Development of Android Application for Measuring Cardiovascular Endurance Fitness for Military Cadet Officers

Mohar Kassim¹, Ahmad Mujahid Ahmad Zaidi² and Rahmat Sholihin Mokhtar³

¹ Director, Centre for Coaching Science, UPNM
² Dean of Academic Management, UPNM
³ Centre for Coaching Science, UPNM

corresponding author’s e-mail address: mohar@upnm.edu.my

ABSTRACT
Mobile software application has become a part of today’s lifestyle. This mobile app is designed to help society to be physically active. The application is named UPNM Cardio Fitness, and is developed on the Android platform. The original purpose of the application is to measure and analyse the level of cardiovascular fitness of 18 years old male Military cadet Officers through a 2.4 km run test. The application is based on a data base using Google Fusion Table that stores and analyses the data received. The application consists of two parts: information of the individual and their respective fitness norms that can be accessed either automatically or manually. The classification of the norms is obtained from the fitness norms of 120 male cadets aged 18 years old. The norms are grouped into five categories which are: Excellent, Very Good, Good, Moderate and Poor. The software consists of 5 hyperlinks which are the main page, individual information, test result, file and record. The application is created using MIT App Inventor Software and Windows 7. The creation of the application has enabled researchers particularly in the Science Training programme in UPNM to carry out tests as well as to identify the level of fitness of their trainees immediately, accurately, and systematically.

Keywords: 2.4km run test, android, cadet student, cardiovascular endurance UPNM, google fusion, MIT App Inventor, mobile application, physical fitness norm, Windows 7

1. Introduction
Physical fitness is a component that is used all the time to carry out an activity. Physical fitness is defined as one’s condition that makes him able to undertake a daily task without feeling tired when maximum energy has been used, and there is still an extra energy for use during leisure time and in an emergency situation. This definition is supported by Penny & Clarke (2005) who state that physical fitness is the ability to carry out daily activities efficiently and energetically, without feeling extreme fatigue, and still have enough energy for recreational activities. This means that fitness is extremely important for every individual, especially in this age of rapid development that requires an individual to be constantly active and be at the optimum level of health. This scenario is in line with the advent of modern science and technology, which has become increasingly advanced in this millennium.
Information Communication and Technology (ICT) revolves all aspects of technology as the medium of information dissemination such as radios, televisions, smart phones, computers and internet. Rapid advancement in ICT creates a lot of impacts in almost every aspects of life. It is used in broadcasting news, sharing educational knowledge including updates on health issues. The development in the field of technology has changed ways human being learn and work [1]. This is due to the globalisation of technology that leads it to be perpetually and continually developed throughout time. Combining the creativity and innovation of the researcher, the mobile app is introduced as something new that has never been created before. This is because technology has been used as a bridge between individual experience and existing knowledge, with new knowledge that is taught and learned through the delivery of mobile application used [2].

This study states that there is a requirement for the existence of a certain norm that can measure the cardiovascular endurance among each individual cadet. Until now, there is no means to measure the cardiovascular fitness to evaluate the physical health status of UPNM cadet students. For now, the administration of UPNM uses the physical fitness tests taken from AAHPERD (1996). The norm is based on conditions that do not fit the local people and most certainly has protocol and circumstances that are different from ours. Therefore, to best evaluate the fitness performance level of cadet students, there is a need for a norm that is valid and reliable in accordance to the protocol and medium suited to the setting of our country. Cardiovascular fitness norm refers to the order or numerical range that shows the physical fitness level of an individual based on a certain guideline. This norm is used to determine a specific fitness level after the completion of a fitness test.

Based on the current development in technology, as predicted, smartphones have become an indispensable communication tool for most people, especially youngsters [6]. The prevalence of using mobile technologies especially smartphones has shown a rapid speed in the ubiquities. This is supported by the convenience of the internet infrastructure for high speed internet access and WIFI facilities installed in most buildings. People are compelled to become digital citizens by having smartphones. Apart from the infrastructures provided, mobile application tools have also played a role in the increase use of smartphones. Smartphones are not purely designed to meet basic needs such as socialising using social applications, but it is designed to be more user friendly whereby anyone can use it despite not being IT savvy [7].

1.1. Research Objectives

This study was carried out to achieve the following objectives:

1.1.1 To develop a cardiovascular fitness norm for UPNM Military Cadet Officers according to their age and gender based on test scores of the mentioned norm.

1.1.2 To evaluate the physical fitness level of UPNM Military Cadet Officers based on a number of criteria fixed.

1.1.3 To build portable application software based on the cardiovascular fitness level of UPNM for Military Cadet Officers.

In this study, detailed planning was required in order for the above objectives to be achieved. Besides, the concepts of this study, which are portable application software and cardiovascular fitness norm, have to be made clear so that no complications can interfere with the achievement of the study.

1.2. Significance of the Study

The translation of data into an application that is being done in the research is something that has not been done before. The app is hoped to aid lecturers and physical trainers in managing as well as administrating a physical fitness test. The new system will inevitably improve the quality of the pre-existing management system. In addition, the creation of the app is crucial in managing the test results as there is no systematic way to save the information thus far. The app which is a computerized system helps other researchers to record, analyse and save the information of the students’ physical fitness data to be stored online. The cadets can also find out quickly of their performance or the norms achieved from the test conducted.
1.3. Research Instrument

Cardiovascular Endurance Fitness Norms:
In order for the researcher to assess the level of physical fitness of a person in a study, there should be a test that is consistent with the subject matter of the study. The physical fitness test carried out in a study is considered as an instrument. Instruments in a research for a physical fitness test must have high validity and reliability in order for the result to be precise and indisputable [12], [13]. In this study, the chosen instrument is a 2.4 km run test developed by Kenneth H. Cooper in 1968 for the US military [14]. The 2.4 km run test has high validity, r=0.92 [15] and r=0.86 [16]. After the 2.4km run test is carried out, the results are then analysed. The cardiovascular endurance fitness norms produced will then be the guideline data to build the mobile software application that uses Android as the platform. The norms are to be accessed via smartphones.

Smartphone and Mobile Application:
The smartphone is a combination of mobile phone and personal digital assistant (PDA). The mobile phone uses an operating system such as Symbian, Windows Mobile, Android, iOS, Palm, and numerous mobile softwares. It comes with internet access and is able to support multimedia applications [17]. The 2 in 1 concept used in smartphones is useful to many users especially those who are frequently engaged in outdoor activities such as attending seminars or meetings, taking data of patients, retrieving serial number in hardware store, organising daily routine, finding direction or for navigation purposes and many more. For the PDA to function, smartphones are equipped with a microprocessor and memory chips such as RAM, ROM or flash card [18].

The operating system of a smartphone represents the producers. The two profound operating systems are Google’s Android and Apple’s iOS. Both of the operating systems have their own unique characteristics that represent the producer or company. Statistics has shown that smartphones using Android as the platform are more prevalent than others with a market share of 82% worldwide [19]. The chart below shows the differences between Android market and other operating systems.

2. Methodology
CONSTRUCTION OF CARDIOVASCULAR FITNESS NORMS
The research is done through experimental observation. It is designed to use the pre-existing instrument developed by Cooper Institute. Descriptive statistics analysis through SPSS version 20 was used to calculate and interpret the data. The findings have enabled the researcher to describe the frequency, percentage, mean and standard deviation of the existing demographic variable such as sex, race, height and weight. The samples of the study are 18 year old UPNM Foundation Programme male cadets for admission in the 2013/2014 session. A total of 120 male cadets carried out a fitness run test of 2.4 km representing 30 per cent of the total male cadets in the foundation programme [22].

2.1. Application Production
The cardiovascular endurance norms produced are then used as the main data for the production of the mobile application. The method of production of the mobile application is using the System Development Life Cycle (SDLC) model. It is a form of a database system development cycle and operation of the software. According to [23], the SDLC model consists of 6 phases, and they are: preliminary investigation, system analysis, system design, system deployment and maintenance phase. These phases are cycles for the working of a process that will identify the strength or weakness of every phase. The first phase which is the preliminary investigation phase is the phase for producers of the app to identify the problems and needs for information systems. In the first phase of this research, the producer has identified and recognised that there is still no application system created specifically in recording, saving and managing the cardiovascular endurance physical fitness test information of cadets.

The second phase is the system analysis whereby the system analyses new requirements which a specified system needs after the current system is studied in depth. This phase is the most crucial phase because developers can develop the application based only on its needs to carry out the process easily as planned. The hardware required in this study is a computer and a mouse whereas the software required is online MOT Apps Inventor and an internet connection. MIT App Inventor is used because it is done virtually in the cloud by the website http://ai2.appinventor.mit.edu/ and does not require an installation of the app in the computer system. Problems and needs of the end users will be analysed in more detail so that the goals can be achieved.

The third phase is the application design phase. There are three main tasks in this phase, and they are: providing alternative application, choosing the best application design, and writing an application design report. The application producer will create more than one design to fulfil the need for information. Required specs from the previous phase will be studied and the application design will be prepared in this phase. The desired feature and operation will be described in detail including screen display, functions, hardware and software.
The fourth phase is the application development phase. In this phase, the application is developed using the software and hardware. The application is then put into work to test its functionality. A test typically takes about 2 weeks especially if it is complex. All feedbacks and responses are taken to ensure all procedures have worked out as planned.

The application deployment phase is the fifth phase which is the installation of the new system. End users will be taught and guided in using the application. Another name for this phase is the application conversion because there are conversion processes or changes from the older system to the new one. End users will be trained to use the new application accordingly.

The last phase is the maintenance phase whereby maintenance begins with updating the application. Evaluation is then made to see whether the application is productive and dynamic.

3. Results
All respondents were randomly selected for this study. Descriptive statistics showed mean scores and standard deviations for all respondents involved in the 2.4 km run test (M=10.86, SD=0.91). Table 1 shows the test scores of the students in the 2.4 km run test. The minimum and maximum time recorded is 9.17 and 13.13 mins while the median and the skewness showed 11.13 and -0.036. The statistics/data produce a bell-shaped curve to show normal distribution.

Table 1: Descriptive Statistics for UPNM Foundation Programme Male Cadets

| 18 Years Old Male Military Cadets Officers |
|-------------------------------------------|
| Minimum                                   | 9.17 |
| Maximum                                   | 13.13|
| Mean                                      | 10.8646|
| Median                                    | 11.1350|
| Std. Deviation                            | .91960|
| Skewness                                  | -.036|

18 year old Male
N                                           120
Table 2 shows the test result of the norms from the 2.4 km run test conducted on the male cadets. There are 5 predefined classifications in the production of a particular grade of fitness norms, and they are: Excellent (5), Very Good (4), Moderate (3), Satisfactory (2), Poor (1). According to [12], grading a test enables a set of people to be classified according to their abilities and achievement. Every level states the scores achieved starting from the highest to the lowest which is 5 to 1. Norms are also used by the National Physical Fitness Award Singapore (NAPFA) [24.] From the table, the highest achievement which is Excellent with the score of 5 starts from 9:40 and below, the next level is Very Good with the scores of 4 is from 9:41 to 10:40, the Good level with the score of 3 is from 10:41 to 11:31, and the satisfactory level with the score of 2 is from 11:31 to 12:24 and lastly, the Poor level with the score of 1 is from 12:25 and above.

| Category    | Score | Duration (mm:ss) |
|-------------|-------|------------------|
| Excellent   | 5     | < 9:40           |
| Very Good   | 4     | 9:41 - 10:40     |
| Good        | 3     | 10:41 - 11:30    |
| Satisfactory| 2     | 11:31 - 12:24    |
| Poor        | 1     | 12:25 >          |

Note. (mm:ss)=(minutes:seconds)

4. Application Development
The application is named ‘UPNM Cardio Fitness’. The app is produced to measure the level of cardiovascular endurance of 18 years old UPNM male Military Cadet officers. The application is produced using a software programme developed by Google which is then taken over by MIT. This software can be accessed through gmail account via website which is http://ai2.appinventor.mit.edu/. The researcher created a gmail account specifically for this study which is norm.upnm@gmail.com. The account is officially dedicated to the construction of the mobile app. Figure 2 shows the front page of the software used to develope the ‘UPNM Cardio Fitness’ mobile app.

The researcher was required to create a specific file using .aia format in the process of building the app. By using the format, the application is developed by following the guidelines in the app’s construction framework. Tutorials are provided in building the app by MIT. They have prepared the process and procedure for those who intend to create their own application. The tutorials have facilitated the researcher in building the app. Interestingly; MIT App Inventors 2 does not require an Android emulator to run as the application player. The software uses an emulator developed by MIT AI2 Companion itself that can be downloaded straight to the smartphone. Hence, the researcher could run and test the application at the same time.

Figure 2: Interface features of MIT Apps Inventor through the UPNM_CARDIO_FITNESS.aia file
The researcher then changed the format from .aia to .apk to test the application. The application is downloaded from the registered account into the smartphone. The smartphone will open the UPNM CARDIO Fitness application. Figure 3 below shows the UPNM Cardio Fitness app that has been installed into a smartphone.

![UPNM Cardio Fitness app installed into a smartphone](image)

Figure 3: UPNM Cardio Fitness app installed into a smartphone

After the installation process, the app can then be opened. The installation process takes about 1-2 minutes depending on the specs of the smartphone used. The app can be installed on all smartphones running different versions of Android as the platform. Once installed, the icon of the app is selected and the homepage is displayed as shown in Figure 4. The front page displays the information that needs to be filled, and they are: name, identification card number, age and gender. The information is saved together with the 2.4 km run test result conducted. After the information on the front page is completed, users have the opportunity to use the application by running the 2.4 test and get instantaneous result. Users have two options to choose either ‘count’ or ‘manual’ by selecting the icon at the bottom of the page. ‘Count’ serves to start the 2.4 km run test as the user starts running. The result will be displayed automatically. As for ‘manual’ icon, the users need to enter the duration in the 2.4km run test on their own, only then the test results will be displayed.

![The front page of the UPNM Cardio Fitness application](image)

Figure 4: The front page of the UPNM Cardio Fitness application

![Display of the front page after the ‘count’ button is selected](image)

Figure 5: Display of the front page after the ‘count’ button is selected

Figure 5 shows the front page when ‘count’ button is selected. The display shows a digital stopwatch that will be automatically activated for the 2.4 km run test carried out by the end user. There are ‘start’, ‘stop’, and ‘reset’ buttons. Users may follow the instructions displayed on the page. ‘Result’ button is selected to get the run test result immediately. The result is displayed according to the time recorded. A ‘menu’ button is provided at the bottom of the page to return to the main menu.

The user selects the ‘manual’ button to know his or her level of achievement or performance in the run test. The image displayed after the button is selected is as shown in Figure 6. Users only need to enter the duration of the run
according to the formats used for time. The units according to the formats used for time are minutes, seconds and tenth of a second. Then, the ‘result’ button is clicked to get the run test result and the level of achievement.

Figure 6: Front page after ‘manual’ button is selected

The displayed ‘result’ page shown in Figure 7 shows the result in the 2.4 km run test by a user. Users get an immediate result that will be displayed according to the fitness norms uploaded in the application. The cardiovascular endurance fitness norm of an 18 years old male is used as the database in this application. The page shows individual details filled at the home page of the app. The additional feature available on this app is that each recorded time using this app can be stored in the cloud using Google Fusion Table. A ‘save’ button is provided for storing data in Google Fusion Table. Figure 7. ‘Result’ page displayed after run test is conducted either automatically or manually

When the ‘save’ button is selected, the data is stored immediately into the Google account via Google Fusion Table. Google Fusion Table is an additional feature to manage data to be stored virtually or online [25]. Google Fusion Table was launched in June 2009 by Google Inc. The upside of this function is that data can be accessed anywhere by using internet and a Google account. This method makes it easier for researchers to access data and conduct studies for the next data collection.

Figure 7: Results of 2.4 km test run

5. Discussion and Implication

The result of this research almost resembles the result that was conducted in the study by [14]. Many thought that physical activity and physical fitness are directly related. However, they are defined differently and used in a different context. Physical activities can contribute to physical fitness. Discipline and methods of training must be strictly followed to produce expected results to achieve physical fitness by carrying out physical activities.

The second objective is to build a cardiovascular endurance fitness norm based on the 2.4 km run battery test. The norms were produced from the test conducted on a total of 120 male cadets. The test result is then analysed to construct a fitness norm. However, the norm is limited to male individuals aged 18 years old only. Data mining
and production of norms with age ranging from 17 to 25 years old are needed so that the norms can be compared in the future research.

The third objective is to build a mobile application through Android system based on the cardiovascular endurance fitness norm produced. The app, called the UPNM Cardio Fitness was successfully produced using the fitness norms as the baseline of the product. The production has created a new dimension of storing and managing information from the transformation of a test result that can now be easily obtained and accessed. The views and ideas from a committed technology expert has helped the researcher in making sure the goals are achieved. The additional functions in this app can be updated and enhanced from time to time as there are many elements of fitness from other sports that can be included into the application. The new app can be shared easily and is user-friendly.

6. Conclusion
Overall, the product of this research which is the cardiovascular endurance fitness norms for 18 years old UPNM male Military cadets Officer can be used as a guideline to measure the overall level of fitness for the reference of many people. With the production of the norms, the level of cardiovascular fitness norm for an 18 year old male can be assessed through the 2.4 km Run Test. The norms measures and determines the level of fitness accurately when the test is done. Generally, the fitness norms benefit a lot of people especially teenagers who fall into the age category of interest. Amongst the benefits are not only to know the level of fitness but also acts as the motivation to create a better lifestyle that is healthy and safe. Recent studies of Kassim, M. et al. (2015), states that physical fitness is when a person has the ability to perform daily tasks without fatigue with minimal energy consumption and has surplus energy to be used for more challenging activities.

Hopefully, this research gives an impact to several parties which are involved in the management of sports team particularly for trainers to harness the privilege of using technology in recruiting the talents especially in sports. Therefore, it is crucial to have full understanding on the efficient training system to produce quality and planned goals for any team or athletes. Consistent with the research conducted by [26] that proposed an efficient training system using fitness test procedure, it should have high potential to make it as an interesting experience to attract people involved especially youths. In addition to the technological aspect that gained attention especially the millennials who want to obtain information easily without depriving the quality of the information. The outcome of this research could be patented as the proprietary of the UPNM and also utilized as a fitness guideline to produce fitness norms for every age and gender in Malaysia.

References

[1] Sharplies, M. 2000. The Design of Personel Mobile Technologies for Lifelong Learning. Computers and Education, (34) 177-193.

[2] Salman, A. 2010. ICT, the New Media (Internet) and Development: Malaysian Experience. 15(1. The Innovation Journal: The Public Sector Innovation Journal., 15(1).

[3] Cardinal, D. 2013. Beyond megapixels: The future evolution of smartphone cameras. Retrieved fromhttp://www.extremetech.com/extreme:
http://www.extremetech.com/extreme/151334-beyond-megapixels-the-future-evolution-of-smartphone-cameras

[4] Taylor, M. 2014. The Evolution of the Smartphone. Retrieved from pocketnow: http://pocketnow.com/2014/07/28/the-evolution-of-the-smartphone

[5] eMarketer. 2014. 2 Billion Consumers Worldwide to Get Smart(phones) by 2016. Retrieved from eMarketer:http://www.emarketer.com/Article/2-Billion-Consumers-Worldwide-Smartphones-by-2016/1011694

[6] Kassim, M., & Ali, N. R. 2015. An Effective Coaching Through ‘Coaching Model’. Journal of Scientific Research & Development, 2(9), ISSN 1115-7569.

[7] Shanmugapriya, M., & Tamilarasia, A. 2011. Designing an m-learning application for ubiquitous learning environment in the android based mobile devices using web services. Indian Journal of Computer Science and Engineering (IJCSE), 22-30.

[8] Sarwar, M., & Soomro, T. R. 2013. Impact of Smartphone’s on Society. European Journal of Scientific Research, Vol.98 No 2, 216-226.
[9] Haron, Z., & Husain, S. 2010. Persepsi Mahasiswa SPI Terhadap Amalan Gaya Hidup Sihat Menurut Islam Dalam Aspek Penjagaan Kesihatan Dan Pemakanan. 1-8. Retrieved from http://eprints.utm.my/10789/1/Persepsi_Mahasiswa_SPI_Terhadap_Amalan_Gaya_Hidup_Sihat_Menurut_Islam_Dalam_Aspek_Penjagaan_Kesihatan_Dan_Pemakanan.pdf