



Kitchen Automation Tool

Coursework Report

Media Specialist Practice CI7820

Submitted by: Bikash Chintak Dash (K1934145)

Faculty of Science, Engineering and Computing

Kingston University, Kingston Upon Thames, Surrey, London

Motivation

The idea originated from a basic problem of daily tracking of the groceries as the millennials were time-bound and it was tough to always follow up with the volume of groceries left in the kitchen. And then the idea originated, there should be a real-time application to monitor the groceries and the exact amount of food left in the container to cook. This was a small imitative which was taken by RadioStudio Lab to make a basic IoT model that will monitor the kitchen inventory item weight and set the data at a real-time basis. Later a company named SKE lab based in Toronto came with the same solution but have few adjustments and upgrades. But they were not specific towards any problem or specially-abled help.

Major problem towards the health sector is an irregularity in food habits. Some researchers suggest "circadian rhythms" can be disturbed due to the irregular food habits and skipping of meals. They have a higher risk of type 2 diabetes, high blood pressure and obesity. They also quoted that 80% of central Europe are likely to be affected by social jetlag. Though the major focus for this project was towards the eating disorder, though the disorder's cause is not specific the process of treatment is well-tailored. The treatment needs a thorough monitoring of your diet and logging your diet and emotion using an application which is accounted by a clinician or your local GP.

1. Aim:

To design an application to monitor and revise all the counts in the report with the help of real-time access of the consumption from the container and appliances.

To make the usability more flexible and the design more blended with user aesthetics.

2. Objective:

A clear and effective solution towards the need of the specially-abled people those need a small push to revive the health condition with small help of health-tech.

The solution is based on IoT framework. Where the product uses real-time monitoring of the diet. The focus is not specific towards a group of people rather it's for all the health and wellbeing. Discussing the model of the solution it's both hardware and software-based. Where the user needs to purchase the device and integrate it with a mobile application. The whole IoT ecosystem connects using Microsoft Azure Cloud.

The application also focusses on other needs of the users which includes:

- Fitness
- Diabetic
- Recovery
- Foody
- Anecdotes
- Monitor Grocery

But this project focus on the recovery of the user for an eating disorder. The user can be Anorexic or Bulimic may suffer from other eating disorder. The user can log emotion and monitor diet exactly with each unit of food intake. Other features than recovery can be worked further in future and will be discussed. There is also a feature which includes food bin, where the user can track the amount of food wasted. But these accounts in secondary features of the application.

3. Method:

The application building follows the design thinking process with iterative learning from various insights and existing user feedback. The feedbacks which are considered with critical ratings or one-star rating in Play Store or App Store. Those are the existing application to monitor the eating disorder. Some of the existing solutions are Rise Up and Recovery Record the application is completely tailored for eating disorder recovery. A mobile application can be used to influence health behaviour.

3.1 Measures:

Eating Disorder Diagnostic Scale (EDDS; Stice, Telch, & Rizvi, 2000). This measure is a brief self-report measure used to diagnose eating disorders, such as anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED). Which includes evaluating the user emotion after eating a meal. But the existing application needs to log the user meal using the phone camera and few questionnaires related to the type of food, the quantity of food etc. But Grossify uses somewhat a different approach to measure the food intake by the user. As tracking calories with a mobile device or application is associated with higher eating disorder pathology (Simpson & Mazzeo, 2017). This helps to shape the analytics in a manner which depicts no numbers but still, there is a pie chart which depicts the user analytics of food intake with Carbs, Fats, Proteins, Sugar, Body Calories. Any critical intake will trigger an alert and user can be advised by the clinician who so ever monitors the user recovery.

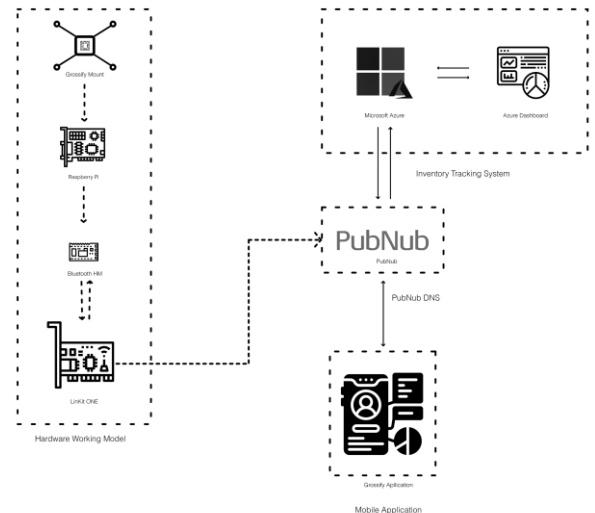
The measure taken by Grossify is more transparent than any process of the existing application in the market. It can transmit the real-time data of the user's diet intake and compare it with the log intake.

4. Product Ergonomics:

Grossify is an IOT solution which focuses on solving problems in a real-time scenario. Where the devices are connected to a hub and the hub transmits the data to the servers. The proposed business architecture includes two phases of application governance.

Phase I: The company which provides a solution which includes manufacturing or assembly of the products and packaging. The management team is focused on providing a solution for both user and clinician (other medical organisations), they also monitor the data management and security of the application and data of the respective users with the help of CRM services. Also wired with the cloud they can extract data on request.

Phase II: The product includes the individual devices (smart jars or containers), hub and the mobile application. The devices interact with the mobile application showing the real-time volume of food in the container.



[Application Architecture](#)

The application architecture which includes the working of the whole solution comprises 4 sections

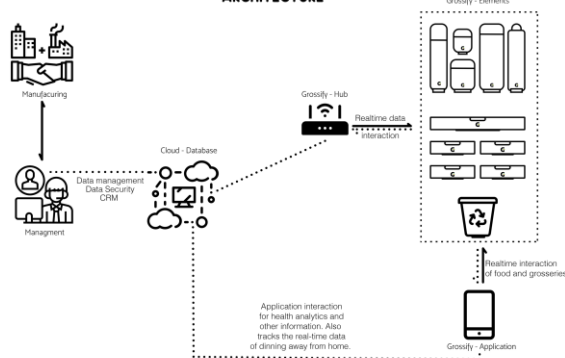
- Hardware Working Model
- PubNub DNS
- Inventory Tracking System
- Mobile Application

The sequence of data flow from source to information includes the iteration through all the mention phases.

Hardware Working Model: It is the primary source where the data is generated, where the containers are mounted with a small device named as *Grossify Mount* which is made of 4 load cells that measure the quantity of food-filled and used in an instance basis. Each instance states the amount (volume) of food taken from the container. The other components such as *Raspberry Pi 4* and *Bluetooth HM 10* helps to compute the data to the *LinkIt ONE* module to transmit the data to the real-time cloud.

PubNub DNS: It is a real-time infrastructure-as-a-service which process the data in a real-time basis scenario. And further transmits the data to cloud for respective user database and analytics.

BUSINESS APPLICATION ARCHITECTURE



[Business Architecture](#)

The business architecture helps understanding the cycle of data and device dependency in a product which is depicted in the diagram above.

Inventory Tracking System: The data received from the PubNub servers are further transmitted to *Microsoft Azure Cloud* where the data will be stored and processed for analytics. The cloud will also store the container (volume) information and further reflect in the mobile application for each API instance.

Mobile Application: The application is built for an android platform which have screens that reflect the user profile and container (volume) data. The mobile application also processes the other data (e.g. emotion, behaviour log).

The whole cycle of the user information and the food container data strictly follows the architecture and give authentic and accurate data (exception 0.99% network glitch).

Discussion: Points need to be discussed, such as subscription tier for cloud access and generating enough revenue to balance the free tier subscription and paid tier subscription.

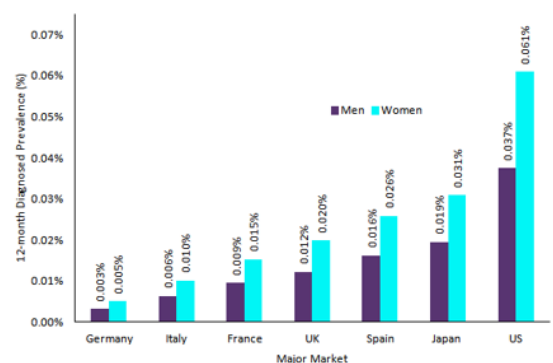
5. Literature:

Research and finding suggest that estimated that 64% of Americans own a smartphone, with even higher rates among younger adults (Smith, 2015). The dependency on the mobile application in today's era depicts that mobile applications (apps) that can be used to influence health behaviours (Ellison, Wonderlich, & Engel, 2015). Some of the existing application in the market use empirically-based principles and have potential to be used as adjuncts to successful treatment (Juarascio, Manasse, Goldstein, Forman, & Butryn, 2015) such as RiseUp and Recovery Record which only focus on eating disorder. About 1.6% of women and 0.8% of men are affected by with the binge eating disorder. The most affected gender, in this case, are women with 4% anorexic and 2% bulimic and other 2% with binge eating disorders.

The causes of these disorders can be body dysmorphic disorder, genetic predisposition, DSM – IV, cognitive attentional bias, personality traits and gastrointestinal disorders. (Eating disorder, 2013)

The most application offers fixed interventions, interventions are tailored to the needs of individuals address heterogeneity in the eating disorder population, leading to more acceptable and effective care, and better clinical outcomes (Collins et al. 2004; Darcy and Sadeh-Sharvit 2017; Juarascio et al. 2015). Application tailored for an eating disorder may not generate enough revenue to revise the existing model of application for the eating disorder. But this product not only focuses on the eating disorder or recovery of a user but also the product can widely use by the healthy peoples those can help generate enough revenue to support the society those are in need. The model proposed by this application is completely interlinked. Which can be explained with a scenario where User A can purchase the product and use premium membership for their better lifestyle. The revenue collected from them can be beneficial for another low-end user those can only afford to buy the product and use them for recovery.

Figure 1. 7MM, Age-Standardized 12-Month Diagnosed Prevalence of BED, Ages ≥13 Years, 2019



The data depicted by the epidemiologists segmented across seven major market sectors which depict 125,000 cases in the year 2019.

6. Method:

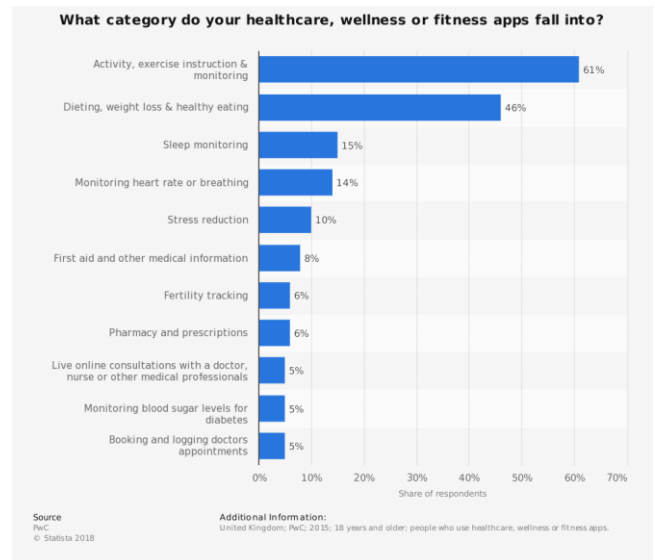
The design process followed is the design thinking process of IDEO which is conceptualized to build an application in an iterative manner. The design thinking process is classified into three major steps Understand, Explore and Materialize. The process of developing a solution for this project was not dependent upon user perception rather collecting the existing user pain points from the feedback from Play Store and App Store.

To understand the pain points of the existing user solution in the market. The major application which is considered best for recovery of eating disorder such as Rise Up and Recovery Record those are approved by the department of Psychiatry and Behavioural Sciences, Stanford University by a team of researchers. The study included an unguided self-help program which suggested that users had selective utilization pattern. But those application needed user input which has can have lots of loopholes. But this application solution replaces the logging of the meal, with those smart jars (containers) which measure the food quantity against the volume of food cooked.

The existing application logs meal, emotion and behaviour. Which also had some usability issue and had an odd user interface which reduces the user engagement. A user review says *"the user interface is unpleasant and complained about the navigation of the application"* (IMG_11_PNG). While other review states *"it annoying as the application cannot save some meal logs"* (IMG_11_PNG). A reviewer says *"the model of presenting the content is not mature enough"* (IMG_9_PNG). A reviewer quoted *"she had to fill the meal log 6 times a day which made her uninstall the application"* (IMG_7_PNG). These are some of the pain points which needed a rework or additional features to make the user experience better.

User Survey:

Primary user target group includes users with eating disorder and those who needs recovery. But also these user group needed a device to monitor the diet strictly. Which currently is not available in the market in one bundle of product.




The statistics above shows 47% of the population for the UK (lack of global content the data is illustrated specifically for the UK) uses the mobile application for Dieting, Weight loss & healthy eating.

Affinity Mapping:



Persona:



Shopie
34 Yrs

ABOUT

A chef who only loves to cook not eat. And she is very particular towards her body shape. But she also cant keep a balance towards the diet and is sometimes stubborn about not having a good course of meal.

PERSONALITY

Introvert ————— Extrovert Thinking ————— Feeling

Sensing ————— Intuition Judging ————— Perceiving

GOALS

- To find right support to keep her food schedule.
- A solution which can monitor and help her recover and keep up which her solution.

PAIN POINTS

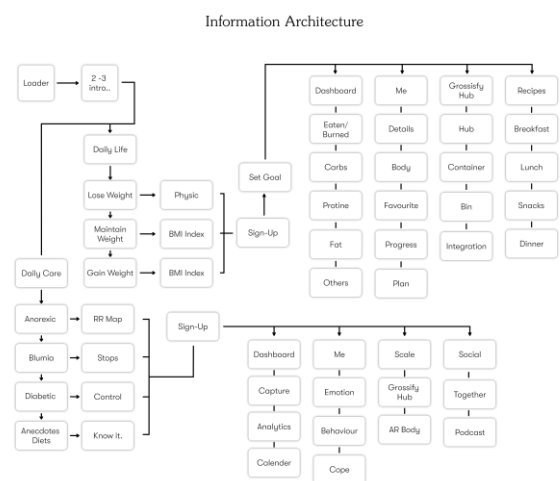
- She is bluemic person who wants to recover and needs a virtual guide.
- She needs an eye on whatever she eats and the count for calories she took vs calories she lost.
- She also cannot present her doctor a report of her diet and exactly mention her intake and quantity.

Looking at the user case scenario the user is a chef who loves to cook but at the same time dislikes to eat herself. She needs to monitor her groceries as well as look after her health to recover. Looking at her personality she is an introvert which makes her difficult to confront or share her views with others and is less open to her own clinician. Her emotions are high, with and high intuition which can be conflicting to judge her growth and health. She stands quite neutral for her judgement and perseverance. This makes her a complete fit for using the product and have fruitful results out of the solution.

Pain points includes a virtual guide which can

help her track and monitor her diet and suggest her faster and effective recovery rather just using some application in the market which needs to log the information for a meal. She has her health band which helps her monitor her calorie burn and hence she can just take a close look at her food intake.

Above information allows us to ideate the solution in a rough manner. And build and the application. But before jumping into application we can have a closer look at the information architecture.



Architecture Map - II

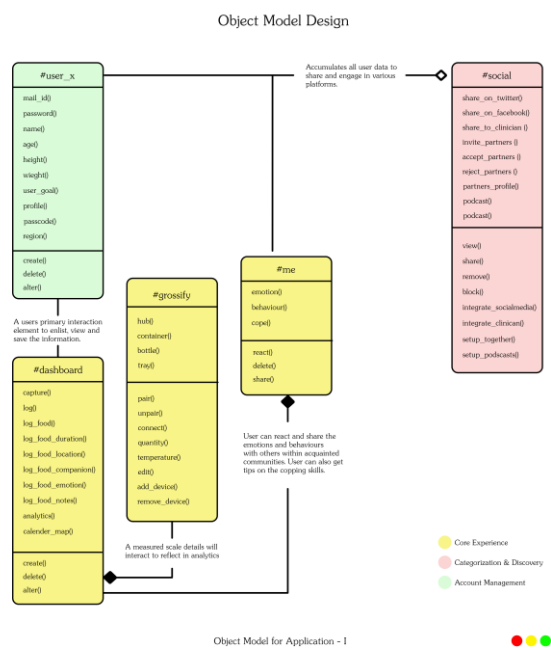


The user flow can be mapped using the information architecture which is drawn for the whole product but the prototyping and testing (user flow). The product is segregated for two types of categories where the user interacts with options and their subcategory:

- Daily Life
 - Fitness
 - Foody
 - Anecdotes
 - Monitor Grocery
- Daily Care
 - Recovery
 - Diabetic

The classification for the user onboarding is done with the user choice of symptoms and emotions faced by the day-to-day life. This is the basic phase of user handshaking and trust establishment. The second phase is to evaluate the BMI index with height and weight. The user can also set the time for logging the meals. Further discussion can be made in the low-fid screen and high-fid screen.

Object Model Diagram:



Core Experience:

It includes the dashboard, scale and me (user profile) which is the major experience for the user within the application and user input matters a lot so these are the primary input element. Those elements will help to evaluate the user behaviour and helps in recovery with many effective statistics. Also, understand the user emotions with effective diet history.

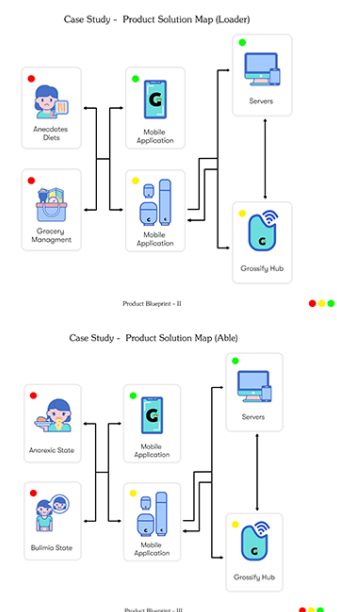
Categorization & Discovery:

The other specification includes features such as Social influences which are Facebook, Twitter and Logbook (which is the history of the diet and emotions where user can react to each session of the log).

Account Management: The user needs to enlist and alter all the data as this case scenario is a solution for changing information about the user as there will be an improvement in user's weight and change in the BMI index or make stability in both mental and physical health.

Discussions: Information Architecture helped pulling the outline of the application and filter out a lot of features which were discarded later in the run after gathering information from the existing applications and suggestions from the articles online. Such features include "AR Body where the idea was to scale the user growth in a decent manner and reflect the positive effect of the recovery."

Case Study Diagrams:



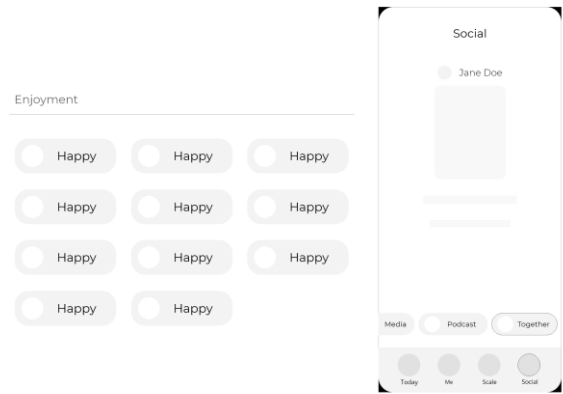
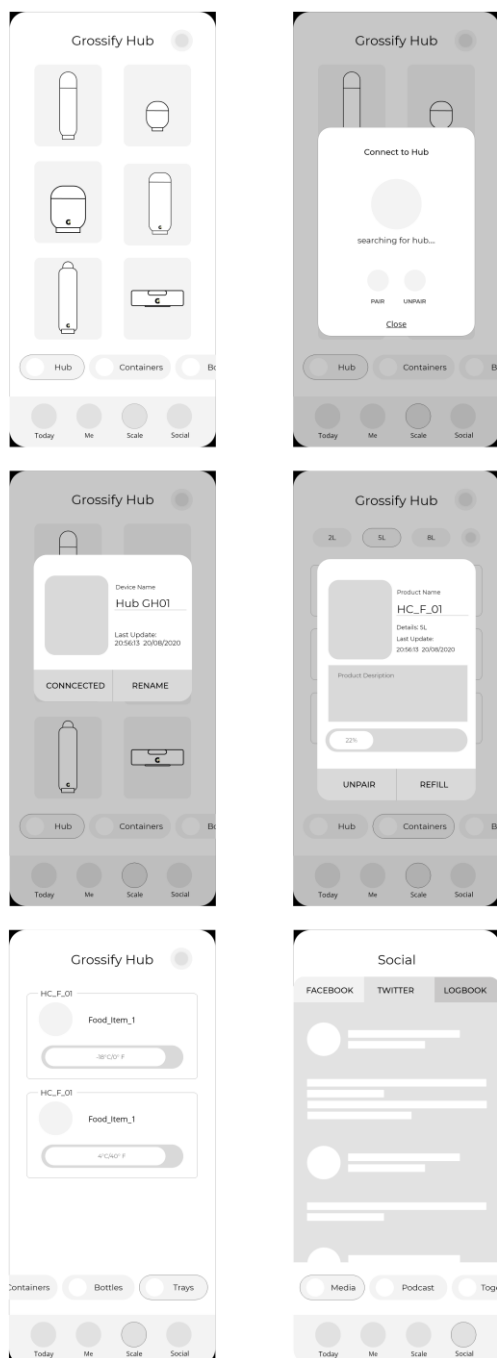
The above case study was drawn from the possible iteration in the services provided by the model of the solution. The Product Model II and III are applied to the existing solution presented. That shows the error rate of the solution model. The states (presented with colour dots in the top left corner of the card.) were the condition is red has a higher rate of error and with yellow shows, the error by devices for paring flux and green shows the no error state (exception network dependency).

6. Deliverables:

The major deliverables include Low Fidelity Wireframing, High Fidelity Wireframing and Prototyping. This report is specific to the IOT design and innovation hence the design screens to be discussed are those which were changed in final design or includes core experience of the application.

Low Fidelity Wireframing:

IoT integration screens:



Discussion:

The UI element framed for the grossify hub makes the integration and device listing simpler and easy to understand the device connectivity.

The second screen is to integrate the hub with the mobile application this step is the primary handshaking of the application and physical layer of and application development.

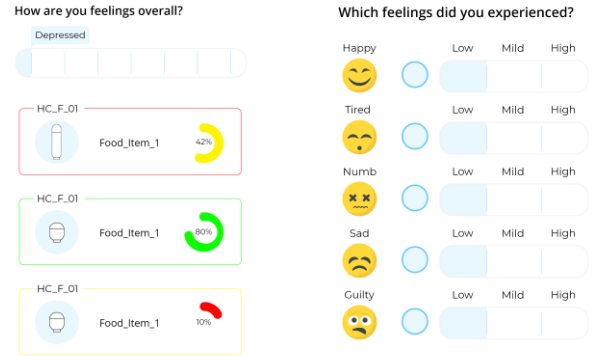
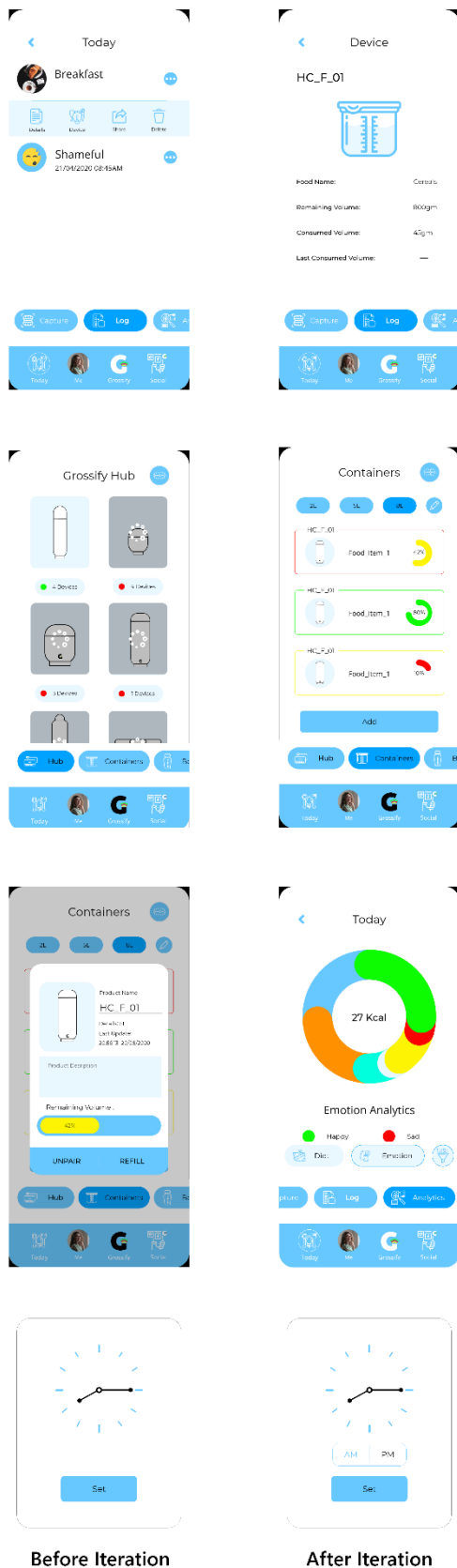
The third screen is detailed for hub name and connection. The button "connected" acts as an info button, but later in HLD it was corrected as "unpair" and the "rename" button replacing with "refill". This was done for the individual container to check the details and pain/unpair the device from the Hub and Application. It was unnecessary to edit-bind (for hub) the device once the connection is established.

The emotion tab or feelings log was enlisted to tap on the emotion and select the emotion not specifying the intensity of the emotion. And later was discarded in HLD.

The social screen with a tab together was not quite feasible with technical aspect though it had enough reasoning to reflect the motivational quotes and images from the existing social platform.

Lastly the HLD doesn't have the screen design or further work on pairing up for coping skills because it needs a network and the focus of this application was only towards the IoT devices and integration. But will be further worked in future.

High Fidelity Wireframing:



Discussion:

Log screen with meal and emotion also have option to share and look in the details of the event generated and also edit the details as per the user need but each of the change enlisted will have a log and the user will be able to ask the product owner to provide a detailed history. User can also look the device details where the user exactly gets the data of the containers and the quantity of food reduced.

The Grossify tab have process validation screen as the container integration is in a null state which depicts the red icon. Though post connection the icon turns green and while connection establishment its yellow.

Each of the container tab is encircled with red in the above image which shows the health of the device and the health bar with percentage value shows the food health in the container.

Appendix:

Artefact Link

<https://kingston.box.com/s/vphxq4gygwv193qrrgu39k0j2pvrzlj>

Prototype Link

<https://xd.adobe.com/view/1401f708-fe3f-468f-67fb-baa2d9dff3bb-6230/>

Prototype Video

<https://kingston.box.com/s/jlg78nv7h3hzbed7ph49uozxa2i6z3dr>

Bibliography:

Diabetes. 2020. *Irregular Eating Patterns Could Lead To Type 2 Diabetes - Diabetes*. [online] Available at: <https://www.diabetes.co.uk/news/2016/jun/irregular-eating-patterns-could-lead-to-type-2-diabetes-92058673.html> [Accessed 17 May 2020].

Stice, E., Telch, C. F., & Rizvi, S. L. (2000). Development and validation of the Eating Disorder Diagnostic Scale: A brief self-report measure of anorexia, bulimia, and binge-eating disorder. *Psychological Assessment*, 12(2), 123–131. <http://dx.doi.org/10.1037/1040-3590.12.2.123>.

Simpson, C. C., & Mazzeo, S. E. (2017). Calorie counting and fitness tracking technology: Associations with eating disorder symptomatology. *Eating Behaviors*, 26, 89–92.

Smith, A. (2015). U.S. smartphone use in 2015 (Retrieved January 4, 2017, from Pew Research Center) <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>.

Collins, L. M., Murphy, S. A., & Bierman, K. L. (2004). A conceptual framework for adaptive preventive interventions. *Prevention Science*, 5(3), 185–196. <https://doi.org/10.1023/b:prev.0000037641.26017.00>.

Juarascio, A. S., Manasse, S. M., Goldstein, S. P., Forman, E. M., & Butryn, M. L. (2015). Review of smartphone applications for the treatment of eating disorders. *European Eating Disorders Review*, 23(1), 1–11. <http://dx.doi.org/10.1002/erv.2327>.

Smink FR, van Hoeken D, Hoek HW (November 2013). "Epidemiology, course, and outcome of eating disorders". *Current Opinion in Psychiatry*. 26 (6): 543–8. doi:10.1097/ycp.0b013e328365a24f. PMID 24060914.

En.wikipedia.org. 2013. Eating Disorder. [online] Available at: https://en.wikipedia.org/wiki/Eating_disorder#cite_note-Sm2013-8 [Accessed 18 May 2020].

Levinson, C., Fewell, L. and Brosof, L., 2017. My Fitness Pal calorie tracker usage in the eating disorders. *Eating Behaviors*, 27, pp.14–16.

Kim, J., Sadeh-Sharvit, S., Darcy, A., Neri, E., Vierhile, M., Robinson, A., Tregarthen, J. and Lock, J., 2018. The Utility and Acceptability of a Self-Help Smartphone Application for Eating Disorder Behaviors. *Journal of Technology in Behavioral Science*, 3(3), pp.161–164.