An Implementation of Interactive Healthy Eating Index and Healthcare System on Mobile Platform in College Student Samples

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ABSTRACT This research focuses on designing and structuring a smart healthcare system for college students in Taiwan. It is expected to utilize the method of technology for assisting college students in controlling their dietaries and physical activities by establishing an interactive healthy diet evaluation and healthcare system. Due to the rapid development of smart phone applications, the users can easily record the dietary contents, nutrients, and exercise process anyplace and anywhere. This system contains diet module and exercise module. It can automatically supply the proposal with accordance to the users' basic information of age, gender, favorite food, and exercise. Students can observe the taken nutrients or calories and then regulate their dietary and exercising habits. This can protect them from chronic diseases that might happen in future as well.

INDEX TERMS Daily eating habits, smart healthcare system, technology assist, interactive healthy diet, smart phone APP.

I. INTRODUCTION

The college life is the beginning for the students learning how to live independently. Most students live in their homes before college and their dietary habits connect with their family closely. It means that the students can build a balanced dietary habit at home. However, after these students leave home without any experiences in living alone, they are probably going to have a wrong dietary habit. This will result in the crisis of having too much calories or obesity. In the long run, the wrong dietary habit will raise the rate of chronic diseases. It is a heavy burden both on the health insurance and the people. Dietary education is a strategy to prevent from the wrong eating habit. Due to the insufficiency of the dietitians, the nutrition education still cannot be promoted extensively. For this reason, an innovative system is proposed. With the system, people can record the dietary nutrients and then the system proposes the feedback in the chart. This allows the users knowing the condition of their nutrient intake and also reminds them to change the eating habit.

Obesity is one of modern illnesses. Due to the change of lifestyles in modern societies, stress of life, being easy to obtain food and lack of the knowledge of nutrients may cause body function degeneration and endocrine imbalance [23].

The followings are some reasons for obesity.

A. UNDER HEAVY STRESS
Being stressful for a long period of time will result in a negative impact on a person's body and mind and even chronic illnesses, such as being fat. The fat stocked in a person's stomach is the main reason for leading to hypertension, hyperglycemia and hyperlipidemia [24], [25].

B. LACK OF EXERCISE
World Health Organization (Global recommendations on physical activity for health) [1] suggests people exercising 15 minutes a day to live longer and adults doing medium intensity exercise 150 minutes per week. Lack of exercise will weaken the functions of insulin and compose fat.

C. DIET CHANGE
Heredity can be one of the elements being obese; however, the change of lifestyles and being fast food junkies are the

key factors. According to the 2017 Taiwan Health Agency statistics, approximately 85% of male workers ate outside five days a week and chronic illnesses were closely related to diet. Chronic illnesses are caused by bad lifestyles accumulating month after month. The best way against chronic illnesses is to avoid it. Unhealthy diet and lack of exercise are the primary factors in obesity, being fat is also the important cause of chronic illnesses, and eight causes of death are relevant. For now, 51% males in Taiwan are over weighted, and 36% females are over weighted. To maintain ideal weights, people should intake every type of food and cut down salt, oil and sugar to prevent from chronic illnesses.

D. LACK OF NUTRIENT KNOWLEDGE

Research on eating outside in 2017 indicated that only 5% interviewees could answer the knowledge about six types of food, protein and calories completely, and up to 40% interviewees ate more than five kinds of meat, with amount higher than the recommendation of Health Promotion Administration, Ministry of Health and Welfare. The result showed that people still lacked the knowledge of nutrients, and, according to the research, only 70% interviewees would read the ingredients before purchasing the product and more than 80% interviewees regarded the ingredient tag being able to help them eat healthier [2].

In conclusion, people eating too much meat and lacking the knowledge of nutrition may be the dangerous causes of chronic illnesses. People have forgotten the importance of health in a delicate life. In the past, diseases were the main causes of death, which now turn to chronic diseases. Figure 1 shows top 3 death causes of cancer, heart attack and cerebrovascular disease, which, as a big issue, cannot be ignored anymore [3].
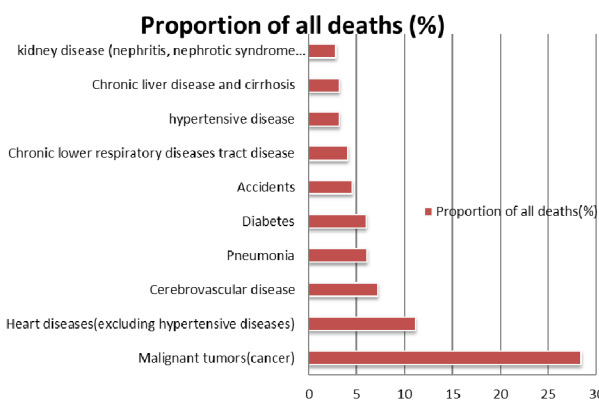

FIGURE 1. Ten leading causes of death in Taiwan [4].

Keeping balanced nutrition and exercise can prevent people from getting fat and chronic diseases. Glanz [5] said that nutrition, diet and health were the interaction of being healthy. American College of Sports Medicine (ACSM) [6] indicated that being fat and having chronic diseases became the international health problems and also emphasized the

advantage of doing exercise regularly. Combining diet control with exercise can not only reduce medical costs but also promote the quality of life.

A good habit of balanced diet can increase the metabolism and also prevent from illnesses. For the immature diet thought, good habits can be controlled by tracking the diet records. Through the exercise records, users can review themselves and avert illnesses, and the proper exercise can release the stress and keep a person in good body shape. Users can understand the nutrition and prevent from illnesses by this system.

In the past, using the App for sport and diet usually need to sign up as a member in complicated data. The above problems cause users unwilling to use the App. For the rapid development of technology when everyone holds a smart device, shown in Figure 2, there are still not any Apps combining diet and exercise in current market. When such App is able to be developed, users can order their own meals by personal diet records through the Internet and review their exercise habits in personal exercise records.
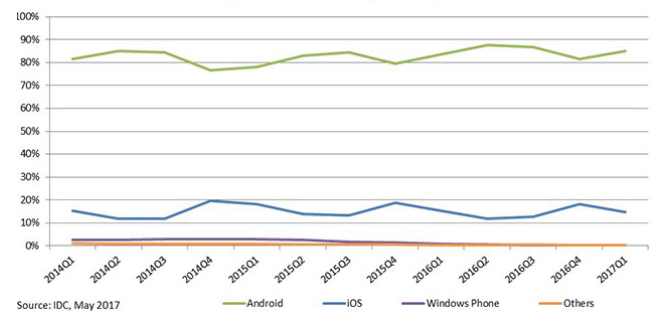
FIGURE 2. Worldwide smartphone OS market share [7].

The research purpose requires users inputting their personal data on the smart phones, and then the system will suggest diet recommendations based on personal data. After selecting the meal from the diet module, the system will record it and suggest the calories consumed by the exercise module. The system can integrate the long-term diet with exercise records to help college students complete personal nutrition evaluation and exercise management. For many students, it is their first time living away from home. However, they probably lack comprehensive knowledge of nutrition and then choose the food that contains high fat, high calories, and high sugar. As the time passes, students will keep a terrible dietary habit which will cause obesity and chronic diseases in the future. In this case, the best method is to record all nutrients taken in a day and the calories burned when they exercise. Students can know the situation of dietary and exercise. By this, they can control things they eat or choose substituted food. This research conducts the experiment based on 80 students in Tunghai University, aiming to know whether the system can assist student in changing the wrong life habit by recording dietary.

II. LITERATURE REVIEWS

Recently, the eat-out proportion has been growing every year. How to let the excessively busy modern people have a balanced diet and eat out safely and healthily is the topic being pondered deeply. Observing international studies on diet noted down and the relevant materials of users would note down and deposit in the server for medical personnel reference only; however, it couldn't offer an individual for keeping personal dietary records yet. Matsumoto *et al.* [8] and Antoniou *et al.* [9] referred to the mechanism of intelligent ration in personal diet project which commonly depended on the user's complicated operation and input of detailed personal information including height, weight, age, interest, and hobby to conduct the calculation and analyses. It tended to cause the users inconvenience and affect their willingness to use it. For this reason, the customer-oriented way, combining with the mechanism capable of taking down the habit of exercise, can be used for designing a convenient and easy-using interactive system of health diet estimation and health protection for all users. This paper will discuss the problem in modern diet custom (eating habits) in order to find out the importance of exercise in preventive medicine and explore the combination of mobile devices in the field of healthcare system-related applications.

A. PROBLEM IN MODERN DIET CUSTOM

The type of compatriot occupation has changed from agricultural industry to service and hi-tech industries in Taiwan, revealing that jobs have changed from consuming a large number of calories into merely maintaining basic physical strength. Because the change in the lifestyles of modern people gradually leads to more calorie absorbed than consumed, the diet choice agrees more with the starch food of high calories, while having the meals cooked outside with large amount of oil, excessive starch, high sugar, and high salt causes the majority's eating habits tending to heavy taste gradually and additional burdens on the body. In the environment of diet such as the introduction of American fast food restaurants, taking McDonald as an example, where the meal adds highly fried food with sugar beverage mostly, it is likely to cause fat compositions to let consumers absorb excessive oil and saccharides, etc. Actually, attitudes towards employment type and the change of cooking culture are closely bound up. For instance, rotation system, responsibility system, and indefinite overtime work may cause modern people not eating on time and sleeping deficiently because of overwhelming stress. It tends to cause the unhealthy situations of eating and drinking immoderately and absorbing too much calories that cause the fat.

Ministry of Health and Welfare referred to ten major causes of death among countrymen in 2017 that 80% of death was related to improper eating habits. For example, patients with diabetes needed to strictly control blood sugar to suppress sickness; kidney patients needed to strictly control salt (sodium) in food; and, cardiovascular patients needed to control fat in food.

Based on above-mentioned points, proper diet control is closely linked to health. Compatriots' nutrition health status demonstrates the growth of fat and increasing chronic diseases in recent years. It is not only a method to control chronic diseases and simply implement correct diet knowledge, but to prevent users from chronic diseases. Healthy diet has great impact on humans. Research pointed out that improper diet for a long time could easily cause obesity and produce fatal chronic diseases. The habit of healthy diet should be cultivated from childhood. In 2003, WHO (Would Health Organization) demonstrated five states of personal diet, including the nutrition absorbed when fetus developed in womb affected the fetus health, deficiency in nutrients and infancy tending to cause innate cardiovascular disease, body and adolescent taking in adequate protein and healthy fat to support developing energy, and adulthood and the elderly containing individual diet to reduce the risk of cardiovascular and chronic diseases. These are the correct and healthy diet recommended by WHO and the basic way to prevent from chronic diseases [10]. As the result, in the research of Hsiao, appropriate diet selection was quite important for resisting various chronic diseases. Using correct diet to prevent from chronic diseases and control sickness is also the design principles of this paper [11].

B. APPLICATION OF MOBILE DEVICES COMBINED WITH MEDICAL CARE FIELD

It was mostly cumbersome and inconvenient to carry medical instrument in the past, which even needed to be used in particular locations. Thanks to the development of technology, the functions of large machines can be replaced by mobile or wearing devices to reach the goal of convenient portability and to use it without restrictions to space. Hsu indicated that exercising was a quite common prescription in medical treatment. Using intelligent mobile phones to match the acceleration detecting device in this research allows the detection of the information which examines a plurality of positions of human bodies, passes the information collected to the intelligent mobile phone for analyzing and distinguishing movements through bluetooth technology, and records the time that movements pass to really grasp the patient's exercise situation [12]. In the research of Jones, regular exercise could remarkably improve the conditions of patients with chronic diseases [13].

Studies on CAST/Center for Aging Services Technology referred that the elderly was mostly lack of activities due to physical degeneration and the reduction of food variety, making the problems in unbalanced daily diet quality [14]. They also used RFID technology for recording the daily diet habits and building up the long-term and continuous diet records as the survey for doctors and loaded a RFID CF Card Reader on PDA to return data (Tag ID) back to the server by Wi-Fi. By this mechanism, the long-term diet situation and the change of diet habits could be known, and the disease could also be found out earlier.

In addition, some studies used the action apparatus and information systems for people keeping fit. For example, the research of My Meal Mate [15] from Britain referred that diet record and diet suggestion, the UbiFit Garden [16] for mobile devices uses bluetooth equipment to record daily activities, and using RFID to record Chinese food [17]. These different methods show the urgency of diet records. However, it's still not possible to give detailed feedback to students with complete nutritional information and as a purpose of their diet education.

In website's information system, the research of Dhillon's work for the old man being offered to note down the health conditions let the health status of the old man be taken care of [18]. In the research of Fujimura, noting down the user's state of exercise. Additionally, the friends could see mutual records and encourage each other [19].

III. RESEARCH METHOD

A. SYSTEM ARCHITECTURE

The design of the interactive health diet and healthcare system can be separated by three parts of smart phone App, website, and server. Using App for recording and analyzing all diet and exercise processes also provides some suggestions and then sends the data back to the server, so that the App and the server can share the data through the Internet. After the user installs the App and keys in personal data, the system will analyze the user's health conditions. When all of these steps are finished, the App will give some recommendation about eating and exercise. Besides, the records are able to be reviewed at any time. The server collects and manages the data in PC so that managers and medical workers can apply the data to medical services through this system.

In the front-end, the smart phone App is developed based on the Android mobile operation system to record user's basic diet and exercise data, analyze the diet and exercise records, convert them into health suggestions, and then send the results back to the server. The back-end is constructed by Apache server to receive and manage data; if needed, managers and medical personnel can have those records for medical purposes. In this case, it is more convenient for medical workers finding out users' unbalanced diet or lack of exercise and then noticing the users to make improvement immediately.

B. DESIGN of SYSTEM FLOW

As in Figure 3, it is necessary for users to type in personal data when using the App for the first time, in order to provide personal data for the front-end and the back-end. After the preparation work, the system will come up with the first health evaluation information and analyze whether the users are healthy or not. Based on the evaluation, the system will give appropriate diet plans and exercise distances for being sent to the diet and exercise modules in the front-end App. Both modules are evaluated in a cycle of one day; the diet module calculates the total calories that have been taken and the exercise module records the total distance of exercise
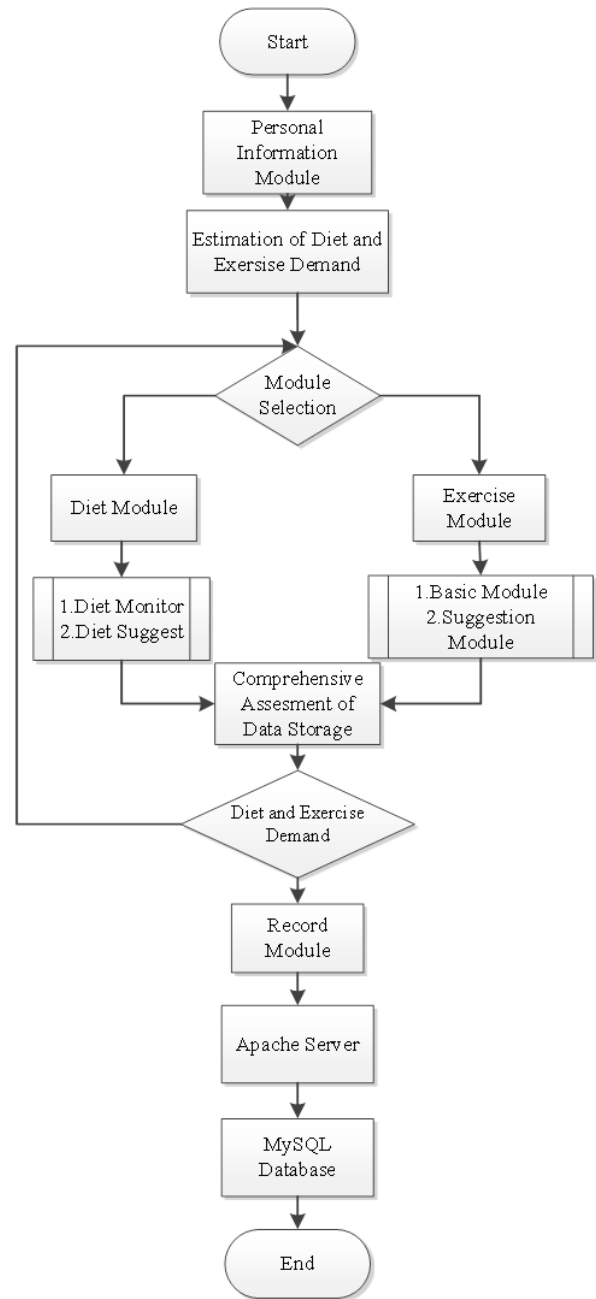
FIGURE 3. Healthcare system App.

which will be converted into calories burned. Through the evaluation of these two modules, the system will determine whether the diet and exercise are balanced or not. If it is balanced, the data will be stored in the server database; or, if it is not, the system will give some advices and analyze them again. However, if diet and exercise are still not balanced, the data will be recorded and sent back to the server.

The managers and medical workers have the access authority to the historical records through the Internet browser. When the diet and exercise conditions are not in normal value for a long time, the user would be contacted and offered some guideline.

C. SYSTEM FUNCTION

There are two parts of the interactive health diet assessment and healthcare system; the front-end is the mobile Android App, while the back-end is an Apache server to implement PHP and MySQL. Personal Data (PD), Diet Module (DM), Exercise Module (EM), Multi Data Evaluation Module (MDEM), Record Module (RM) and JsonParser are all included in the front-end App. The back-end is run by an Apache server to write the website functions, and MySQL is used as a database. The following are the 5 functions of the front-end.

1) PERSONAL DATA MODULE

To manage user-related data, such as height, weight and blood type, they are stored into the mobile phone's SQLite database and created the compatible MySQL list on the back-end system. The historical records can be used for comparing the difference from the past and further giving suggestions according to the diet module and the exercise module.

2) DIET MODULE

Diet Survey: This function will look into the mobile phone's SQLite database and calculate the balance in diet and exercise modules. If it is balanced, the system won't give users any suggestions, otherwise it will remind the users to be aware of the amount of calories that need to be consumed or supplied in a day, and then the data will be sent to the diet suggestion module and the exercise suggestion module.

Diet Suggestion: It receives the data after the calculation with Diet Survey and translates the weight into calories that a person should absorb a day. Finally, it gives suggestions of diet and different kinds of exercise and then sends back the records and food suggested lists to the mobile SQLite database.

3) EXERCISE MODULE
a: BASIC MODULE

Users can set up the exercise time and distance freely and insert the data and route in the mobile. The SQLite database can be shown on the Google Map for users inquiring their exercise experiences.

b: SUGGESTION MODULE

It accepts the data from Diet Survey and converts the over-supplied calories into exercise distance based on the user's weight and then writes the suggestion data, running data and route in the mobile phone's SQLite database.

4) MULTI DATA EVALUATION MODULE

It runs at the background and evaluates whether the diet module and the exercise module should be updated or should not dynamically send the renew data to the diet module and the exercise module immediately.

5) RECORD MODULE

Record Module shows the health conditions according to the diet module and the exercise module by graphs in order to reach self-survey. It uses JsonParser for transmitting the data to the back-end server. Currently, Android cannot directly send the SQLite data to MySQL database of Apache server. Thus, it needs JsonParser to transmit information to PHP of Apache server for transforming to MySQL database.

D. EXPERIMENT DESIGN

Most college students tend to eat food containing high calories and high fat. This situation will cause a heavy burden on the body and form a bad dietary habit.

Students can use this application to record their food and drink. It helps students know the nutrients which can prevent the body from too much burden. The application will provide the dietary feedback curve for students understanding their health conditions and avoiding the happening of diseases.

80 students from the engineering college are invited to conduct this experiment. For the first four weeks, the students have to keep the diet records on the paper; for the rest four weeks, they have to record on the application. Each student has to record at least three days in a week. The record should include two weekdays and one weekend. They need to record a complete content including breakfast, lunch, dinner, and other snacks. This experiment mainly utilizes different tools to test whether students can record a correct dietary habit or not. Moreover, it is possible to know whether electronic tools can help students improve the inconvenience of paper records.

IV. SYSTEM IMPLEMENTATION
A. SYSTEM DEVELOPING ENVIRONMENT

The system developing environment could be used as the developing tool as follows.

a: ENVIRONMENT

MacBook Pro 15'' Retina, CPU 2.3GHz, RAM 16GB, SSD 256GB.

B. SQLITE AND MYSQL SYNCHRONIZATION

Healthcare system App is designed for mobile equipment. In the database design, Android's mobile device with SQLite is used. Being more compatible with most of the SQL software in the market is their advantage. When the healthcare system App records user's records and data, it will send the data to the server in every 24 hours to offer managers and system maintainers for checking whether there are problems. The healthcare system App will send the records and data to the back-end for maintainers' inspection, synchronization and backup. The back-end healthcare system uses Apache server and MySQL database record and backup the user's data. Besides analyzing and sending back the data, it also allows users retrieving data when they reinstall the App again. Figure 4 shows the synchronization process of the healthcare system's SQLite and MySQL data list. The Json on the healthcare system App is used for sending data to Apache server through HTTP Protocol, and the php, written by JsonParser,
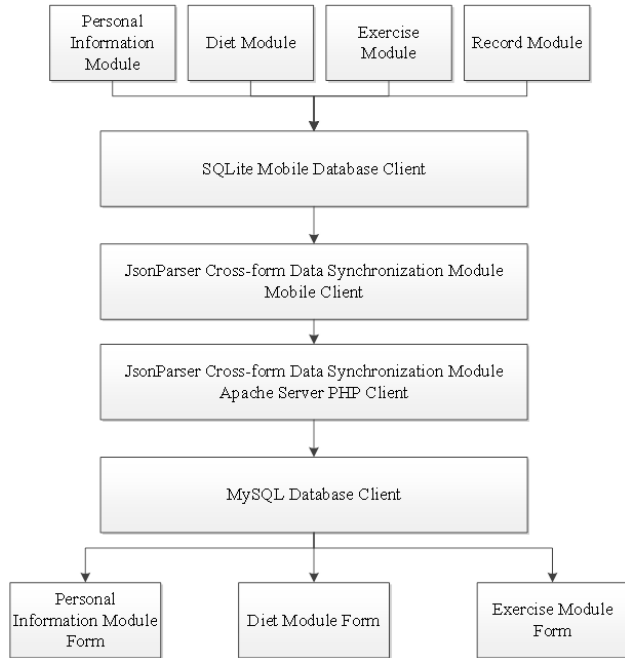
FIGURE 4. Data synchronization.

gets the data from SQLite and fills in the data at the right columns and rows. The user can simply type in the name and birthdate to retrieve the old data.

C. INTRDUCTOIN of HEALTHCARE SYSTEM FUCTION

The user interface of the healthcare system is mainly designed for smart phones. Because of the limitation of screen size, every unit just fits to a finger width. Both input and output will be shown on the screen, and some problems need to be overcome, such as font size, icon and layout. The following are the operation process, as in Table 1, Table 2, Table 3 and Table 4.

TABLE 1. Personal data.

No	Procedure	Description
1	Start App	Turn on Healthcare System App.
2	Type in personal information	Type in name, age to certify with the back-end server.
3	Back-end server certification	Search the relevant data or edit a new client in the server for synchronization.
4	First use this App, edit new client information	Offer the blanks to fill in name, gender, age, height and weight, and then choose the modes of gaining, loosing, or maintaining weight.
5	Make sure the data are correct and build a new file	Confirm personal data and follow procedure 3 to edit or synchronize.
6	Enter the home page of Healthcare system	Log in the first page to continue

1) PERSONAL DATA MODULE

As shown in Figure 5 and Table 1, when a user turns on the App for the first time, it will verify with the back-end server

TABLE 2. Diet module.

No	Procedure	Description
1	Click on diet	Click on the diet button in Healthcare System.
2	Enter the diet module	Enter the homepage of diet module, which appears the calories that have been taken and offers diet suggestion and diet record function.
3	Select diet suggestion	Click on single diet suggestion, choose diet suggestion or daily diet suggestion
4	Single diet suggestion	Choose the meal time and list the food for user's selection, which are organized by calories and shown by standard unit Kcal/100g.
5	Suggestion food list	Five different calories sections or common food can be chosen.
6	Food selection	Pick one food and go on, or just finish ordering. The system will record all the ordering food and list them as user's usual food for future selection.
7	Daily diet suggestion	Offer five different calories sections for selection.
8	Recommend food	List out breakfast, lunch and dinner.
9	Click on basic record	Click on selection list mode or manual input mode
10	Menu mode	The menu mode offers six categories of food, usual eating food, and searches function.
11	Six categories of food	The list offers total six categories of food, including grains, meats and beans, vegetables, milk and olein.
12	Select food	After the chosen food is taken, one can keep ordering, and the system will record and evaluate the result and add the data as usual food for future selection.
13	Usual food	A user can put the food which they usually eat into the usual food list to make it easier & more convenient.
14	Search mode	Log-in the search bar to find the food database.
15	Manual input	After selecting the manual input mode, a user can fill in food name, calories (Kcal/100g), and food category, confirm it as a common food or not, and then record them on the list.

TABLE 3. Exercise module procedure.

No	Procedure	Description
1	Click on exercise	Click on exercise on Healthcare System.
2	Enter exercise module	Enter the home page of exercise module, which shows the required calories and daily calories consumption and offers suggestion module and basic module for selection.
3	Basic module and suggestion module	Offer users to choose duration module, distance module and fat-burning module and then set up parameters. Suggestion module will auto-analyze the user's daily fat consumption and offer new suggestion of exercise distance.
4	Exercise UI (data)	Show the current time, exercise duration, consuming calories and exercise distance.
5	Exercise UI (map)	Users can check the exercise routes.

to insure whether the user has ever logged in. If there is no record, it will offer a list for the user to fill up and send back to back-end server for backup. People who have not used this App would be required the personal data such as name, gender, age and weight, which will be converted into

TABLE 4. Record module and health information.

| No	Procedure	Description
1	Click on record	Click on the record on Healthcare System
2	Enter record module	Enter the homepage of record module to show the rate of daily diet and exercise condition as well as offer weekly average calories and monthly average calories.
3	Weekly average calories	Offer a user for reviewing the weekly average calories by broken line graph.
4	Monthly average calories	Offer a user for reviewing the monthly average calories by broken line graph.
5	Health information module	Click on health information
6	Health information	Offer the standard healthy index to compare with a user's.
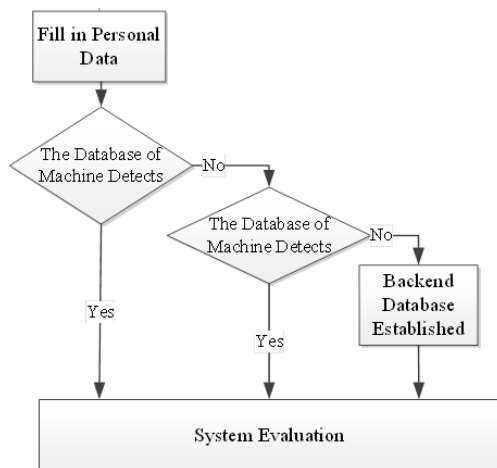
FIGURE 5. Personal data certification.

BMI value. The healthcare list will come out with a health value according to the first height and weight which is then sent to the exercise module and the diet module for the amount of calories that need to be taken.

2) DIET MODULE

Diet module receives the data from personal data module. After receiving exercise module, it will conduct the background monitoring; after that, the data are sent to diet suggestions and basic records. As shown in Figure 6 and Table 2, the diet suggestion module analyzes recent diet conditions and basal metabolic rate to offer users with the diet suggestion and exercise time. It also allows the users chooseing the meal of breakfast, lunch or dinner and then gives some advice about food. The basic record is responsible for recording user's eating schedules, such as breakfast, lunch, and dinner, and the name, calories, and nutrition of food. Recording after all these procedures, the data will be synchronized and analyzed with those in the exercise module. After the multi data evaluation of diet module and exercise module, if the result is lack of calories or deficiency in exercise, the diet module will receive the update from the multi data evaluation module.
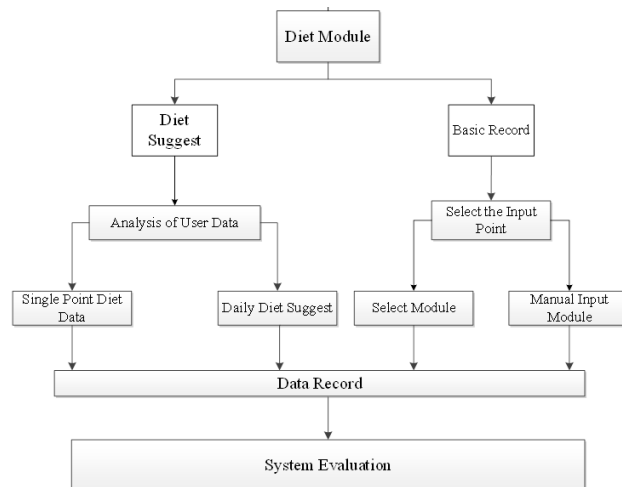

FIGURE 6. Diet Module.

Diet suggestion receives the update and then analyzes and evaluates it again; the last step is to give a new suggestion to users.

3) EXERCISE MODULE

For user registration, basic data, such as age, gender, height, weight, and activity being heavy, medium, or light, are input. Daily energy intake is then calculated according to the information. Furthermore, a complete diet database is established in the article, with which a user could search for intake food and the system would calculate the intake nutrient for the feedback. Moreover, the daily energy intake is calculated by deducting daily energy consumed by exercise and basic energy to understand the appropriate daily energy intake.

The exercise module collects data from personal and diet modules, and the procedure is shown in Figure 7 and Table 3. The suggestion module will analyze a user's age, height and weight to offer the users' basic daily exercise and then check the calories consumption records to suggest and adjust to the new distance. If the calories are under the basal metabolic rate, the system will suggest the users cutting the exercise distance to deal with unbalance. If the situation is the calorie consumption being higher than the basal metabolic rate, the system will suggest extending exercise distance for the user. The basic module offers a user for setting up the regular distance and duration. The suggestion module and the basic module will record the exercise distance, duration & route and supply for user reference. All the data will be transferred to the mobile phone database SQLite as the storage and integrated the evaluation data together with the diet module. Comparing the diet module and the exercise module, if the metabolic rate consumption is higher or less, the exercise module will be either revised or updated. The user will receive the new suggestion exercise distance after relative data input evaluation.
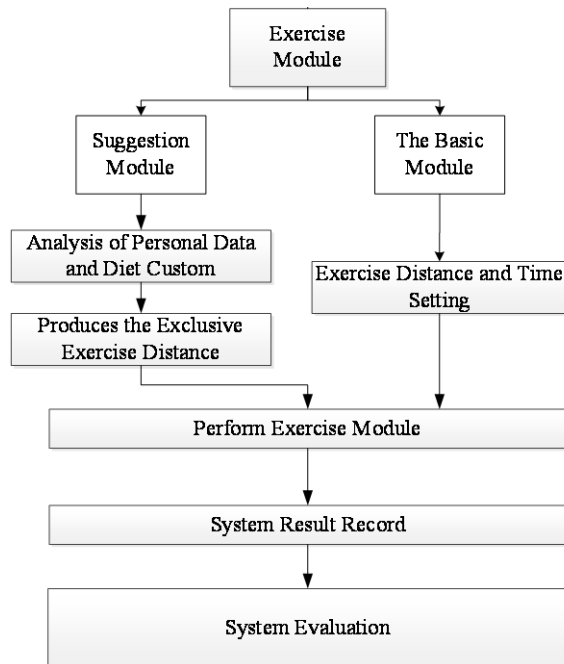
FIGURE 7. Exercise Module.

4) MULTI DATA EVALUATION MODULE

Multi data evaluation module monitors the data from both diet module and exercise module under the background data and analyses simultaneously and then provides users with the suggestion data instantly. Based on different age, height, and weight in personal data module, those data are evaluated and came out with Suggestive data. When the evaluation launches, it collects the data from the diet module and the exercise module simultaneously and keeps modifying the suggestion data and feedback those modules to keep a user's body balance. There are four conditions in the multi data evaluation module. 1. Diet calories under suggestion calories, it suggests users gaining more calories and stopping exercising until the calories get balanced. 2. Diet calories over suggestion calories, it updates the suggestion data and exercise module to consume more calories. 3. Exercise distances under suggestion distance, it keeps the diet calories and suggests users maintaining the current exercise distances. 4. Exercise distances higher than suggestion distances, it updates the diet suggestion to get more calories and halts the exercise module until it gets balanced.

5) RECORD MODULE AND HEALTH INFORMATION

Record data from the multi-data evaluation module and store those data in the smart phone App database. In the future, if a user needs to review the history of diet module and exercise module, the data will be shown by graphs. The record module is linked to the diet record and the exercise record in SQL format and stores a copy on the SQLite database in smart phone and through the Internet to be stored in Apache server

by JsonParser. Health information offers users with the basic healthy data for comparing with their current status from this function support shown on Table 4.

The system would calculate daily intake of energy, fat, and protein, according to individual physiological data, and feedback the information to the users for understanding the diet habit. The users could adjust the diet, according to the system feedback, to make improvement.

Since Prochaska and DiClement [20], [21] proved that behavioral alternation required a sequential process, the transtheoretical model was proposed. The transtheoretical model (TTM) is the contemporarily psychological structure, aiming at delineating how human beings establish an effective behavior or ameliorate the present behavioral reactions. This model explains the way experiences or motivations having an effect on behavioral adaption and maintenance. The flowchart below compares the five different types of APP users:

Pre-contemplation: Users unintentionally make any changes.

Contemplation: Carefully considering changes and planning on executing in six months.

Preparation: Ready to change the behavior within a month.

Action: Positively altering the unhealthy behavior which will start in six months.

Maintenance: Maintaining the positive behavior for at least six months.

The change of the behavior is a dynamic and multi-stage process, not a single time event, a change, or unaltered, but a process which gradually traverses in stages. In the "behavior change stage", the length of each stage of the process is emphasized. Before getting into the next stage, we need to comprehend the tasks clearly. Although the time spent at each stage is different, the tasks in the process are unchanged. The change of cross-theoretical model can be separated into five stages [22]. Through this theory, the users can understand their eating conditions and know whether it is improved or not. Taking the vegetable and fruit in chart 8 for example, users who have not implemented the health management plan can distinguish whether they are unintentional or have changed intentions in their willingness to implement a health management plan. If they are still pondering and preparing, the user's personal willingness can be intuitively comprehended. However, those users who have already implemented the plan can be subdivided into actively changing the execution plan or developing long-term habits. The steps of the system classification can assist the users or the dietitians in clearly knowing the stages they are in and also judging the users' dietary habits.

V. RESULIT

In order to know whether the system has influence in students or not, 80 students from engineering college are

randomly invited to conduct this experiment. There are 47 boys averagely at the age of 21.3 years old, weight 71.2 kg, height 172.8 cm, and BMI 24.6. There are 33 girls averagely at the age of 21.6 years old, weight 62.5 kg, height 162.4 cm, and BMI 23.7. Comparing with the standard published by Ministry of Health and Welfare, the BMI of boys and girls, who go under this experiment, is higher than the ordinary people. Therefore, they have to change their dietary habits; simultaneously, they also need some information systems to assist them and improve the method they record on the paper. Table 5 shows the characteristics of university students using the healthcare system App.

TABLE 5. Characteristics of university students using the healthcare system app.

Characteristics	Boys Mean	SD	Girls Mean	SD
Age	21.3	0.6	21.6	0.4
Weight (kg)	71.2	24.	62.5	21.
Height (cm)	172.8	8.2	162.4	8.5
Body mass index	23.8	4.5	23.7	7.5

This experiment is separated into two stages. For the first four weeks, 80 students are invited to record the diet on the paper. Each student has to note down at least three days during seven days. The record should include two weekdays and one weekend. The whole nutrition they eat in one week is calculated. During the paper record stage, none of these 80 students can fulfill the record.

TABLE 6. Evaluation of the dietary intake records provided through healthcare system app.

Eating event (*n*=80)					
Completeness	Breakfast	Lunch	Dinner	Other	Exercise
Complete	60 (75%)	72 (90%)	74 (70%)	56 (70%)	72 (90%)
Incomplete	20 (25%)	8 (10%)	6 (7.5%)	24 (30%)	8 (10%)
Total	80 (100%)	80 (100%)	80 (100%)	80 (100%)	80 (100%)

At the second stage, shown as Table 6, students are required to record on the application for four weeks. 75 percent means that 60 college students can fulfill the records of breakfast; 90 percent indicates that 72 students can fulfill the records of lunch; 92.4 percent shows that 74 students can fulfill the records of dinner; as for the snacks, 70 percent, i.e. 56 students, can fulfill it; and, 90 percent means 72 students can fulfill the records of exercise.

VI. DISSCUSION

A good diet habit could prevent users from chronic diseases and postpone bad illness conditions. The targets mainly focus on eat-out persons, and their diet records are kept in a server for medical consultation and also the users' review. These data will only be stored in client-end or hospitals for medical treatment. There is no such a self-survey system being able to keep personal diet records all the time. Besides, previous systems used to reduce the user's willingness in the process of ordering meals because of complicated procedures.

This research completes the Personal Smart Healthcare System and allows out-eaters tracking their daily diet situation and the amount of exercise to balance their diet. It not only prevents from illnesses, but also saves the insurance cost. The smart meal ordering system can simplify the user interface and process to be a study tool for medical research. Through Personal Smart Healthcare System, the long-term recording data can be a medical research material to control diseases (over-weight, under-weight), and the use of red, yellow and green signals can help users understand food ingredients. Diet and exercise are two major factors in health to control users' weight and cardio-pulmonary functions through index management and to keep notifying their body conditions.

In the experiment of the first four weeks for recording on the paper, none of the test takers can fulfill the records because they might lose the paper and forget about taking it for recording. Nonetheless, in the following four weeks, they are able to keep records on the application, and more students can complete the records. Not only can the students avoid bringing it, but it can provide abundant nutrition information as well. Students can know the nutrients and decide the food they eat or even choose other substitute food. They can record the dietary content rapidly and the calories they spend on exercising conveniently. Through recording on the application, 83.5% of students can complete the records.

Since the recording rate of breakfast is lower because students rush to the class, only 60 students, which is 75 percent, can fulfill four dietary records. Therefore, the system should add a revised function for students to re-register, intending not to interfere students' ordinary life but to cater to the demand on the rush morning. In this research, the achieved rate of lunch and breakfast is more than 70 percent. Through the application, college students can fulfill their dietary records on time, showing an outstanding situation and willingness of improvement.

From Figure 9 and Figure10, two common types of fruit and vegetable can be chosen to compare the one allowing us seeing the condition before the start and the performance after 4 weeks. It is clear that users in the pre-contemplating stage largely decrease, while users in preparation drastically increase. As a result, it is suggested that users are willing to change with the assistance of the system which can be observed after 6 months. College is a critical period to cultivate the dietary habit. A bad dietary habit will affect people in a bad way; however, the nutrition education plays an important part. This system replaces the traditional nutrition education to solve the deficiency in nutrition education. Eventually, it will help college students maintain a good dietary habit.
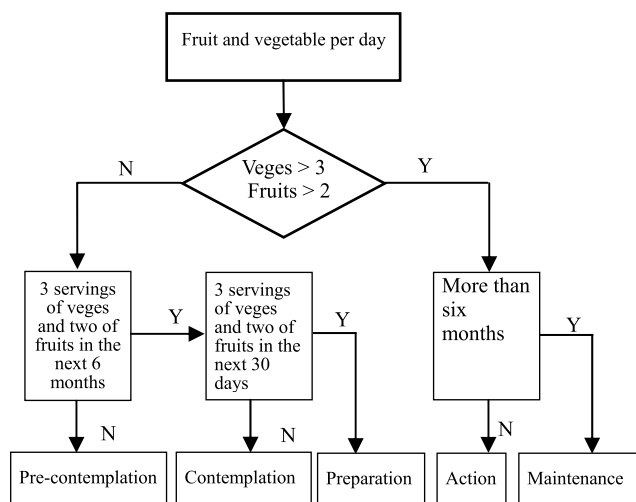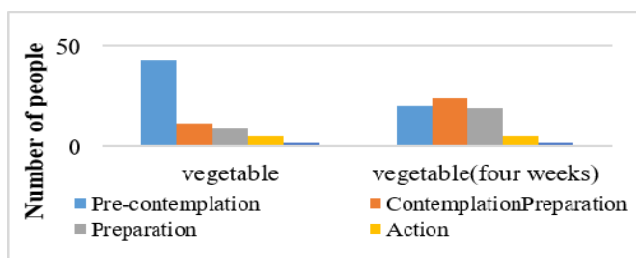
FIGURE 8. Transtheoretical model (Veges and Fruits).

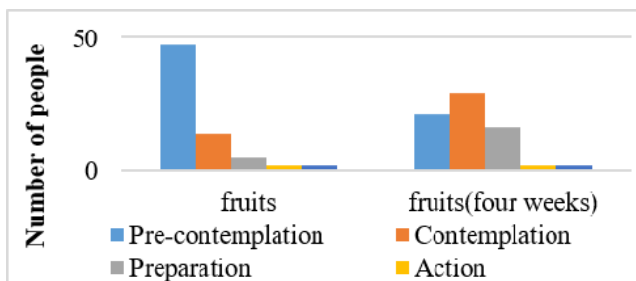**FIGURE 9.** Comparison of using the system (vegetable).

FIGURE 10. Comparison of using the system (fruits).

VII. CONCLUSION

This research focuses on the development and design of a smart healthcare system. It is discovered that similar systems domestically or overseas are all about diet, but few about ordering and exercise system. If those systems can be combined with this research, they would become more complete. In the design process, some experts and users are interviewed for their opinions to simplify the operating interface and processes. Nonetheless, some insufficient and hidden problems can still be improved. Besides, as time passes by, people start eating healthily rather than simply being full and well; good diet and abundant exercise help better sleep, emotion management, and brain degeneration. It is expected to utilize the technology in this paper for assisting college students

in controlling their dietaries and physical activities by the established interactive healthy diet evaluation and healthcare system. This can protect them from chronic diseases which might happen in the future as well.

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