CAT301 Research Methods & Special Topic Study

Assignment 1: Literature Review
Mobile Applications in Healthy Lifestyle

Ponnmalar Elumalai, Nur Fatihah binti Ab Aziz, Nur Arina Izzati Binti Kairol Nizam, Raaga Vilassini Raja, Dr Sukumar Letchmunan

ponnmalar9931@student.usm.my, fatiehah.aziz99@student.usm.my, arinaizzati@student.usm.my, rvilassini@student.usm.my, sukumar@usm.my

School of Computer Sciences, Universiti Sains Malaysia
11800 USM, Penang, Malaysia

1. Introduction

Lifestyle defined as the interests, opinions, behaviours, and behavioural orientations of an individual, group, or culture. Lifestyle has different forms of significant influence on physical and mental health of human beings. Statistics show that more than 1.4 billion adults aged 20 were overweight and around 35% of people aged 15 were insufficiently active worldwide [1]. The increasing prevalence of people who are affected by chronic illnesses such as cancer, diabetes, obesity and others, proved that millions of people follow an unhealthy lifestyle. Thus, in recent decades, mobile applications in promoting a healthy lifestyle are more interesting to researchers. Mobile applications or smartphones are chosen to be a tool to tackle the issues because they are significantly lowering the costs for having personal workout trainers, reducing the burden of people in finding healthy cuisines and others . There are a variety of applications that are available in the market which are using various techniques in order to assist people to lead healthy lives. The techniques are including physical activity tracking, meals suggestion, food calorie counting and shop suggestion. In this literature review, we studied different applications that promote a healthy lifestyle such as *Calorie Counter - MyFitnessPal*, *FoodFight,* and *Health-On* . We focus on the methodology that is used in the respective applications and how effective they are in users lifetime. We also distinguish the advantages and weaknesses of applications in order to identify the best application features that are needed for users.

2. Mobile Applications in Promoting Healthy Lifestyle

Reviewing scientific articles in a health topic involves systematic but time consuming steps, and in order to improve the process and find relevant articles more quickly, we focus on more specific work regarding healthy lifestyle and diet applications.

There are a total of 17 studies about the related work. Out of 17, there are 15 studies regarding health applications focusing on calorie counting, fitness, diet plan and exercise plan. The applications being studied are *Calorie Counter - MyFitnessPal* [2, 3]*, My Meal Mate* [4, 5, 6]*, SapoFitness* [7]*, FoodFight* [8]*, CoviHealth* [9]*, BeWell*

[10], *Diet-Aid* [11, 12]*, Health-On* [13]*, myPDA* [14]*, eBalance* [15] *and CalNag* [16]. The other 2 studies focus on investigating different types of calorie counting applications [17] and analyse the solutions for disease related to unhealthy applications[18].

In the next analysis, we will discuss further about the methodology used in related work regarding health applications.

2.1. Methodology and Input Of Related Work

Methodology is an essential step to assure a valid data and reliable result for the research where it should be associated with the objectives of the research. When talking about healthy lifestyle and healthy diet, weight and height are the most important data that needed to be collected. It will be used to calculate the Body Mass Index (BMI) and Basal Metabolic Rate(BMR) [12]. The *eBalance* app collects the measurements after 14 weeks of intervention where the diet quality, physical activity were obtained from questionnaires [15]. The methodology used to study the *MyFitnessPal* calorie tracker could be a great example on how the researcher can obtain reliable data. There were 105 participants involved from a community eating disorder clinic where the participants need to complete self report measures of anxiety, depression, and eating disorder symptoms [2]. Involvement from the right user of the application such as the participants from the community eating disorder clinic can provide an absolute result to the researcher. In other research conducted [17], 31 of *MyfitnessPal*'s users were interviewed and the interview sessions were recorded for the analysis purpose. A set of questions were prepared with the aim to explore their practices of using *MyFitnessPal* and their cohesion to their daily calorie goal where it consisted of questions about the history of using *MyFitnessPal*, their practices and evaluation of the app [17]. *SapoFitness* apps make use of the local database where they retrieved the physical activity history and the food saved in the database [7]. *FoodFight* app also uses the same method as *MyFitnessPal* by conducting interviews with the potential users to match users' expectations and desires [8].

Interview method can always be one of the most effective for qualitative research as it can benefit the researcher by providing in-depth information. However, the pilot trial

methods are also reliable as the primary outcomes were feasibility and acceptability outcomes of adherence to the trial and adherence to the interventions [4]. [5] describes the frequency usage of an electronic dietary self-monitoring and weight loss smartphone app called *My Meal Mate*. The usage of a randomized pilot trial to collect a sample of 128 overweight volunteers to receive a weight management intervention delivered by the smartphone app was explained in [4]. The selected participants were invited to attend a guideline enrollment session where height, weight, and percentage body fat were measured by research assistants, and guideline questionnaires self-completed. The purpose of the guideline questionnaires were to gather in- depth information on demographics, technology usage, attitudes toward weight loss, physical activity, eating behavior, and a variety of psychosocial variables [4]. Minimization software package 1 to 3 groups was used because it is said that this method has the advantage over simple or stratified randomization of providing very similar balanced groups in small samples [4]. Although the pilot trial is a time taking method, it also can be the best way to collect accurate data and information.

Observations on participants' actions during the experiment and inquired about their perceptions that can be seen in the *CalNag* app were also reliable [16]. Comparing the proposed solution with related software could outdo other methods when it comes to gather information and responses from the users. This method can be seen in developing *myPDA* apps under the analysis section [14]. Research paper [9] mentioned the *CoviHealth* developed mobile application will be distributed mainly to a teenage population consisting at least 356 volunteered students from a secondary school aged between 13 and 18 years old. The data acquired were selected from the eligible students with the questionnaires filled before and after the time of the study where then the data were classified as a Gauss distribution [9]. It is also possible to use Android Nexus One to automatically monitor a person's physical activity, social interaction and sleep patterns as being used in *BeWell* apps [10]. Knapsack algorithm or weight reduction algorithm were developed such as in *Health-On* apps to recommend the appropriate products related to user diet and to keep track of nutritional intake for calorie prescription [13, 18]. They select 30 obese volunteer with BMI more than 25 kg/m2 participated in the *Health-On* pilot program for 12 weeks [13].

2.1.1 Expected Output Of Related Work

As people nowadays use smartphones as their daily needs, the technology can act as a medium to guarantee the user's health and suggest their potential to be used in health-promoting strategies. The output of the apps should be conveniently effective to the users with a simple user interface. The findings of expected output for the related apps are describe as below:

1. *MyFitnessPal* provides breakdown of daily calorie, suggests nutrient intake and gives feedback on the number of calories and nutrients needed. *MyFitnessPal* advises the users on the amount of calories needed to reach a goal [2].

2. *My Meal Mate* provides a food intake diary for users to monitor their diet intake. It allows self-monitoring of diet, physical activity and weight. The users can view feedback via text message [5].

3. *SapoFitness* apps provide dietary evaluation, Body Mass Index (BMI) and the maximum daily calories [7].

4. *FoodFight* should calculate progress of goal and type of plan they are on [8].

5. *CoviHealth* provide output such as Body Mass Index (BMI) calculation, diet plan with calendar and training plan with calendar [9].

6. *BeWell* provides outcomes of wellbeing scores that are updated based on both automatic sensor data from the phone and through the manual input by the user via the portal [10].

7. *Diet-Aid* allows users to log food, activities during the day and also log their body measurements. The application shows a summary of energy income and expenses for each day. It also can view a graph with Macronutrient that contains protein,carbohydrates and fat [11].

8. *Health-On* has 4 theme pages: main, diet, physical activity, challenge and ranking. Each page allows users to easily see their achievements and to maximize user convenience and app effectiveness with a simple user interface. The algorithm suggested the goals of daily calories from dietary intake necessary to achieve weight loss [13].

9. *myPDA* gives output of Body Mass Index (BMI), Basal Metabolic Rate (BMR), and the daily energy expenditure [14].

10. *eBalance* provides nutrition intake in comparison with Diet Reference Intake (DRI). It also displays suggested foods on diet intake according to the tuser [15].

11. *CalNag* allows users to weigh, scan food before cooking , daily food consumption goals, upload images of palm [16].

The following section describes the advantages of the related mobile application that can benefit the users.

2.2. Advantages

One of the most widely used mobile application *Calorie Counter: My Fitness Pal* which is a calorie-counting app helps users to track and input their daily food intake , gives feedback on the number of calories and nutrients needed and also allow the user to set weight and nutrition goals so that can advice based on it [2]. Research showed that there is no difference between the usage of *Calorie Counter: My Fitness Pal* and weight loss treatment [17]. The use of *Calorie Counter: My Fitness Pal* shows dieters' negotiations between what was needed and what was convenient, rather than a blind following of the suggestions of the app [3].

Then , the automated time- and date-stamped information collected by the *My Meal Mate* app is a strength because it allows for objective analysis of dietary self-monitoring.The work presented is also unique in considering not only the frequency of self-monitoring, but also the pattern of monitoring over time [5]. *SapoFitness* application acts as a motivation tool for weight reduction and increased physical activity so that users can have a good and balanced nutritional state . It also offers a

continuous alert system activity, sending alerts/messages concerning the user diet program taking into account also his/her physical activity with a suggestion of a diet or exercise plan [7].

As for *Food Fight* application , it able to record data through taking photos with the desired information consisting of what types of food was being captured [8]. While *CoviHealth* has the medical control which is the most central feature because it provides reliable information to teenagers with a personal captivation of the users [9]. As for *BeWell* application, it concurrently monitors multiple dimensions (e.g., sleep patterns, social interaction, and physical activity), representing a more complete picture of the user's overall wellbeing [10].

Apart from that, *Diet-Aid* application addresses interoperability issues in health and personal data. Interoperability is a fundamental requirement for health care systems to derive the benefits promised by the adoption of HL7-based systems and Electronic Medical Records(EMRs)[11,12]. Whereas, The offline intervention for *Health-On* enables nurses, nutritionists, and exercise trainers to inspect goal achievements and provide periodic feedback. *Health-On* can calculate health age from basic health information [13] .

For *myPDA* application, it improves the awareness of balanced diets, encourages following healthy plans and promotes increasing exercise levels [14]. While *eBalance* application provides tools for monitoring diet and physical activity while instructing and encouraging healthy diet and physical activity [15]. The *CalNag* application has its special feature that automatically calculates accurate portion size of a meal with little user effort [16].

The following section describes the weaknesses of the related mobile application.

2.3 Weakness

Based on the related work of the mobile applications that previously described in *2.0*, there are some weaknesses that can be analysed from each mobile application.

First and foremost, the research of *Calorie Counter-MyFitnessPal* is retrospective and based on self-report. Then, there is no psychometrically valid measure of calorie

tracking usage of the application, and therefore, they used a measure developed solely for the purposes of the study[2]. Next, the second study with different research which also focuses on *Calorie Counter-MyFitnessPal* has a weakness as the knowledge was only dealt with at a superficial level as the application provided general information but did not assess the user's knowledge in an effort to change it[3].

My Meal Mate application research was a prototype app and there are some participants reported that they frequently encountered bugs that caused the application to close. [5]This shows the weakness of the application and it may affect participant engagement. *My Meal Mate* application in other research also has a weakness that can lead to human errors as the meals entries feature is allowed to be done manually[6].

The weakness of *SapoFitness* happens in databases and they need to include the use of a web service that will connect to a server database that will support the current local database freeing storage space from the mobile device in future projects[7]. As for *Food Fight* mobile application, the weakness includes the lack of social features and the way their algorithm is calculated. So, it will be advantageous if they can introduce the features on the social elements and then improve or replace the algorithms for calculating weekly grades with a machine learning algorithm[8].

In *CoviHealth* mobile application, the only weakness is that it is not implemented for young people in secondary school. So in future work, a group of young people from secondary school will be selected for the tests in order to verify if the innovation proposed stimulates the interest in the mobile applications related to nutrition and physical activity[9] . This *BeWell* application is limited to three well being dimensions which are sleep patterns, social interaction, and physical activity but does not yet incorporate a number of other important health components such as diet and stress[10].

From the research of *Diet-Aid* application , it would be advantageous for the systemerati to add some nutritious information about the ingredients, such as the amount of vitamins in the ingredients for users to consider[11]. In other research regarding *Diet-Aid* application, the weakness is because the users are unable to access the *Diet-Aid* ubiquitously[12].

As for *Health-On*, it was designed as a pilot test so that direct weight reduction effect could be measured. For weakness, this application design is limited as it does not allow direct comparisons with other forms of treatment.[13] Other than that, metabolic rate and calorie expenditure are only assumed, but not determined through individual differences[13]. Differences between daily calorie expenditure calculated may occur and affect the application.

In *myPDA,* the application has small font sizes, lack of diet plans, nutrition information, and lack of functions to promote exercising[14]. For *eBalance* application, it is equipped with only manual questionnaires and has no physical activity tracker that can lead to human error [15] while the weakness in *CalNag* can be seen as users are required to scan the foods manually one by one and not all at once[16]. This leads to a delay in using this application.

Through all the weaknesses found in all related mobile applications, some of them can be used as an advantage for us to improve our functionalities in our future project. We also plan to analyse their weaknesses and treat it as a new challenge to adapt with our future project.

3. Summary

Mobile applications are one of the best platforms to encourage people to continuously follow a healthy lifestyle due to its advantages. Generally, all the mobile applications that we examined had fulfilled their objectives with their special features. Although, there are a variety of applications available in a wide range but still users looking for applications that are more efficient, unique and precise that require minimal efforts which we can see from their feedback in each article on respective applications. In overall, *Calorie Counter: My Fitness Pal* , *My Meal Mate, and SapoFitness* found as three most desirable applications from this literature as they fulfil most of the requirements provided by users. These three projects can be main references for other health applications in future to enhance the productiveness of applications.

References

[1] FARHUD, D., 2020. *Impact Of Lifestyle On Health*. [online] PubMed Central (PMC). Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4703222/> [Accessed 21 November 2020].

[2] Cheri A Levinson , Laura Fewell , Leigh C Brosof. "My Fitness Pal Calorie Tracker Usage in the Eating Disorders." 2017. *Online*, https://pubmed.ncbi.nlm.nih.gov/28843591/. Accessed 04 Nov 2020.

[3] Laing BY, Mangione CM, Tseng CH. "Encouraging Use of the MyFitnessPal App Does Not Lead to Weight Loss in Primary Care Patients." *JCOM*, 2015. Accessed 19 Nov 2020.

[4] Carter, M., Burley, V., Nykjaer, C. and Cade, J., 2013. Adherence to a Smartphone Application for Weight Loss Compared to Website and Paper Diary: Pilot Randomized Controlled Trial. *Journal of Medical Internet Research*, 15(4), p.e32.

[5] Michelle C Carter, Victoria J Burley and Janet E Cade. "Weight Loss Associated With Different Patterns of Self-Monitoring Using the Mobile Phone App My Meal Mate." 2017. *JMIR Mhealth and Uhealth*, http://mhealth.jmir.org. Accessed 20 Nov 2020.

[6] Carter, M., Burley, V., Nykjaer, C. and Cade, J., 2020. 'My Meal Mate' (MMM): Validation Of The Diet Measures Captured On A Smartphone Application To Facilitate Weight Loss. [online] semantic scholar. org. Available at: <https://www.semanticscholar.org/ paper/'My-Meal-Mate'-(MMM)%3A-validation-of-the-diet-on-a-Carter-Burley/9543af77b5abd5098eef637cca579fb39e6f13f9> [Accessed 22 November 2020].

[7] P. Devi and K. Devi, "SAPOHEALTH : A MOBILE FITNESS APPLICATION FOR NUTRITIONAL ASSESSMENT", 2020. [Online]. Available: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.300.8806&rep=rep1&type=pdf. [Accessed: 21- Nov- 2020].

[8] T. Chang, "Food Fight: A Social Diet Network Mobile Application", 2020. [Online]. Available: https://digitalassets.lib.berkeley.edu/techreports/ucb/text/EECS-2012-133.pdf. [Accessed: 21- Nov- 2020].

[9] M. Villasana et al., "CoviHealth", *CoviHealth: Novel approach of a mobile application for nutrition and physical activity management for teenagers*, 2019. [Accessed 22 November 2020].

[10] N. Lane et al., "BeWell", *BeWell: A Smartphone Application to Monitor, Model and Promote Wellbeing*. [Accessed 21 November 2020].

[11] Chuan-Jun, S., Yin-An, C. and Chia-Wen, C., 2013. *Personalized Ubiquitous Diet Plan Service Based On Ontology And Web Services*. [online] Ijiet.org. Available at: <http://www.ijiet.org/papers/329-K012.pdf> [Accessed 21 November 2020].

[12] Tudor, C., Cristian, P., Natalia, P. and Marius Andrei, C., 2008. *Web Application Used In Education For A Healthy Diet*. [online] Researchgate. Available at: <https://www.researchgate.net/publication/41137593_Web_Application_Used_in_Education_for_a_Healthy_Diet> [Accessed 21 November 2020].

[13] Han, M., Cho, B., Kwon, H., Son, K., Lee, H., Lee, J. and Park, J., 2019. A Mobile-Based Comprehensive Weight Reduction Program for the Workplace (Health-On): Development and Pilot Study. *JMIR mHealth and uHealth*, 7(11), p.e11158.

[14] IEEE 2012 International Conference On Advanced Computer Science Applications And Technologies (ACSAT) - Kuala Lumpur, Malaysia (2012.11.26-2012.11.28)] 2012 International Conference On Advanced Computer Science Applications And Technologies (ACSAT) - Mypda: A Mobile Healthcare Application For Personal Diet Assisting | Kurdi, Heba A.; Alkhowaiter, Arwa; Al-Muaibed, Arwa; Alotaibi, Bodor; Alhaweal, Roaa; Alotaibi, Taghreed | Download. [online] Booksc.org. Available at: <https://booksc.org/book/32539487/572a8d> [Accessed 22 November 2020].

[15] Naimark, J., Madar, Z. and Shahar, D., 2020. The Impact Of A Web-Based App (Ebalance) In Promoting Healthy Lifestyles: Randomized Controlled Trial.[online] Semanticscholar.org. Availableat:<https://www.semanticscholar.org/paper/The-Impact-of-a-Web-Based-App-(eBalance)-in-Healthy-Naimark-Madar/edaf45212c6ae047ab51bf371800bf47ad5da8e5> [Accessed 15 November 2020].

[16] Semanticscholar.org. 2020. Calnag: Effortless Multiuser Calorie Tracking | Semantic Scholar. [online] Available at: https://www.semanticscholar.org /search?q=CalNag %3A%20 Effortless%20Multiuser%20Calorie%20Tracking&sort=relevance> [Accessed 22 November 2020].

[17] Didziokaite ,G., Saukko , P. and Greiffenhagen ,C.,. "Doing Calories: the practices of dieting using calorie counting app MyFitnessPal." *Metric Culture: Ontologies of Self Tracking Practices. Bingley: Emerald*, vol. Chapter 8, 2018, pp. 137-156. Accessed 05 Nov 2020.

[18] Zbigniew, F., Gabriel-Miro, M. and Kevin, C., n.d. *Electronic Monitoring Of Nutritional Components For A Healthy Diet*. [online] Available at: <https://www.researchgate.net/publication/228753601_Electronic_Monitoring_of_Nutritional_Components_for_a_Healthy_Diet> [Accessed 21 November 2020].