addition to that, smartphones already has a built in pedometer that can be used to measure the amount of step count the user already took. This data should be enough to calculate the user's activity throughout the day and unlike a seperate piece of technology, all the user has to do is to carry their phone as they walk.

3.3.3 LoFi interview

For this project, an interview was conducted with some experts on this particular field of study regarding the project's concept and their opinions on the topic. These professors have some experience in human media interaction and human-robot interactions. Three interviews were conducted with: Dr.Douwe Dresscher, Dr.Edwin Dertien who both are in the Robotics and Mechatronics faculty (RAM) and Dr.Jamy Lee who is a professor in the Human Media Interaction (HMI) faculty. Due to the nature of the project, a proper user evaluation requires at least a week of experimentation to test the effectiveness of the concept. Originally the user evaluation was supposed to feature some form of prototype in which the three participants would have to use for a week or at least three days. However, due to time constraints and uncertainty the experiment was reduced to a simple lofi prototype. The experts were shown the LoFi prototype and they were also given the introduction of the project to give them a better insight on the situation.

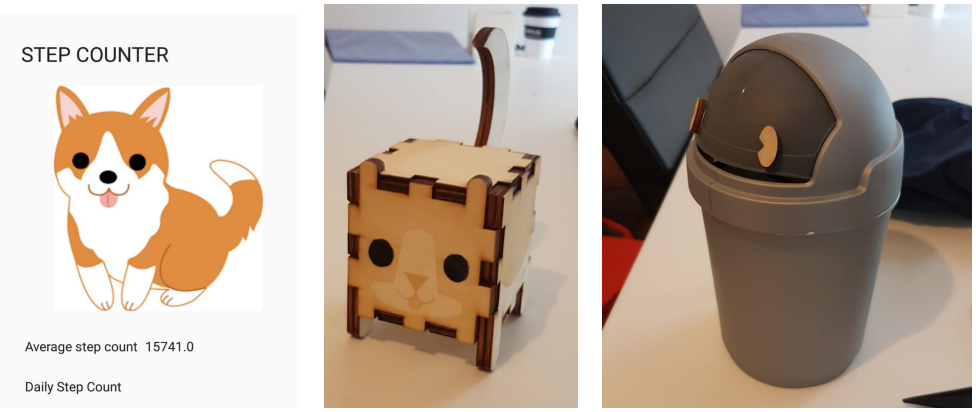


Image 21: LoFi prototypes (Digital, physical Pet and robot assistant)

There are mixed opinions regarding how the project should be handled as all three experts seem to have their own interpretation of the solution. During the interview, one of the bigger questions of whether it should be digital or physical was also discussed. Using some

form of embodiment (Robots, Physicality, Body) has several benefits regarding novelty. Novelty is the main argument when it comes to choosing digital or embodiment as a medium. Novelty can be used to grab one's attention as well as increase one's motivation to interact with the product. On the other hand, novelty can also be detrimental as novelty items tend to have a short product life span. This may cause issues as an artificial creature may require a long time for it to form a bond with the user.

3.3.4 Preliminary requirements

During development, it is safe to assume that some compromises would be needed in order to make the project available on time. In addition, some designs are subject to change either due to new information that was not discovered before or through feedback from user testing. In either case the application is at risk of changing too much of its feature to the point where it might no longer be effective at reaching its main goal. To make sure that the application does not deviate from its original goals, several design rules and requirements will be listed. This list would also highlight the most important features of the application which would help the developer focus on certain features during development.

1. The app must be usable in university grounds (Preferably without internet).
2. The app must be able to track the users performance.
3. Avatar must be appealing (also means not too cute nor too ugly)(Preferably customizable).
4. The app must be easy to use and navigate.
5. The app has to be able to notify the user.

Chapter 4. Specification

4.1 Features

The application would have a variety of features built into the system to accurately measure the user's behaviour. A step counter will be used as a means to monitor the user's current behaviour. In addition to that a virtual avatar will be used to help visualize the user's current health. The avatar should act as the user's pet similarly to how dogs often their owner to walk them or need their attention.

4.1.1 Step counter

The main input the application will be using to measure health and or progress will be the phone's pedometer. The pedometer measures the number of steps taken by the user each day and based on the results, the application can identify if the user is making progress or if they even participate in doing any activity. The use of a pedometer also gives the app the ability to gain some context in terms of user behaviour. For example, if the pedometer does not find

much movement within a given time frame, it is safe to assume that the user is currently sitting down or standing in the same spot. Alternatively, if the user is moving then it shows that the user might be walking around.

4.1.2 Virtual pet

The virtual pet is the main feature of the application that helps it differentiate itself from other health applications. The main purpose of the virtual pet is to function as both a companion and as an indicator of the user's performance. The less the user engages in physical activity (walking) the more angry, upset or frustrated the avatar becomes. If the habit continues for a month then the avatar would also start gaining weight. Alternatively, if the user fulfills all of the avatar's needs by reaching a certain step count then the avatar will show more positive attitudes towards the user. The avatar won't gain weight if it is happy and if it was fat then it will start to lose weight. Positive and negative attitudes are displayed through the use of animations and notifications. The user will also be given the ability to customize their virtual pet to further increase their bond with the artificial agent through personalization.

4.2 Avatar designs

To make the virtual pet as believable as possible, a number of designs have to be made for their interactions, appearance and behaviour. Interactivity is the number of options a user can do with the avatar to create the illusion that they are communicating and forming a bond with the avatar. The design of the virtual pet plays a major role in the overall tone and character of the agent. Character behaviour helps make the pet application more life-like as it appears to be more sentient and expressive. In addition to the three main design principles, the application also allows the user some level of customization for their virtual pet. This is so that each user can personalize their pet by means of cosmetics and accessories.

4.2.1 Interactivity

To design an interactive experience a number of actions is considered that will allow the user to communicate or play with the virtual pet. Most of these interactions would be similar to how owners can interact with their pets. Some actions included the ability to pet, feed, complement, clean, groom and play fetch with the virtual pet. These small interactions will play a part in the believability of the virtual pet as well as making the application more immersive. Allowing more interactivity also allows the user to spend more time and play around with their virtual pet more which in turn helps form a bond between the user and the pet. Most interactivity will be managed through a combination of buttons, sensors and touch screen capabilities see table 3.

Action	Sensor	Implementation
Petting	Touch screen	Tap on the virtual pet
Feeding	Button	Press a button and food will be given to the pet
Complementing	Sensor: voice recognition	Say “Good boy/girl”
Cleaning	Button + Touchscreen	Press a button to go to cleaning or grooming mode, use the touch screen to rub on the virtual pet
Grooming		
Fetch	Button + Touchscreen	Press a button to go to a fetching mini game mode, use the touch screen to throw a frisbee or ball

Table 3: Interactivity action table

Engaging in any of the actions would not change the pet’s mood as the pet’s mood is only based on the step count. To increase the believity of the virtual pet, some actions will not be available depending on the pet’s mood. For example, if the pet is upset due to the fact that the user does not reach his or her step count quota then the pet would not like to be pet, cleaned, groomed or play fetch. This would not be a significant change as it is more than just a small attention to detail to sell the believity of the pet’s behaviour. Additionally, special animations will play when the user do these actions to increase believity and give some form of feedback.

4.2.2 Character design

Character design plays a large role in selling the appeal of the application. If the virtual pet looks unappealing in any shape or form then the users wouldn’t like to see it let alone spend time with it. As mentioned previously when discussing the robotic pets, eyes plays a large role in selling portraying emotion and behaviour. As such the avatar should have large eyes to make it easier for the user sees their mood. Colour also plays a role in portraying emotions as it is a simple yet effective method to visualize mood. Additionally, users can customize their pets to make them more personalized and unique from other user’s avatars.

To design the full character a number of head sculpts, eye designs and potential accessories were made for the base design. The base design refers to the pet without any accessories or alterations due to the “increasing weight” feature, animation and mood. The base design will be the same for all users when they hatch their eggs until they start customizing by adding accessories. To avoid the “uncanny valley” effect as well as to save time, simple designs were made for the base form of the virtual pet. The egg is a small feature at the beginning of the app that allows the user to hatch their pet from an egg. It symbolizes a new beginning similar to how the user will start changing their habits by using the application.

Head Sculpt

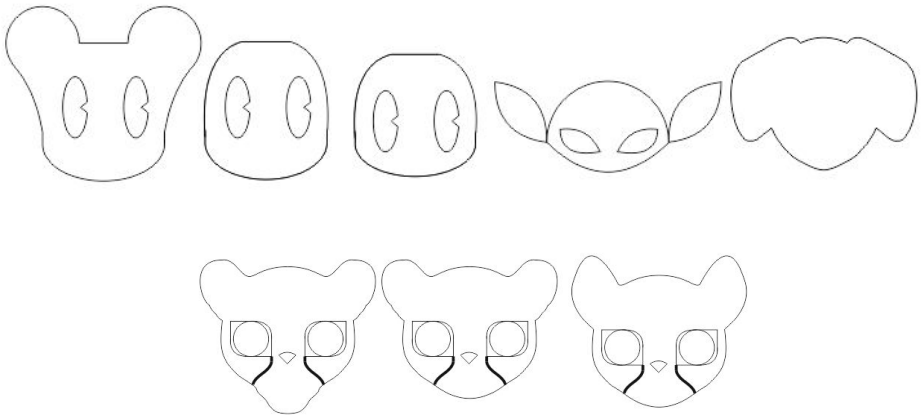


Image 22: Head sculpts

Hatching

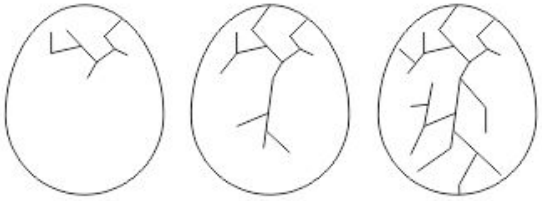


Image 23: Cracking egg - base image

Eyes

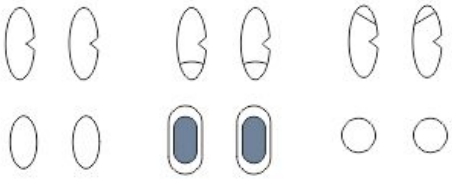


Image 24: Different eye variations

4.2.3 Character customization

Character customization allows the users to alter the physical appearance of their virtual pet. Customization allows the user to personalize their pet to their liking which would help them empathize with their virtual pet even more. Customization will be done by providing the user with a number of cosmetics that they can add to their virtual pet. In addition to changing physical appearance, the user is also given the ability to name their pet.

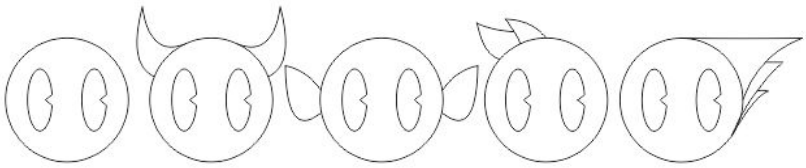


Image 25: Customization options

Customization can be implemented by using a separate window for customization similar to a character creation page of a video game. Unlike a video game where the character creation is mainly accessible only at the beginning of the game, the user is allowed to change the look of the virtual pet at any time. Customization can also function as a secondary reward in which the users can earn by reaching certain milestones. One possible implementation would be through ingame currency which can be earned either through step counts or achievements. Other possible implementations include making the cosmetic the reward itself by achieving certain milestones.

4.2.4 Character behaviours

Character behaviours play a large role in selling the believability of the virtual avatar and it helps visualize the character's mood. Since the mood of the avatar functions also as an indicator of the user's progress it is important to make the expressions as clear as possible. Character behaviour will be represented with a number of visual cues such as colour, animation and notifications. Colour refers to the avatar's body colour and it scales directly with its mood. Since the avatar would have a fairly simple design, a single primary colour and maybe a secondary colour should suffice. The limited number of colours would make it look less complicated and thus easier to process.

Animation simply refers to how the virtual pet will move around and it will be the key feature to visualize their behaviour. Most of the animations will take place in the eyes as those are the most emotive parts of the entire body. Additionally, body language and simple gestures such as jumping up and down can help the virtual pet appear more life like. Idle animations should also be implemented to further enhance immersion as real pets would also act on their own without their owners. Notification allows the virtual pet to communicate directly to their users. The notification mostly help visualize the mood of the virtual pet.

4.3 Notifications

Most sports applications utilize notifications as a means to remind the user to take some exercise. This means that notifications can be used as a medium to condition the user to exercise by means of creating a prompt or cue. This is highly beneficial as notifications do not require the user to open the application all the time. In addition to that, the notification will be omni-present in the phone including in the home screen and lock screen. Most apps also have a

feature that allows the user to immediately enter the app's main page by clicking on the notification. This gives a layer of convenience for the user, promoting more uptime or visits for the application.

Most sports application uses notifications practical use such as to remind the user to exercise rather than to motivate them. However, virtual pet applications such as My tamagotchi forever uses notifications not just to remind the user to use the app but to personify their characters even further. The Tamagotchi app essentially utilizes the notification as a means to give the virtual pets a voice in which to communicate to the user. This allows the virtual pet to be more expressive and helps create the illusion of a conversation. This makes the pet slightly more life-like and it also gives some charm to the application even when it is not directly in use.

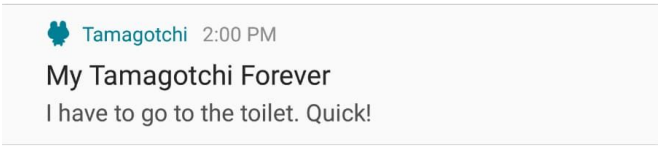


Image 26: Tamagotchi notification

The GP application would employ a similar technique as the one present in the tamagotchi app. However, to make the notifications more immersive a dialog tree will be made giving different notifications each time the application sends one. The dialog tree will be based on the virtual pet's mood at the time the notification is sent. Since the mood of the pet corresponds to the number of steps taken recently, the more steps the user took regularly the happier the notifications become. If the user continues to ignore the application then the pet will start sending bitter or desperate notifications.

Happy

- @user! I know you've walked me already but can you do it again?
- I think it's a nice time to go outside now
- I'm bored, let's go for a walk :D
- Hey @user! I want more walkies
- @user, @user, @user HI! Can we go for more walks

Neutral

- @user Can we go outside?
- Hey @user, is it possible to go outside
- I want to go for a walk, do you mind joining me?
- Pssstt…. I think it's time for a short walk
- Hey @user, aren't you bored? Let's go for a walk
- Hey @user! You haven't move in awhile, do you want to go outside maybe?

Upset

- @user PLEASE I WANT TO GO OUTSIDE
- It's getting pretty boring here, can we go for a walk? :(
- @user I don't feel so good…... :(
- Hey @user, I don't feel all that great. Could we go for a walk
- This is no fun at all, can we please go for a walk :'(

During walking

- Thank you for walking me @user
- Such a nice day to walk around :D
- You're doing great @user!
- I feel so much better now
- Thank you for this
- Isn't it nice to walk
- We should do this more often

Milestones

- Congratulations @user, you've taken ##### steps
- You've taken ##### of steps today
- Keep it up, you've taken ##### of steps today

4.4 Development tools

To make the project come to fruition, a number of development programs are used to either design certain features or provide virtual assets for the application. Most of these development programmes are chosen based on the developer's experience, available features, and number of tutorials. Because of this CorelDraw is used as it allows the developer to create digital visuals for the application such as the virtual pet, title, app icon and notification icon. For software development, the application is made in Android Studio as it is a program that most android developers use.

4.4.1 Android Studio

Android studio is the main platform in which the application is developed and it is chosen due to the popularity of the platform as well as the number of available tutorials. Android studio has a drag and drop feature which allows their developers to design the layout of the application fairly easily. In addition it also gives the developer the ability to program the code itself directly. This gives the developer plenty of customization as well as the ability to design certain features that are not readily available in Android Studio. Some notable features that are designed through programming include the step counter, notification and avatar.

Most of the advantages of the Android Studio lie in the fact that the integrated development environment (IDE) is specifically made to be used to develop android apps. This means that the development of the application is fairly straightforward as there is no need to download certain plugins or libraries. In addition to these, there are a number of tutorials both in stackoverflow and youtube to assist in programming the application. Certain features in particular such as the step count and the notification was copied from youtube videos. Some notable changes were made to accommodate the application but most of the basic concept remains relatively the same.

However, due to the developer's limited experience with the IDE and time constraints some features have to be cut. Some notable features that were cut include: customizations, achievements and interactivity. More on cut contents will be explained and justified in the compromises segment of the document. Other than limited experience and time constraints, debugging also plays a large role in the development of the application. Most features have seperate tutorials which basically means that in order to integrate them together some trial and error is required. It is also worth noting that the application is functional enough for the user testing as the main features were finished at the time for user evaluation: avatar, step counter and notification.

4.4.2 CorelDraw

CorelDraw is mainly used for the art of the application which includes the avatar itself, title, notification icon and application icon. Originally the aesthetics would also be designed in CorelDraw but due to limited time and skill this feature was unfortunately scrapped. Some concept art regarding the aesthetics can still be found on the customization segment of the document. The main reason CorelDraw was used is because this is the only program the developer knew how to make digital/ virtual art. In addition CorelDraw allows for tracing pre made images if needed and it is fairly decent in visualizing 2d images. The main drawback CorelDraw has over other digital art programmes is its inability to create dynamic lighting/ colouring. In addition, making animations is impossible in CorelDraw which limits the potential expressiveness of the virtual pet.

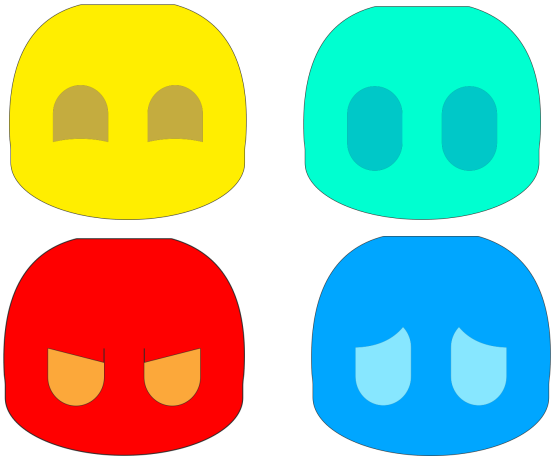


Image 27. Colours and moods of the virtual pet

The image above (image 27) is the final concept art for the virtual pet and its expressions. As seen in the images the colour of the virtual pet changes accordingly with the expression it is representing. Certain colours are often associated with a certain mood or emotion such as red with aggression or yellow with cheerfulness and joyful sensations (see table 4).

Colour	Mood and Emotion	Effect on people
Red	Aggression, Passionate and energetic	“Fight or flight”, Attention
Yellow	Joyful, outgoing and friendly	Optimistic, Excitement
Blue	Sadness, boring, conventional	Intellectual activity, reason, and logical
Cyan	Friendly, rational and unique	Peaceful, rationality and calmness

Table 4: Colours and what they represent (Sevinc Kurt and Kelechi Kingsley Osueke, 2014 and https://colorpsychologymeaning.com/color-turquoise/ taken at 18/6/2019)

4.5 Prototype 1

Several prototypes were made to test each main feature individually to simplify development as well as keeping an organized code as much as possible. Each new rendition of the application will keep on adding a new feature to the application and/or fixes an issue present in the previous prototype. This segment of the document will function similarly to a design log of how the final prototype is made. The final prototype is the version that will be used for user testing. From the user testing, new insights could be discovered allowing for a better version to be adapted in the next project. Unfortunately, due to time constraints only one user evaluation will be conducted.

4.5.1 Layout and step counter

The first prototype of the application was primarily to experiment and play around in Android Studio as well as to experiment on potential layouts and create the step counter. For the layouts several rules were made to help design a proper layout. These rules include:

1. The virtual pet has to take at least 40% of the screen space
2. The step counter is clearly visible on the homepage of the application
3. Everything should try to be as symmetrical as possible

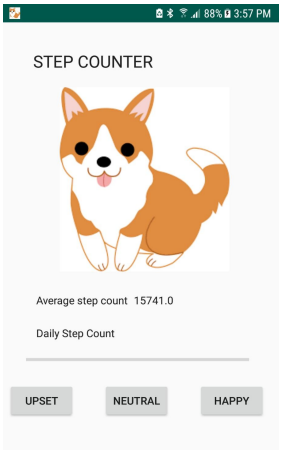


Image 28: Prototype 1

The Android Studio's click and drop feature makes it easier for a variety of layouts to be tested. However, a simple layout where everything is centered is chosen as seen in image 28 as it meets all the criteria mentioned above. In this rendition of the application several buttons were added to test the different emotions of the virtual pet but they do nothing thus far. It is worth noting that that the current avatar is a sample image taken from ya_webdesign.com[2] and it will not be the image representing the virtual pet.

[2] https://ya-webdesign.com/download.html

The step counter is fully functioning during this stage of development as it continually measures accurate values throughout its run time. Additionally it is placed directly beneath the virtual pet as it is an important feature that the user should acknowledge. Some issues encountered with the step counter is its inability to reset itself after a day of use as originally intended. This will become a major issue as the virtual pet will continue to be happy forever as the value never truly goes down.

4.5.2 Notifications and Avatar

The 2nd prototype implements the actual images for the virtual pet application and also added the notification functionality. As mentioned before, most of the art designs and colorations are made in CorelDraw. Because CorelDraw is not designed for artistic purposes, the visual design of the virtual pet remained simplistic. However, from the research done beforehand, it is at least known that the eyes are the most expressive features of a living creature. This was why most robotic pets often focuses more on animating the eyes than anything else. Unfortunately, CorelDraw does not have any functions that make animation possible which leads to a lack of animation. Android Studio does not make animation any easier but if it were to be implemented it is possible to have a set of videos playing different emotions and behaviors. Most of these animations will be looped but it can still give the illusion of dynamic movement and interaction.

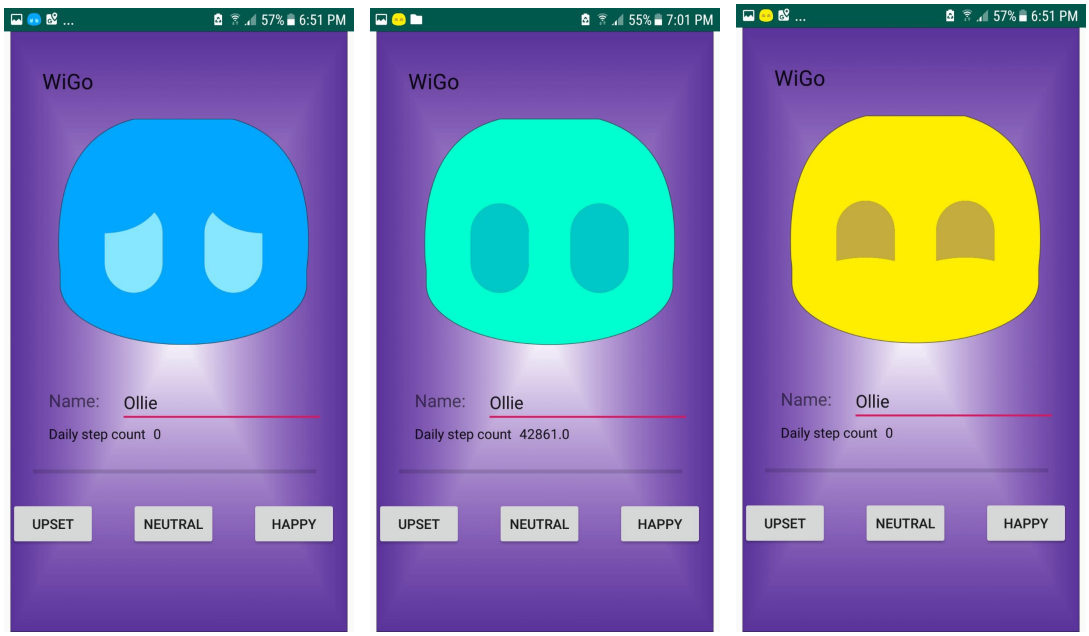


Image 29: Avatar expression and prototype layout

In addition to introducing the avatars, this prototype also creates the notification feature as seen in image 30. Android studio allows the developer the ability to change the notification icons of the same application. This was utilized to its full extent by having the virtual pet appear as the notification icon of the application. By giving the user visual cues of their pet's expression they might be more likely to empathize with them as compared if only texts were used. In this prototype only one line of each expression was used. Additionally, only three expressions were used as the angry expression may be considered too negative. However, It is not difficult to add another expression should it be needed. The pseudo code and tutorial of the notification can be found in the appendices of this document.

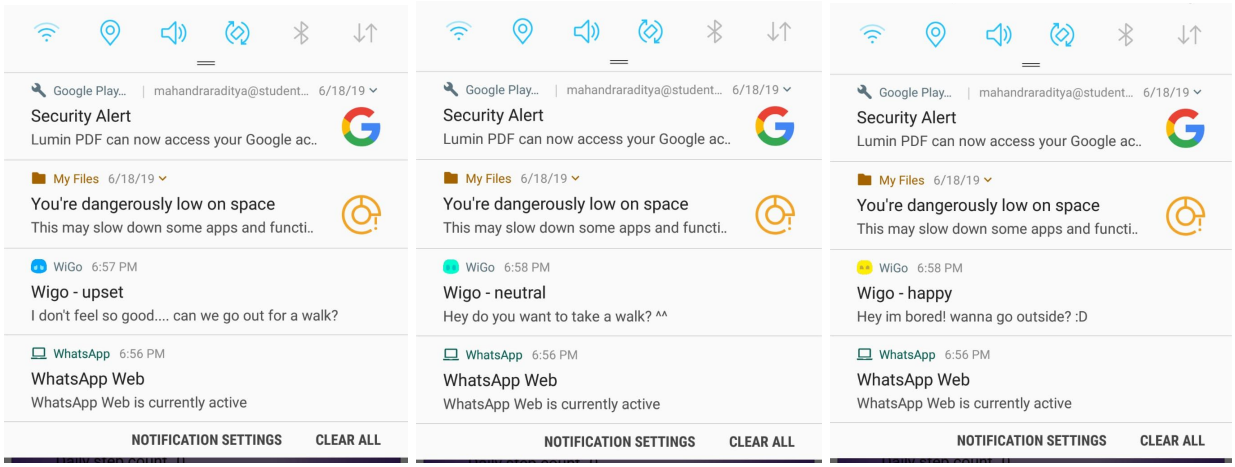


Image 30: Notification from the application

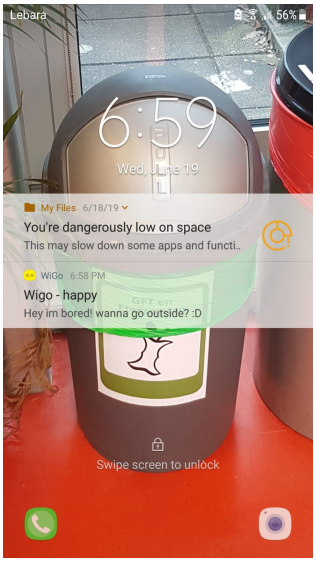


Image 31: Notification on front page of the phone

4.5.3 Connecting the Step counter and expressions

The third prototype was a simple improvement to the previous iteration of the application as it does not add any new features or make changes to the visuals of the application. This prototype consists mainly of simple bug fixes and refinements as well as the new interaction between avatar, notifications and the step counter. Previously the step counter does not revert back to zero after midnight but this issue was alleviated after an alarm system is implemented into the program. The alarm system would not be visible by the users, it is implemented simply to reset the step counter back to zero after midnight.

4.5.4 Prototype compromises

Due to time constraints and limited skill with the Android Studio IDE, some compromises were made. As mentioned before most of the features that are added to the application would be the main features as they are integral for the user testing. These main features were: 1) the step counter, 2) the notification and 3) the avatar and its expressions. At its core, the main idea behind the project is to provide positive feedback by giving some form of social encouragement and responsibility through empathy. Unfortunately, although the other features mentioned in specification were originally added to strengthen the bond between the user and the virtual pet, they are not compulsory. Each of these features played a large role in the overall experience but they were cut because they are not part of the preliminary requirements. Some notable features that are cut were:

1. Character customization
2. Login page (+hatching)
3. Interactivity
4. Animations

4.6 User Testing

Before a second prototype is developed, the first prototype was used as part of a user testing experiment. This is done to measure the effectiveness of certain elements in the application as well as finding features that were lacking or too troublesome. This research data would be used in the development of the second prototype. During this experiment the features that would be of interest are the step count, the notifications and the virtual pet itself. In addition, the users are given the opportunity to mention a feature that they would like to have on the application. Some features that were also in consideration will also be mentioned during the interview to see which of the discarded ideas are worth-while developing.

4.6.1 Procedure

The procedure of the initial experiment is a controlled user test as most of the features were not usable independently. The procedure starts with an explanation of the project to give the user tester a better understanding on the application's purpose as well as its usability. Due to time constraints, the user is tasked to role play a scenario where they have used the app for three days in 30 minutes.

- On the first day the user was given a scenario where they did not reach 5000 steps which causes the application to be upset.

- On the second day the user bike broke down midway to the university and walked for 6770 steps. This makes the application neutral.

- On the last day the user has to walk from their house to the university which allowed them to reach 10000 steps.

Each user is then asked on how they feel towards the application and virtual pet. The purpose of the experiment is to simply find the key features of the application as well as rank them based on importance. Additionally, minor features were also discuss to see any potential improvements that can be made and added to the application.

4.6.2 Results - Notifications

The notifications have a fairly negative response primarily due to the virtual pet sounding either "too needy" or too demanding. The users find the virtual app too negative especially when the app was satisfied. To give an example: everytime the user reaches 10000 steps the app will still ask if the user wants to walk more. Despite the happier tone, the user would prefer some form of acknowledgement or reward rather than a plea for more walks. Also the majority would like to have a notification when a milestone is reached just to clarify their achievement.

Additionally the notification seemed to have a larger impact on the overall interactivity between the user and the application. This is shown by the fact that during testing, the user opens the application only once and for the rest they mostly rely on the notification. In the current condition of the app, most users treat the application more so as a glorified alarm to exercise. This shows that the main page requires much more work in order to be effective and that the notification plays a much larger role than anticipated.

4.6.3 Results - Virtual pet

Generally positive feedback but most users feel that the virtual pet is not lifelike enough to warrant any emotional investment. Is this due to the lack of any expressive animations, art or some form of life like mannerisms. This is expected as in this version of the virtual app is

nothing more than an image that changes depending on the mood of the application. Some users also pointed out that the current design of the virtual pet resembles a pig's nose.

Due to the limited time and resources there can only be a single improvement to be made on either the customization and the animation. The customization focuses more on the personalization of the virtual pet whereas the animation will enhance the expressiveness and the emotion of the pet. The interview has concluded that animation plays a larger role in making the virtual pet more effective as the user testers feel like they have a better chance empathizing with a more expressive creature rather than a personalized one.

4.6.4 Results - Miscellaneous

The step count plays a large role in the application and thus its contribution is fairly important to the user's experience. Unfortunately due to the main app's lack of appeal, it is fairly seen by most users. However, when instructed to look at the step count and asked for a reaction most users mention several issues regarding progress. Firstly, most people do not have a sense of scale on what can be considered as a good number of steps. Secondly, after being told that the goal is 10000 steps, most people think that the goal is too far or too unrealistic. These two feedback shows that the milestones needs to be toned down and a better sense of progression is needed.

Chapter 5. Realization

5.1 Final Prototype

The final prototype has several improvements compared to the first prototype. The improvements are made mostly in response to the feedback gained during the first user testing. Several improvements were also made to make the application more usable without technical assistance from the developer. This makes it possible to conduct a 3-day experiment as a second user test.

5.1.1 Character redesign

Due to the number of people mentioning that the previous virtual pet looks like a pig's nose, the pet has been given a new appearance. The new design still retains most of the colour palettes from the first prototype as most users were satisfied with the previous colour schemes. The redesigned head resembles that of a cat for a number of reasons. Firstly, cats are recognizable household pets that like to walk around. This gives WiGo some form of familiarity without resembling something it shouldn't have (ie. a pigs nose). A reasonable argument could be made that a dog would be a more suitable model. However, a cat was chosen because the simplified head of a cat looks similarly to something that portrays a fast moving creature. This is mostly credited to the angular nature of a cat's head and the pointy ears. It also helps that the world's fastest land animal also happens to be a cat (the cheetah).

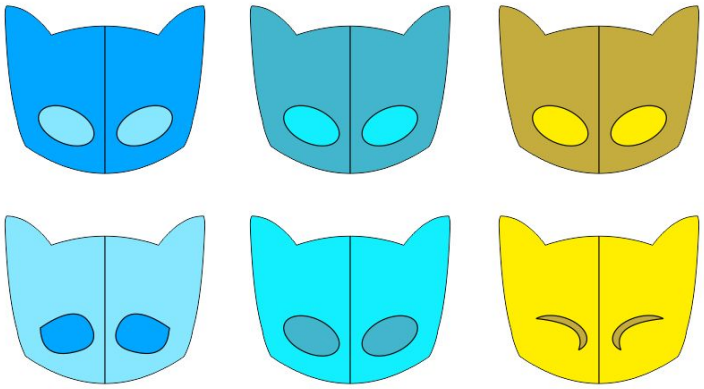


Image 32: the new designed head

5.1.2 Animation

Several users have also mentioned the importance of animation during the first user test as animation gives the virtual pet more life and character. During the first prototype, most of the users are fairly aware of the fact that the virtual pet are just pictures. In order for them to be convinced that the pets are life like, more effort has to be put into development. Due to the limited skills in animation, only limited movements were used in the application. In addition the animation was programmed and not drawn. This allows the application to change the animation fairly easily. It also allows for a more dynamic response should be needed, but this was not implemented as much as was hoped for The animations were fairly simple as seen in the images below:

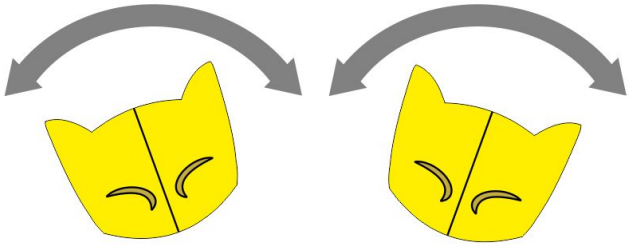


Image 33: WiGo happy animation

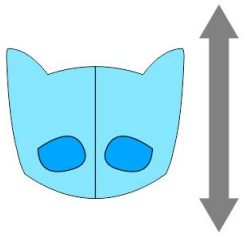


Image 34: WiGo sad animation

There is more to be desired from the animations but this should suffice for now. The simple animations are reminiscent of simple emotions; when WiGo is sad

5.1.3 Revamped step-counter and new progress bar

Minor adjustments were made to the step counter to make it more useful as a measurement tool. Currently a simple goal was added next to the step count to help indicate what how much step a user needs to take daily. Adding a goal gives the user a better understanding of how much they've progressed during the day. It also provides a target for the user to reach, giving them more motivation to see it through. In addition to the small changes made here, there are also improvements made to the reward and mood system of the application. The application would now respond when the step count is at 2500 and 7500 instead of the old 5000 and 10000 mark . This is made to lower the bar for success as well as to give an opportunity to compliment the user as much as possible.

Expression	Prototype 1	Prototype 2
Sad	Below 5000 steps	Below 2500 steps
Neutral	Between 5000 and 10000 steps	Between 2500 and 7500 steps

Happy	Above 10000 steps	Above 7500 steps

Table 5: Step milestones for each expression

Alongside the changes to the step counter itself, some changes were made to the UI itself. One of the most prominent addition to the user interface is a progress bar located in the center of the application. The progress bar is made to track progression much easier as well as to give a visualized form of the step counter. The progressbar is also connected to a series of medals which correlates to the number of step count: Bronze (reaching 2500 steps), Silver (reaching 5000 steps) and Gold (reaching 7500 steps). The medals are another technique to create a sense of validation and progression within a shorter amount of time/steps. Additionally, medals are a lot more recognizable as a symbol of accomplishment and victory.

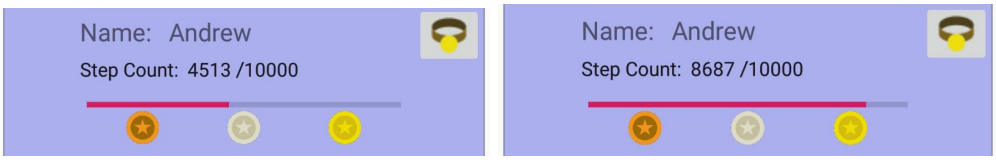


Image 35: Step counter and progress bar

The step counter will also be visible in the notifications feed. This is primarily due to the fact that in the previous experiment, everyone claimed that they prefer to use the application as a glorified alarm clock. Additionally, the first user test also indicated how important the notifications are to the application. As such as a quality of life improvement as well as a basic reminder the step count will always be visible on the notification screen as long as it is active. Whenever the user reached a certain milestone, the phone will send a “medal’’ notification to congratulate the user at the moment he/she reached the milestone. This will make the application feel more reactive and dynamic as it reacts based on reaching a certain condition rather than a schedule. This conditional notification is also implemented when the user reaches the daily milestone of 10000 (Goal reach notification) or when the user is walking (Thank you notification notification). Medal notifications can be seen in image 36:

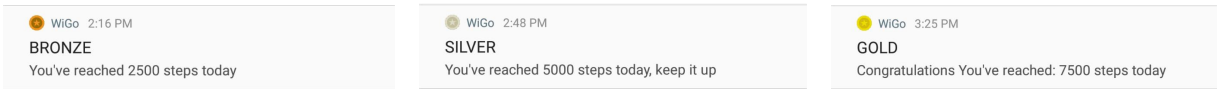


Image 36: Medal notifications

5.1.4 Notification changes

Significant changes are made to the notification system to make it sound more congratulatory. In addition to dialog changes, the system on how the application handles sending notification is also altered. In the first prototype the users were originally supposed to see a notification only at 12:00 and 20:00. The new version would also send notification at these times as well but it will also send notifications based on other factors such as step count or

when the user is walking. This new dynamic response is added to make the virtual pet feel more life-like and responsive. The list of notification schedules and conditions can be seen in table 6:

Type	Name/id	Description
Scheduled Notification	Invitation notification	A message to remind the user to take more walks
	Result notification	A message to inform the user about their daily progress
Conditional Notification	Bronze notification	A message telling that the user have earned a bronze medal
	Silver notification	A message telling that the user have earned a silver medal
	Gold notification	A message telling that the user have earned a gold medal
	Goal reach notification	A message indicating the user have reached the daily milestone
Conditional Notification	Thank you Notification	A message saying thank you to the user if they are walking with their phone
Step counter Notification	Step Counter	A notification that displays the user's current step count

Table 6: Different types of messages and their description

Vibrate
Does not vibrate

Condition	Prototype 1	Prototype 2
At 12.00	Send invitation notification	Send invitation notification
At 20.00	Send result notification	Send result notification
Reaching 2500 steps	-	Send Bronze notification
Reaching 5000 steps	-	Send Silver notification
Reaching 7500 steps	-	Send Gold notification
Reaching 10000 steps	-	Send goal reached notification
Walking between 12.00 - 14.00	-	Send a thank you notification
Walking	-	Send step counter notification

Table 7: Conditions to trigger each notification

Other small changes include the removal of the angry notification as the testers from the user testing has a clear negative response towards it. This is because they found it too negative/ ungrateful which makes it sound like they are being punished. The users prefer the concept of receiving no rewards should they fail to meet the requirements rather than a punishment. Another minor adjustment is that the step count is now always visible on the notification screen. In the first user testing, the users does not open the application as often as they should. To ensure that the user is aware and are able to track their progress, the step count is now being sent as live notification. Additionally, any scheduled or conditional notification will also have or at least referenced the step counter's value during the time the message was issued.

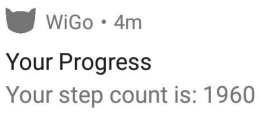


Image 37: step count when not in use

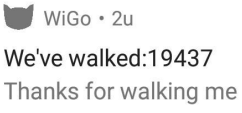


Image 38: step count during walking

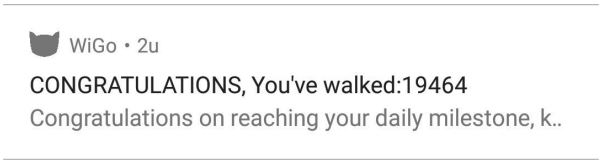


Image 39: Notification at 20:00 if you passed the daily milestone

5.1.5 Layout

There have been a few but significant changes to the overall layout of the application. This is mostly due to the feedback gained from the first user testing and the overall development of the application. Aside from being used in the first user test, the first prototype was also designed to be used as a testing ground for underdeveloped features. Although most of the features works by the time the interviews were conducted, the user would have to spend at least an entire day to utilize the application correctly. This why the buttons in the first prototype were prominent, it is a tool for the designer to control the applications features manually. In the new layout, most of the buttons are removed aside from "test" and "send notification". As the name implies, both of these buttons are used to experiment the UI and test the notifications respectively. Additionally a new button was added called "reset" that reverts the step count for the day back to zero. The application has a working automatic reset but the button was left there just in case the automatic reset does not work. It is essentially a fail safe for the users to be able to manually reset their step count.

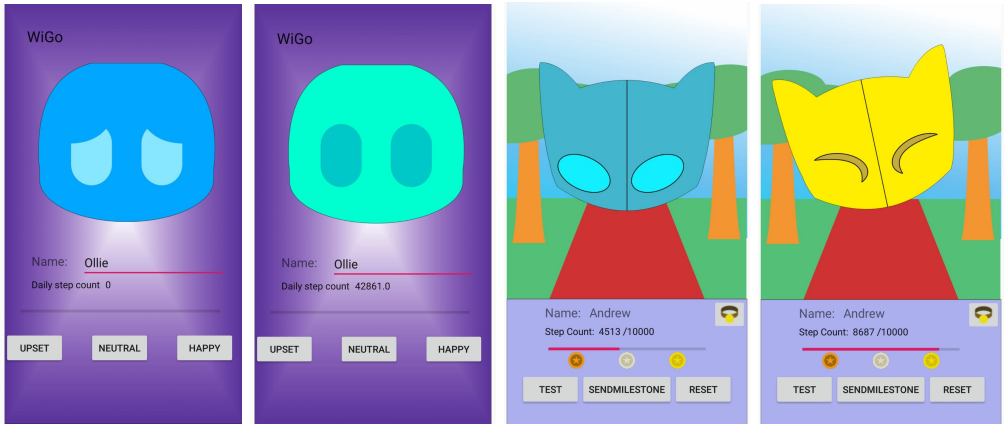


Image 40: Old vs New design

As previously mentioned, the progress bar and the medals are also introduced into this new prototype. It is located below the name which is now a full text rather than an editable text box. This was a minor change as one user found it disturbing that the editable text box was constantly active. To change the name of the virtual pet the user would now have to press the new name tag icon  which will send them into a new popup window. Unfortunately when saving the name of the virtual pet, the application always seemed to crash. As a compromise, the name will be manually changed in the code when and if the user downloaded the application manually through a USB cable.

In addition to the new head, the background of the application was also changed after some testers finding it to be too dull and uninteresting. One of the more popular demands is an outdoor based background as people generally like to walk outdoors. To match the art style of the head, a simplified scene from a park is used as background. Originally the red part of the background was suppose to be a road but due to the placement of the head, most users associated it with the body of the virtual pet.

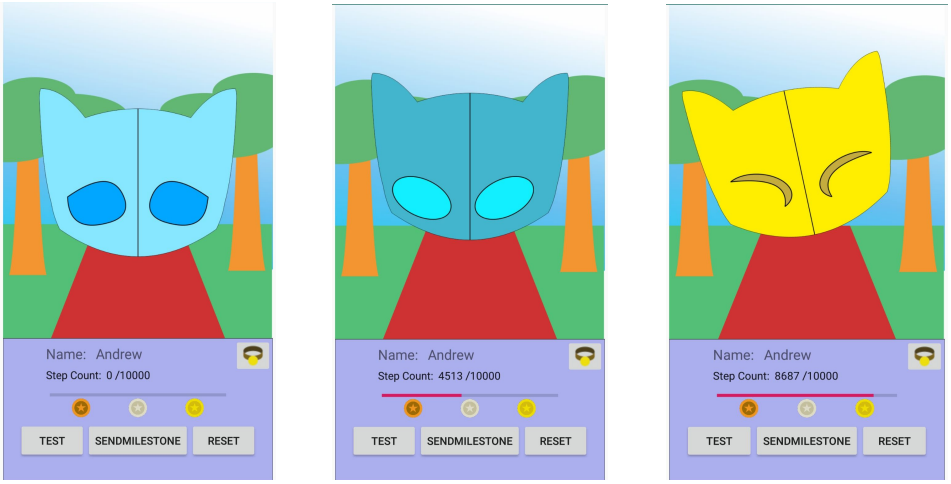


Image 41: Different expressions of WiGo - Sad, Neutral and Happy

Graphical improvements aside, the virtual pet also behaves slightly differently than in the previous prototype. Originally the virtual pet has a relatively simple behaviour/routine in which the virtual pet based it's mood on the number of step count. This means that the virtual pet is always happy when the step count reaches 10000 (old high milestone) and sad when the number of step count is below 5000 (old low milestone). This means that the virtual pet will always start the day feeling sad as the step counter was reset back to 0 which is below 5000. This also means that until the user reaches 5000 steps, the virtual app will always be sad. Because this may compromise the relationship between the pet and the user, the pet will now only be sad if the user is still under 2500 steps (new low milestone) at 12.00 PM. Before 12.00 PM the virtual pet will always show the neutral mood. Additionally, if the user somehow manages to reach more than 7500 steps (new high milestone) before 12.00 PM then the application will be happy for the rest of the day.

5.1.6 Compromises - Character customization

Due to time constraints, not much progress was made towards the character customization. Originally, the user was allowed to make minor cosmetic changes towards their pets to make them more personalized. However, this was deemed to laborious and difficult to make as to provide a decent level of customizability, the developer would need to create a decent number of artistic assets, program a seperate screen for customization and create some form of currency for the customization. Artistic assets are fairly straight forward as the cosmetics need to be drawn in order for it to visualised on the virtual pet. Considering that a decent number of cosmetics is needed to have an impact in customization, this may take a lot of time. Due to time constraints this was eventually scrapped, especially considering the amount of time required to design, and draw the assets.

Programming a seperate screen for customization is fairly laborious and time consuming as the amount of buttons and images (artistic assets) that has to be implemented is quite numerous. Additionally, a decent level of programming skills is required from the developer to program this feature within a fairly limited amount of time. The developer would also need to be concerned about the layout of the customization page as the user would need to see both the cosmetics icon and the virtual pet model with the cosmetics on. The developer would also need to think on how the user could get new cosmetics. It would be a waste not to implement some form of milestone or currency for the user to achieve or use respectively to gain cosmetics. Adding these features also would cost more time but even if they are excluded, the main idea of being able to customize the character would already be too time consuming. Some level of customizability is still implemented but it is fairly limited as the user is given only the ability to change the name of their virtual pet. Unlike cosmetics, name change is fairly easy to implement and it is also fairly effective at personalising the virtual pet.

5.1.7 Compromises - Login page + Hatching Sequence

The login page was first conceptualize just as a form of formality for the user and also to provide the terms of agreement page of the application. It would ask the permission to use the Android's built in step counter as a means to avoid monitoring the user's behaviour without their consent. These were cut simply because this level of formality and safety concerns is not required for the first usability tests. Most participants in the usability test were informed beforehand on what the application will record and as such most of the formalities will be done by hand during the interview or installation.

The hatching sequence was originally conceptualized to symbolize a new birth as the user would have their lifestyle changed to become more active by using the application. It was supposed to be symbolic for a new start as well as creating an impact when the user is first introduced to the virtual pet. Due to the importance of first impressions, this feature could have been an additional attention to detail to help make the virtual pet more life like. Unlike customizability, the hatching sequence would not require a lot of investment as the assets for the egg has already been made (as seen in image 42). Additionally, the programming would not be as difficult as customization as adding an image on top of the virtual pet could suffice to create the illusion hatching. This was cut from development due to the one time use of the feature. Additionally, this feature was a small attention to detail that was not significant enough to be added for the first usability test of this project.

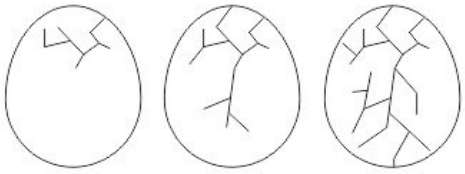


Image 42: Hatching egg

5.1.8 Compromises - Interactivity

Originally the plan was to allow the user to do a variety of exercises and make these exercises in to games. Additionally a number of small interactions such as petting, feeding, complementing, cleaning, grooming and playing fetch were considered to be put in to the application. However, this was eventually cut due to the amount of work that is required to program, animate and visualize said actions. These features were mainly implemented simply to enhance the experience of the user and to add a little bit of extra interaction between the user and the virtual pet. Even though these interactions are not that significant to the overall functionality of the application, it helps enhance the immersion of having an actual pet. These interactions would also make the virtual pet more life like and it would also give the users more options to play around the application. This could potentially increase the level of empathy the user has towards the virtual pet as emotional bonds become stronger the longer the person interacts with the object. Emotional bonds also becomes stronger the more expressive, life like and animated the virtual pet behaves.

Chapter 6. Evaluation

The first user test gives a clear idea on what the project aims to accomplish but it lacks validity as there are several factors that were heavily overlooked. Time played an important role in the application as the user may have a different opinion after spending time with the application. Relationships take time to develop and users weren't able to bond with the virtual pet during the 30 minute interview. In addition to lack of time, the presence of a tester may also affect the user's experience with the application. As it is a controlled environment, users may have acted in ways they don't normally do. In other words, since they are following a scripted scenario, they wouldn't be able to predict how they would actually feel about the application. The interview was sufficient enough to obtain trivial issues such as how the application look, operated and showcasing the feature. However, to test how the user truly feels about the application, a second user test will be held with a version of the application that can work independently from its developer.

For the second user test, a number of participants were invited to test the application for at least 3 days. Most of the applicants that were invited are students and alumnis from the University of Twente. This is because these testers are the main target audience for the application. In short, these students will be given an APK file of the application. Additionally if there are any issues with the installation or general errors, they will be offered a manual installation with the developer.

The 3 days time period was meant to give users plenty of time to form an opinion on the app as well as to increase the likelihood of them bonding with the virtual app. Empathy scales with the number of interactions, therefore the longer the user spend time with the virtual pet, the higher the chances they can form a bond. The bond can also be a negative relationship as the user could find the application to be too intrusive or annoying over time. The long duration is also required to test if there are any "novelty effect" in the application. People may find the idea to be good at first glance but as soon as they use it for a couple of days they might lose interest in the project.

6.1 Procedure

There are some requirements that the user needs to have in order for the experiment to be viable for research. All of the requirements are mandatory as the experiment can not even be conducted should the user does not meet a single requirement. The first requirement is that the user must have an Android as the application is only available for Android devices. This is mainly because the application was developed in Android Studio which is an IDE exclusively for making Android applications. The second requirement is that the participant must be a student of the University of Twente or at the very least an Alumni or a student from another university.

This is because the experiment is mostly concerned with UT students and in order to emulate the target group as much as possible, only those who are currently studying in the UT (or at the very least studied in a university) will be interviewed. The final requirement is that all participants must provide time to install the application and conduct an interview after the trial period is over. The installation would need to be done with the developer as some settings within the participants phone might need to be changed.

List of requirements:

1. The user must have an Android
2. The user needs to be a University student or at least alumni
3. The user needs to conduct an interview at least 3 days after using the application

At first the testers are invited to participate in the experiment and if they agree, they'll have to sign a form to proceed. Once the form is signed the users are invited to a group chat via WhatsApp where the APK file will be uploaded. The users are then instructed to download the app and use it for at least three days before scheduling an interview with the tester. The interview will last approximately 30 minutes. The schedule for the users can be seen below:

1. Sign the ethics paper and agree to participate in a 3-day long user test
2. Download the application
3. Read the protocols and instructions sent via the whatsApp group
4. Use the application for three days
5. Schedule an interview with the developer
6. Participate in the interview

Instructions

- Keep the app open at all times
- Do not press the "save name" button in name tag pop up
- Do not press the return/reverse button (to quit just press the home button)
- Do not use any buttons after midnight. Buttons can be used to experiment but only at 8pm and beyond.
- Do not access the app via the notifications as they seem to open a new page (some ppl can get away with this by pressing the back button but I suggest to just not use the notification for access entirely)

Error/bug protocols

- In the event that a button is accidentally pressed or if there is a bug in the step count; press the reset button to continue. Be aware that resetting the step count would mean losing all of your progress for that day.
- If the app fails to restart in the morning, just restart it manually using the restart button.

Installation or update protocols

- Download the APK file received from the official WiGo whatsapp group chat

- If the file fails to download, please check in the “download” file folder of your phone and open it there manually
    - You should see a pop up asking if it is ok to download an application from an unknown source
    - Click “yes”
- If you have any previous versions of the application, please uninstall that application first, turn your device off and on again and proceed to download the APK file again.
- If all else fails, contact the developer immediately and a manual USB installation can be arranged.

There are 2 different stages of the interview: the first being a Standard Usability Scale questionnaire and the second being a more general interview. The questions for the second stage will be left as general as possible so that the flow of the interview can change depending on the topic of interest. Nevertheless, a guideline is made just to keep some form of linearity and consistent information. Additionally, the question on the second stage may change depending on the answers obtained from the SUS questionnaire. More details on the interview can be seen in the appendices.

6.2 System Usability Scale

The System Usability Scale (SUS)(J. Brooke, 1986) is a reliable and common tool for measuring usability of a gadget or application. For this experiment, the users are given a SUS question specifically for apps. Some questions are more important than others in regards to the experiment but all of them were still asked during the interview. This is because some important data or correlation of data may appear from asking all the questions. The SUS questionnaire can be seen in the appendix. For convenience, these are the SUS questions that were asked (Blue questions are questions that are deemed more important for this experiment).

1. I think that I would check the app frequently.
2. I found the application unnecessarily complicated.
3. I thought the application was easy to navigate.
4. I think that I would require technical assistance when I am using the application.
5. I found the various features available in the application well integrated.
6. I thought there was too much inconsistency in this application.
7. I would imagine that most people would learn to use the application very quickly.
8. I found the application quite intrusive at times.
9. I felt very confident using the application.
10. I required some time to get adjusted to the application before I was able to appreciate it.

Results

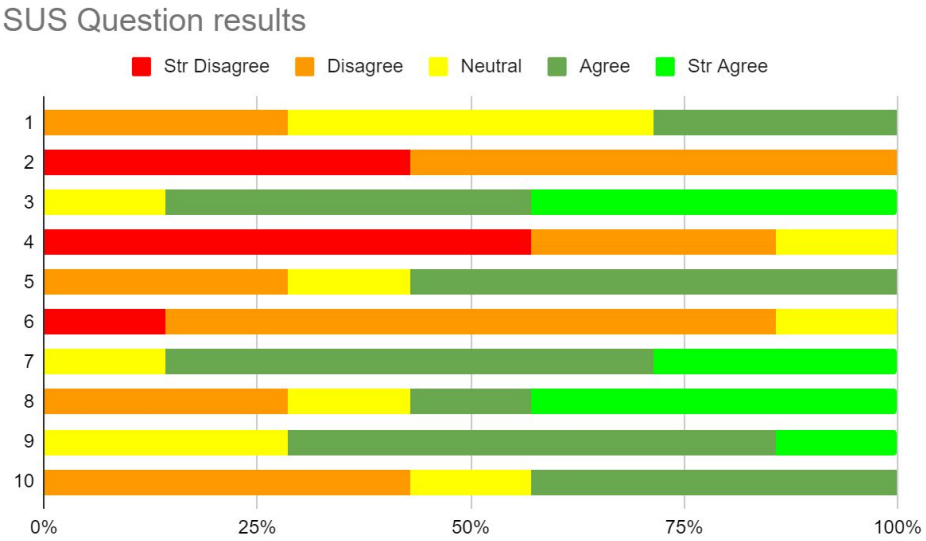


Image 43: Results of SUS questionnaire

When it comes to bonding, time plays an important role and this is measured by the frequency of the application being opened (question 1) and the duration in which the user spend or use the application (question 10). Both the results from question 1 and 10 seemed to highlight a more neutral response from the users. This essentially means that the users opens the application often enough to use it properly as well as spending a moderate amount of time with the application. However, whether or not the user has bonded with the application is a different subject as it is possible that they are opening the application due to the fact that they are in an experiment.

Question 5 and 6 focuses more on the quality of the application in terms of its features and design. Question 5 is about how well the features were implemented while question 6 is more on the consistency in the general theming and functionality of the application. Both questions seems to yield a positive response towards the app given that question 6 asks for the inconsistency (which is why a lot of people disagree). Unfortunately the same could not be said to question 8 as a lot of users generally agrees on its statement regarding the app's intrusiveness. Question 8 focuses more on the notifications, one of the three main features of the application. The results indicate that users found the app to be really intrusive. Some users don't have a problem with the intrusion but the majority does seem to have an issue.

Some questions are considered less important than others (Q2, 3, 4, 7 & 9) because they do not add much for the research question. Most of these questions were based on the complexity and/or interactive elements of the application. Because the application has a limited number of features and buttons, these questions tend to be fairly positive in the application's favor.

In addition to the SUS questionnaire, a more direct set of questions are used to measure the level of investment and immersion the user has with the application. These two questions focuses more on the level of investment and immersion of the user. The main purpose of these questions is to measure the user's overall interaction with the application as well as to provide a clearer picture of how the user feels towards the application. The level of investment focuses more on how much the user is willing to cooperate with the application, more specifically how much they have improved. Measuring the level of immersion on the other hand focuses more on how much the user is willing to take care of the application.

Question 11. Level of investment

Stage	Description
Stage 1 (Not invested)	Doesn't walk more than they use to
Stage 2 (Mildly invested)	The participant occasionally walks more than usual
Stage 3 (Invested)	The participant significantly walks more
Stage 4 (Very invested)	The participants took initiative to walk before a notification pops up

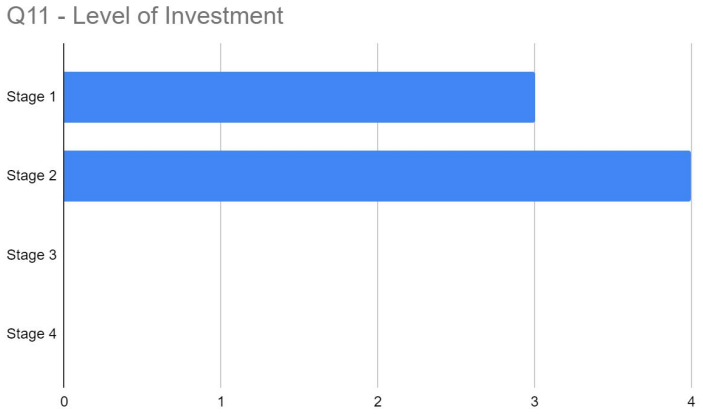


Image 44: Results of question 11

12. Level of immersion

Stage	Description
Stage1 (Not immersed)	The participant completely ignore their virtual pet
Stage 2 (Mildly immersed)	The participant occasionally checks their virtual pet
Stage 3 (Immersed)	The participant looks at the notification as much as possible
Stage 4 (Very immersed)	The participants actively try to keep the virtual pet happy

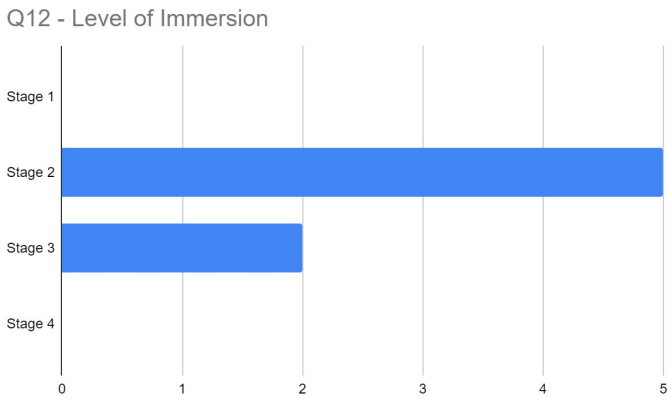


Image 45: Results of question 12

Analysis

Both questions indicate that the users were able to immerse themselves into caring for the application but they were not able or willing to invest time or energy into it. In simpler terms: some users were able to empathize with the application, at least to the extent of caring for it by checking the notification regularly as proven by Q12. However, despite their willingness to bond with the virtual pet, they did not care for it enough to change their habits as seen from the results of Q11. The application did make an impact to most of the testers but the improvements was fairly minor especially when it comes to the overall goal of the application. To further understand why the results are as it is, an interview is held right after the questionnaire. This would highlight the users reasoning behind their answers for question 11 and 12.

6.3 Interview results

To get a clearer image on each of the user's personal experience with the application, an interview was held right after the SUS questionnaire. The aim of the interview is to gain qualitative data on the users opinions, experience and attitude towards the application. This will give a more accurate understanding of the relationship between the user and the virtual pet as a bond or personal preferences is not something that could easily be gauged by numbers. The interview consists of 5 main questions alongside a few smaller sub questions depending on the user’s answer. These questions were mostly focused on the effectiveness of the design and concept rather than the functionality of the application. This is an important distinction as this means the user’s were not allowed to complain about unintentional bugs should they appear. During the interview, the user will mention all the issues they have with the application and

some that had to do with a bug are filtered out due to their lack of significance in the research. This is done to form a list of what could be done better for the next iteration of the application. The list of questions used in the interview for both the SUS questionnaire and general interview can be seen in the appendix. Additionally, some bugs that were found will be listed and explained further in the report.

6.3.1 Results

The results were promising but slightly underwhelming as the application seemed to have a positive effect on the user but not by a large margin. Most users typically consider the application as a slightly more complicated “alarm clock” or reminder. The majority of the users claimed that they do care for the virtual pet albeit not to the extent of an actual animal. This was expected but the results from the interview has shown that the user’s limited empathy towards the application does not meet certain requirements. The interview indicated that the application was able to motivate users to walk further than they did before and/or initially planned. However, when it comes to motivating the user to start walking, the application fails to do so. This was caused by a number of factors such as the user’s availability, lack of motivation and the user’s emotional perception towards the application.

The user’s availability plays an important role in determining whether or not the user will follow the application’s instruction. This is because the user may not have time, energy or option to do what the application instructed. Even simple walks require time and energy, if the user is too busy with their work and/or ill they may not be able to do simple tasks. For reference, 2500 steps takes a round 20 minutes when walking leisurely and 15 minutes when brisk walking. This means 10000 steps would take the user around 45 minute to one hour to accomplish which may not be possible during a busy schedule. There are also issues regarding the act of other physical activities that can’t be measured by the application. Some users mention that it is unfair to rule out other forms of exercises simply because the application cannot record it. There are some users that likes to run without their phones or engage in an early morning swim. As such some time of physical activity are unintentionally omitted from the application.

Additionally, motivation and intent of the user also plays an important role in determining the application’s effectiveness. This may be quite obvious but it is a valid point nonetheless as the majority of the users could agree. The majority of the users mentions that the application fails at motivating them to start walking when they are working or relaxing. However, the application did manage to motivate them to take longer steps when they are already walking. One of the most common examples is rerouting their routines to create a longer path to increase their step count. Some examples may include: walking a longer route to buy groceries, go to a similar store that is further away than the one he/she normally goes to and taking longer routes to get to classes. This might be a minor improvement but it is still a decent progress towards a more healthy lifestyle.

Despite its shortcomings, some progress were made in motivating the user as it also increased the step count of the user. This may be a minor improvement but it is still a small progress to the desired goal. More effort is required to actually create motivation rather than just to amplify it as the app seemed to do at the moment. Some feedback was also added by the users that may help improve the application for future iterations.

6.3.2 Improvements

One of the most important improvements that needs to be added is the one regarding the art and animations of the virtual pet. As mentioned in this report itself, animation plays an important role in selling the believity and expressivity of the virtual pet. Although the app itself does contain a few bits of animation, a more dynamic and fluid animation may be required to further enhance the experience. On the topic of animation, some users also claimed that the virtual pet could also be redesigned to make it look more life-like rather than in its current state. However, this may become controversial as some users prefer the simplistic style of the current iteration. Perhaps an art style that is more akin to a properly designed mascot or cartoon character is required to make the virtual pet work.

The artificial intelligence of the application could also be improved as the current iteration functions more like a number of if statements and a schedule. Although this approach was sufficient enough to bring the concept to fruition, its effectiveness leaves much to be desired. A smarter AI may be required to make the application behave more like an actual living creature. This is because real life pets are often unpredictable, develop their own personalities and behave more dynamically than the current iteration could provide. Some users would like the application to have more variable and random response or dialog throughout the day. This will make the application seemed more spontaneous and life-like while giving it more opportunities to portray some form of personality. However, this may cause other issues such as the application being too intrusive or annoying.

Some users also suggest adding interactivity to the application as a means to bond with the virtual pet. This could potentially increase the user's empathy towards the virtual pet as it allows them to directly interact with their virtual pet. This was originally part of the application but it was unfortunately scrapped due to limited time and programming knowledge. However, after this feature being recommended by a few users, it might be worthwhile to implement some form of interactivity in the next iteration of the application. Interactions could be divided into something that is mandatory (such as feeding and grooming) or something optional (such as hitting or petting).

Chapter 7. Conclusion

How can a system that uses empathy help to create an active lifestyle?

Sedentary lifestyle is a fairly common issue amongst people studying or working in an office based environment. To alleviate this issue, enhancing the experience of an active lifestyle might be more beneficial than to simply reward the patient or to scare them off with the potential risks of a sedentary lifestyle. Perceived empathy seemed to be one solution that can be used to improve motivation as it seemed to be quite effective in improving one's self determination and reduces burn out. This could be implemented through technology making it more accessible and convenient for the user.

The projected started as a means to alleviate sedentary lifestyle while simultaneously promoting active lifestyles. To achieve this goal, a variety of different concept ideas were made alongside various interviews and experiments. Throughout the development of the project, the idea of perceived empathy is implemented as the main core of the project. Interviews and experiments were done with experts and students respectively to gain as much insight as possible. The interview was done twice: the first experiment was conducted to find design flaws where as the second experiment was done to measure the effectiveness of the concept idea.

The project seemed to yield promising results as the general feedback from the interviews and SUS questionnaire seemed to be relatively positive. However, despite its promising results the app is still far from its original goal. The app succeeded in motivating the users to take more steps but it fails at motivating the users to start walking. In a sense the application is greater at enhancing the experience but fails to motivate the user to break off their routine. This means that the application only manages to reach half of its goal in motivating the user to walk more. The users does mention that the idea could work but a significant amount of investment is required for it to be fully effective.

Several improvements that could be made includes the improvement in animations and art, smarter AI and increasing interactivity. Animations and art needs a significant improvement as the current iteration was not effective enough to reach the concept's full potential. Smarter AI may be required to consider other factors as well as to make the application behave more like an actual living creature. Interactivity has proven to also play a large role as it allows the users to directly interact with the virtual pet. This may increase the likelihood of bonding. All of these three factors contributes to the believability of the artificial pet which may boost the user's ability to sustain and initiate the motivation to become more active.

As it stands, a system that uses empathy can create an active lifestyle but it is fairly limited in its capabilities. As mentioned before, a significant amount of improvement and resources are required to make an object or a virtual creature look alive and worthy of empathy.

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2) http://img.directindustry.com/images_di/projects/images-g/2005-huggable-photo-mit-media-lab-10110-9447358.jpg
3) https://www.researchgate.net/profile/Pericle_Salvini/publication/260696239/figure/fig2/AS:527919925923840@1502877326074/Kismet-by-Cynthia-Breazeal.png
4) https://sap.mit.edu/sites/sap.mit.edu/files/styles/legacy_article_image/public/images/articles/legacy/standard/introducing-nexi-internet-celebrity/2_hi_0.jpg?itok=aXOnAuww
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6) https://images-na.ssl-images-amazon.com/images/I/51LtByererL._SY300_QL70_.jpg
7) https://www.designboom.com/wp-content/uploads/2017/11/sony-aibo-robot-dog-designboom-1200.jpg
8) https://s.hdnux.com/photos/74/75/25/15979841/5/gallery_medium.jpg
9) https://www.bandai.com/tamagotchi/img/products/42800_42813_OriginalRedGlitter.jpg
10) https://cdn-images-1.medium.com/max/640/1*r-cZ7h7L_qPXtpePHpckYQ.png
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12) Original screenshot
13) Original photo
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15) Original photo
16) https://thewoodenwagon.com/Merchant2/graphics/00000001/BBJ24510-1.jpg
17) Original screenshot - image of dog from: https://ya-webdesign.com/download.html
18) https://cdn.vox-cdn.com/thumbor/E4bo4yJt6OEWFFgZxnnjQGuiO58=/277x347:4032x3024/920x613/filters:focal(1758x1365:2402x2009):format(webp)/cdn.vox-cdn.com/uploads/chorus_image/image/60083811/IMG_8683.0.jpg

The rest are originals: 18 - 45

Appendices

Expert Interview

Prototypes

Procedure

Duration: 5 min (Interact with the prototype)

Interviewer

1. Set the virtual agent and robot pet together
2. Let the user do typing exercises
3. Give some sort of feedback to the user to respond to
4. Observe user behaviour

Interviewed

1. Typing exercises
2. Interact with the robot
3. Walk or do exercises with the robot

Reasoning

1. **Typing exercises:** Testing the responsiveness of the user to the robot. This will examine how intrusive the robot has to be to gain the user's attention
2. **Interact with the robot:** To observe how well the user interacts with the robot and how much emotional investment the user is willing to give to the artificial agent
3. **Walk or do exercises with the robot:** To see how effective the intervention is at promoting the desired behaviour.

User Evaluation Questions

1. Can you form an emotional connection to the artificial agent? Why so?

    a. If yes, Ask are you motivated to start walking?

    b. If no, Why doesn't it work and how can it be better?

2. What are the issues you face when interacting with the robot?Is it too confusing to use? Is it too intrusive? Is it too annoying?

3. How can it be better?

Interview Questions

1. How to form an emotional connection between the user and a synthetic character?

2. In your experience what are the potential issues regarding the use of artificial characters to form meaningful bonds with their users? How can this be alleviated or what counter measures can be taken into consideration

3. Is there any issues regarding the use of artificial characters as a method to increase motivation and strengthen resolve?

Consent Form lo-fi prototype test

DESCRIPTION: Hello, my name is Mahandra Raditya and I am a student of Creative Technology from the University of Twente. I am here to conduct a user usability test for my graduation project. You are invited to participate in **a research study** to help motivate users to take a more active lifestyle through the use of synthetic characters. You will be asked interview questions about the experience you just had with the artificial agent. The interview data will be analyzed by the research team, provided you grant consent.

PROJECT DESCRIPTION: The project is a synthetic character represented as both a digital and robotic agent. The synthetic character will be used to help motivate students to be more active by using empathy. The virtual character will give feedback on the user's behaviour; If the user sits too much than the character will give some form of negative reaction (Upset, Angry, Sad etc). Alternatively, if the user become more active by doing short exercises or brisk walking around the UT the virtual agent will give a more positive reaction (Happy, Excited etc).

TIME INVOLVEMENT: Your participation will take approximately 15 to 20 minutes.

RISKS AND BENEFITS: There are no major risks associated with this study. The only benefit gained from participation will be the involvement and development of the project itself. **I cannot and do not guarantee or promise that you will receive any direct benefits from this study.**

PAYMENTS: You will receive no reimbursement for your participation.

PARTICIPANT'S RIGHTS: If you have read this form and have decided to participate in this project, please understand your **participation is voluntary** and you have the **right to withdraw your consent or discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled**. **The alternative is not to participate.** You have the right

to refuse to answer particular questions. The results of this research study may be presented at scientific or professional meetings or published in scientific journals.

CONTACT INFORMATION:

Interviewer contact:

Email: mahandra.raditya@gmail.com

Phone: 06 8331 5622

PROTOCOL DETAILS:

Protocol Approval Date:

Protocol Expiration Date:

Independent Contact: If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the University of Twente Ethics Review Board.

Name of participant:	Name of interviewer:
Signature	Signature

Programming sources and tutorial videos

Step counter
https://montemagno.com/part-1-my-stepcounter-android-step-sensors/
https://www.youtube.com/watch?v=pDz8y5B8GsE
https://www.youtube.com/watch?v=CNGMWnmldaU

Animations and images
https://developer.android.com/guide/topics/resources/animation-resource#scale-element
https://www.youtube.com/watch?v=_BSJlw_xnuc
https://www.youtube.com/watch?v=fqU4zc_XeX0
https://www.tutorialspoint.com/android/android_animations.htm
https://developer.android.com/guide/topics/resources/animation-resource

Notifications
https://developer.android.com/training/notify-user/build-notification
https://www.youtube.com/watch?v=CZ575BuLBo4

Vibrate:
https://stackoverflow.com/questions/18253482/vibrate-and-sound-defaults-on-notification

So android 8 devices can have notifications
https://www.youtube.com/watch?v=hW1Yjc0m7GQ

Pop up and name
https://stackoverflow.com/questions/42464807/in-a-popup-change-text-in-a-span
Create popup: https://www.youtube.com/watch?v=fn5OlqQuOCk
https://www.youtube.com/watch?v=eX-TdY6bLdg
Save text {potential solutions}:
https://www.youtube.com/watch?v=EcfUkjlL9RI
https://www.youtube.com/watch?v=fJEFZ6EOM9o&list=PLrnPJCHvNZuDJsRLWnl-AV4WQVgkJ1HU4

Get time:
https://www.tutorialspoint.com/get-current-time-and-date-on-android
https://www.youtube.com/watch?v=E8RL0wvTa9M
https://stackoverflow.com/questions/32929754/how-do-i-pass-the-hour-and-minute-in-an-android-bundle

Layout
https://www.youtube.com/watch?v=gkh-5pmYEa0

Pseudo Code - Step Counter

```
On Create {
        //Initialize counter variables:
        Int noOfSteps
        Int dailySteps
        Int currentSteps

        Set progress bar

        //Set up notifications
        build.sadMessage
        build.neutralMessage
        build.happyMessage
        build.Milestone
        build.Medal

        Set up notification channels (important for android 8 and above users)

        Set up images           //moods of the virtual pet

        Set up handler          //make the system check the time even when not in use

        //Set name tag
        Set up pop-up button
        Set up name on text

         // turn on sensor(Step counter)
            counter =  findViewById(R.id.counter);          //Connects counter to the text box
            Create sensor manager;
            sadMessage = build new notification;
            neutralMessage = build new notification;
            happyMessage = build new notification;

            Milestone = build new notification;

            medal = build new notification;


            //Avatar and mood: connecting the images to the image display on the main page
            avatarHead = findViewById(R.id.avatarHeadImg);
            avatarEyes = findViewById(R.id.avatarEyesImg);


        Set notification manager for 12:30
        Set notification manager for evening
```

```
        Create an alarm to send notification at 12:30 - notification_receiver class
        Create an alarm to send notification at 20:00 - notification_receiver_Evening class

        //classes
          progressBar();
          dynamicBehaviour();
          dailyMilestone();
  }


 //Repeat this the same runnable code block again another 2 seconds
private Runnable runnableCode = new Runnable() {
        public void run() {
        checkHour;
        checkMinute;
                handler.postDelayed(this, 2000);
    }
  };

 ////////////////////////////////////////// STEP COUNTER + mood ////////////////////////////////////////
public void onResume(){
    runnableCode.run();
    Get values from sensor;

    progressBar();
    dynamicBehaviour();
    dailyMilestone();

    if(countSensor != null){
       Read the sensor for any changes
       Update progressBar();
    } else {
       Write: sensor not found
    }

  }


  protected void onPause(){
         runnableCode.run();

    if (checkHour <= 23 && checkMinute <= 59){
       Update progressBar();
       Update dynamicBehaviour();
       Update dailyMilestone();
    } else {
       Execute reset();
```

```
        }

    }


public void onSensorChanged(SensorEvent event) {
        if (noOfSteps < 1 ) {
            noOfSteps = (int) event.values[0];
        }

if (checkHour <= 23 && checkMinute <= 59){
            dailySteps = (actual value received from the sensor) - noOfSteps;
            Update dynamicBehaviour();
            Update dailyMilestone();
        } else {
            Execute reset();
        }

       Write text: dailySteps " /10000";

        Update progressBar();
        Update dynamicBehaviour();
    }

public void onAccuracyChanged(Sensor sensor, int accuracy) {
             // this is empty
 }


public void resetButtonClicked(View view){
        Execute reset();
    }

public void reset(){
        noOfSteps = 0;
        dailySteps = 0;
        counter.setText(dailySteps + " /10000");
        Update progressBar();
 }

public void progressBar(){
       Progress bar = dailySteps;   // Progress bar was already set to have a max of 10000
}

public void dailyMilestone(){
             Set Medal notification and channel;

             if (dailySteps >= 2500 && dailySteps < 2600) {
```

```
            Vibrate once;
                    Make bronze notification;

             } else if (dailySteps >= 5000 && dailySteps < 5100) {
            Vibrate once;
                    Make silver notification;

            } else if (dailySteps >= 7500 && dailySteps < 7600) {
                    Vibrate once;
                    Make gold notification;

           } else {
           if (moodNumber == 0){

                    Make sad notification but replace text with: "Your step count is: "+dailySteps;

           } else if (moodNumber == 2){

                   Make happy notification but replace text with: "Your step count is: "+dailySteps;

           }else{

                   Make neutral notification but replace text with: "Your step count is: "+dailySteps;

           }


            Building medal notification;
            Set a channel for the notification;
            Send the notification to the notification feed;
}

public void dynamicBehaviour() {
            Detect if the user is walking - userMove == true      //it doesn't really work in this version
            if(userMove) {
            Draw and animate the WiGo to walk and be happy on the app home page;
             } else{
           if (checkHour <= 11) {
                    if (dailySteps >= 7500) {
                            Make happy notification
                            Draw and animate the WiGo being happy on the app home page
                   }
           } else {
                    Execute mood();
            }
            Update progressBar();
 }
```

```
public void mood(){
        if (dailySteps <= 2500){
                Draw and animate the virtual pet being sad on the home page
              Update progressBar();
                moodNumber == 0;

        } else if (dailySteps >= 7500){
                Draw and animate the virtual pet being happy on the home page
        Update progressBar();
                moodNumber == 2;

        } else {
        Draw and animate the virtual pet being happy on the home page
        Update progressBar();
                moodNumber == 1;
        }
}

public void moodNotification(){
    Set notification channel: Mood_Channel


        if (dailySteps <= 2500){
                Make sad notification
                Build notification
                Send notification to notification feed

        } else if (dailySteps >= 7500){
        Make happy notification
                Build notification
                Send notification to notification feed

    } else {
        Make neutral notification
                Build notification
                Send notification to notification feed

  }


public void MilestoneClicked(View view){                    //When the “Milestone” button is clicked
        Set notification channel: Milestone_Channel
        if (moodNumber == 0) {

                Make a sad notification that says: "You've only taken "+dailySteps+" steps today"
                "Could we please go for a walk?";
```

```
        } else if (moodNumber == 1) {

                Make a sad notification that says: "You've taken "+dailySteps+" steps today"
                "Keep it up, we're almost there"";

         } else if (moodNumber == 2) {

                Make a sad notification that says:
                "Congratulations You've taken: \"+dailySteps+\" steps today :D"
               "Congratulations on reaching your daily milestone"

        }
        Build notification
        Send notification to notification feed

}



   public void testButtonClicked(View view){                    //When the “Test” button is clicked
        dailySteps = Random number between 10 - 10000;
       Update progressBar();
        Update mood();
        Update moodNotification();
        Update dailyMilestone();
   }


   public void nameTagClicked(View view){
      Open Pop.class;
   }

}
```

Psuedo Code - Notification

```
Public class Notification_receiver extends BroadcastReceiver {

   //Notifications
   Build sadMessage;
   Build neutralMessage;
   Build happyMessage;
   Build dailyMilestone;

   @Override
   public void onReceive(Context context, Intent intent){

         Make a notification manager
         if (MainActivity.moodNumber == 0) {

                  Make sad notification
                  Build notification

     } else if (MainActivity.moodNumber == 1) {

                  Make neutral notification
                  Build notification

      } else if (MainActivity.moodNumber == 2) {

                  Make happy notification
                  Build notification

      } else {
        Build new notification
          Send notification with message: whats up?

     }
```

Psuedo Code - Pop class

(Developer's note: this did not work)

```
protected void onCreate(Bundle savedInstanceState) {

    Claim window layout;
    Set the size of the window;

    Declare variables to layout ids:
    nameEdit =          findViewById(R.id.editName);
    applyNameButton =   findViewById(R.id.applyButton);
    saveButton =        findViewById(R.id.saveName);



    saveButton.setOnClickListener(new View.OnClickListener(){
        public void onClick(View view){
            Execute saveData();
        }
    };

    Execute loadData();
    Execute updateViews();
}

//Name save
public void saveData(){
    Save changes //saveButton
}

public void loadData(){
    Set the new name on the pop up window to appear in the home page name text //applyNameButton
}

public void updateViews(){
    Update changes
}
```

User Testing - Procedure

Requirements:

1. The user must have an Android
2. The user needs to be a University a student or at least an alumni
3. The user needs to conduct an interview at least 3 days after using the application

Installation
The user needs to have a short 5 minute interview with me to download the app.

Trial period and to do list
The user should have at least 3 days to interact with the application to give them a better opinion on the app. Giving the user time with the application also allows them to form an emotional connection with the virtual pet for better or for worse. During the trial period, the user has a goal and to do list that they must fulfill:

- Make the app “happy”
- Make the app “upset”

Interviews
After the trial period is over, the users will be evaluated one by one for an interview regarding their experience with the application. The interview will last approximately 15 minutes. There are 2 different stages of the interview: the first being a Standard Usability Scale questionnaire and the second being a more general interview. The questions for the second stage will be left as general as possible so that the flow of the interview can change depending on the topic of interest. Nevertheless, a guideline is made just to keep some form of linearity and consistent information. Additionally, the question on the second stage may change depending on the answers obtained from the SUS questionnaire. More details on the interview can be seen below.

User Testing - Consent Form prototype test

DESCRIPTION: Hello, my name is Mahandra Raditya and I am a student of Creative Technology from the University of Twente. I am here to conduct a user usability test for my graduation project. You are invited to participate in **a research study** to help motivate users to take a more active lifestyle through the use of synthetic characters. You will be asked interview questions about the experience you just had with the artificial agent. The interview data will be analyzed by the research team, provided you grant consent.

PROJECT DESCRIPTION: The project is a synthetic character represented as both a digital and robotic agent. The synthetic character will be used to help motivate students to be more active by using empathy. The virtual character will give feedback on the user's behaviour; If the user sits too much than the character will give some form of negative reaction (Upset, Angry, Sad etc). Alternatively, if the user become more active by doing short exercises or brisk walking around the UT the virtual agent will give a more positive reaction (Happy, Excited etc).

TIME INVOLVEMENT: Your participation will take approximately 15 to 20 minutes.

RISKS AND BENEFITS: There are no major risks associated with this study. The only benefit gained from participation will be the involvement and development of the project itself. **I cannot and do not guarantee or promise that you will receive any direct benefits from this study.**

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to refuse to answer particular questions. The results of this research study may be presented at scientific or professional meetings or published in scientific journals.

CONTACT INFORMATION:

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Email: mahandra.raditya@gmail.com

Phone: 06 8331 5622

PROTOCOL DETAILS:

Protocol Approval Date:

Protocol Expiration Date:

Independent Contact: If you are not satisfied with how this study is being conducted, or if you have any concerns, complaints, or general questions about the research or your rights as a participant, please contact the University of Twente Ethics Review Board.

Name of participant:	Name of interviewer:
Signature	Signature

User Testing - Interview

General questions

Gender:

Male	Female

Age:

0-25	26-50	50+

How physically active were you before the intervention:

Stage1 Not active	Stage 2 Mildly active	Stage 3 Active	Stage 4 Very invested
Doesn't exercise Only walks to get to places	Occasionally exercise Engaged in mild exercise at least once a week Takes a walk from time to time	Exercise quite frequently whenever possible. Engaged in extensive exercise once a week Takes walk regularly	Exercise regularly Engaged in extensive exercise more than once a week Jog or walk long distances regularly

1st round - S.U.S

1. I think that I would check the app frequently.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

2. I found the application unnecessarily complicated.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3. I thought the application was easy to navigate.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

4. I think that I would require technical assistance when I am using the application.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

5. I found the various features available in the application well integrated.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

6. I thought there was too much inconsistency in this application.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

7. I would imagine that most people would learn to use the application very quickly.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

8. I found the application quire intrusive at times.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

9. I felt very confident using the application.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

10. I required some time to get adjusted to the application before I was able to appreciate it.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Extra questions

11. Level of investment

Stage1 Not invested	Stage 2 Mildly invested	Stage 3 Invested	Stage 4 Very invested
Doesn't walk more than they use to	The participant occasionally walks more than usual	The participant significantly walks more	The participants took initiative to walk before a notification pops up

12. Level of immersion

Stage1 Not immersed	Stage 2 Mildly immersed	Stage 3 Immersed	Stage 4 Very immersed
The participant completely ignore their virtual pet	The participant occasionally checks their virtual pet	The participant looks at the notification as much as possible	The participants actively try to keep the virtual pet happy

2nd round - Usability interview

Q1. What do you normally do during your breaks before using the application?

Q2. How much change does the application impact your day to day life?

Q3. How do you feel about the application when you were using it? (Emotionally and motivation)

Q4. How effective were the main features of the app: Step count, Notification and Pet itself

Q5. What are the issues do you experience when using the application? Try excluding things like bugs or technical issues.