American Journal of Engineering Research (AJER)
e-ISSN : 2320-0847 p-ISSN : 2320-0936
Volume-03, Issue-06, pp-20-29
www.ajer.org

Research Paper Open Access

A Design of Mobile Health for Android Applications

Dr. Vuda Sreenivasa Rao[1], Dr. T. Murali Krishna[2]
Professor, School of Computing and Electrical Engineering, IOT, Bahir Dar University, Ethiopia.
Asst. Professor, Dept of CS & IT, College of Natural & Computational Sciences, Wolaita Sodo University, Ethiopia.

Abstract: **-** For healthiness and wellness, exercising is one of the key factors. In this paper, a mobile health application is developed to recommend healthcare support referring to exercises on the Android Smart Phone. This application has been designed to provide exercise advice depending on Body Mass Index (BMI), Basal Metabolic Rate (BMR) and the energy used in each activity or sport (e.g. aerobic dancing, cycling, jogging working and swimming). Also, this application has been designed to present special exercise advice for patients with health issues. Moreover, it has been designed to store information in a database and to have the ability to produce reports to users.

Keywords: **-** *E-Health, mobile Health, BMI, Android, mobile application.*

I. INTRODUCTION

Mobile phones have significant impact on consumers and their life style because the phones can works as small computers. Therefore, lots of applications and services have been developed and provided on mobile phones. One area of those applications is healthcare applications. Gartner reported that 'mobile health monitoring' would be ranked as no. 5 of 'the top 10 consumer mobile applications for 2012' [1]. It is consistent with 'the top 10 strategic technology trends for 2013' that includes 'mobile device battles' and 'mobile applications and HTML5' [2]. The rate of mobile phone usage in today's world has increased exponentially at a fast and unimaginable rate. Based on the company "The Mobile World" in 2014 [MW2007] the global mobile phone usage had exceeded 4.25 billion at the end of 2014 which is equivalent to around half of the world's population [3]. Moreover, it has been predicted that the market value of mobile health will increase to be more than 11 billion USD by 2018 [3]. For medical applications, the industry of medical applications is predicted to grow about 23 percent annually over the next four years, whereas, it has been estimated at 150 million USD currently. Nevertheless, by 2015, more than one third of about 1.4 billion smart phone users will have at least one mobile health application [4].

In the past decade or so, mobile phones were merely seen and classified as portable communication tools, with the sole capability of making calls, without any physical connection to a landline. Today, certain advancements have been achieved in mobile computing industry through the inclusion of GPS systems, accelerometers, and even touch screens. Different kinds of mobile operating systems have been introduced in response to the goal of designing increasingly powerful software to take advantage of the number of processors packaged in computing hardware. Some of these operating systems are the Symbian OS, the Apple Ios Windows Mobile and Android. Due to the advanced nature of computer architectures for embedded systems computing, mobile computing has become well integrated into the very fabric of our modern way of living. It is a very useful tool for personal health monitoring and many devices such as iPhone, iPad, Google Nexus and other mobile computing devices have applications developed for health monitoring and targets specific needs of individuals. Our developed application which runs on the android platform is customizable and user friendly.

Besides, consumers have more concerns about their health. Thus, healthcare is increasingly considered for better quality of life, with the active approach focusing on prevention of their health, instead of passive approach focusing on treatment [4]. Exercise is the major option to prevent disease and illness, to gain better heath and to maintain. However, to do exercise, there are many kinds of sports, for example, aerobic dancing, jogging, walking, swimming, tennis and yoga. It is questionable, how long should one who has different body characteristics take for each kind of sport. Therefore, this mobile health application has been designed to

provide appropriate time expense with each activity or sport, for not only normal users / consumers but also patients with health issues. This application is based-on the Android, which occupies more than 70% of the smart phone market in the worldwide [5].

A. Evolution of Mobile Devices

The convergence of technologies provides many advantages to consumers. Due to the combination between advanced mobile phone technology and computer technology at present, mobile phones are not just telephones, they have become smart phones, see their history as in Fig. 1[3]. Particularly, after the 3rd Generation International Mobile Telecommunications or 3G mobile networks were officially launched in Thailand in May 2013, smart phones and other mobile devices can be used efficiently because the transmission speed of data increases significantly.

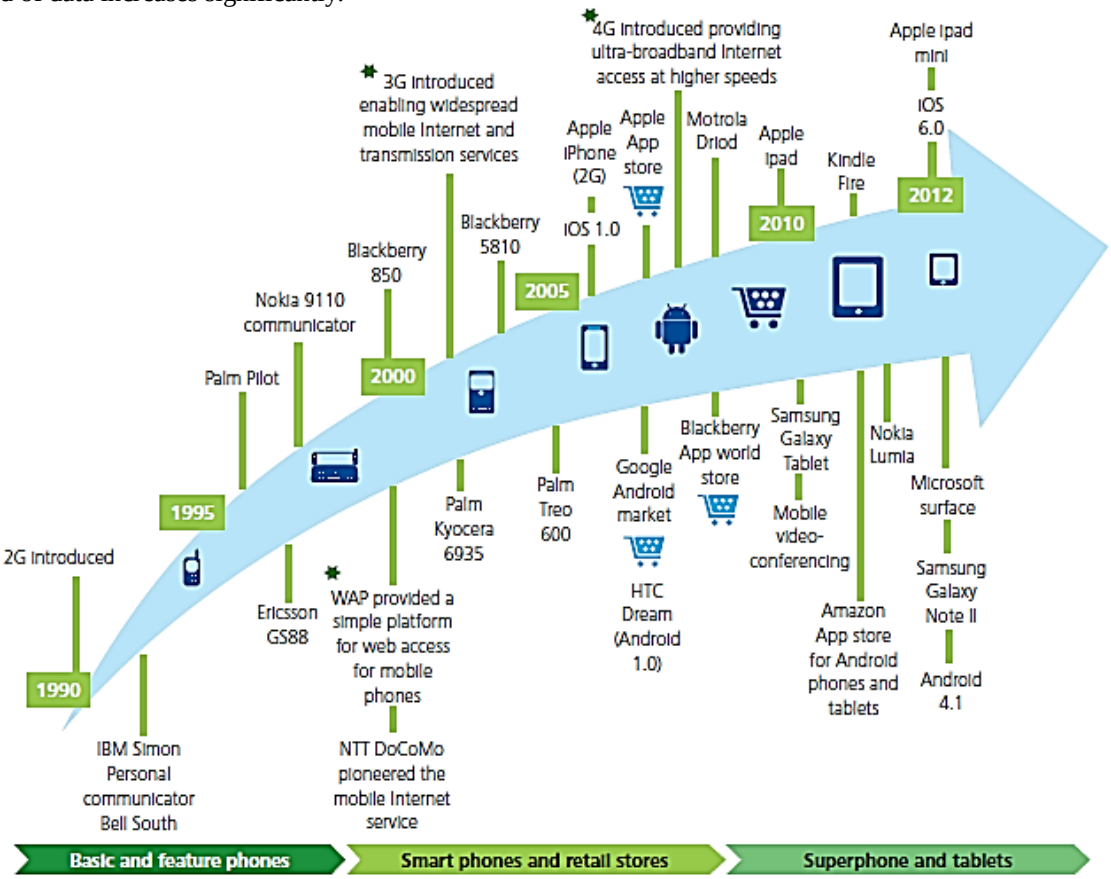


Fig. 1. The history of smart phones and mobile devices.

B. mobile Health

'Mobile Health' can combine health and mobile device technology, especially smart phones. It can be defined as 'medical and public health practice supported by mobile devices (e.g. mobile phones, patient monitoring device and wireless devices)' [1], whereas, 10 years ago, it has been defined as wireless telemedicine involving the use of mobile telecommunications and multimedia technologies and their integration with mobile healthcare delivery systems [6].

To understand clearly about 'mobile Health', understanding the mobile Health ecosystem is required. As shown in Fig. 2 [7], the mobile Health ecosystem overlaps several dynamic spheres, consisting of health, technology and finance, whereas, government is the influencer that has power to set regulations, policies, and strategies that can affect all spheres throughout the development and use of mobile Health inventions. The stakeholders in mobile Health influence the drivers, as shown in Fig. 3[7], so that mobile health can help consumers to have better health.

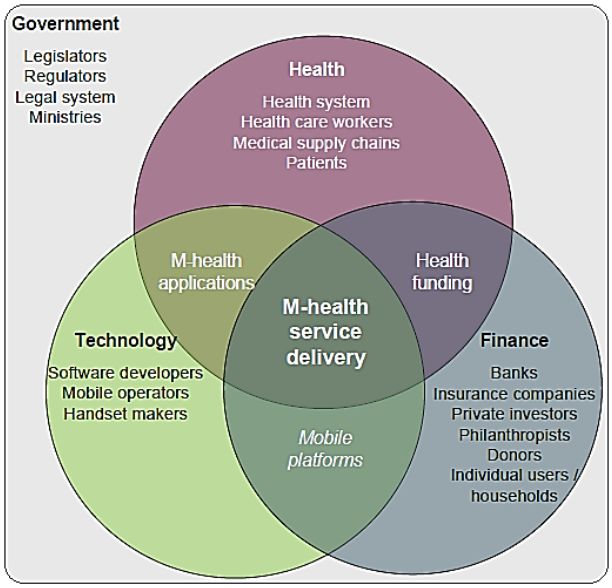


Fig. 2.The ecosystem for mobile Health.

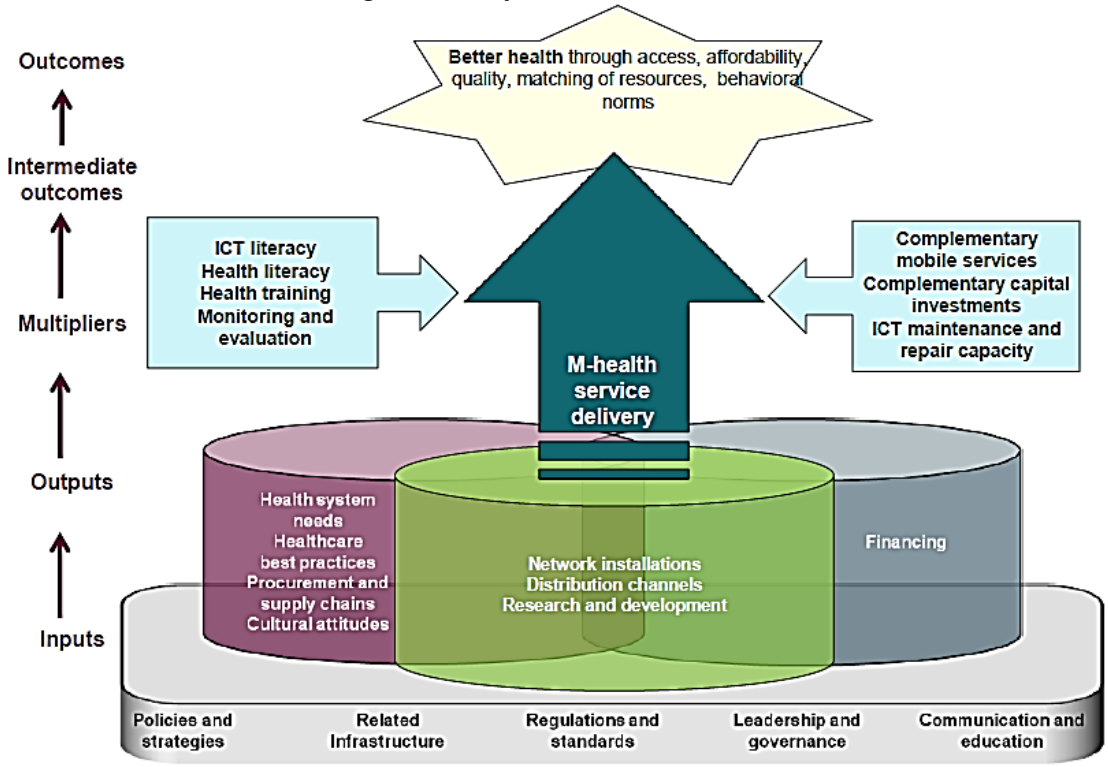


Fig. 3. Framework for mobile Health outcomes

II. PROPOSED SYSTEM DESIGN AND METHODOLOGY

A. System Architecture

The following architectural diagram shows the different modules that make up the Mobile Health android application.

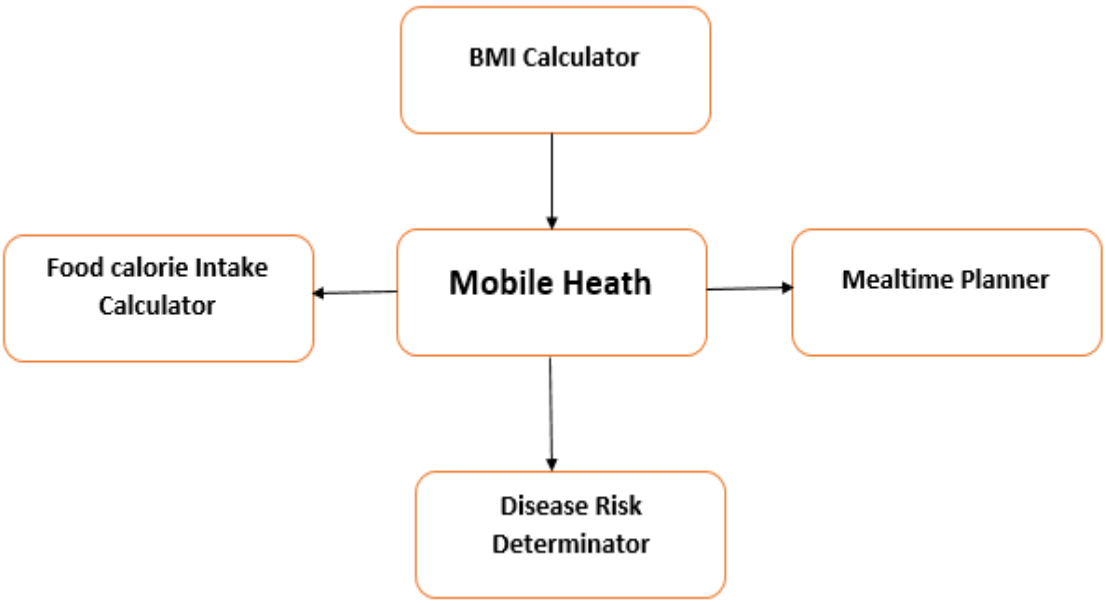


Fig. 4. Android Architectural Framework and Module development.

The proposed android architectural framework and module development as presented above encompasses four (4) modules namely: (1) Food calorie Intake Calculator (2) Mealtime Planner (3) BMI Calculator and (4) Disease Risk Determinator.

(1) Food calorie intake Calculator Module
This module computes the calorific content values for the user interactive menu choice for breakfast, lunch and dinner. This module computes the customized menu choice and offers suggestions for other menu options to achieve your goal of either losing weight or eating healthy foods.

(2) BMI Calculator module
This module calculates the Body Mass Index (BMI) for a person based on the height and weight of the person using the formula: BMI = Weight (kg)/ (Height (m))^2 . The essence of this module is to generate useful information regarding the BMI parameter used for ascertaining a person's risk of heart disease, diabetes etc. The BMI is a heuristic proxy for estimating human body fat based on an individual's weight and height.

(3) Disease Risk Determinator Module
Based on the computation of the BMI and the user specification of the nature of work, exercise routine and other factors, the Disease Risk Determinator module then determines your risk profile and tracks it while offering excellent Meal time Planner to get back into shape and avoid unnecessary hospital visits due to poor healthy lifestyle.

(4) Mealtime Planner Module
This module presents to the user the various meal plans for breakfast, lunch, and dinner based on the amount of calories needed by the person taking into consideration, age, type and nature of work, several favorite dishes for breakfast, lunch and dinner.

A. Exercise and Related Indexes:
Exercise is any body activity that enhances physical fitness and / or maintains overall health and wellness. There are several reasons for exercise, for example, strengthening the cardiovascular system and muscles, weight loss, honing athletic skills and enjoyment. However, to evaluate and indicate the change of body after performing exercise, there are few indexes to be considered, as follows:

1) Body Mass Index (BMI): is a measurement of body fat based on height and weight, as shown in formulas [8]. It is calculated as weight (kg) divided by height squared (m2). This index is classified into four groups, based on WHO Asian BMI classifications, as shown in Table 1 [9, 10]. However, this index is mainly for men and women who are 18 – 65 years old.

2) Basal Metabolic Rate (BMR): is calculated from the variables of height, weight, age and gender [11]. This index is more accurate than calculating calorie needs based on body weight alone. However, each gender uses different formula to calculate, as shown in (2) and (3) [12].

Category	Weight	Meaning
1	<18.5	underweight
2	18.2 to < 23	Normal Weight
3	23 to < 27.5	Pre-obese
4	>=27.5	obese

Table 1**.** WHO Asian BMI classifications.

3) Metabolic Equivalent of Task: is a unit used to estimate the amount of oxygen used by the body during physical activity. One metabolic equivalent (MET) is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O_2 per kg body weight x min. [13,14]. The formula to calculate for caloric expenditure can be shown in (3), while the estimated METs for some kinds of exercises are shown in Table 2 [15, 16].

Where BMI = Weight (kg)/ (Height (m))^2
Where BMR = C1+(C2*M)+(C3*H)-(C4*A)
Where: BMR = Basal Metabolic Rate (Kcal. /day)
C1 = 665 for women or 66 for men
C2 = 4.35 for women or 6.23 for men
C3 = 4.7 for women or 12.7 for men
C4 = 4.7 for women or 6.8 for men
M = Body Weight in Kilograms
H = Height in Meters
A = Age in years
Kcal = 0.0175•MET•M•T
Where: Kcal = Caloric expenditure in Kilocalories.
MET = Metabolic Equivalent of Task or Activity in METs.
M = Body Weight in Kilograms.
T = Time of the activity in minutes.

Activity	MET Value
Cycling 16-19.2 km/h	6.0
Cycling 19.2-22.4 km/h	8.0
Cycling 22.4-25.6 km/h	10.0
Jogging 8 Km/h	8.0
Jogging 9.7 Km/h	10.0
Jogging 11.3 Km/h	11.5
Jogging 12.9 Km/h	13.5
Walking 4 Km/h	3.0
Walking 4.8 Km/h	3.5
Walking 5.6 Km/h	4.0
Walking 7.2 Km/h	4.5

Table 2. Examples of MET values for cycling, jogging and walking.

A. *Safe Exercise for Patients:*

There is a misunderstanding that patients with diseases should do nothing, he or she cannot do exercise. In fact, each patient can do regular exercise at least 150 minutes per week (50 minutes per day at least 3 days a week), except patients with heart diseases who need consultation from the doctor. The benefits of safe exercise for patients include [17]:

- Strengthening heart and cardiovascular system.
- Improve circulation
- Helping body use oxygen better.
- Improving heart failure symptoms.
- Lowering blood pressure.
- Improving cholesterol.

Nevertheless, each patient must check or consult the doctor first, before starting an exercise program because the doctor can help to find an appropriate exercise program for each level of fitness and physical condition. In addition, he or she must stop the exercise immediately and contact the doctor if any bad signs or symptoms occur [17].

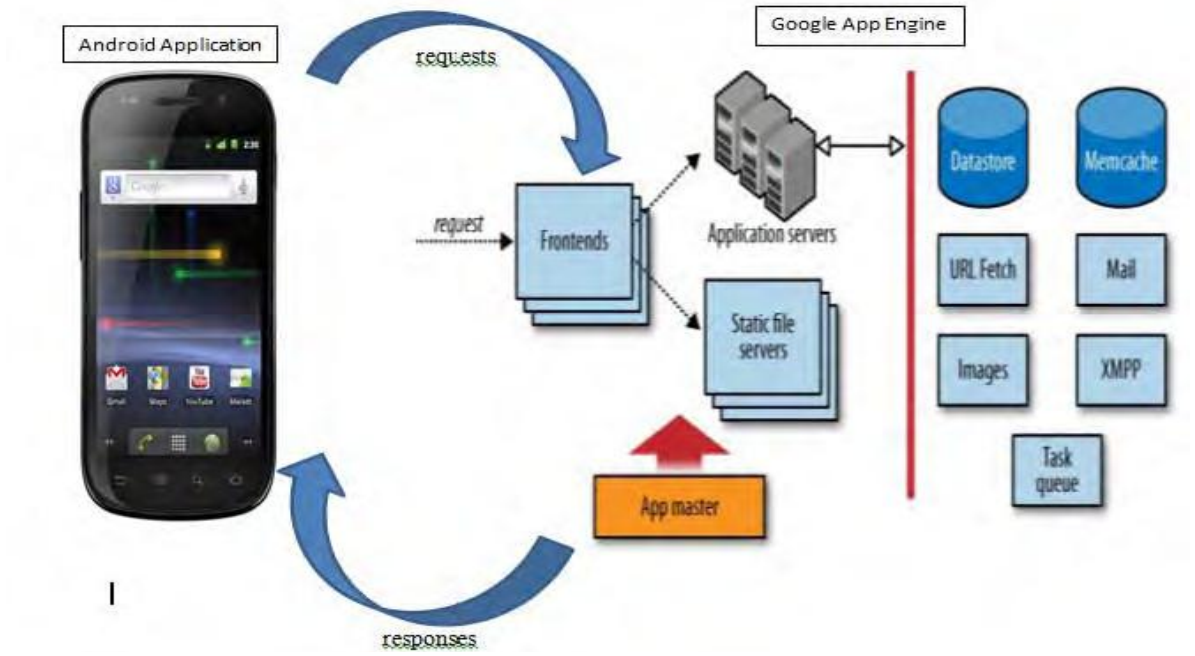


Fig. 5. Overall System Architecture source.

C. System Components

1 Web Application.

The system enables information access via the web. The web application resides and runs on The Google App engine infrastructure.

2 Database Server

This component hosts the database which would store information related to the various dishes that are made available to the developers. The data is hosted in a MySQL database and accessed by the Android application.

3 Web Service

The web service is made available to enhance faster the android application and the database.

4 Android Application

The Android application which makes it possible for a user to plan meals, track daily food requirements and generate useful help tips for the user.

As shown in Fig. 6, the mobile application is an important part that functions on a smart phone. This system was designed based on the Android Operating System and used Adobe Flex to create the user interfaces. It consists of several functions, including BMI calculation, BMR calculation, exercise caloric calculation, recommended exercise, diary and profile. There is also an important part called the provider service. Its main function is data processing. However, both parts require HTTP protocol for interfacing.

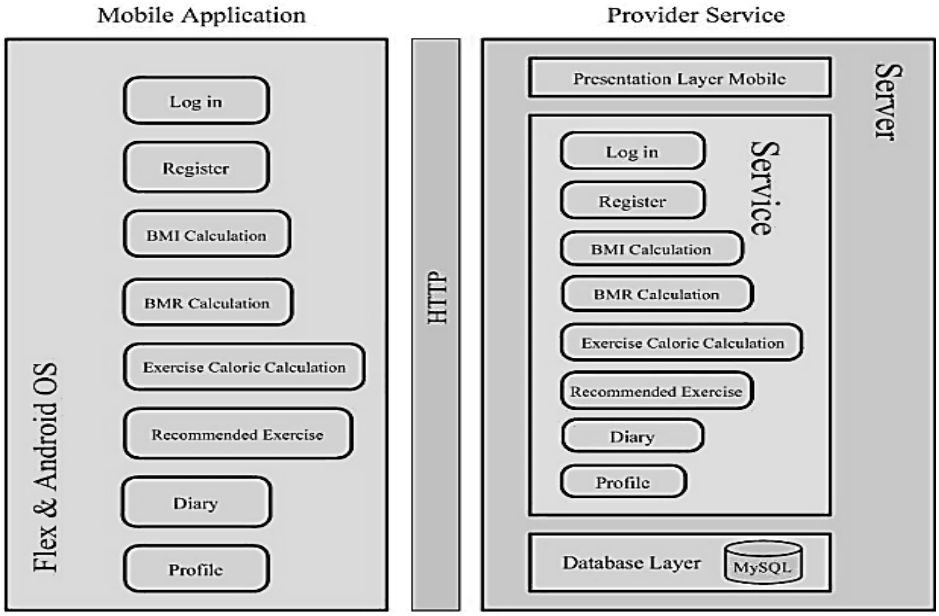


Fig. 6.The conceptual framework of the recommended exercise system

.

After planning and analysis activities, the system design was conducted. In this design phase, the system process diagram was presented in Fig. 7**.**

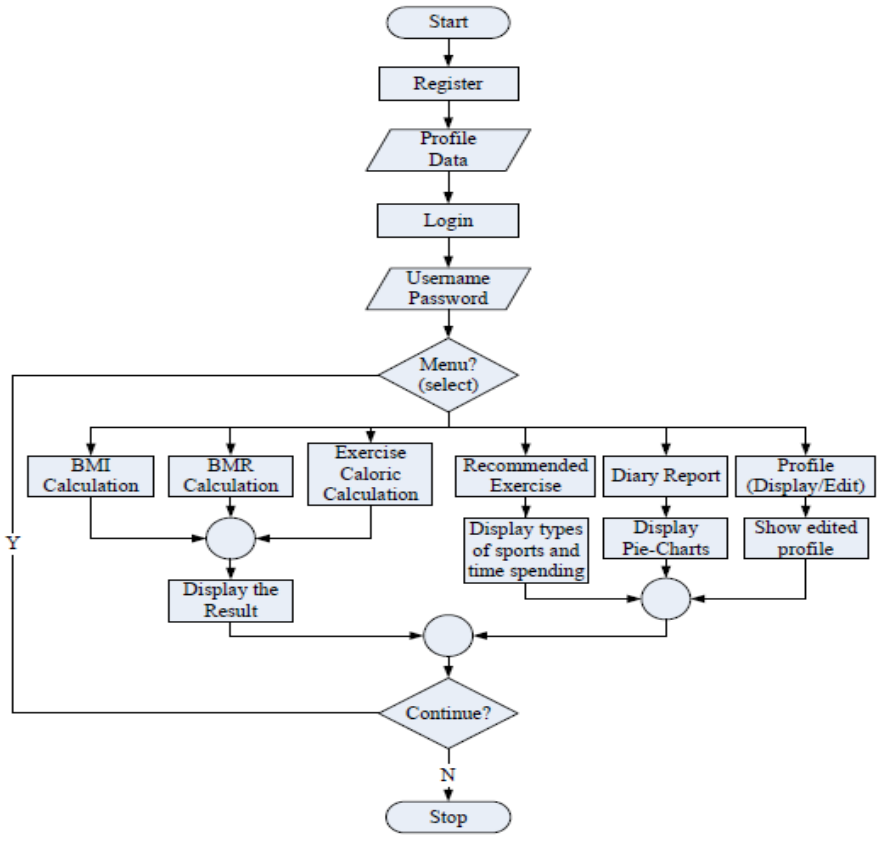


Fig. 7**.** The system process diagram.

III. RESULTS

Particularly, this section mainly presents User interfaces for BMI calculation, BMR calculation, exercise caloric calculation, recommended exercise and dairy, as shown in Fig. 8 – Fig. 9.

Therefore, it is easy for a developer or a programmer to communicate with stakeholders about each display that should be shown to users by the system.

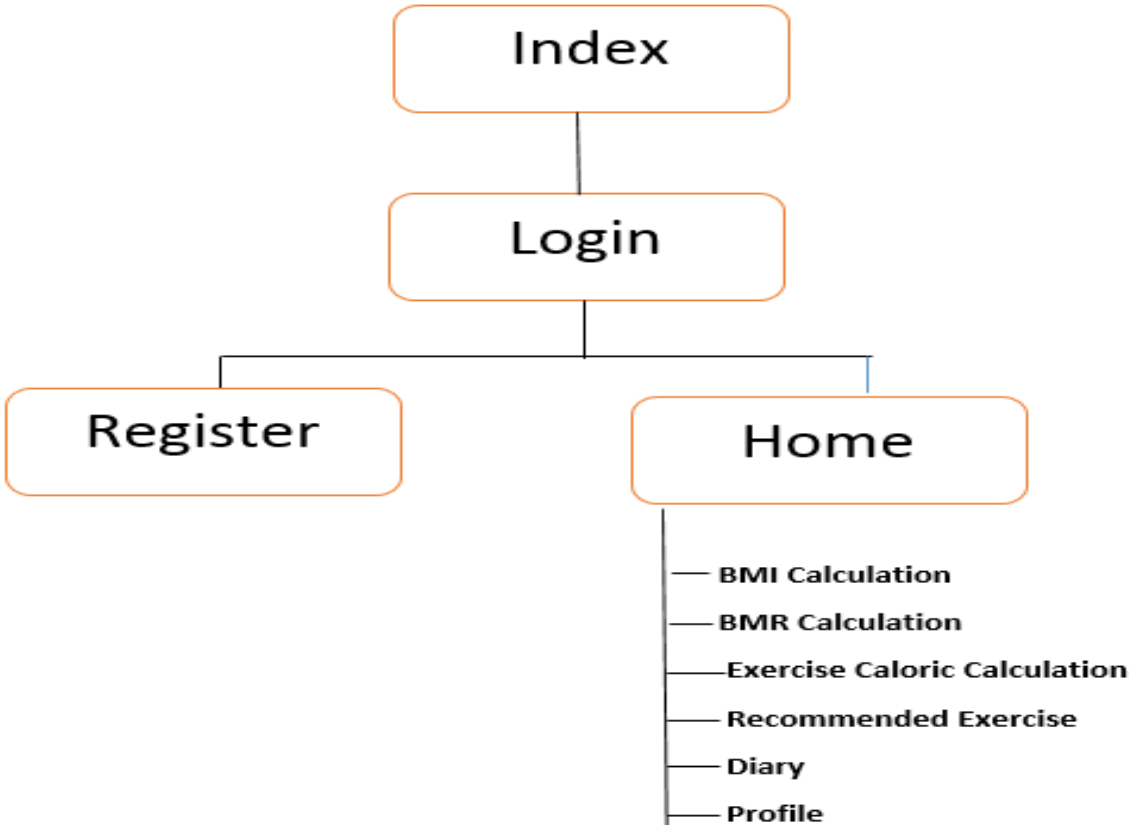
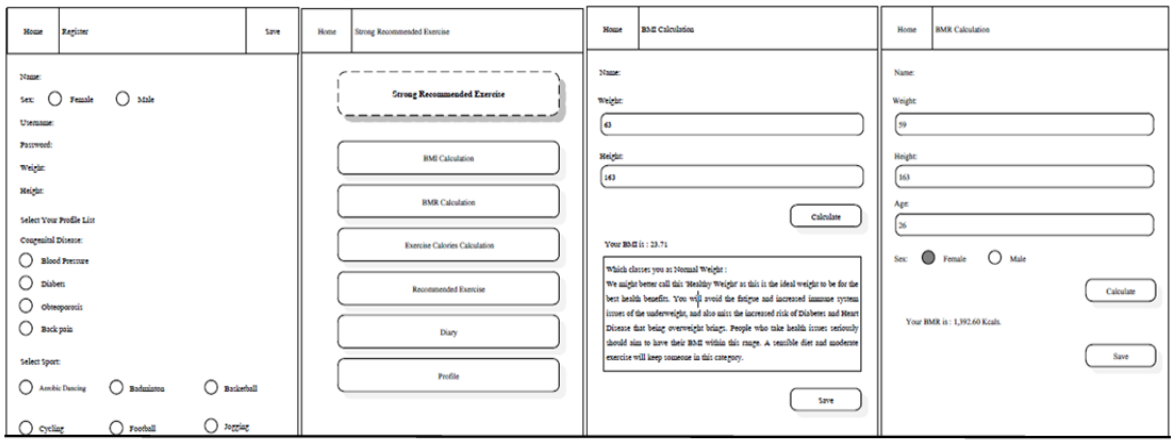
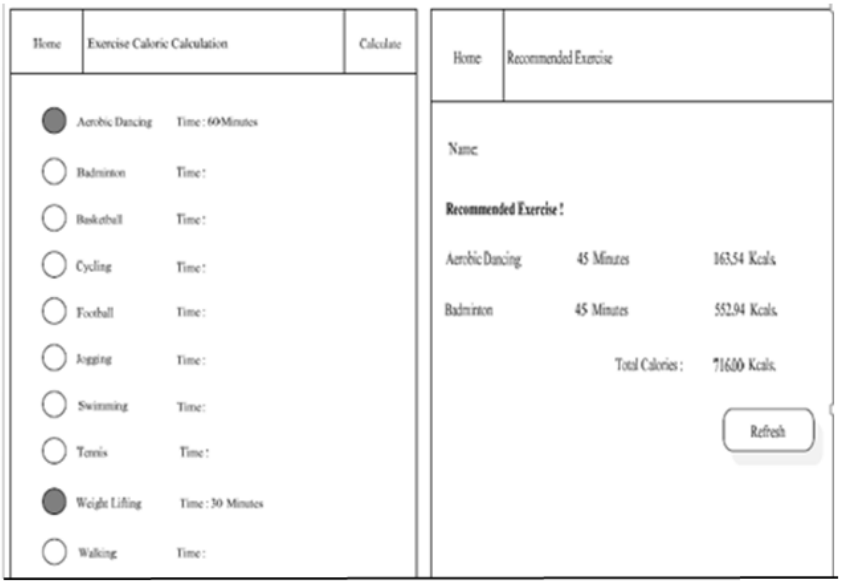


Fig. 8. Overview of the recommended exercise system.



(a) (b) (c) (d)



(e) (f)

Fig. 9. User interfaces (a) Register (b) Main menu (c) BMI Calculation (d) BMR Calculation (e) Recommended sport and time duration (f) Recommended exercise and caloric expedition.

IV. CONCLUSION

This paper presented necessary guidance and health recommendations for mobile users who have installed the android applications. The proposed system model generates food tips and recommendations for different categories of people who are underweight, overweight or obese due to a computation of their body mass indices. It specifies certain exercise regimen types that are appropriate for these different kinds of people. Further expansion to allow for versatility and ubiquity is to implement the Personal Health Monitor app on other mobile platforms apart from android.

This design of a new mobile health application called 'Recommended Exercise System on the Android Operating System' has been conducted. It has been designed to recommend exercise for each individual who has different age and physical characteristics (e.g. sex, weight and height). Therefore, he or she can exercise appropriately, not too less or too much, with different kinds of sports that he or she selects. Also, several functions have been included (e.g. calculation of BMI, BMR, caloric expedition and report). Furthermore, this mobile Health application has been also designed to be able to support different kinds of patients and exercises (e.g. back pain).

REFERENCES

[1] Robert Sowah, Joana nkrumah-buadu and Seth y. fiawoo "design and development of a personal health Monitoring system on android mobile platform", International Journal of Engineering Science and Technology (IJEST), Vol. 5 No.06 June 2013, 1313-1320.

[2] Gartner Identifies the Top 10 Strategic Technology Trends for 2013. Available at: http://www.gartner.com/newsroom/id/2209615, accessed August 2013.

[3] M Health in an m World: How mobile technology is transforming health care. Available at: http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/us_chs_2012_mHealth_HowMobileTechnologyIsTransforming Healthcare_032213.pdf, accessed August 2013.

[4] Gartner Identifies the Top 10 Consumer Mobile Applications for 2012. Available at: http://www.gartner.com/newsroom/id/1230413, accessed August 2013.

[5] Anbalahan S., (2007): Common mistakes in two-tier applications. Plynt Publication, http://www.palizine.plynt.com [date accessed: 23/05/12].

[6] Arshad U., et al.: Exploiting Mobile Computing in Health Care. Department of Computer Science, University College London. Webpage: www.cl.cam.ac.uk/~cm542/papers/iwsawc.pdf [date accessed: Dec 12, 2012]

[7] Bmi-calculator.net, [online source] from http://www.bmi-calculator.net/, [date accessed: 23/05/12]

[8] Hicks J., et al. (2010): And Wellness: An Open Mobile System for Activity and Experience Sampling. UCLA CSD, UCLA Stats, San Diego, USA.

[9] Holmes A.T. (2011): The fitness Corner Blog. (January 27,) Webpage http://www. doctorholmes.wordpress.com [date accessed: 23/05/12].
[10] Lane D. N., et al.: Be Well: A Smartphone Application to Monitor, Model and Promote Wellbeing. Computer Science Department Dartmouth College, Dartmouth Medical School, Dartmouth Institute for Health Policy and Clinical Practice, IT University of Copenhagen. ww.cs.dartmouth.edu/~Campbell/papers/bewell_pervhealth.pdf [date accessed: August 2, 2011].
[11] McArdle, W. D; Katch, F.I; Katch, V. L; (2001): Exercise Physiology, 5th Ed. Lippincott Williams & Wilkins.
[12] Meier, R. (2009): Professional Android Application Development. Wiley Publishing, Inc., United States of America.
[13] Palani swamy G.: Two-Tier and Three-Tier Architecture with example. Webpage http://www.c-sharpcorner.com/uploadfile/go [date accessed: September 28, 2010].
[14] Sanderson D. (2010): Programming Google App Engine, 1st Ed. O'Reilly Media, Inc., United States of America.
[15] Severance C. (2009): Using Google App Engine. 1st Ed, O'Reilly Media, Inc., United States of America.
[16] Speckmann B., (2008): The Android Mobile Platform. Eastern Michigan University, MSc. Ypsilanti, Michigan.
[17] Thaicoding.net, [online source] from http://www.thaicoding.net,[date accessed: 23/05/12].
[18] Widén A. (2010): Diabetes care on smart phones running the Android platform. MSc. Thesis, Chalmers University of Technology, Gőtenborg, Sweden.
[19] Woubshet B. (2012): Android ECG Application Development. OULU University of Applied Sciences, BSc.

AUTHOR INFORMATION

Dr. Vuda Sreenivasa Rao received his M.Tech degree in computer science and engineering from Sathyabama University from 2007.He received PhD degree in computer science and engineering from Singhania University, Rajasthan, India from 2010. Currently working as Professor in School of Computing and Electrical Engineering, IOT, Bahir Dar University, Ethiopia. His main research interests are Data mining, Fuzzy logic, Mobile communication, cloud computing and Network Security. He has got 14 years of teaching experience. He has published 39 research papers in various international journals and 4 international conference papers. He has Editor-in-Chief in 3 international journals and 132 Editorial Board / Reviewer Board memberships in various international journals. He has Technical committee member in various international Conferences. He is a life member of various professional societies like IEEE, ACM, MAIRCC, MCSI, SMIACSIT, MIAENG, MCSTA, MAPSMS, MSDIWC, SMSCIEI, SNMUACEE and MISTE.

Dr. Telkapalli Murali Krishna has obtained his PhD in Computer Science & Engineering from University of Allahabad, Uttar Pradesh. He received his M.Tech in CSE from Acharya Nagarjuna University, Andhra Pradesh. He received his M.Phil (Computer Science) from Madurai Kamaraj University, Tamilnaadu. He holds MCA from Osmania University, Hyderabad. Currently working as an Asst. Prof. in Computer Science, Wolaita Sodo University, Ethiopia. His main research interests are Data Mining, Software Engineering, Network Security, and Artificial Intelligence. He has more than 15 years of teaching experience. He has published 4 papers in International Journals and presented 5 papers in national conferences. He is a life member in CSI, IACSIT, IAENG, CSTA, and SDIWC. He is a member in Reviewer Board of IJCAT journal. He is a member in Editorial board of IJRSSET journal.