1. Introduction

The main objective of this project was to implement various tools and prototyping techniques to create an interactive user centred prototype. The first part of this assignment involved the creative exploration of the design space where we explored several methods such as brainstorming and mind mapping to help us narrow our focus down to one design that we wanted to make a prototype of. The second part was the actual prototype that we came up with.

The first aspect of our prototype that we both agreed on was the fact that it would be a screen based application. The reason for this was that almost everything is starting to function with the help of mobile apps and making the process much easier than it used to be. A few examples of this would be Taxi services such as Uber and online portals for checking one's bank accounts and so on. Eventually, we did end up adding some physical objects that our app would control but that comes later.

After careful deliberation, research and various activities, we decided to create an application that would help monitor people's pets when they are not a home. The entire process is outlined below.

2. Use of Creative Tools to Explore the Design Space

2.1 Brainstorming

The very first step of our project was simply sitting and discussing our ideas. This led to our first brainstorming session where we thought of working on some sort of a home app. Keeping that as the central theme, we thought of appliances that we can control with an app using the Wi-Fi to help make certain tasks easier. As a result of this we produced our first mind map which is attached below.

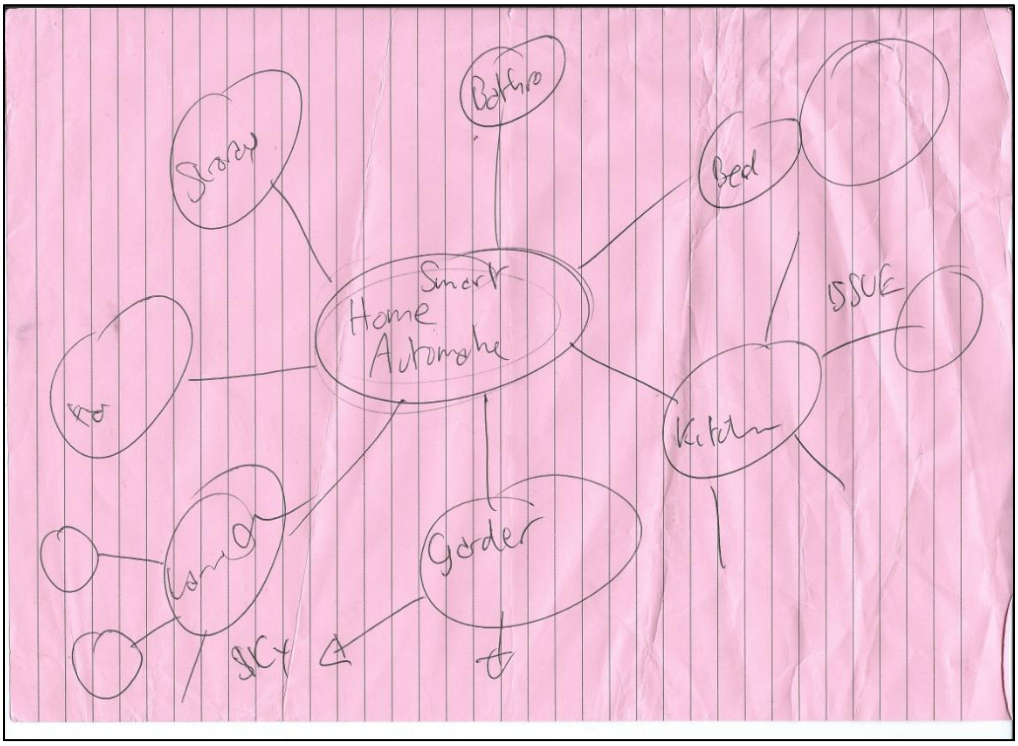


Figure 1

This session was carried out with the help of our professor and in the end we got a number of options that we could explore in our project. We needed to find an issue that could be solved or made easier to handle using a mobile application. The possibilities were numerous. We could investigate an appliance in a bathroom, or perhaps a tool in the garden. However, we had to consider safety issues as well. Not all appliances in the house should have the feature of being controlled via an app. For instance, if we decide to control the microwave or the water heater from elsewhere, it might lead to accidents. This again, narrowed our options down a bit further.

This led to our second brainstorming session where we finally narrowed our results down even further and selected a focus point for our prototype.

While working on the second session we spoke of people who have pets. Both of us have had pets in the past and there have been several occasions where they had to be left alone at home for short or long spans of time. This creates a lot of anxiety in the owners mind as they are constantly worried about what their pet might be up to, alone in the house. Hence, we decided to work on a pet monitoring system that can be accessed via one's smartphone anytime they wanted.

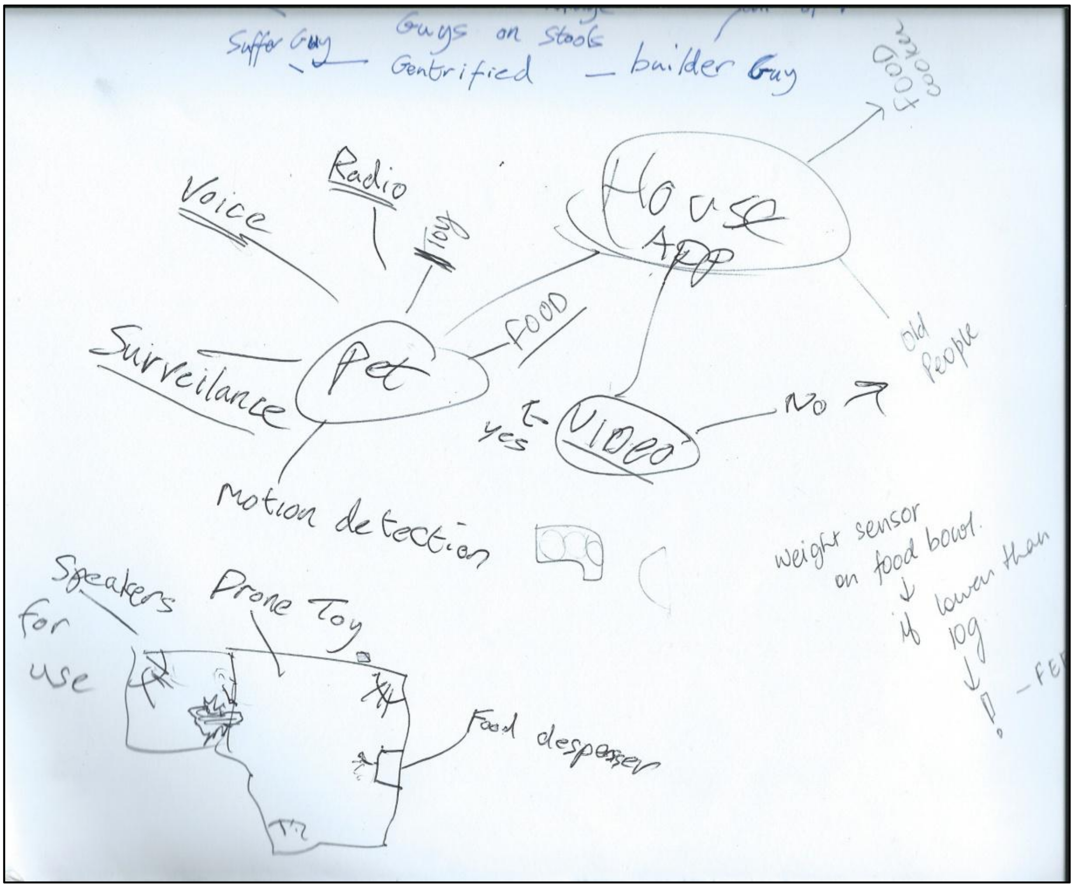


Figure 2

The second mind map was much more specific and gave us the specific direction to base our prototype on.

2.2 Research and Data Gathering

For our research we chose to find out if there are any products already available in the market that does this and also ask a few people who were pet owners if they required any specific features that we could implement in our prototype.

As it turns out, there are several pet monitoring devices available in the market and they seemed very similar to each other.

Most of these devices had one thing in common, which was a camera. Apart from that, some had treat dispensers while others had chat features. A few of them had a laser toy option for cats. On careful study of these products, we decided to go for something that included more features than just a camera or a treat dispenser, all of which would be customisable by the user.

Figure 3

The second study we conducted involved actual pet owners who could tell us specific problems that they encountered with this kind of situation.

For this I chose my roommate (male, 23) and an old classmate of mine (female, 23). My roommate has two big dogs while my old classmate has four small ones. Both seemed to like the idea of having an app that could monitor the pets' activity from outside of the house.

My roommate said that his dogs were well trained and knew exactly where they were allowed to go and where they were not. He said that a camera would be handy if he ever wanted to check on them. He also liked the idea of giving them treats when he wanted to.

My old classmate loved the idea of the pet app. She said that her dogs were unruly and that she often comes back home to torn sheets and other artefacts. Feeding her dogs was also a problem for her since her dogs were left home alone for prolonged periods of time every single day. She also mentioned that she would often feel very sad about the fact that her dogs were all alone at home and she would like to talk to them and play with them if she could.

2.3 Final Mindmaps

Taking into mind all these inputs and considerations, we generated a third mind map listing the functionalities of the application. Using the ideas generated here, we moved on to the next part of our project which included sketching and wireframing.

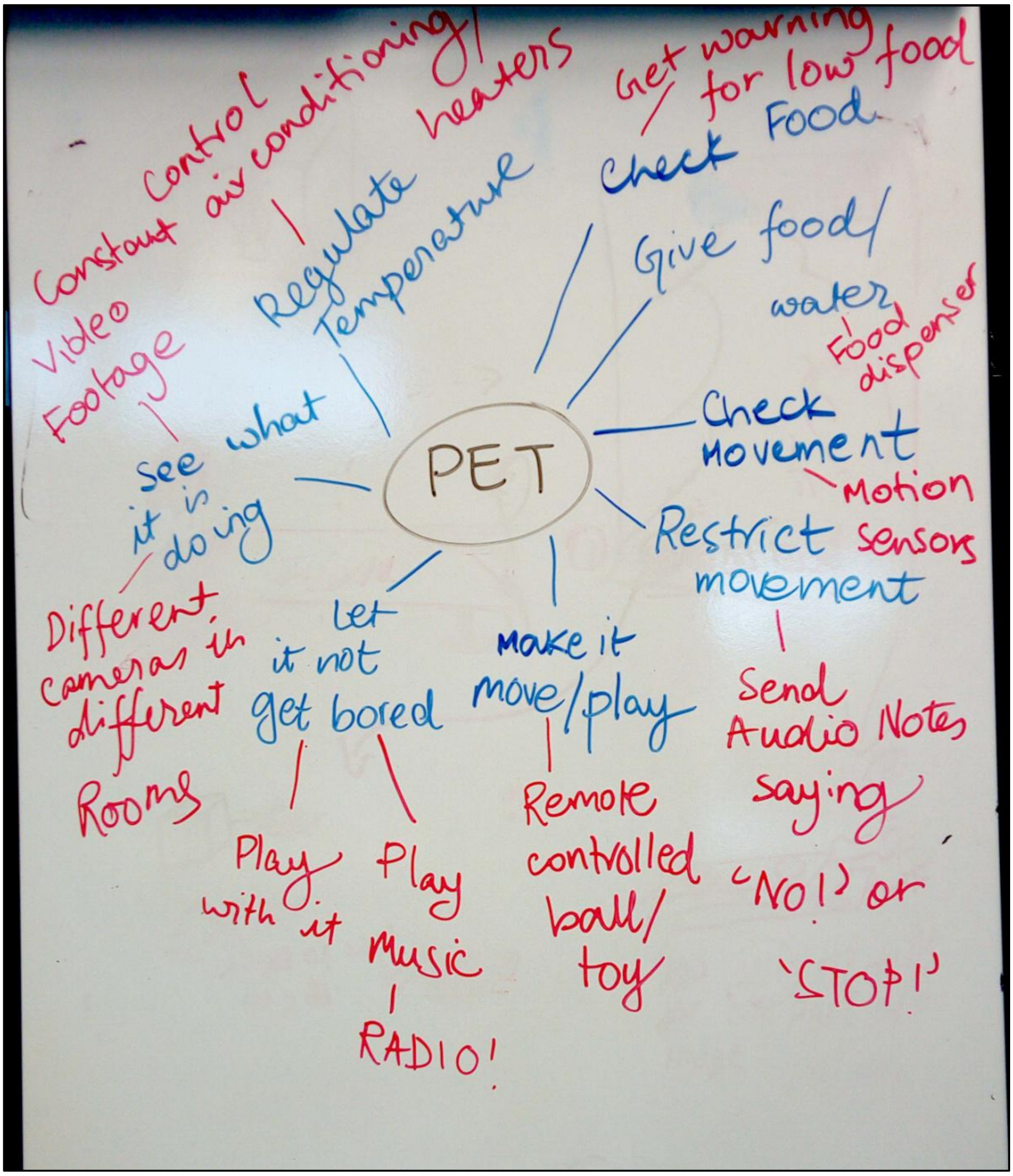


Figure 4

3. Sketching and Wireframing

After our last mind map, we selected the functionalities that we wanted to implement in our design. We used data from the casual interviews, the devices available on the market and our own experiences with our pets. We decided to implement the following aspects in our pet monitoring design prototype. For each aspect, there would also be the need to have some external physical devices which would do the required job at home.

- There would be constant video feedback.
- There will be two way speakers for the user to communicate with their pet. They can also play the radio.
- There will be food and water dispensers which would notify the user when they need to be refilled.
- There will be a toy of some sort that can be controlled by the user to play with their pet.

The two unique things that we decided to add to the app were the radio and the food dispenser. From past experience and reading, we thought that it would be nice to have the radio function as many scientists say that dogs (which we assume the majority of the pets would be) have a musical sense and different types of music have different effects on them. For instance, heavy metal tends to make them agitated while classical music calms them down.

The other thing was the food and water dispenser. Most of the apps on the market only have devices that give out treats. We wanted to have a sturdy food and water dispenser that would not only refill the food and water bowls but will also indicate how much food or water is left in the bowls. It would also notify the user when the quantity has become too low.

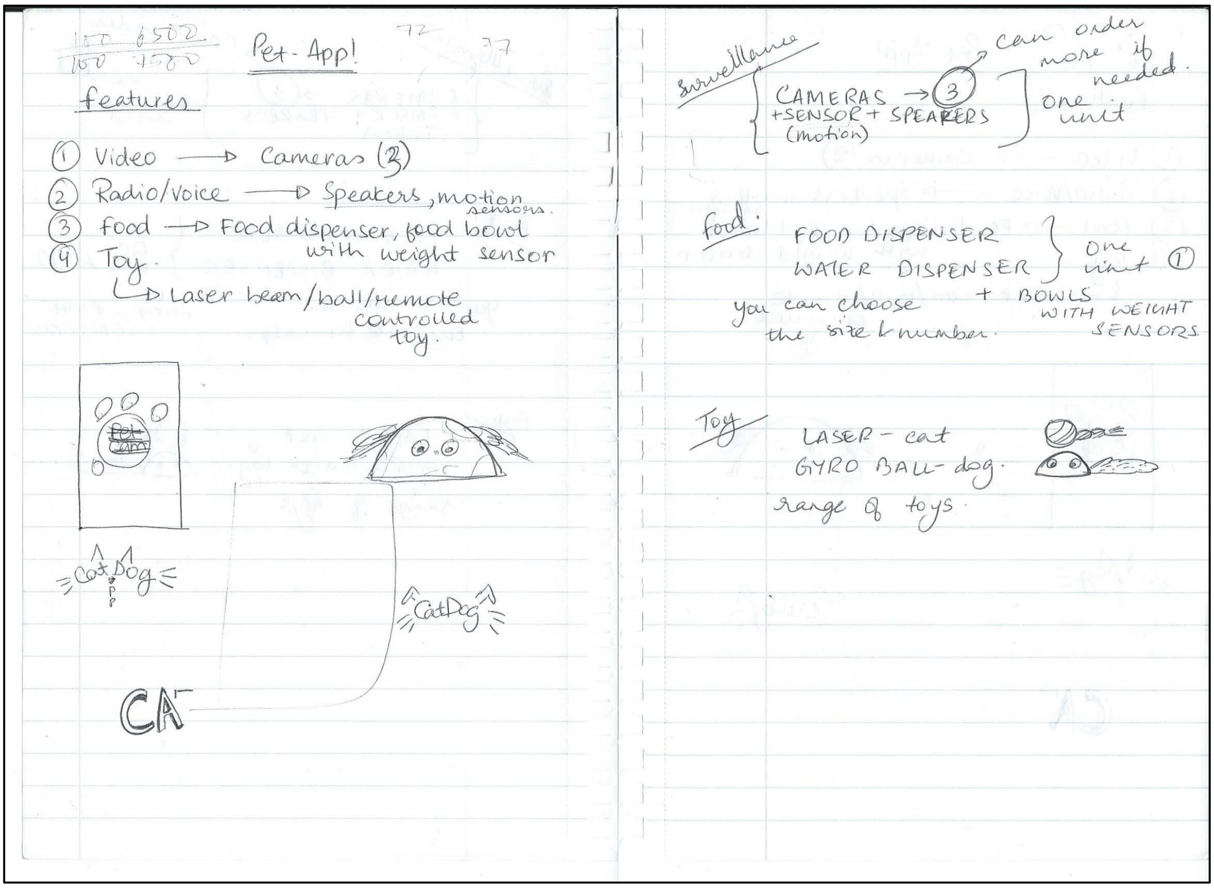


Figure 5

In the image above there are some rough sketches and notes that helped us develop the prototype further. As mentioned above, we divided the functions into four specific categories of video, audio, food and play. We also noted what kind of physical devices we would need to perform those functions.

For the toy, we considered various options such as a laser beam or a moving rat-like object. Finally, we decided to keep it simple and use a ball that would move according to the users wish.

The following are sketches of the physical devices that we would need.

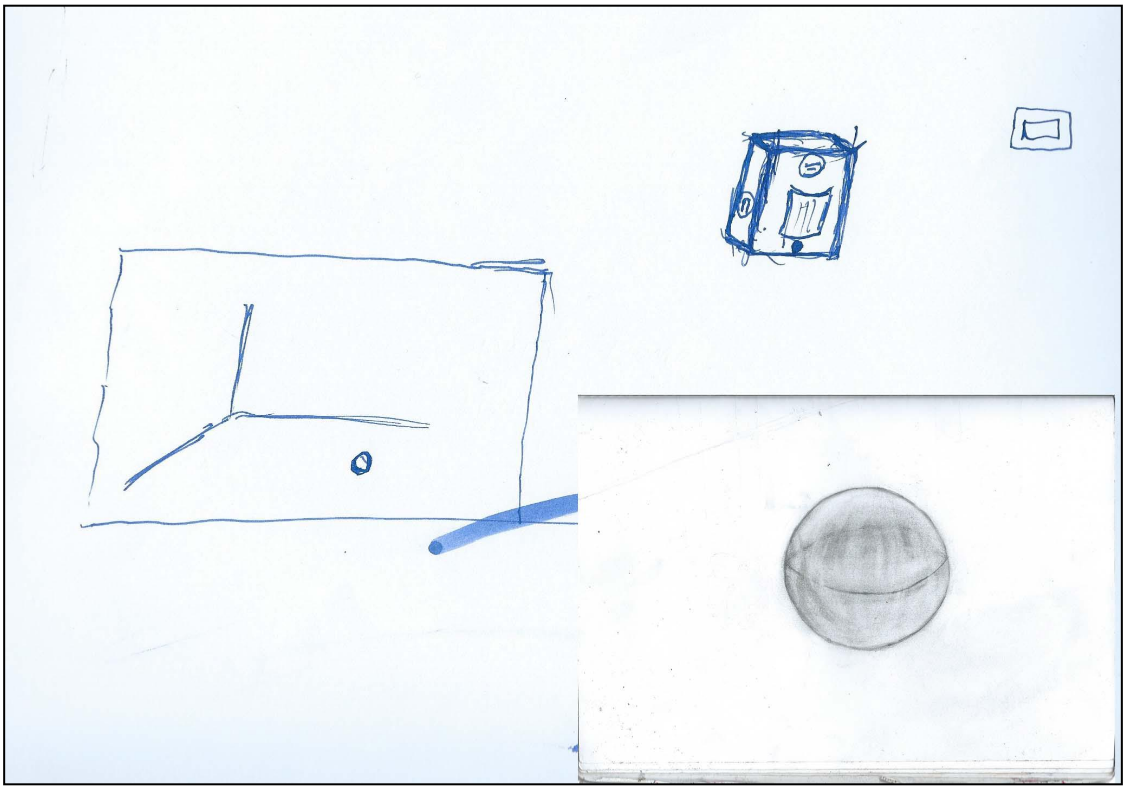


Figure 6

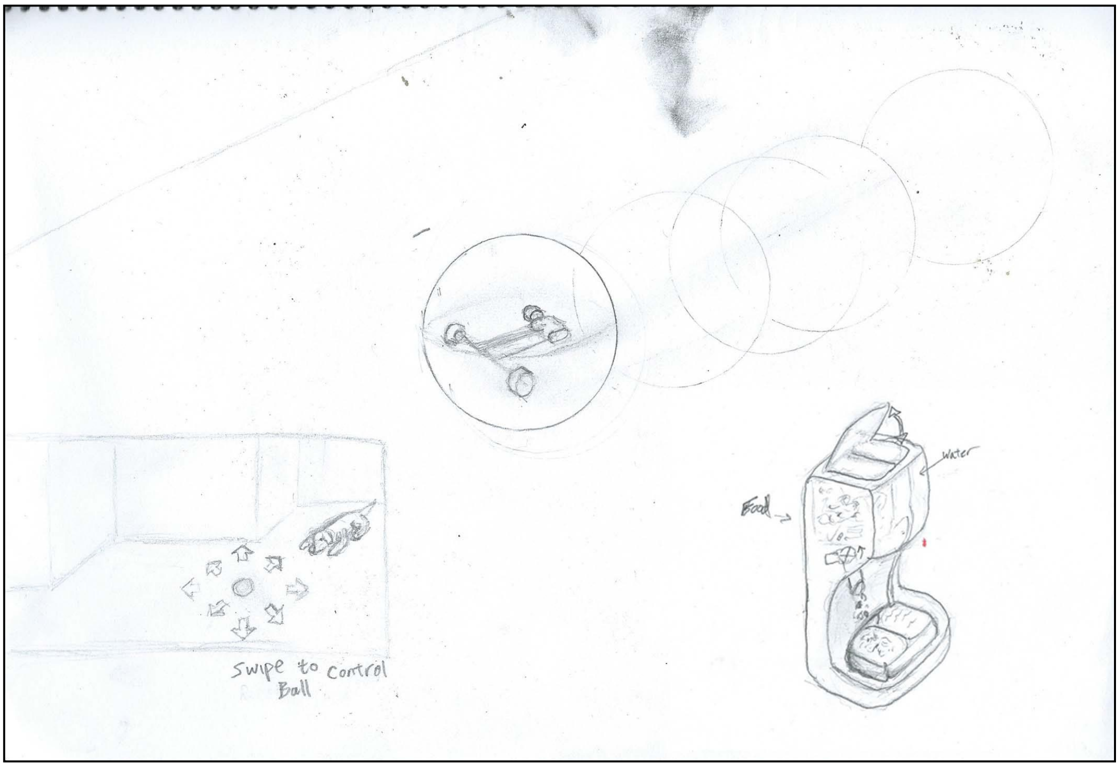


Figure 7

We then moved on to the wire framing and started to imagine what the interface of the app would look like. Keeping in the mind Don Norman's design principles, we wanted the application to have good mapping, affordance, feedback, visibility, constraints and consistency (Norman, 2013). We tried to keep the application as simple as possible, even though it had multiple functions.

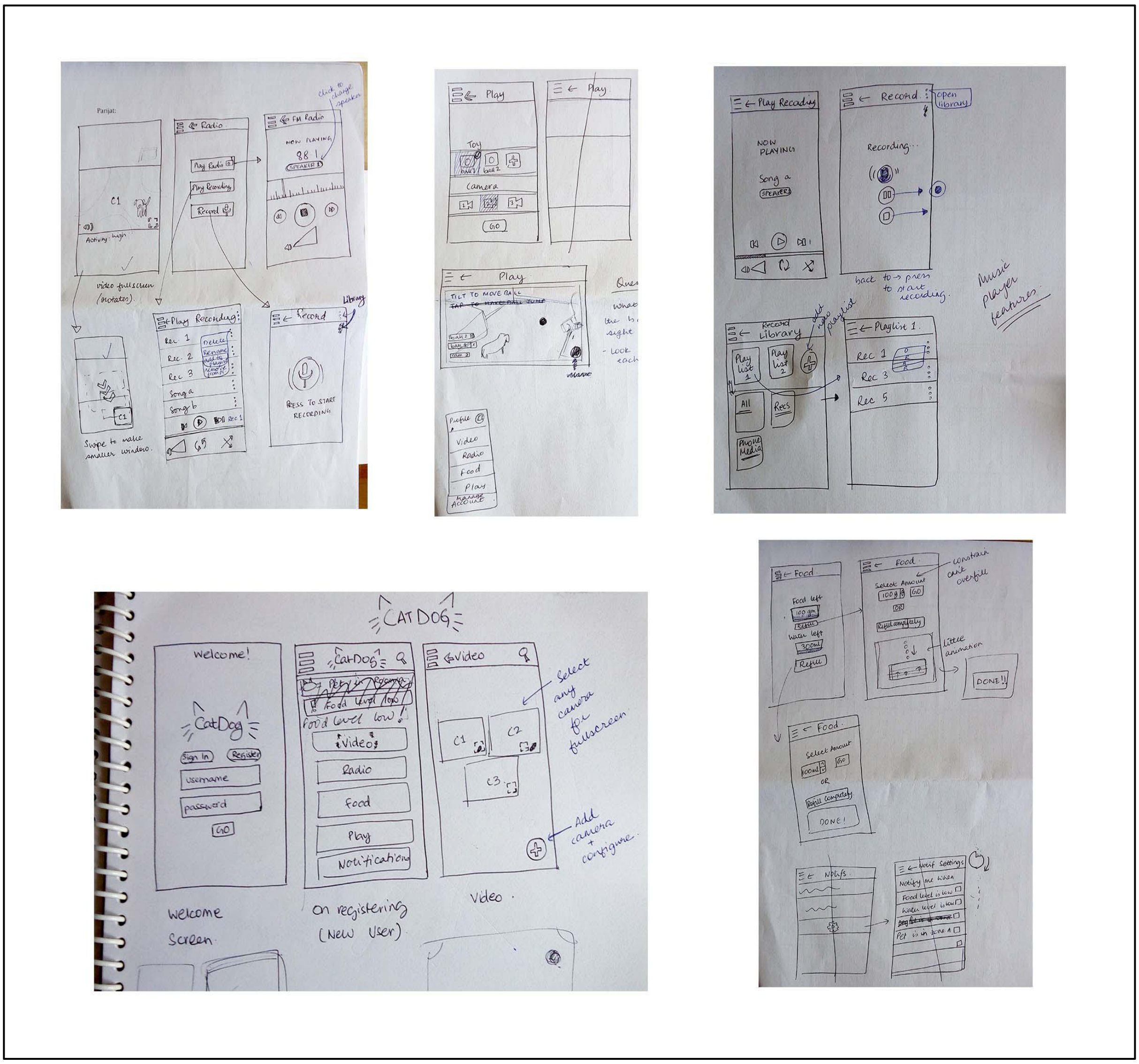


Figure 8

The above images can be termed as the wireframing of the application. They are rough sketches of what the interface would look like. After completing this outline, we decided on which parts to implement in the final prototype and which parts to reject. We also made notes on the sketches to give us a good idea of how to start making the final low fidelity prototype. By now we had a concrete idea of what the final app and the objects would look like and how they were going to function. After this step, we moved on to the prototyping which is the last part of our assignment.

4. Prototyping

At this stage of our project, we had a clear idea of what we needed to build our low fidelity prototype. The idea was articulated in the table below.

ASPECT	PHYSICAL COUNTERPART
Video The user can see the live video feed at any time from their phone.	**Cameras with motion sensors and speakers** Each camera unit consists of a wide angle lens camera, two way speakers and motion sensors. The user can purchase as many units as they want and set them up in different corners of the room or different rooms.
Audio The user can hear the audio from the house and also record their voices and play them in the house. Additionally, they can also play the radio in the house.	**Speakers** The user can select which speaker they want their voice/the radio to play from.
Food The user can refill the food and water bowls of the pet.	**Food and Water Dispenser** Each dispenser contains a food bowl and a water bowl which have weight sensors and tell the user when they have to be refilled.
Play The user can play with their pet using their phone.	**Remote Controlled Toy Ball** Each ball can be controlled by the phone to move in a specific direction to keep the pet engaged.

4.1 Screen Based Paper Prototype

The paper prototype was made according to the table above with reference to the wireframe in the previous section.

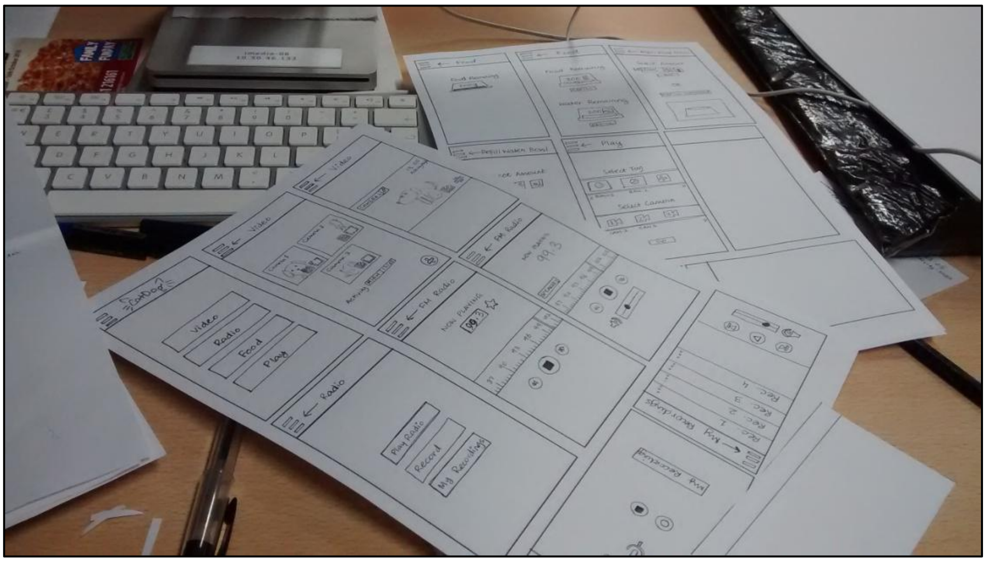


Figure 9

The home screen of the app has four options:

- Video
- Radio/Recording
- Food
- Play

Each of these leads to the respective windows where you can input or manipulate information and perform various tasks. Below is a hierarchical representation of the various screens or windows that one can access in the mobile application.

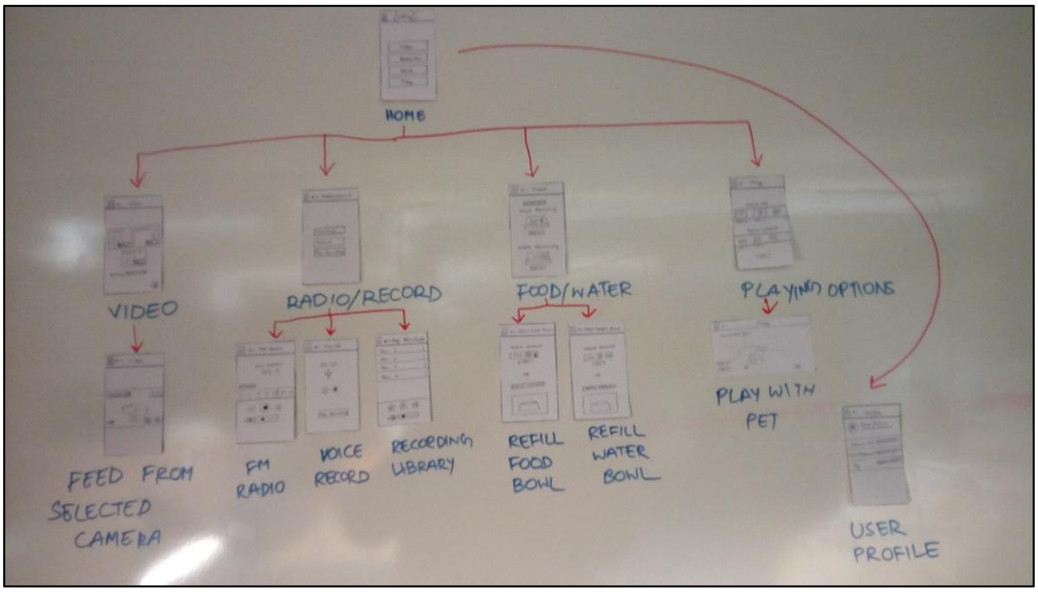


Figure 10

The Video option leads to a screen where you get the feed from every camera that you have installed. You can select whichever camera you want and view it in full screen. You also get some information about the activity of your pet which is detected by the motion sensors. If the activity is high, it means that the pet is moving a lot whereas if it is low, it means that the pet is sleeping or stationary. You can minimize the video camera screen and keep it in any part of the mobile screen as you perform other tasks on the app.

The Radio/Recording option leads to a window where you can access your past recordings. You can also record a new voice message and play it or save it for later. Additionally, you can also play the radio. During each of these tasks, you can select the speaker which you want.

The Food option leads you to the screen that tells you how much food and water is remaining. Accordingly, you can fill up the bowls. You can either choose the amount of food you want to pour or let the machine automatically calculate and refill the bowls completely.

The Play mode lets you choose a camera and a ball and play with your pet. The ball moves whichever way you tilt the smart phone screen.

Some additional features include your profile where you can configure your devices and order more. You can rename your cameras and you also get notifications when food or water level is low.

Follow the link for the video prototype.

https://youtu.be/WwL43RVG-yw

4.2 Physical Prototypes

Figure 11: Cardboard prototype of food and water dispenser

Figure 13: RC Ball prototype made from bubble wrap, tape and string

Figure 12: PIR motion sensor to represent IP cam/ motion sensor prototype

In order to demonstrate how we could incorporate physical objects with an ephemeral representation of a human computer interface, my team mate and I decided to adopt the video prototyping technique. In doing so, this technique afforded our team the ability to explore what Bill Buxton refers to as “Video Envisionment” (Buxton, 2010, p. 349). Through this technique we can add the illusion of functionally to our concept and convey out final product.

The figures above are paper and plastic representations of what we envisioned our concept to be. (Figure 11: Cardboard prototype of food and water dispenser, Figure 13: RC Ball prototype made from bubble wrap, tape and string). These physical objects are based on the concept of the internet of things and are intended to be controlled via the smart phone application. Figure 12 (Figure 12: PIR motion sensor to represent IP cam/ motion sensor prototype) features an IP camera which is the users eyes and ears when they have left the home. The user will have the option to monitor different rooms in their home and will also be able to communicate with their animal. (Figure 14: Ip Camera- next page)

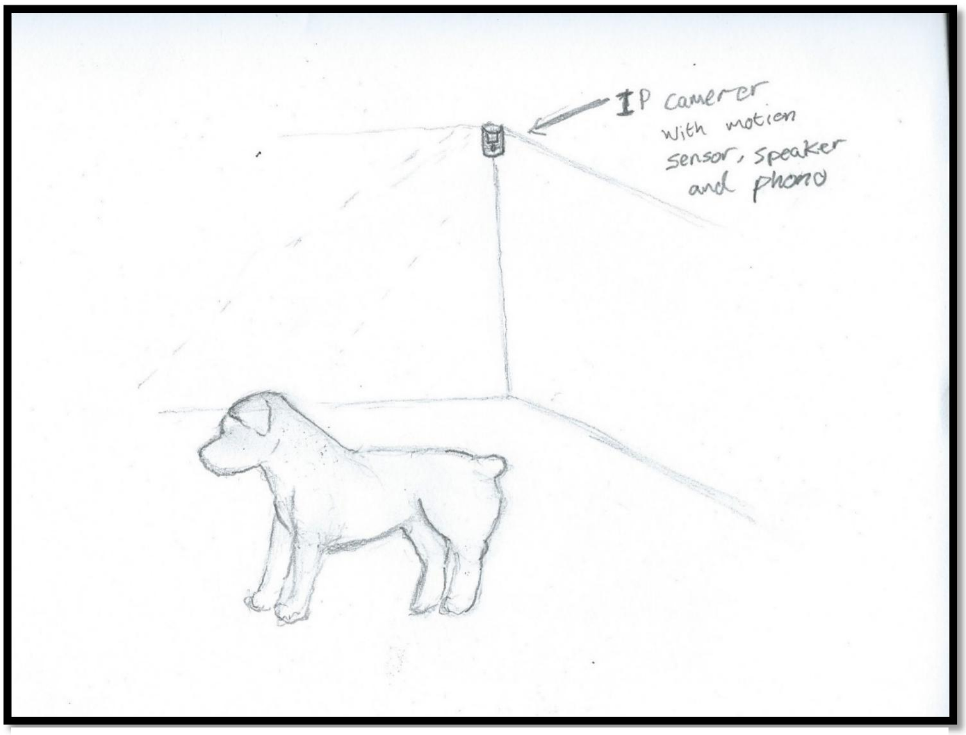


Figure 15: Ip Camera

the camera will also have a zoom function and it will have the ability to move and detect the activity of the animal around the home. In the video prototype our team further demonstrates how our smartphone prototype will afford the user the ability interact with the camera, food dispenser and the remote controlled ball. These objects can be controlled remotely from the application by installing an ESP8266 wi-fi receiver module into the appliances (.example of [ESP8266](ESP8266)) The ESP8266 receives wi-fi signals from the application, these signals are then received by a pre-programmed micro controller (Arduino, Raspberry pi) that then control a motor or some other digital function built into the appliance. (Figure 14: Arduino IDE Sketch for Parsing data between ESP8266 and Smartphone)

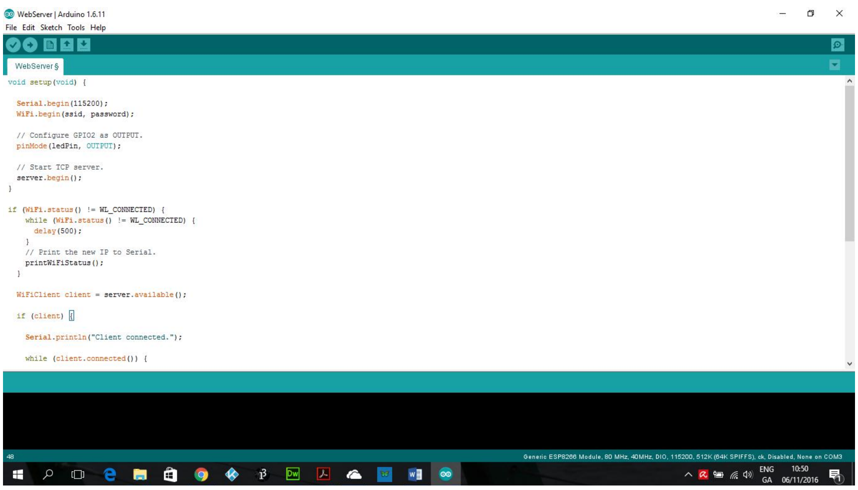


Figure 14: Arduino IDE Sketch for Parsing data between ESP8266 and Smartphone

In our simulation of the food dispenser, we created the narrative that the user is in control of the distribution of food and water. Like the camera, this will be controlled by receiving data. It will also send the user feedback using pressure sensors to determine the actual weight of the food and water. It is recommended that this appliance should be placed in view of the IP camera for additional visual feedback.

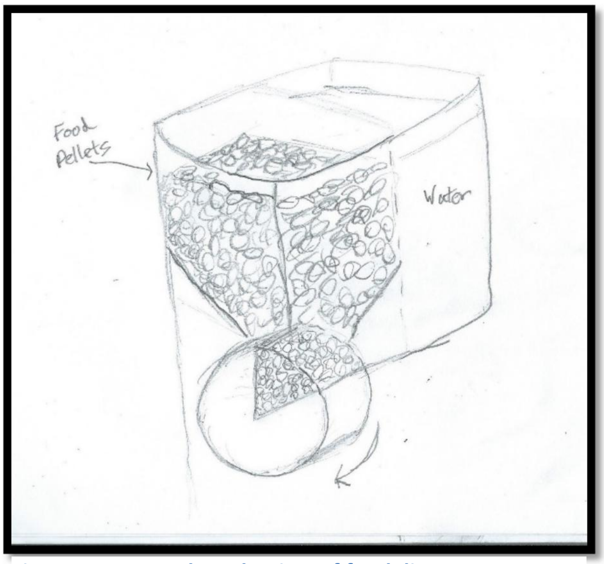


Figure 17: Internal mechanism of food dispenser

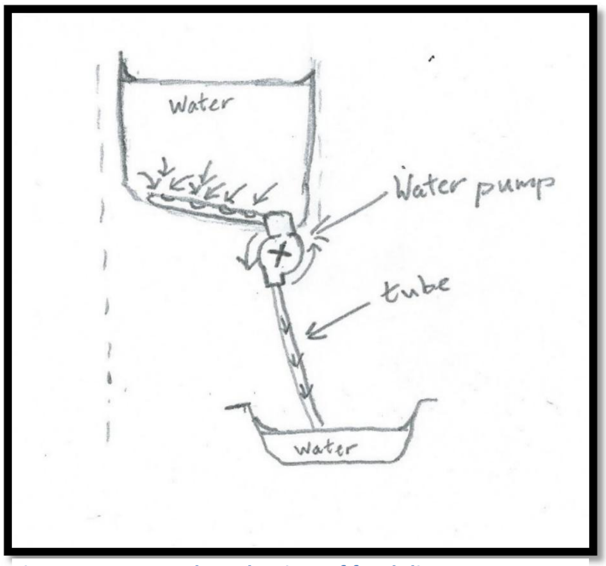


Figure 16: Internal mechanism of food dispenser

The final physical prototype we envisioned was the remote-controlled ball. Our team

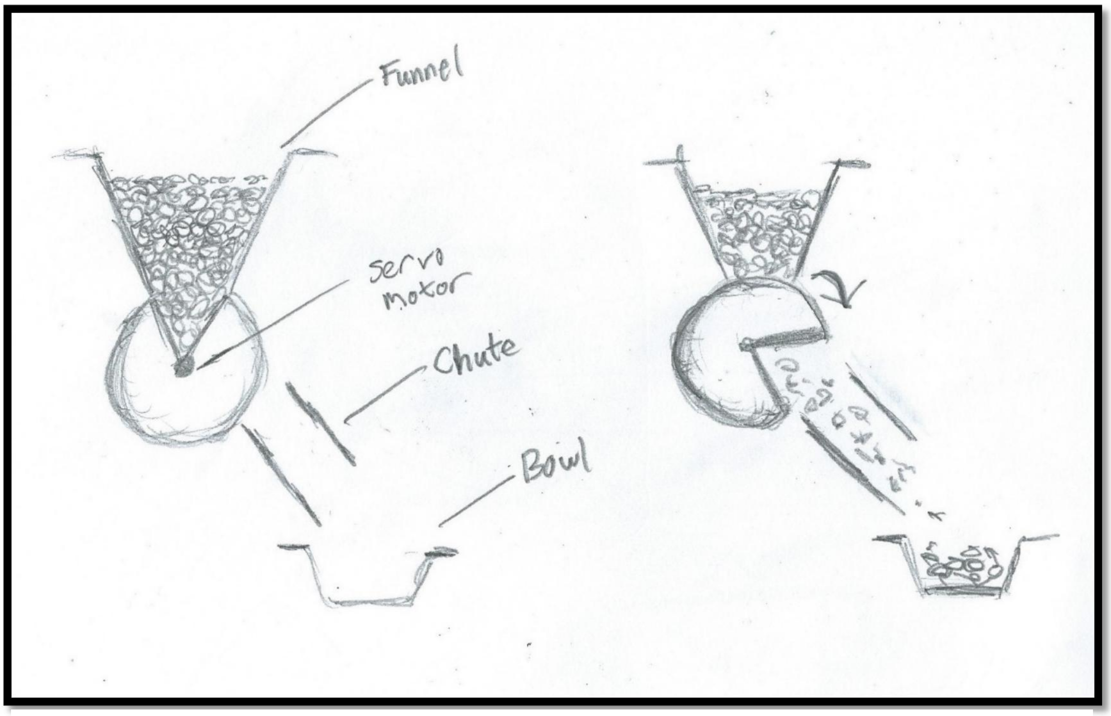


Figure 18: Internal mechanism of food dispenser

developed the concept through researching similar products on the market such as the crazy weasel chaser ball. The remote-control ball operates in the same manner as a remote-control car, the difference being that the RC car is inside the ball and like the other appliances it will be controlled via wi-fi from the smart phone application. The smart phone application will utilise the tilt function to control the RC ball (example of RC tilt control) When the users is not interacting with the RC ball, the ball will navigate itself via built in ultrasonic sensors to a docking station where it will recharge. If the device gets misplaced, it's last movements will be recorded by the application. The RC ball could be constructed from reinforced polycarbonate to which it will be extremely durable.

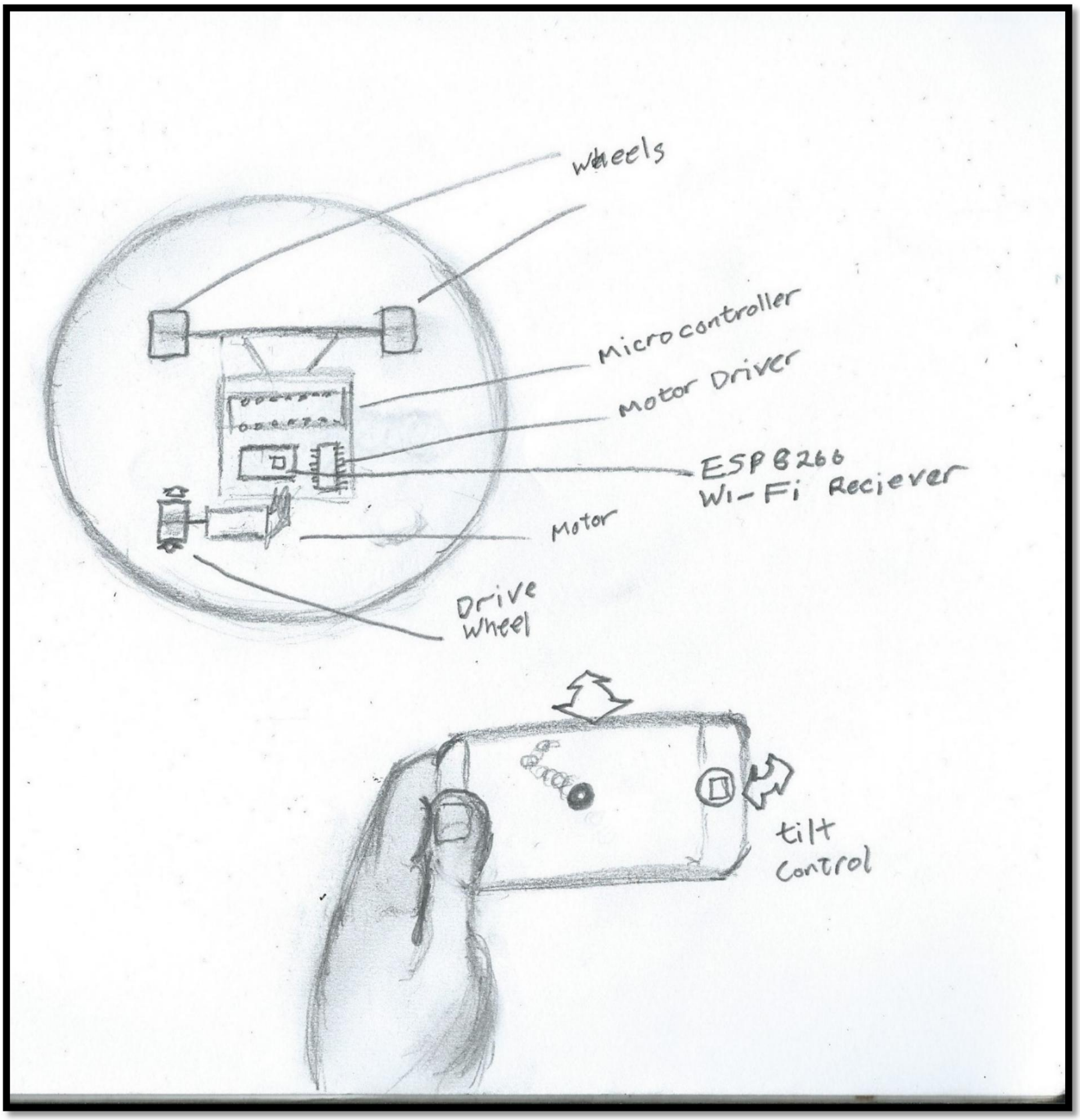


Figure 19: RC Ball Sketch

Conclusion

From the outset of this assignment our team believed that through our research, interviewing mind mapping processes and our own experiences, that we have successfully identified a good conceptual model whereby the user will be given a good peace of mind regarding the well-being of their animal. From our research, interviews and personal experiences we have found that it is important that it is important to socialize with the animal (primarily with dogs), lack of social interactivity can lead to boredom and isolation for the animal. William R. Koehler, author of the 'Koehler Method of dog training' emphasises that the human voice is the best tool when training your dog (Koehler, 1962) and therefore we see the importance of implementing a speaker phone in the system to allow communication with the dog. (Bannon, 2011) emphasises the importance of advocating a design approach that is focussed towards a human centred experience regarding ambient technologies. So instead of just having a machine set on a timer preforming tasks such dispensing food at a specific time of the day or having some device or toy perform some random action as entertainment the animal, it is the user who determines these experiences. In our design, the user will have more interaction with their environment than other similar products offer.

Through the sketching and wireframing processes our team could hone in on the more important aspects of the concept and decided on a mobile based application that would allow its user access to observing and interacting with a domesticated animal, by the means of applying the conception of the internet of things. The application of Don Norman's design principles, enabled our team to incorporate good mapping, affordance, feedback, visibility, constraints and consistency into our design process (Norman, 2013). In our design the goal was to simplify the application and keep it practical, while still enabling the user to multi-task. After completing this outline, we decided on which parts to implement in the final prototype and which parts to reject. Sketching out ideas gave us a good insight of how to start making the final low fidelity prototype. We now had a concrete idea of what the final app and the objects would look like and how they were going to function.

The final phase of prototyping was to create a narrative for our conceptual model in the form of a video prototype. Video prototyping allowed us to demonstrate how we could incorporate physical objects with an ephemeral representation of a human computer interface, this technique afforded our team the ability to envision exactly how we would expect our concept to work in a real-life situation, to utilise what Bill Buxton refers to as "Video Envisionment" (Buxton, 2010, p. 349). Through this technique we can add the illusion of functionally to our concept and convey out final product. In the video, we give examples of how the mobile application controls the IoT devices (IP Camera, Food Dispenser, RC Ball). The video also shows how we envisioned the design of the application, how it is mapped, the visibility and the feedback. The last section of this report is concerned with the technical aspects of our concept, and here we show sufficient evidence as to how the concept will work in the real world.

Figure 20: materials

Figure 21

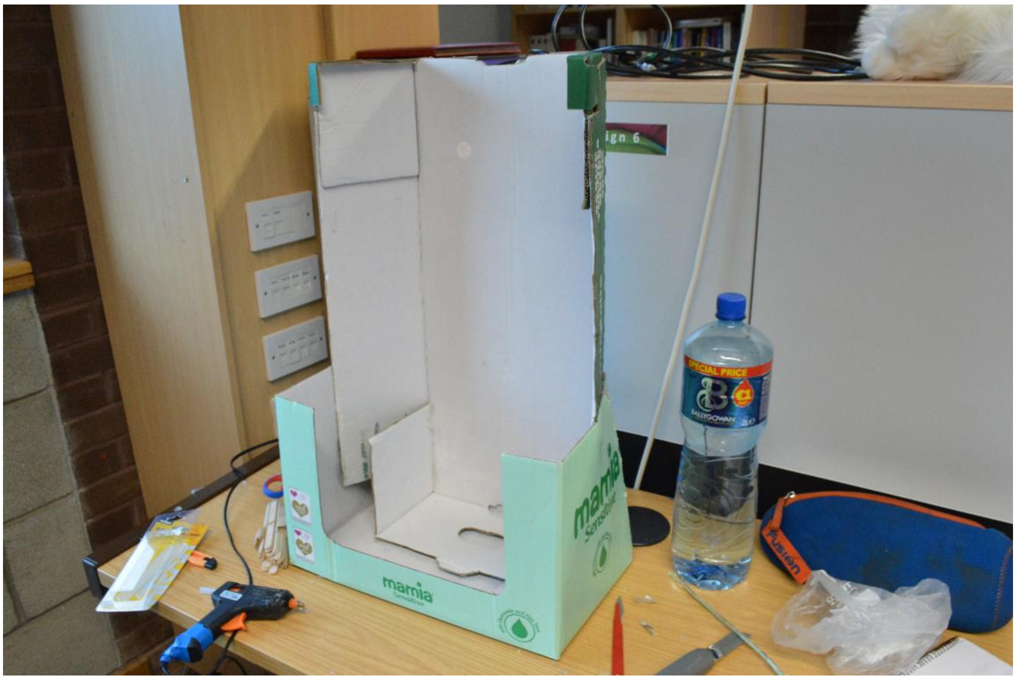


Figure 23

Figure 22


GARLIC
TORTILLA
WRAPS
READY
TO EAT
sunnyhills
mamia
Sensitive

Figure 24

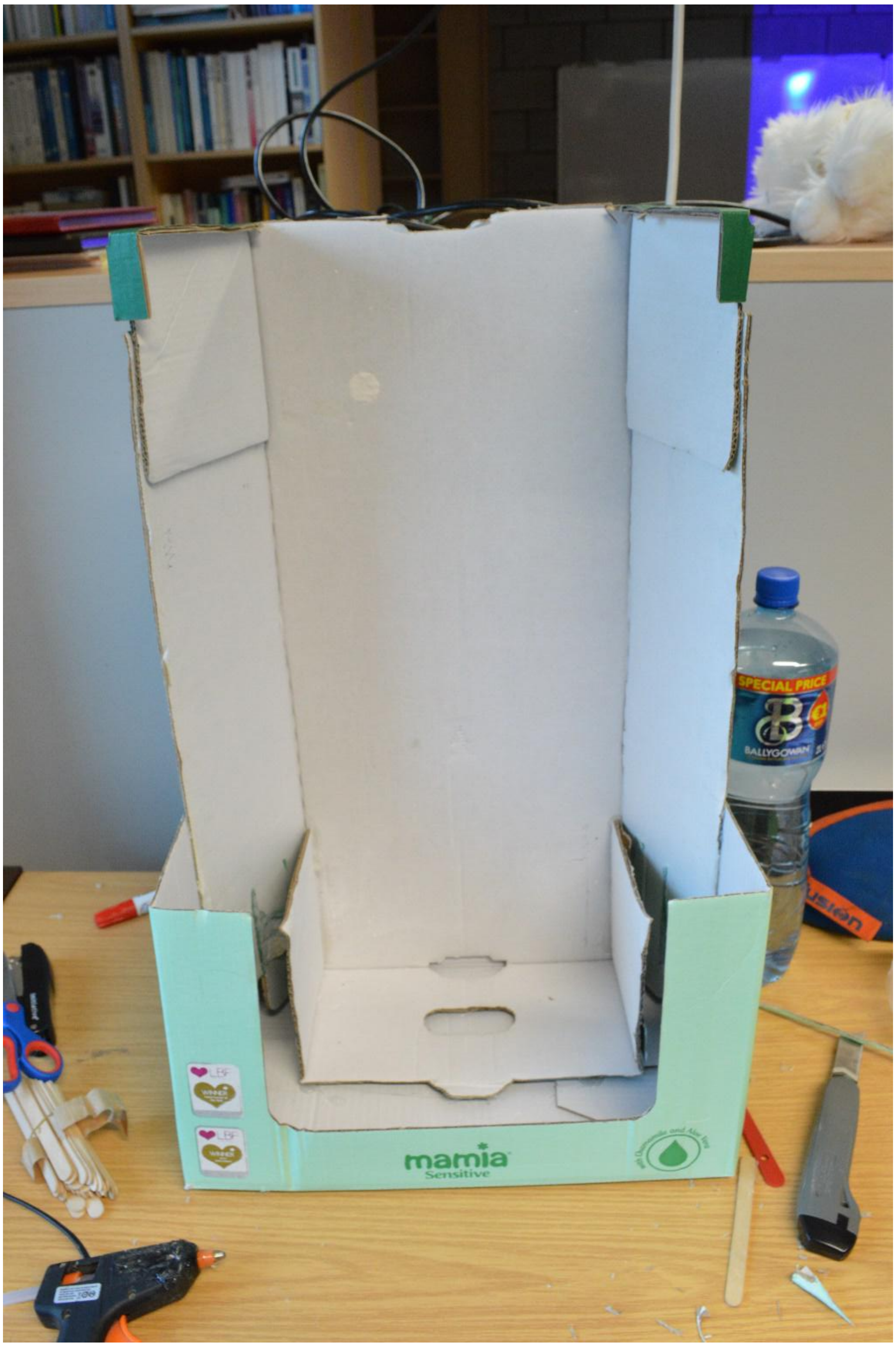


Figure 25

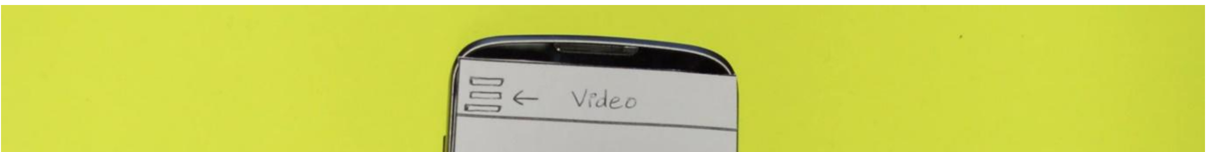
Figure 26

Figure 27

Figure 28

Figure 29

Figure 30



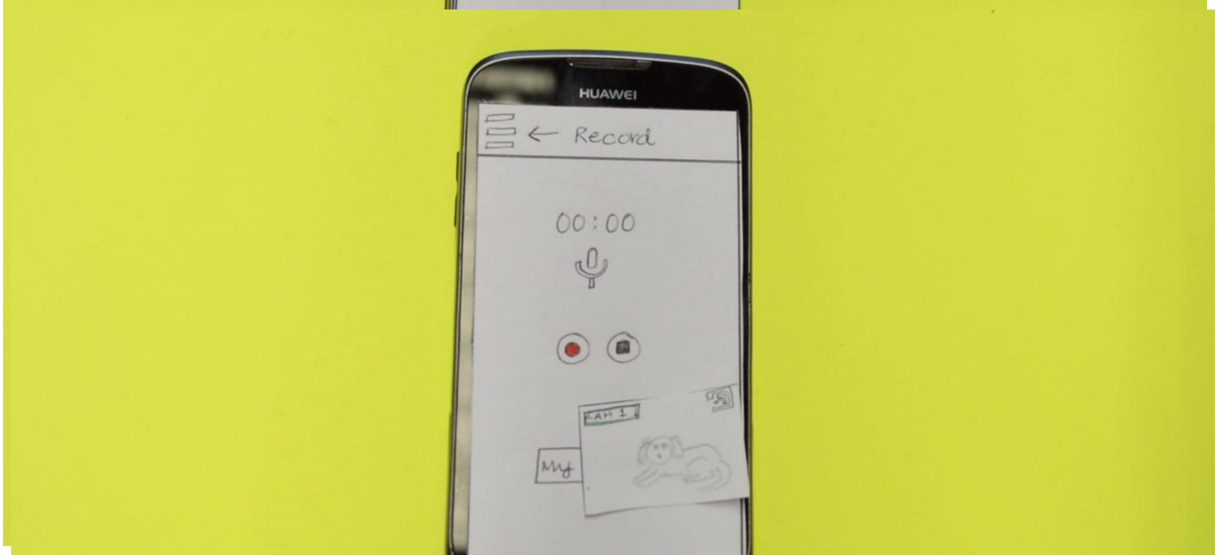


Figure 33

Figure 32

Figure 36

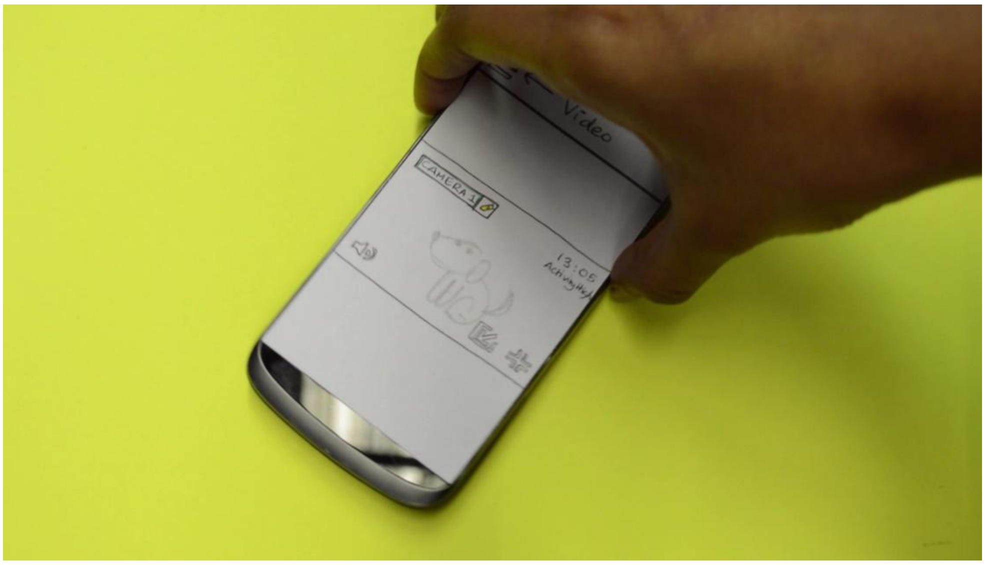


Figure 35

Figure 34

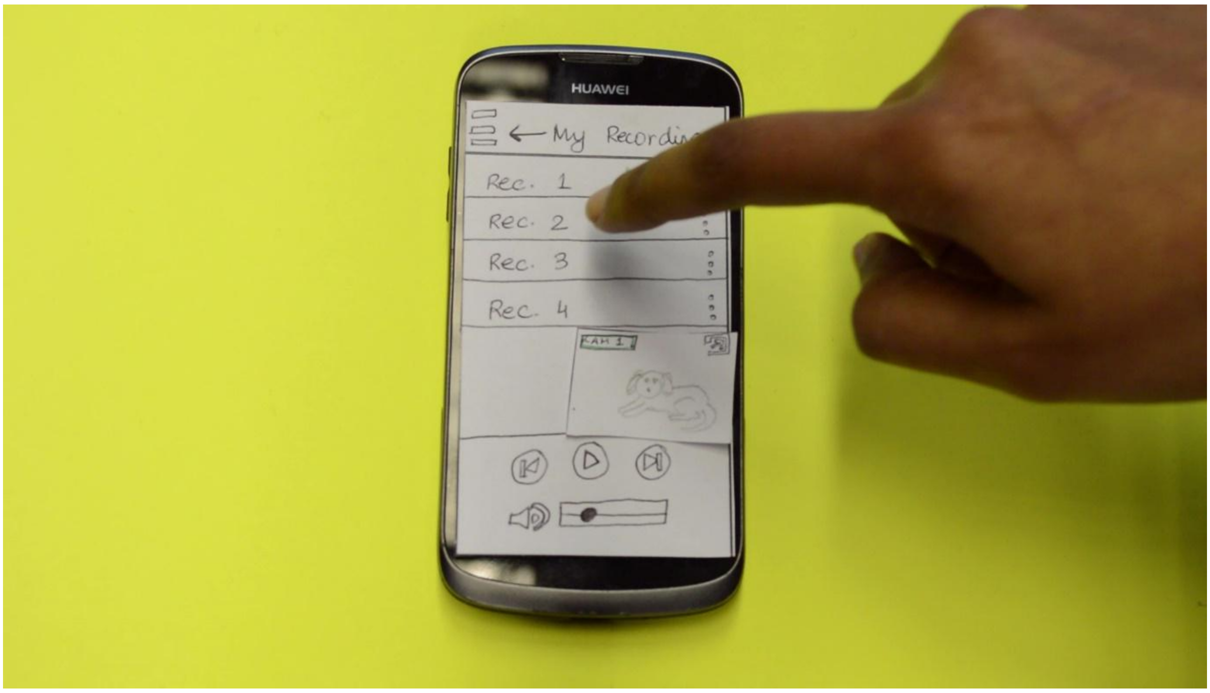


Figure 38

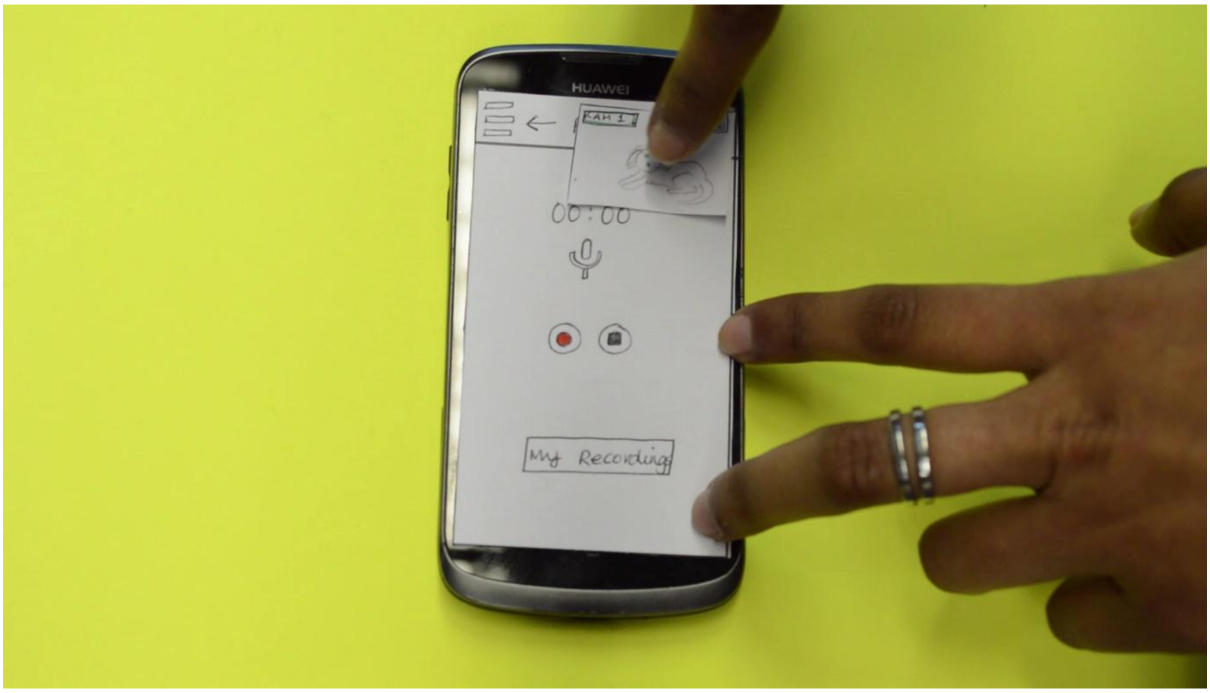


Figure 37

Figure 39

Figure 40

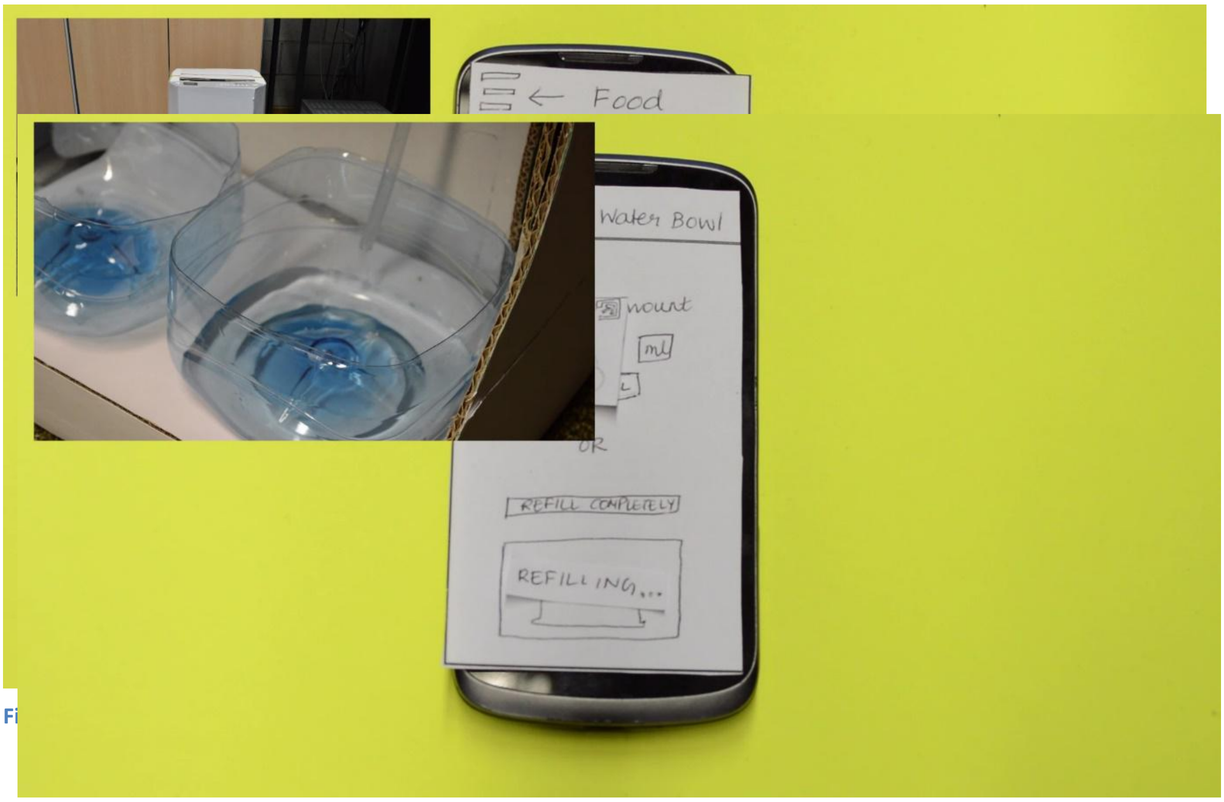
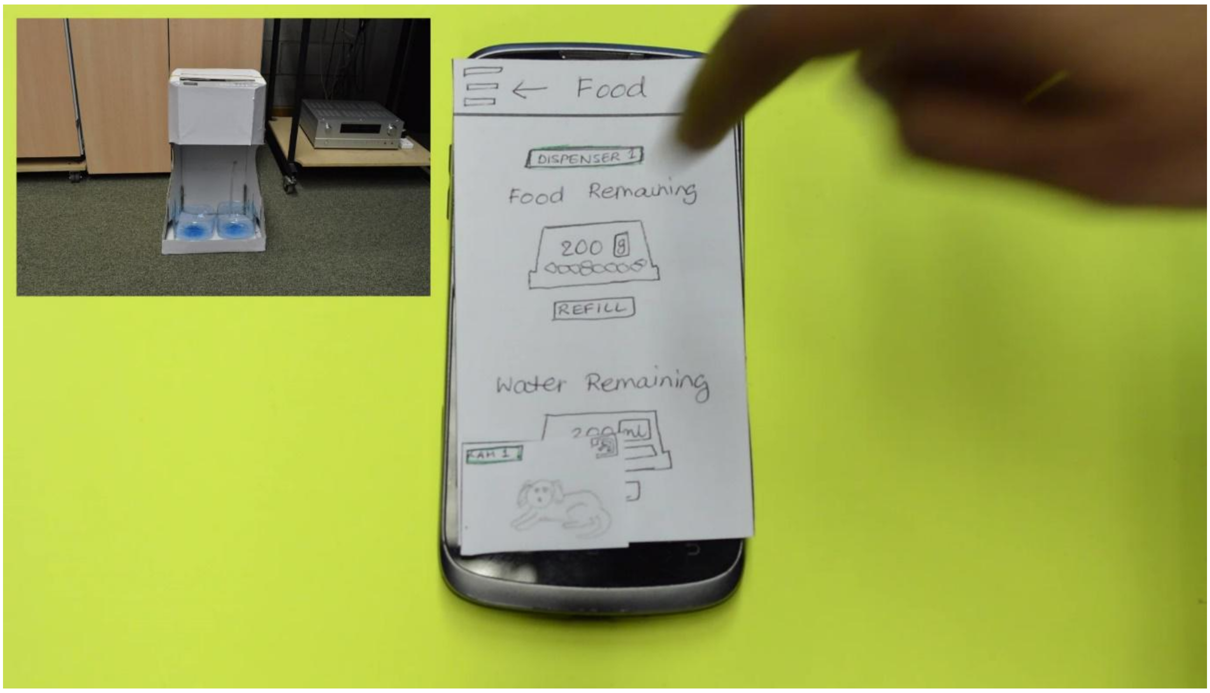


Figure 41

Figure 43



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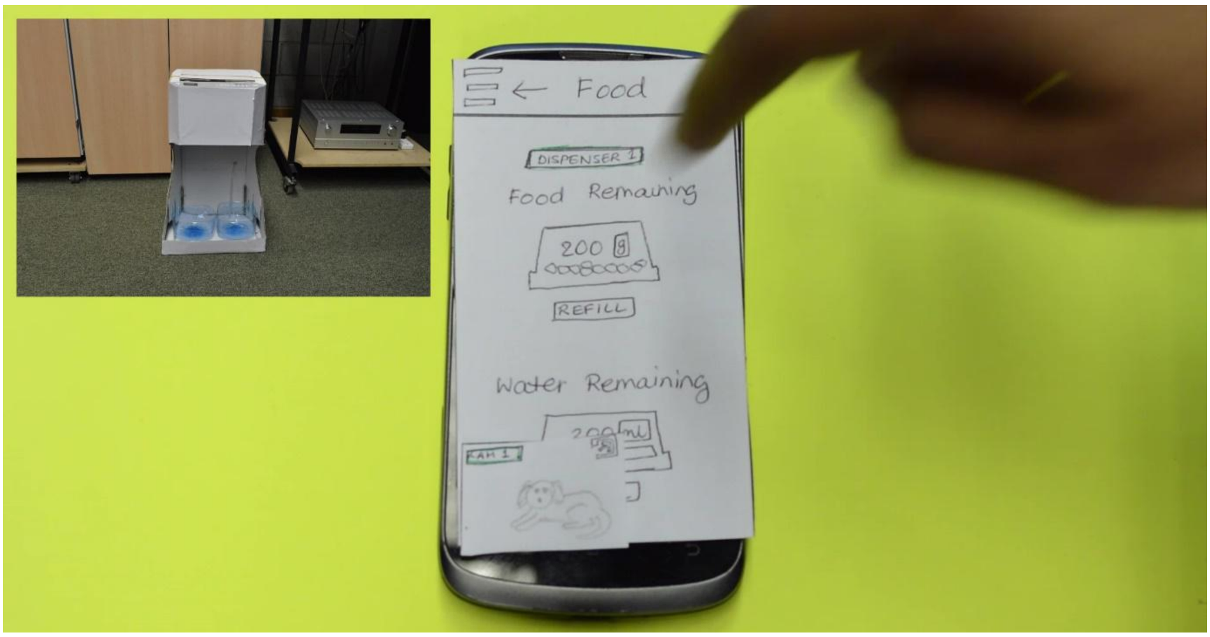

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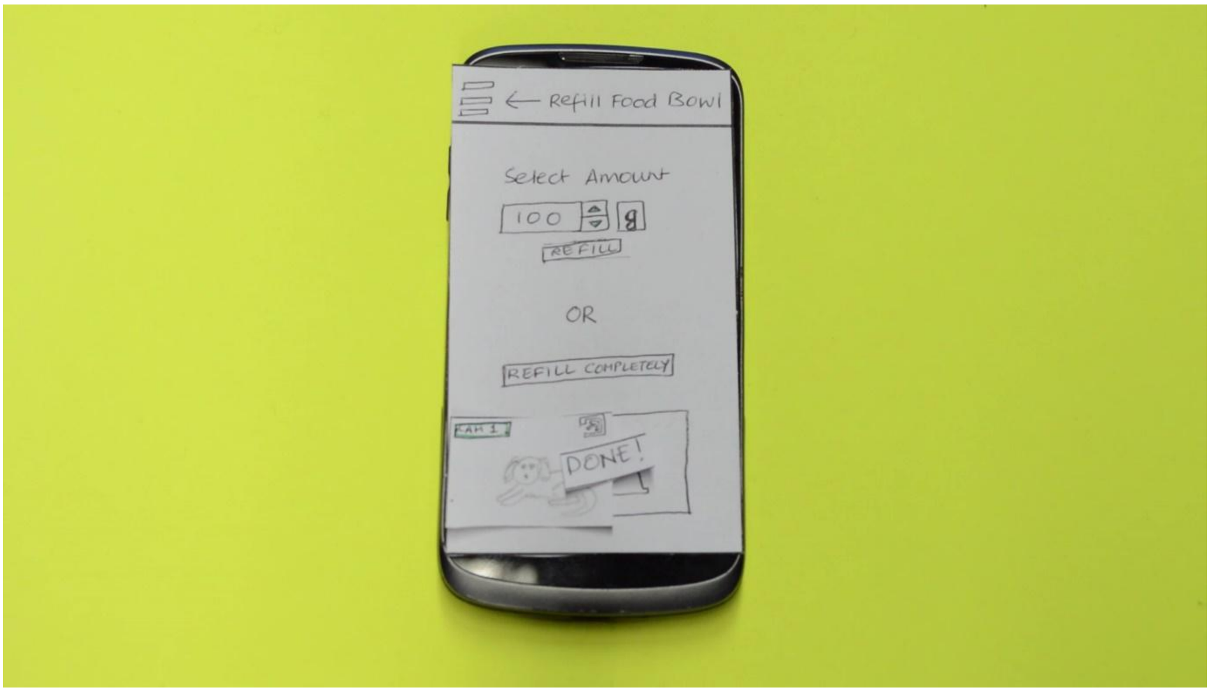

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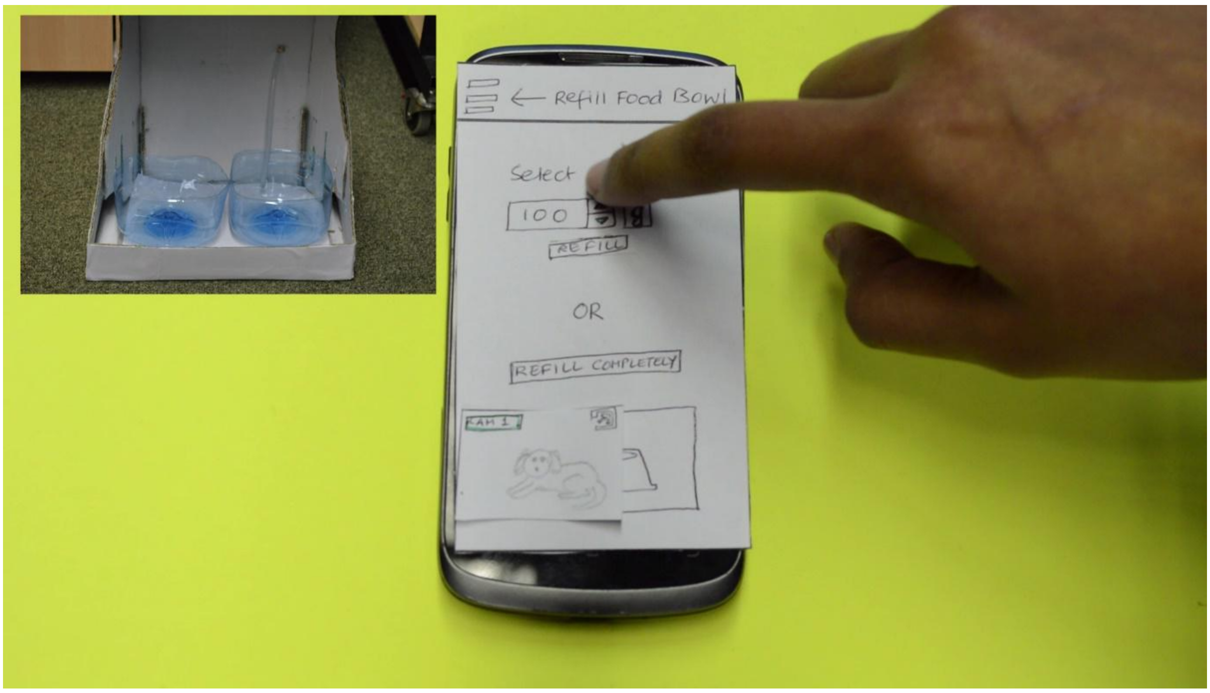

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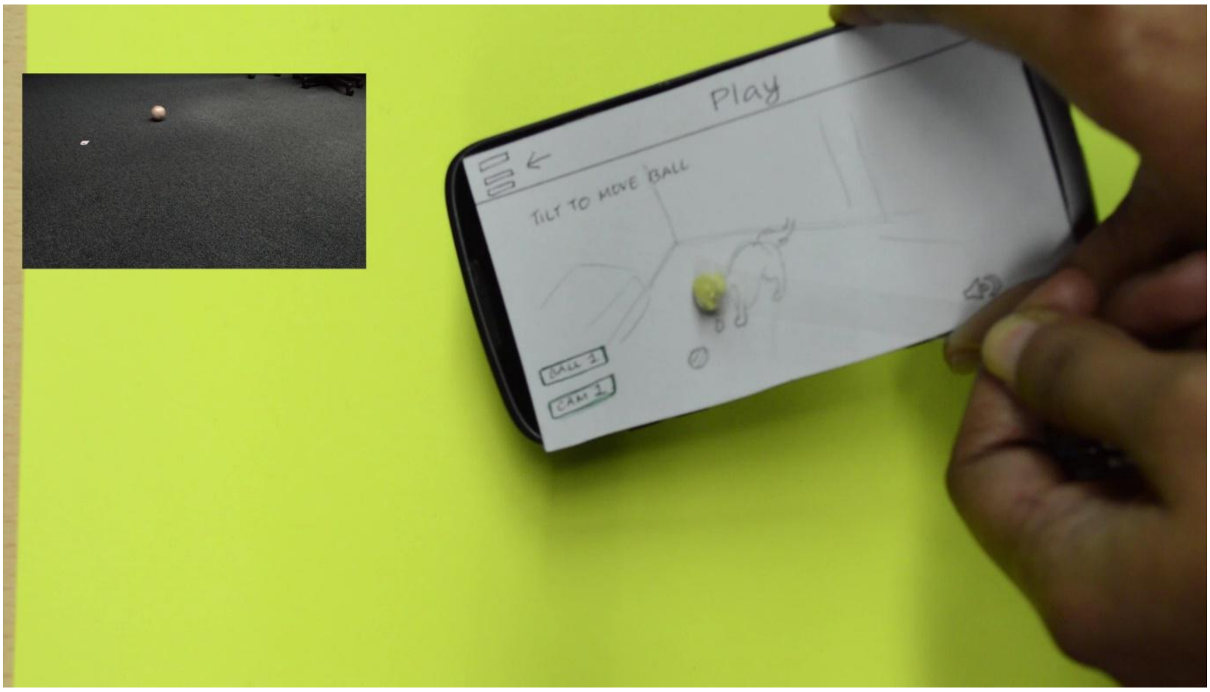

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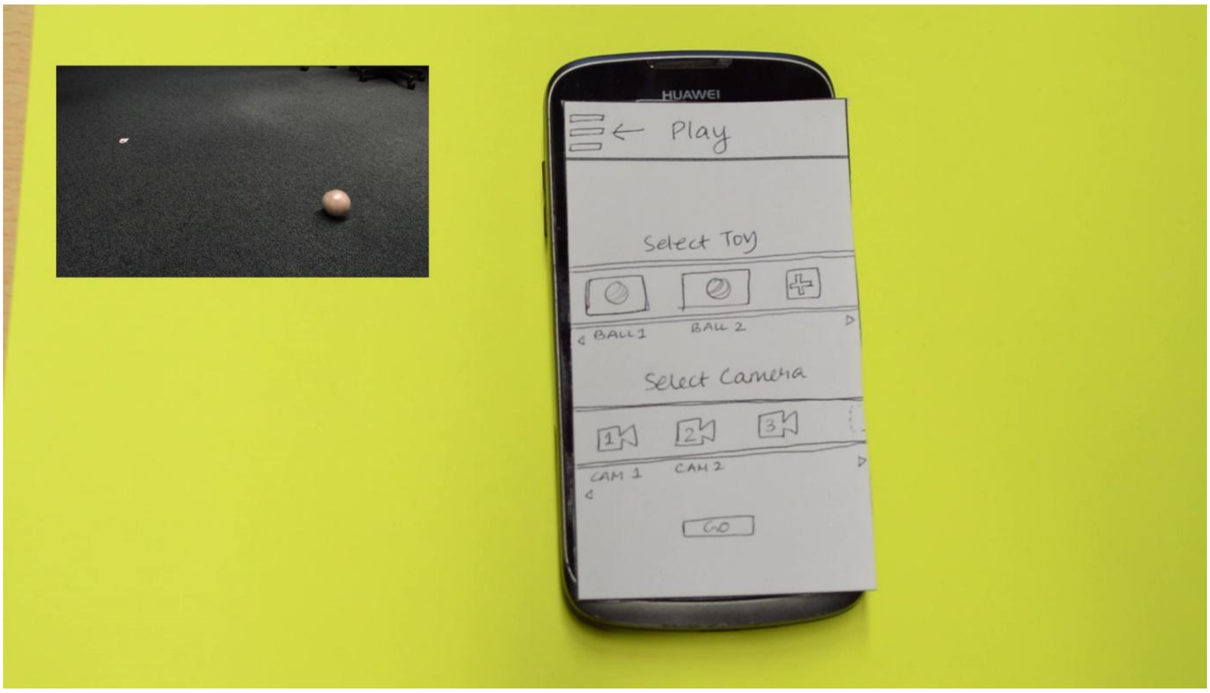

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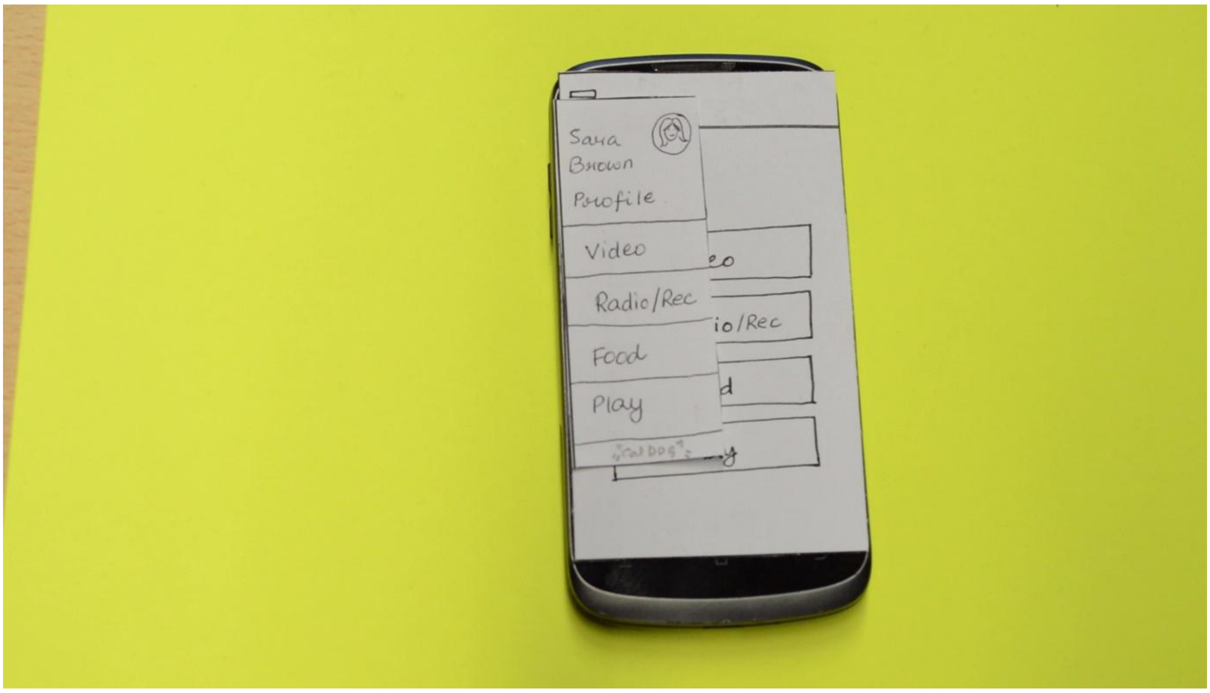

Figure 51

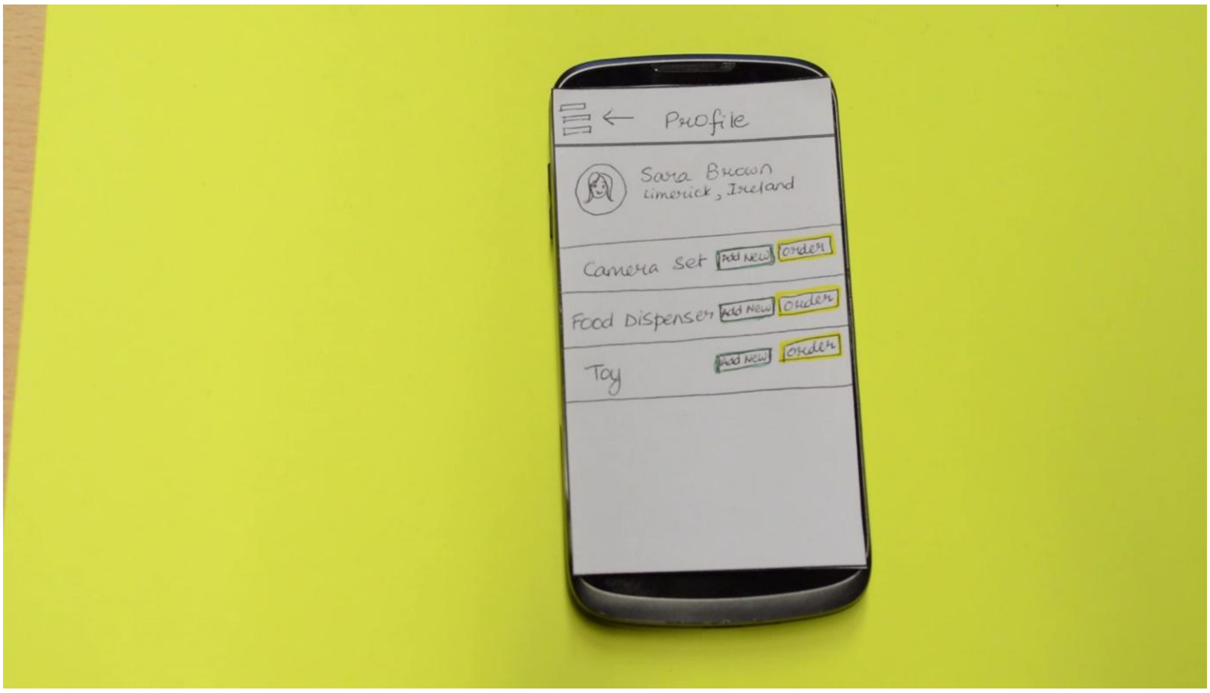

Figure 50

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