Journal of Agriculture and Technology Management (JATM)
24(3): 13-17 (Special ICAMERON Edition)

Original article

Weight diary: An android application monitoring daily routine for body weight prediction through lifestyle mining

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ABSTRACT

Monitoring daily dietary intake and weight is relevant to having normal nutritional status. Being underweight, overweight, or obese primarily results from the imbalance of dietary intake and physical activity. Proper monitoring of daily lifestyle by maintaining healthy weight through balanced dietary intake and physical activity can aid in improving the nutritional status of an individual. With this, an application was developed which could monitor the daily dietary intake and (daily/weekly) weight of an individual, and could provide recommendations in achieving the recommended body weight. The project lifestyle mining was accomplished by using the Agile Methodology. The developed application evaluated using the ISO 25000 quality standards, and results showed that it could be utilized in monitoring the dietary intake and body weight, and further improves the user's nutritional status. It is suggested that the application must be used for a longer period to further determine its affectivity in improving an individual's nutritional status. More information about the user which can contribute to nutritional status can also be considered to be included in the system.

KEYWORDS: *weight diary, body mass index, calorie intake, lifestyle mining, machine learning, weight prediction*

1 INTRODUCTION

Achieving and maintaining recommended body weight is vital to remain healthy and prevent occurrence of disease conditions which can affect an individual's daily living. Being underweight could increase the risk of having anemia and other pathological illnesses which weakens an individual's immune system (J. M. Moon et al., 2020). Being overweight or obese, on the other hand, can increase the risk of non-communicable diseases or NCDs like cardiovascular diseases and diabetes. Excessive caloric intake and not burning them could result in their retention as fat tissues which make them enlarge and travel inside the human body which can result in these disease conditions (Centers for Disease Control and Prevention, 2017).

The Philippines' Expanded National Nutrition Survey results revealed that the trend of overweight and obese Filipino adults, 20 years and older, continue to increase from 16.6% in 2013 to 37.2% in 2018, while chronic energy deficient adults decrease from 13.9 in 2013 to 8.0% in 2018 (Patalen., 2019).

Also, non-communicable diseases or NCDs are the leading cause of disease burden in the Philippines. These conditions are of long duration and slow progression (Asor et al., 2020). Some factors which contribute to the occurrence of these diseases are physical inactivity, high cholesterol, and poor nutrition (Tavakol et al., 2011; Bansal et al., 2011), but several studies show that it can be managed through proper diet and physical activity (Astin et al., 2014; Mishra et al., 2015; Arena et al., 2015). Proper diet can be done through tracking of daily intake, monitoring of BMI and following suggested recommendations from diet plan from registered nutritionist.

Body mass index or BMI is a measure for human body shape based on an individual's weight and height which is defined as the individual's body mass divided by the square of their height. The formula universally used in medicine produces a unit of measure of kg/m^2. Further, it can be used in computing the nutritional status of an individual. The BMI ranges are based on the effect excessive body fat has on disease and death and are reasonably well related to adiposity. BMI was developed as a risk indicator of disease; as BMI increases, so does the risk for some diseases, like NCDs (World Health Organization, 2021).

Goal setting can be an important source of human motivation and it has shown potential in promoting diet and physical activity behavior change. The use of goal setting as a behavior change strategy has been systematically evaluated among individuals (Shilts et al., 2012; Pearson, 2012; Samdal et al., 2017). Behavior changes interventions use different strategies and techniques to support an individual in the change process (Michie et al., 2013). With the advent of technology, mobile applications can be used as a tool in setting goals

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in achieving or maintaining normal nutritional status. There are applications or systems developed which track energy or calorie intake and body weight of individuals. An android mobile application to determine nutritional status of children 0-60 months old was developed (Suryanto et al., 2017). A review of developed systems on health promotion was done and was proven beneficial in controlling and prevention of NCDs (Joseph-Shehu et al., 2019). Applications were also developed, on the other hand, which focused on food recognition in monitoring diet and nutritional intake of individuals (Rewane et al, 2019; Freitas et al., 2020). These systems showed evidence that are beneficial in weight and caloric monitoring.

With this, the study aimed to develop an application which could monitor the daily caloric intake and weight of an individual and, in addition, can provide recommended calorie intake and physical activity based on input data of the user in achieving or maintaining normal nutritional status. Further, the application was tested and evaluated based on ISO 25010 standards.

2 METHODOLOGY

System Development

The development of the system was done in six (6) stages as adapted from the agile development diagram, namely: requirements, plan, design, develop, release, and track and monitor.

Information on dietary or calorie intake and BMI calculation were gathered. This information was used for the system design and development. Strategies were created and brainstorming was performed on obtaining data efficiently and effectively. System development was seen as one of the solutions that could help people who are suffering body weight problems by providing results and better recommendations on how they can enhance their body weight.

Diagrams were made. A design was created and used as a guide in the development stage by making system architecture, such as use case diagrams, context diagrams, operational procedures or flowchart.

System development was done. The testing process was part of this phase initial solutions to problems that occurred and iterated the modules that contained errors. Javascript and Redux Persist databases were used as a programming language in the system development. The developer used Expo for the platform of the system and visual studio for the source code.

Testing of the system was conducted at the Laguna State Polytechnic University Los Baños, Campus, and feedback from respondents was used in the application.

Modules of the system architecture are shown in Figure 1. The Profile Module can track the user's progress of daily food calorie intake and weekly BMI progress. While the Food Calorie Tracker allows the user to input their daily food intake and calculate calories consumed per day and serve as a basis for recommendation because it uses machine learning technique. It also shows the food item list that the user inputted to the system and will be saved to the database. The BMI Tracker allows the user to input personal data like height, weight, age and physical activity level to calculate their BMI range and provide recommendations to improve their body weight. It allows users to save their BMI result to the database. The Food Calorie Intake, on the other hand, shows where the results of food calorie intake are stored. It allows the user to delete previous food calorie data to minimize his/her system storage which can also be used in providing recommendations according to food calorie intake. While, Exercise Module shows the offline recommended fitness workout for the user to help them to improve their body weight. Adequate Module shows the calculated percentage of the weekly calorie intake of the user to predict if the user is going to lose or gain weight. Weight Diary Module shows the saved BMI data results and recommendation and also allows users to delete data results to reduce system storage.

Figure 1. System Architecture

System Evaluation

The developed system was evaluated using ISO 25000 quality model to determine the following factors: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. A survey using likert scalar was done among 22 respondents from the Laguna

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State Polytechnic University Los Baños, Campus. Likert scalar is answerable by four responses which are 4 as Strongly Agree, 3 as Agree, 2 as Disagree, and Strongly Disagree. The mean average of responses is noted for each sub-criterion, and an overall mean for the software quality was also determined.

3 RESULTS AND DISCUSSIONS

A mobile application was developed which shows the dietary of calorie intake and BMI. Figure 2A shows the statistical progress of food calorie intake of the user. It shows daily calorie intake and recommended calories. The green line shows the recommended calorie intake. Figure 2B shows the calculated BMI result and nutritional status. It also shows the prediction on whether the user should maintain, lose or gain weight and provides recommended calorie intake and physical activity to attain his/her goal.

A.

B.

Figure 2. Interface of Weight Diary: (A) Food Calorie Tracker, (B) Recommendation module

Figure 3 shows the result of the time forecasting done using the formulated prediction model.

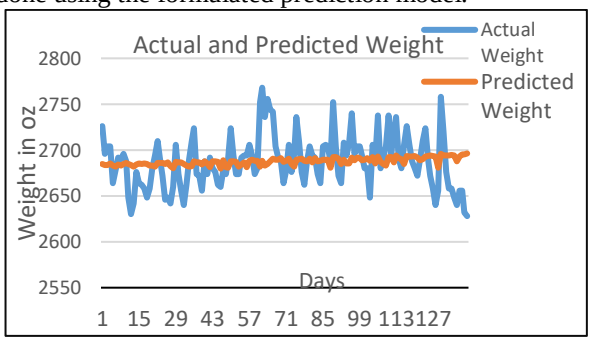

Figure 3. Actual and Predicted Weight

As shown in Table 1, the different modules were tested based on expected output. Different modules included for testing were: registration, profiling of body weight progress, tracking of food calorie and BMI, body weight prediction, recommendation for body weight, viewing of video exercise and previous data, and BMI tracking notification.

Table 1. System Development Test Case

System Module	Actual Output	Remarks
Register	Success	10/10 experiments
Profile body weight progress	Success	10/10 experiments
Track food calorie	Success	10/10 experiments
Track BMI	Success	10/10 experiments
Body Weight Prediction	Success	10/10 experiments
Recommendation for body weight	Success	10/10 experiments
View video exercise	Success	10/10 experiments
View previous data	Success	10/10 experiments
BMI track notification	Success	10/10 experiments

Table 2 shows the results of the user's evaluation for the ISO 25000 standards with an overall weighted mean of 3.52 with an interpretation of "agree" based on the Likert scalar. The sub-criteria for functional suitability, performance efficiency, compatibility, reliability, security, and maintainability got an interpretation of agree, while usability and portability got an interpretation of strongly agree.

Table 2. Evaluation Results

Table 2. Evaluation Results

Factor	Ratings	Interpretation
Functional Suitability	3.42	Agree
Performance Efficiency	3.40	Agree
Compatibility	3.30	Agree
Usability	3.60	Strongly Agree
Reliability	3.50	Agree
Security	3.50	Agree
Maintainability	3.50	Agree
Portability	4.00	Strongly Agree
Overall weighted mean	3.52	Agree

4 CONCLUSIONS

The system can be used as a tool in monitoring

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dietary intake and body weight. The recommended calorie intake and BMI was provided to achieve or maintain normal nutritional status which are specifically designed for the user only. The recommendation was based on all input data of the user. The system can also provide recommendations on physical activity. This application can further improve nutritional status and it can lead them in having a healthy lifestyle.

Based on the result of the software and acceptance testing based on ISO 25000 software standardization, the system passed all the criteria.

With the limited number of datasets, the prediction accuracy using time series is insufficient to serve as basis for the recommendation in the developed system. With this, the factor that contributes mostly to the recommendation is the recommended BMI value.

More data can be inputted in the system to provide more accurate recommendations based on the machine learning technique. It is suggested that the application must be used for a longer period to further determine its affectivity in improving an individual's nutritional status. Further studies in comparing this system tracker and monitoring tool with manual monitoring and actual recommendations of a registered nutritionist-dietitian can aid in improving the system. A system like this can assist nutritionist-dietitians in counseling individuals.

ACKNOWLEDGEMENT

The authors wish to acknowledge the support provided by Laguna State Polytechnic University, Los Baños for the realization of this study.

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