The Design and Development of BMI Calc Android Application

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Abstract. Body mass index is a familiar term for those who are weight conscious. It is the term that let user know about the overall body composition in terms of fat. The available body mass index calculators whether online or on Play Store do not provide Malaysian meal suggestions. Hence, this paper proposes an application for body mass index calculator together with Malaysian meal suggestion. The objectives of the study are to design and develop BMI Calc android application for the purpose of calculating body mass index while embedding meal suggestion module. The design and methodology involve in the process are also presented.

1. Introduction
Mobile phones have crucial influences on consumers and their life style. Nowadays, there are many applications which have been developed for mobile phones and one of those is healthcare applications. Gartner, Inc. has identified ‘Mobile Health Monitoring’ as the fifth among the ‘Top 10 Consumer Mobile Applications for 2012’ [1]. This list is supported by the ‘Top 10 Strategic Technology Trends for 2014’ which includes ‘Mobile Apps and Applications’ [2]. Analysts expect global mobile health market’s value will increase to $11.8 billion by 2018 [3]. As a matter of fact, the medical apps industry is expected to grow by 23 percent next year.

At the time of the study was conducted, the available body mass index (BMI) calculators whether online or on Play Store did not provide any Malaysian meal suggestions. Therefore, there is a need for an application with BMI calculator embedded with Malaysian meal suggestions. The objectives of the study are to design and develop BMI Calc android application which enables to calculate BMI and to incorporate Malaysia meal suggestion module within the application. Specifically, BMI Calc is able to suggest suitable meal for certain Malaysian dishes with related calorific values. The project scope involves the calculation of the BMI, which is to be calculated within the application itself; then suitable Malaysian meals with calories will be displayed.

This paper is organized into several sections. Section 2 discusses the related work focusing on various health monitoring applications. Section 3 presents the design and methodology involves in the process including the flowcharts. Section 4 presents the user interfaces and evaluation for BMI Calc. Finally, the work of this paper is summarized in the final section.
2. Related Work
In order to design and develop BMI Calc Android Application, few related works have been reviewed. The related works are summarized as in Table 1, starting from the earlier published work to the most recent ones.

| Source                        | Technique                  | Feature Used                                                                 | Domain  | Disadvantage/Advantage                  | Future Direction                  |
|-------------------------------|----------------------------|------------------------------------------------------------------------------|---------|----------------------------------------|----------------------------------|
| Sowah, Buadu and Fiawoo [4]   | Android Architectural Framework | Modules: BMI Calculator, Food Calorie Calculator, Mealtme Planner and Disease Risk Determinator | Health | User friendly interface                | Implement on other mobile platforms apart from Android |
| Rao and Krishna [5]           | Modules: BMI/BMR Calculation, Exercise Calorific Calculation, Recommended Exercise Calculation, Recommended Exercise | Interfaces are not user friendly                                              |         |                                        |                                  |
| Madariaga and Linsangan [6]   | Artificial Neural Network   | Obtaining height using camera and measuring weight using load cell            | BMI     | The bottom line detected by searching for horizontal line on the pattern on the floor | Height estimation is better if higher pixel rating is used |

3. Methodology and Design
This research adopts the steps of waterfall model which progress from one phase to another linearly, as illustrated in Figure 1 [6].

Figure 1. Waterfall model steps
Waterfall model was chosen because parts of the application are generally well understood. It can be observed from Figure 1 that the study commenced with stage 1 - the requirements specification. User and application requirements need to be gathered in order to obtain clear picture pertaining to the specific features of the application. Table 1 shows the relationship between user and the application requirements.

| No | User Requirements                  | Application Requirements                  |
|----|-----------------------------------|------------------------------------------|
| 1  | Key-in height and weight          | Height in meters and weight in kilograms will be keyed-in BMI Calc. |
| 2  | View BMI                          | BMI will be displayed up to 2 point forms. |
| 3  | View BMI category                 | BMI category either underweight, normal weight, pre-obese, or obese will be displayed. |
| 4  | View Meal Suggestion              | Menu suggestion for breakfast, morning tea break, lunch and dinner will be displayed. |

Next, it is followed by the second stage which involves designing the workings of BMI Calc Android application and the software.

### 3.1. BMI Calculator
This module calculates the BMI based on the height in meter and weight in kilogram of a user using the formula in (3.1).

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BMI = \frac{\text{Weight (kg)}}{(\text{Height (m)})^2} \tag{3.1}
\]

BMI can be defined as a heuristic proxy for estimating human body fat based on an individual’s weight and height. According to World Health Organization (WHO), Asian BMI classifications can be categorized to 4 groups as tabulated in Table 3 [5]. This classification is intended for both men and women.

| 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 |

### 3.2. Meal Suggestion
The researchers developed meal suggestions on the application utilizing App Inventor 2. The suggestions for breakfast, lunch, and dinner are based on the number of calories needed by the user, which also taking into account several favourite Malaysian dishes. BMI Calc Android Application development using App Inventor 2 is described in Figure 2.

Then, the third stage of BMI Calc application development (Coding) was the implementation stage. Testing was performed concurrently with the programming of the application. The overview of BMI Calc operation is displayed in Figure 2. Two inputs are demanded from the users which are height and weight. Once this information is inserted in the application, user’s BMI will be calculated based on the aforementioned formula. As a result, the user’s BMI category together with suitable meal suggestion for that particular category will be displayed.
Afterwards, stage four involves integrating and testing BMI Calc Application before it can be fully utilized by users. All of BMI Calc functions must be tested to ensure that it is error free and the end result meets user requirements as determined earlier in the study. Finally, stage five requires that the developers to perform frequent operation and maintenance so that BMI Calc keeps on functioning at its best ability.

**Figure 2.** Overview of BMI Calc Operation
4. Results
As shown in Figure 3, the overall test operation of BMI Calc Application had indicated a successful outcome in designing and developing the application. Figure 3(a) shows BMI Calc interface requesting for user’s height in meter and weight in kilogram. Figure 3(b) displays the BMI Calc after receiving input from user. Given example was a user with 1.61 meters tall and weighs 65 kilograms. Once the CALCULATE button was pressed, BMI Calc displayed user’s BMI category as in Figure 3(c). The sum of the calculation indicated that the user was pre-obese.

Finally, when the user pressed on the Meal Planner button, an image suggesting meals to be consumed during breakfast, morning tea, lunch and dinner were displayed as in Figure 3(d). The application also revealed the calculated calories on the suggested meals. Apart from that, the appropriate hour or range hours when each meal should be taken was also recommended.

4.1. User Evaluation
To obtain data on users’ opinion about the application’s ease of use aspect, the instrument - questionnaire was administered. A total of 30 respondents participated in users’ evaluation process. The respondents of the study were the users who had tested the application for the first time. These users were requested to fill out the questionnaire upon the completion of the application testing and rate their experience in using the application.

The questionnaire was constructed into two different sections: section A and section B. Section A was used to obtain demographic background of the users including age, gender and level of education. Data were then analyzed using descriptive method and is tabulated as in Table 4.
Section B contains six elements on the evaluation of the use of BMI Calc application which are a, b, c, d, e, and f. Inferential statistical method was used to analyze data in this section. Table 5 and Figure 4 show the overall results on the evaluation for BMI Calc Application from the aspect of ease use. It was discovered that mode for user feedback regarding the ease of use is 4 and most users are agreeing for ease of use for this application. The range for average based on user feedback is 3.43 to 3.57 with the standard deviation range from 0.556 to 0.817. The highest average is for item a, b, and d based on user feedback is 3.57 (SD = 0.626, 0.728, and 0.679). The lowest average is for item c which is 3.43 (SD = 0.817).

| No | Item                                                   | Min | Max | Mode | Average | Standard Deviation |
|----|--------------------------------------------------------|-----|-----|------|---------|--------------------|
| a. | The app is easy to use                                 | 2   | 4   | 4    | 3.57    | 0.626              |
| b. | It is simple to use                                    | 1   | 4   | 4    | 3.57    | 0.728              |
| c. | It is user friendly                                   | 1   | 4   | 4    | 3.43    | 0.817              |
| d. | It requires the fewest steps possible to accomplish what I want to do | 1   | 4   | 4    | 3.57    | 0.679              |
| e. | It is flexible to use                                  | 2   | 4   | 4    | 3.53    | 0.629              |
| f. | I don’t notice any inconsistencies when I use it      | 2   | 4   | 3    | 3.37    | 0.556              |

Figure 4. Response for Ease of Use
5. Conclusion
An android application that calculates body mass index on different categories including underweight, normal weight, pre-obese and obese is needed by the health conscious community. However, only a few in the market today which can suggest Malaysian dishes as part of the application. Hence, with the development of BMI Calc Android Application, the researchers are able to assist particularly Malaysian people in eating healthily by including Malaysian meal suggestion module in the android application which can recommend suitable dishes based on the body mass index categories.

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