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Mobile Application Development of Nutrition Assessment for Elderly

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Abstract: World is facing population aging problem. Many countries have prepared themselves to handle this problem with the aim that their own citizen received well-being situation. To support a tool to care for elderly, this paper proposed a mobile application of nutrition assessment for elderly. The application has been developed in PHP language and it is online support. The proposed app can be freely available, namely day calorie, from the well-known android app space. Experiments have been done on three different models of mobile phone. The process begins with downloading the proposed mobile application from Google Play domain and then completely installing it into those mobile phones. Before getting started to open the installed app, users must make sure the internet connection are working well. Because the proposed app is working as a user interfacing unit accepting input arguments from user and then sending these data through mobile phone media to processing on a certain server and then return an output back to displaying on the mobile phone. Experimental results on performance test are reported that the average executed time from 20 trials for male elderly case on mobile phones A, B and C are 1.744, 1.686 and 1.639 milliseconds, respectively. For female elderly case on those three models are 2.291, 2.321 and 1.946 milliseconds, respectively. All trials were successful tasks, energy error not exceed 30kcal, each gram error of carbohydrate, protein and oil are no more than 3 grams.

Keywords: Nutrition assessment, aging society, mobile application, food exchange list method

1. INTRODUCTION

The percentage of the elderly is also increasing dramatically. Between 2015 and 2050, the proportion of the world's population over 60 years will nearly double from 12% to 22%, expected to total 2 billion in 2050. The most of this increase in developing countries [1]. In Thailand, the elderly population is increasing continuously, from 13.2 percent in 2010 to 32.1 percent in 2040 [2]-[3]. The factors underlying this transition are increased longevity, declining fertility, and advances in health care [4]. However, 80 percent of older adults have at least one chronic disease (CD_S), and 68 percent have at least two [5]. It is well known that the CD_S could be the result of common lifestyle habits such as dietary practices or physical activity. An important reduce the malnutrition is to improve the dietary habits of the whole population, on the long term, which would help to decrease the frequency of cardio-vascular disease and the morbidity of many chronic diseases such as diabetes. [6]. Thus, a healthy diet that includes adequate amounts of macronutrients including proteins, fats, carbohydrates and micronutrients has long been considered essential in treatment and prevention disease. [7]. It is important to develop adequate and helpful means to assist the elderly to control the dietary intakes of nutrients by themselves. Food exchange lists is to be used widely for control the intake of macronutrients and for development of meal planning for healthy individuals or for those with chronic disorders. [8] These preliminary tools can be useful to control macronutrients and energy intakes. [9]-[10] In order to solve these problem, the new technologies are used for dietary planning problem by computer-based methods [11]-[13]. To share an alternative solution for solving the nutritional problem, this paper proposed a mobile application based on android operating system for meal planning of elderly. It could be used to ensure an adequate intake of macronutrients and other nutrients in diet planning of individuals' elderly. In this paper, we propose a computer-based method for planning optimal menus with respect to food exchange lists-based dietary recommendations and food guide pyramid for individuals' elderly. This method assists a human in fitting regular menus to new health paradigms. The paper consists of four parts, introduction, methodology, experiment and conclusion.

METHODOLOGY

The proposed mobile application program was designed as a user interfacing unit with main job description receiving input and displaying output. It cooperates with a server through internet media that means the installed app on a mobile phone must connects

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internet during use this app. The app can be freely downloaded from *Google Play domain* by the name "Day Carlorie". The overall system including the proposed mobile application can be depicted in Fig. 1 where the steps to proceed with all the incoming data are described in the right hand side.

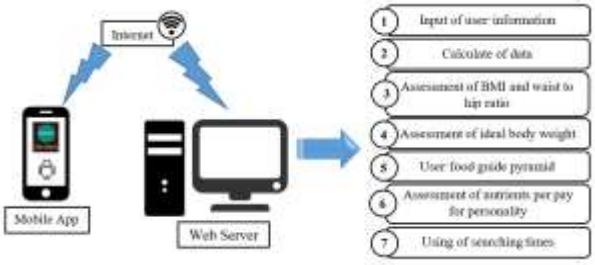
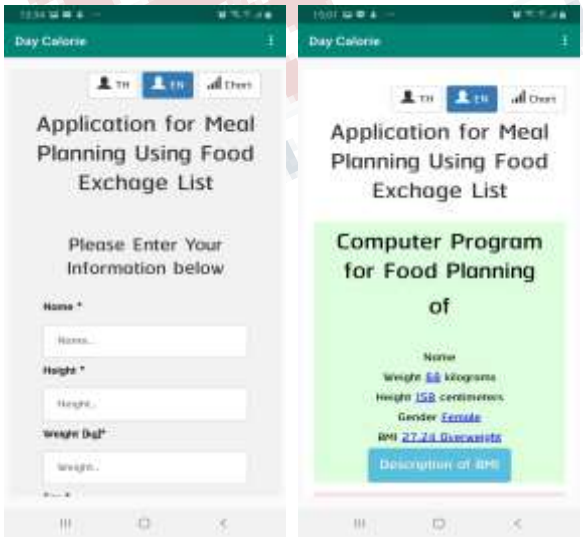


Fig. 1. The system architecture of the proposed "Day Calorie" mobile app.

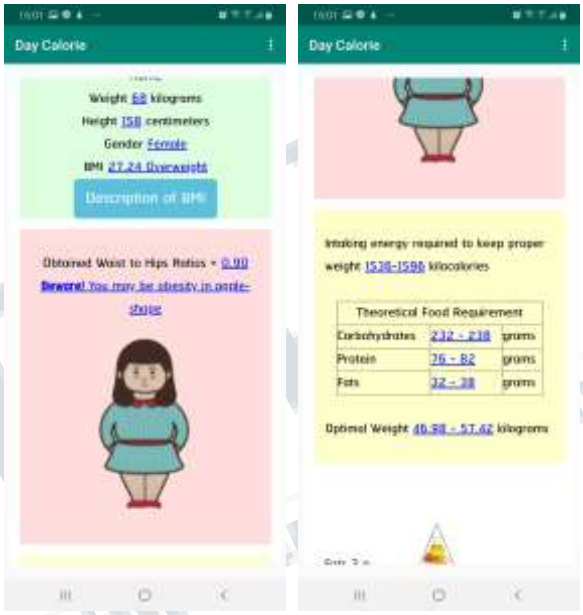
The application is composed of user's information, result of BMI, Result of waist to hip ration, required energy and recommended meal nutrient using food exchange list for individual user. ① is a step to receive the basic user's information including name, height (centimeter), weight (kilogram), sex, daily activity, waist (centimeter) and hip (centimeter). ② is a step to calculate these date according to the Body Mass Index (BMI, measured as kg/m^2). ③ is the result of waist to hip ratios calculate for each user. Both steps ② and ③ can be viewed in Fig.2 from left to right respectively.



(a) (b)

Fig. 3. Scree captions of (a) home page of the "Day Calorie" app and (b) BMI resulting page

④ is the result required energy (RE), macronutrient distribution ranges (AMDRs) which recommended for adjust the weight back to ideal body weight as shown in Fig.3.



(a) (b)

Fig. 3. Scree captions of (a) waist to hip ratio and (b) required energy.

⑤ is the recommended of individual user's food guide pyramid per day shown in Fig. 4 (a) which based on food exchange list equations [14]-[15], these were adjusted to encourage a percent distribution of 55% carbohydrate, 25% fat and 20% protein for elderly [16]-[18]. ⑥ is the daily recommended nutrients in order to change the current weight to be the ideal body weight or standard body weight. The obtained nutrients from computation is shown in Fig. 4(b). ⑦ is the number of iteration for runs and searching times of these application for solving problem.

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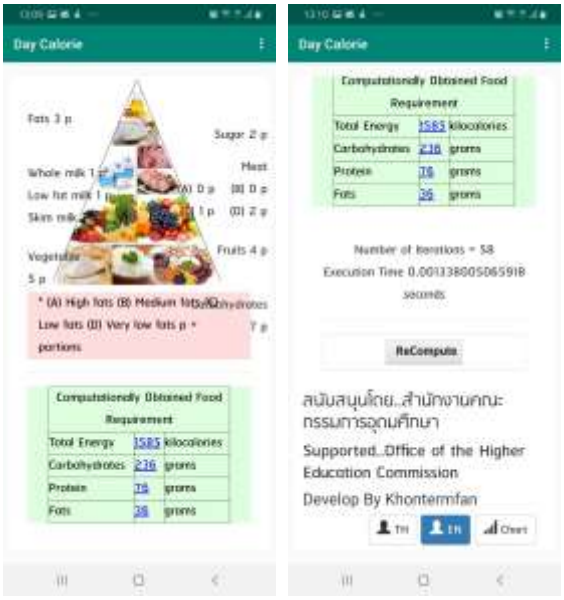


(a) (b)

Fig. 4 Screen captions of (a) user's food guide pyramid and (b) daily recommended nutrients and executed details.

EXPERIMENT AND RESULTS

To verify the proposed mobile app's performance, experiments with real world mobile phones have been set up. Male and female elderly are selected to be benchmark. There are three mobile phone models used in this study. These models called A, B and C are shown in Fig.1 from left to right respectively. The number of trial for each case is 20 and all initial solutions are obtained by random process.

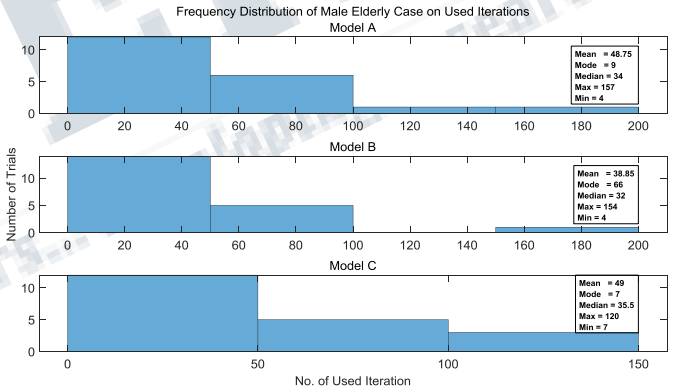
TABLE I: INFORMATION OF TWO BENCHMARKS

Items	Male	Female
Age (Year)	61	73
Weight (kg)	55	58
Height (cm)	168	155
Hip (cm)	88	99
Waist (cm)	78	93
Daily Activity	Heavy	Medium

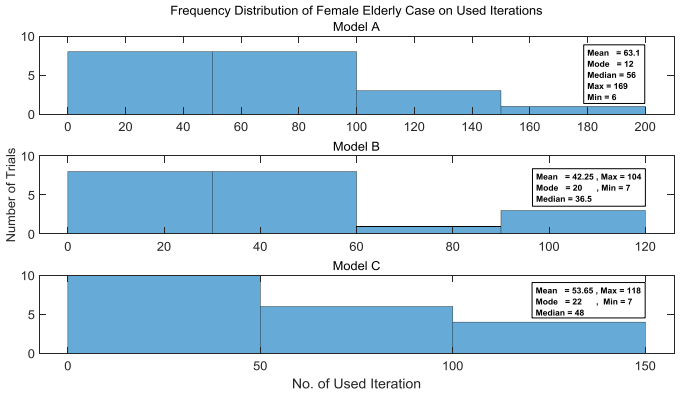
Table I illustrates basic information such as age, height and weight of the two elderly cases, male and female. These data were used in computational step. Elderly is definitely known as someone who has age over 60 years old. Three models of mobile phone selected to be tested with the proposed mobile app shows their technical specification in Table II where CPU, RAM, ROM and OS stands for central processing unit, random access memory, read only memory and operating system, respectively. Model A and C have same specification of memory, display and battery but the CPU of model A is the most up-to-date and of the model C is the oldest among the three platforms.

TABLE II: TECHNICAL SPECIFICATION OF MOBILE PHONES

Item	Model A	Model B	Model C
CPU	Exynose 9810	Exynose 7580	Exynose 9610
RAM (GB)	6	1.5	6
ROM (GB)	128	16	128
OS	Android 8.1 (Oreo)	Android 5.1 (Lollipop)	Android 9.0 (Pie)
Display (inch)	6.4	5.5	6.4
Battery (mAh)	4000	3000	4000



(a)



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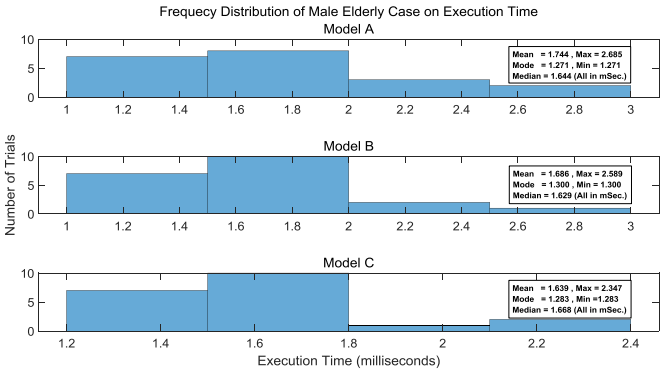
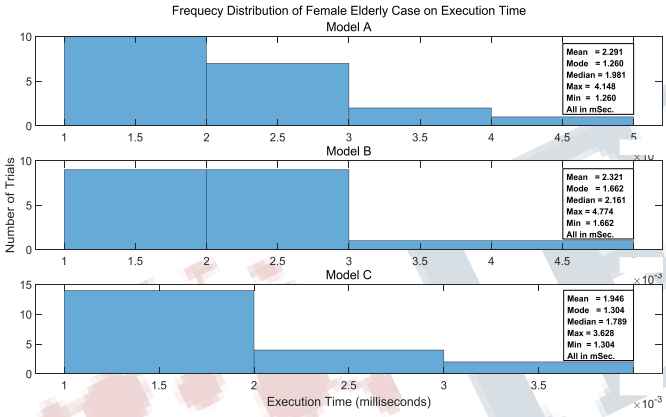
(b)



(c)



(d)

Fig. 5. Frequency distribution of the experimental results, (a) iteration of male case, (b) iteration of female case, (c) execution of male case and (d) iteration of female case

All experiments have been conducted and have returned completely searching results that mean all obtained solution meets the specific requirements including energy error (±30 kcal), carbohydrate error (± 3 grams), protein error (± 3 grams) and oil error (± 3 grams). This paper is interested in performance of the proposed mobile app when it is running on different devices, so that the iteration and execution time have been statistically analyzed and studied.

Fig. 5 shows the frequency distribution of 20 trials for each case. In (a) and (b) display the distribution of number of iteration of male and female, respectively. Roughly consider on the both figures, these frequency distributions are skewed to the left, this phenomenon usually provides greater mean or the mathematic average value than of the mode and median values as well. Figs. 5 (c) and (d) are the frequency distribution of the execution time. Male case shown in (c) has its distribution shape nearly normal distribution but figures in (d) of female case looks like left-skewed distribution.

CONCLUSION

The article presents a proposed mobile application about nutrition planning especially for elderly. The app is already published in a well-known public domain of android os where interested user can explore it easily and freely. The performance verification of the app has been elaborated successfully and satisfied. Further work is planned to integrate a module showing real world food menus for user to choose by himself in each meal.

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