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DESIGN AND IMPLEMENTATION OF ANDROID-BASED DIET AND JOGGING RECOMMENDATION APPLICATION TO OVERCOME OBESITY

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Abstract

Obesity has become a significant global health issue, affecting populations in both developed and developing countries. The World Health Organization (WHO) reported a substantial rise in obesity rates since 1990, with 43% of individuals classified as overweight in 2022. This study aimed to design and implement an Android-based diet and jogging recommendation application targeting adults. Following the Waterfall model, the research adhered to a structured, sequential process that included requirements analysis, system design, implementation, testing, deployment, and maintenance phases. The application calculates Body Mass Index (BMI) based on user input, such as weight, height, age, and gender, categorizing individuals into seven classifications: Underweight, Normal weight, Pre-obesity, Obesity class I, II, and III. Personalized diet and exercise recommendations are then provided to help users achieve and sustain a healthy weight. The app integrates the Google Maps API to track jogging routes and the Low Carb Recipes API to offer calorie-based meal suggestions. Additionally, the Jogging Tracking feature allows users to monitor their jogging history. The results demonstrate that the application effectively delivers customized dietary and physical activity recommendations, aiding users in managing their caloric intake and maintaining consistent exercise routines. The system proves to be both functional and practical, offering a valuable tool in the fight against obesity, particularly in Indonesia. This research contributes to addressing the global obesity crisis by providing an accessible, technology-driven solution.

Keywords: Android, BMI, Calorie, Jogging, Obesity.

1. Introduction

Obesity has become a critical global health issue, affecting millions of individuals in both developed and developing countries [1-3], with the prevalence of obesity had doubled since 1990 [4]. The data also revealed that, in 2022, 43% of adults were classified as overweight [4]. Alarmingly, obesity is a leading cause of serious health problems, including diabetes [5-8], cardiovascular disease [9-11], and certain types of cancer [12-14]. In Indonesia, obesity has become an increasing concern, driven by changes in lifestyle, diet, and reduced physical activity [8, 15, 16]. Research indicates that obesity can be accurately assessed using a person's Body Mass Index (BMI) value [17]. As a result, maintaining a healthy BMI is an essential strategy for weight control. Individuals who are overweight may seek to lose weight through exercise and diet, while those who are underweight may focus on gaining weight by consuming calorie-dense foods. Addressing obesity is crucial for individual health and reducing the economic burden it places on global healthcare systems. Research has also shown that there is no single "best" strategy for weight management [18], meaning that weight loss and maintenance plans should be tailored to the individual. Healthcare providers must choose the most suitable approach based on each patient's preferences and needs.

Advancements in technology offer new solutions for detecting and managing obesity. Several researchers have developed applications to assess obesity levels [19-21], and mobile apps have proven effective in promoting healthier lifestyles by offering personalized diet plans, fitness tracking, and motivational tools. Weight management apps have the potential to reduce obesity, especially since health knowledge and behaviours shifted dramatically during the COVID-19 pandemic [22]. With the widespread availability of smartphones, individuals now have easy access to health information and recommendations. For example, one app tracks daily steps and calorie intake, while another encourages exercise to maintain health [23].

This study focuses on designing and implementing an Android-based diet and jogging recommendation application for adults (18 years and older). The app uses data such as weight, height, age, and gender to categorize users by BMI and provide personalized diet and exercise recommendations to help achieve and maintain a healthy weight. It also integrates the Google Maps Application Programming Interface (API) to track jogging routes and the Low Carb Recipes API to offer food suggestions based on calorie needs. By incorporating these technologies, this research aims to provide an accessible and practical solution to help reduce obesity rates, particularly in Indonesia.

2. Research Method

This research used the Waterfall model, a traditional approach in software engineering [24]. Several studies have utilized this model in developing Android or web-based applications within the health sector [25, 26]. The Waterfall model is a linear process divided into distinct phases: (i) requirements analysis, (ii) system design, (iii) implementation, (iv) testing, (v) deployment, and (vi) maintenance. Each phase produces specific deliverables that guide the development of the Android-based diet and jogging recommendation application. The stages of the research, structured according to the Waterfall model, are shown in Fig. 1.

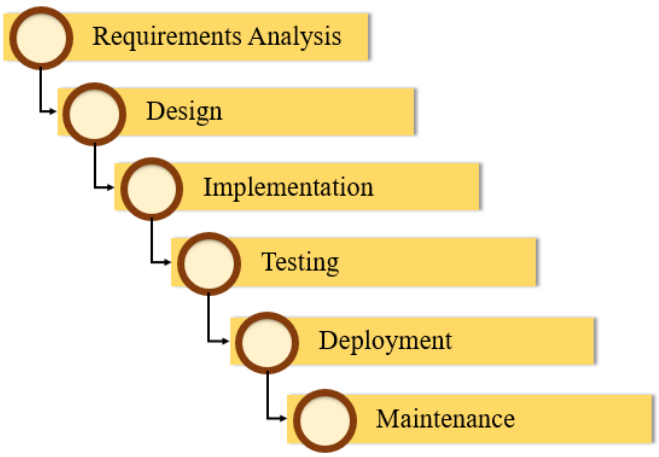


Fig. 1. Stage of research using the waterfall model.

The steps of the waterfall method include:

i) Requirements analysis: In the initial stage, user requirements are gathered through surveys and interviews with individuals facing obesity-related challenges. The primary focus is on understanding the desired features, such as calculating Body Mass Index (BMI), Resting Metabolic Rate (RMR), Metabolic Equivalent of Task (MET), personalized diet recommendations, jogging routines, and intuitive navigation. Additionally, food recommendations are sourced from the Low Carb Recipes API, while the Google Maps API is utilized to track jogging activity.

ii) System design: This phase involves the design of key system components, including the system architecture (see Fig. 2), use case diagram (see Fig. 3), activity diagram, and class diagram. The use case diagram outlines the interaction between the user and the system. The system encompasses various features, including user registration, login, display of diet and jogging suggestions, profile editing, food recommendations, jogging activity tracking, jogging history display, calorie suggestions, BMI level categorization, and time management for diet and jogging recommendations.

iii) Implementation: The implementation phase focuses on developing the application according to the system design. The Android platform was selected for its broad accessibility. The coding for this system was carried out using Kotlin, a versatile programming language primarily used for Android mobile application development.

iv) Testing: After implementation, the system undergoes thorough testing to ensure all functionalities perform as expected. This process includes unit testing of individual components, integration testing of the entire system, and user acceptance testing to validate the application's usability.

v) Deployment: The application is deployed for user access once testing is complete.

vi) Maintenance**:** The final phase involves ongoing monitoring and updates to address bugs, enhance performance, and introduce new features based on user feedback.

2.1. BMI, RMR and MET

BMI is calculated by dividing a person's weight into kilograms by the square of their height in centimeters. The recommended range for a normal BMI, adapted from the WHO global guidelines, is 18.5–24.9. BMI indicates disease risk, with the likelihood of various health conditions increasing as BMI rises. Overweight and obesity are linked to several health issues, including premature death, cardiovascular disease, high blood pressure, osteoarthritis, certain cancers, and diabetes. The formula for calculating BMI is provided in Eq. (1), while the full table of nutritional status categories based on BMI values is shown in Table 1.

$$BMI = \frac{Weight(\text{kg})}{Height\ \text{m}^2} \quad (1)$$

Table 1. Weight status.

BMI	Weight status
Below 18.5	Underweight
18.5–24.9	Normal weight
25.0–29.9	Pre-obesity
30.0–34.9	Obesity class I
35.0–39.9	Obesity class II
Above 40	Obesity class III

RMR is an equation used to calculate the number of calories a person needs in one day [27]. It determines the required calorie intake based on factors such as gender, weight, and age. Since women's calorie needs are generally lower than men's, the RMR differs for each gender. The RMR for men is given by Eq. (2), while the RMR for women is provided by Eq. (3).

$$RMR = 260 + (9{,}65\ \times\ weight) + (573 \times height) - (5.08 \times age) \quad (2)$$

$$RMR = 43 + (7{,}38\ \times\ weight) + (607 \times height) - (2{,}31 \times age) \quad (3)$$

MET (Metabolic Equivalent of Task) measures the amount of oxygen consumed during low-intensity activities [28]. It can also be used to estimate the number of calories burned during an activity. By knowing the MET value, the calories burned can be calculated, the MET value for jogging is 2.8 [28]. Eq. (4) represents the Exercise Calories (EC) formula, which calculates the calories burned during jogging based on the MET value.

$$EC = MET\ x\ 7.7 \times \left(\frac{Weight(kg) \times 2.2}{200}\right) \times \frac{Duration(s)}{60} \quad (4)$$

3. Results and Discussion

3.1. System architecture

The software architecture of the mobile platform outlines the interactions within the system being developed [29, 30]. The mobile software architecture is shown in Fig. 2. The workflow of the designed system architecture is described as follows: (i) The user logs in by entering their account email and password; (ii) Upon successful login, the user receives a confirmation message and is redirected to the Jogging Suggestion page; (iii) The user registers by entering their account email, password, height, weight, gender, and age; (iv) The user receives a message indicating whether registration was successful or failed; (v) The system requests

user data to manage algorithm requirements, such as BMI, RMR, and MET; (vi) The system either receives the user data or returns an error if there is a failure in data retrieval; (vii) The system retrieves jogging data to be displayed on the Jogging History page; (viii) The system receives either jogging data or an error message if there is a failure in retrieving jogging data; (ix) The system saves images to Cloud Storage; (x) The system receives a success or error response depending on whether the image save operation is successful; (xi) The system requests images from Cloud Storage; (xii) The system either receives a success or error response if there is a failure in retrieving the images; (xiii) The system requests the user's mobile phone location from the Google Maps API; (xiv) The system receives a response containing the user's mobile phone location from the Google Maps API; (xv) The system requests food recommendation data from the Low Carb Recipes API, based on the required query parameters; and (xvi) The system receives food recommendation data from the Low Carb Recipes API.

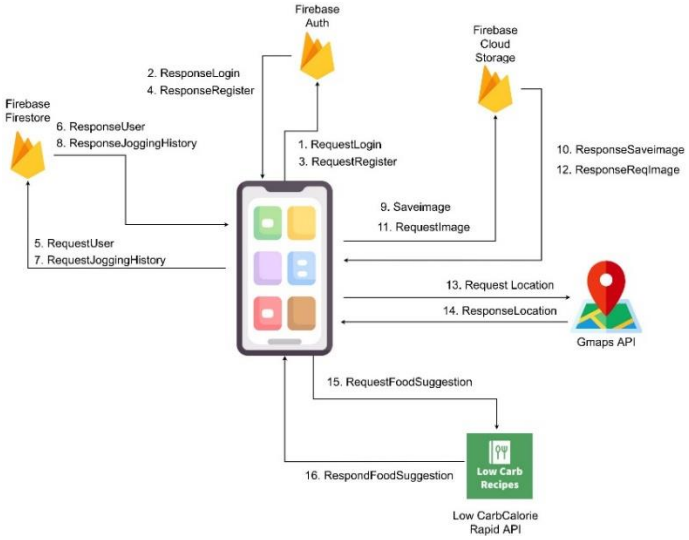


Fig. 2. System architecture.

3.2. Use case diagram

The use case diagram of the designed system is shown in Fig. 3. The system involves three main actors: users, the Google Maps API, and the low-carb recipes API. Users can register and log in to access the system and modify their profile information. The Google Maps API displays a map and records the user's path, while the low-carb recipes API provides food suggestions based on the user's calorie requirements. A detailed description of each use case is shown in Table 2.

Figure 4(a) presents the registration and login page. Users must first register by entering their email address, password, name, height, weight, age, gender, and date of birth. After registration, Fig. 4(b) shows the login page where users can enter their username and password to access the system. On the other hand, the Home Fragment page displays key information, including the user's weight category, required diet duration (in days), recommended jogging duration, and daily calorie needs. This data is derived from the user's profile information.

Users can update their profiles if any changes are necessary. An example of this page is shown in Fig. 5. In the example, the user has a height of 170 cm and is 24 years old. As shown in Fig. 5(a), if the user's weight reaches 75 kg, the system categorizes them as overweight. The system then recommends a 28-day diet and jogging plan, which includes jogging for 28 minutes daily and a daily calorie intake of 1561 kcal. If the user's weight increases to 80 kg, as shown in Fig. 5(b), the system continues to classify them as overweight but recommends a longer plan of 2 months and 17 days, with 26 minutes of jogging per day and a daily calorie intake of 1609 kcal. Figure 5(c) shows the case where the user's weight reaches 100 kg, at which point the system classifies them as Obesity Class I. The system then recommends an extended diet and jogging plan lasting 9 months and 6 days, with 21 minutes of jogging daily and a daily calorie intake of 1802 kcal. In addition to weight tracking, the application features a Jogging Tracking menu shown in Fig. 6(a), and a Jogging History menu shown in Fig. 6(b).

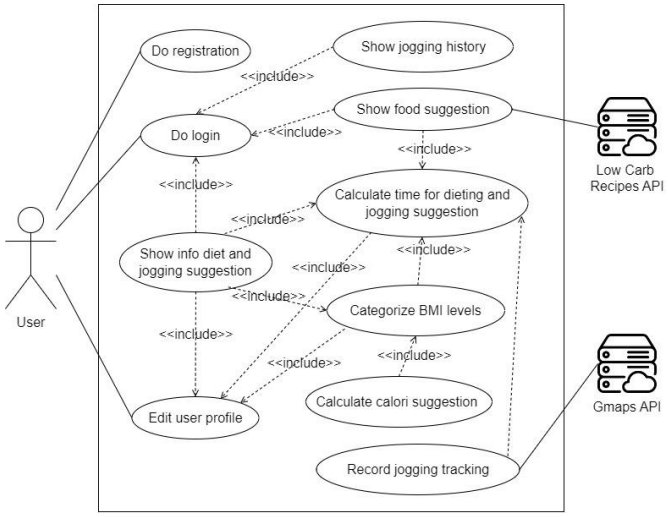


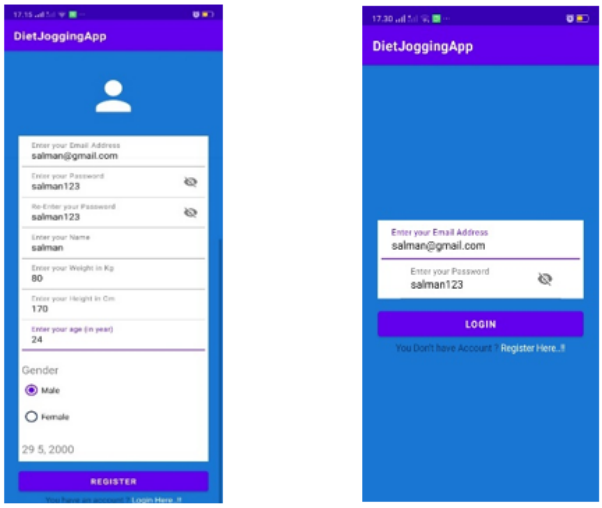
Fig. 3. Use case diagram of dieting and jogging suggestion apps.

Table 2. Use case definition.

No.	Function	Description
1	To register	It is used to carry out the account registration process for users.
2	Do login	Users use it to access all diet and jogging recommendation application features.
3	Show info diet and jogging suggestion	It is used to show information on BMI levels, suggested time for dieting and jogging, and the number of calories needed.
4	Edit user profile	Users use it to update profile data.
5	Show food suggestion	It functions to display information about food recommendations according to the calories needed by the user.
6	Record jogging tracking	It is used to record the jogging route taken by the user.
7	Show jogging history	It functions to show jogging history functions to display information about the jogging history taken by the user.

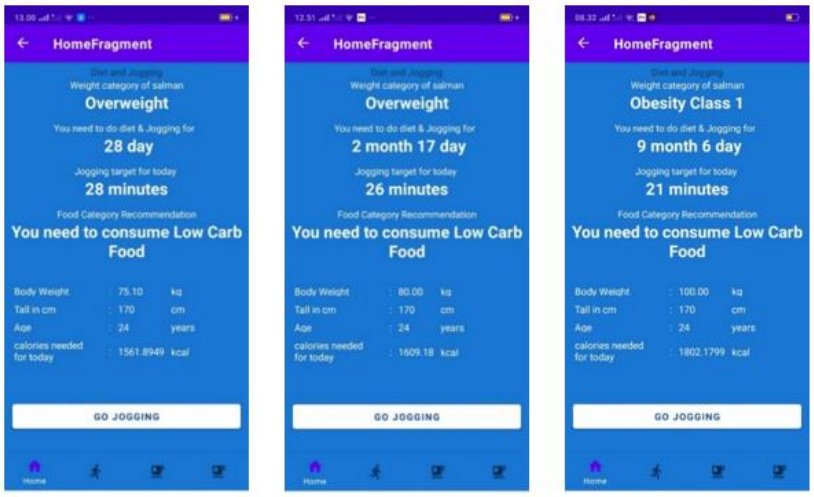
Table 2 (continue). Use case definition.

No.	Function	Description
8	Calculate calorie suggestion	It functions to calculate the calories needed from MET value.
9	Categorize BMI levels	It functions to calculate the BMI value and categorize it by nutrition status.
10	Calculate time for dieting and jogging suggestion	It functions to calculate time for dieting (days) and jogging suggestions (minutes).



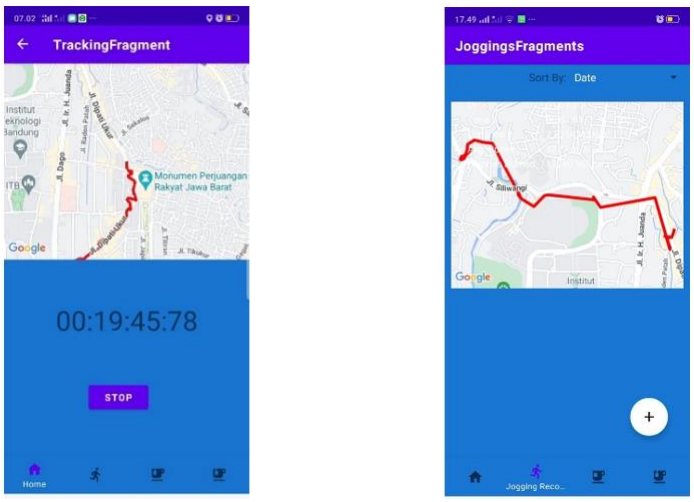
(a) **(b)**

Fig. 4. Register and login menu: (a) register menu and (b) login menu.



(a) **(b)** **(c)**

Fig. 5. Home fragment: (a) 75 kg weight, (b) 80 kg weight, and (c) 100 kg weight.



(a) **(b)**

Fig. 6. Jogging tracking and jogging history: (a) jogging tracking and (b) jogging history.

The Jogging Tracking menu utilizes the Google Maps API to access the user's phone location. Additionally, users have the option to record or save their jogging routes. The Jogging History menu displays previously saved jogging routes stored as images in Firebase Storage. These data can be retrieved from Firebase Firestore. After using the app, a user satisfaction questionnaire was completed to evaluate the application's functionality. The results of this test are shown in Table 3, while the survey questions are shown in Table 4.

Table 3. The test result of functionality.

No.	Functionality	Testing Point	Method	Result
1	Login	Fill login data	Black box	Accepted
		Click the login button	Black box	Accepted
		Validate login	Black box	Accepted
2	Register	Fill data registration	Black box	Accepted
		Click the register button	Black box	Accepted
		Validate registration	Black box	Accepted
3	Edit profile	Edit new data in the profile menu	Black box	Accepted
		Click the save button	Black box	Accepted
4	Home fragment	Display the time for diet (days)	Black box	Accepted
		Display the jogging suggestion	Black box	Accepted
		Display the BMI category	Black box	Accepted
		Display the food category	Black box	Accepted
5	Tracking fragment	Display the location from the user's smartphone	Black box	Accepted
		Save the jogging data	Black box	Accepted

6	Food suggestion fragment	Display the food suggestion list based on the maximal calories needed	Black box	Accepted
7	Account fragment	Display the user profile information	Black box	Accepted

Table 4. Question of beta testing.

No.	Question
1	Can this app provide information about your daily calorie needs?
2	Can this app help you determine the recommended length of time you should jog daily?
3	Can this app provide recommendations for foods needed for a weight-loss diet?
4	Can this app determine your weight category?
5	Does this app have a good user interface?
6	Is this app easy to use?
7	Does this application have benefits for people who are overweight for a weight loss plan?
8	Does this application have benefits for people who are underweight for a weight gain plan?

The survey results were based on user satisfaction ratings, ranging from 1 to 5, corresponding to the following categories: Strongly Disagree (SDA), Disagree (DA), Undecided (UD), Agree (A), and Strongly Agree (SA). A total of 20 respondents who were 18 years old and older participated in the survey, aligning with the target user demographic for this application.

The percentage results for each question are as follows: (i) The first question yielded 85%, indicating that most respondents agreed the application effectively provides information on daily calorie requirements; (ii) The second question received 86%, suggesting that respondents believe the application can accurately provide information on the necessary daily jogging duration; (iii) For the third question, 84% of respondents agreed that the application offers suitable food recommendations for weight loss diets; (iv) The fourth question received 91%, with respondents agreeing that the application accurately determines the user's weight category; (v) The fifth question garnered 93%, reflecting that most respondents felt the application features a well-designed interface; (vi) The sixth question received 85%, indicating that respondents found the application easy to use; (vii) The seventh question yielded 90%, demonstrating that respondents found the application beneficial for weight loss plans; and (viii) The eighth question resulted in 89%, with respondents agreeing that the application is useful for weight gain plans, particularly for underweight individuals.

4. Conclusion

The Android-based diet and jogging recommendation application has been successfully developed and demonstrates practical functionality. The application determines a user's nutritional status based on their BMI, calculated from height and weight. Users are categorized into one of seven groups: Underweight, Normal weight, Pre-obesity, Obesity Class I, II, and III. The application provides tailored diet and jogging recommendations for each category to help users achieve a healthy weight. The system suggests food intake based on the user's daily caloric requirements and recommends appropriate jogging durations for individuals in the

obesity categories to help them burn the necessary calories. Additionally, the application includes a Jogging Tracking feature that allows users to monitor their jogging history. The findings from this research suggest that the developed system offers practical solutions for managing obesity by helping users regulate their food intake and maintain consistent physical activity for weight management. Future research will focus on enhancing the system's ability to calculate the caloric content of food items, ensuring consistency with users recommended daily calorie intake. Additionally, the application could be improved by offering personalized food recommendations based on users' dietary preferences and typical food choices.

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