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SMART DIET ASSISTANT APPLICATION FEATURING A FOOD DIARY AND MENU RECOMMENDATIONS BASED ON THE DECISION TREE ALGORITHM

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ABSTRACT

Body health is strongly influenced by a balanced and regular diet, yet many people still struggle to manage their daily food intake according to their calorie needs and health conditions. This study aims to develop Smart Diet Assistant, an Android-based application that helps users record daily food consumption through a food diary feature and provides healthy menu recommendations using the Decision Tree algorithm. The application was developed using Kotlin with a Jetpack Compose interface, Room Database for local storage, and an MVVM architectural approach.

User data including age, gender, body weight, height, activity level, and medical history are used to calculate daily calorie needs via the Mifflin-St Jeor equation and to determine menu recommendations based on BMI status and health conditions such as diabetes, gastritis, and high cholesterol. The Decision Tree applies a rule-based approach to filter appropriate menus for each user profile.

Testing was conducted through Black Box Testing across two iterations and User Acceptance Testing (UAT) with 27 respondents. All functional scenarios passed in the final iteration. UAT results showed a usability score of 4.63/5 (92.59%) and a motivation impact score of 4.54/5 (90.74%), both categorized as Very Good. These results confirm that Smart Diet Assistant effectively functions as a decision support system helping users monitor calorie intake and receive personalized diet recommendations suited to their health conditions.

INTRODUCTION

An irregular diet is one of the leading causes of increasing overweight cases and metabolic disorders in modern society. The busy daily activities make it difficult for many individuals to control their food consumption, causing calorie intake to frequently exceed daily requirements. Daugherty et al. (2020) explained that consistent food recording can increase user awareness of eating patterns and help the success of diet programs.

In recent years, the development of mobile technology has provided great opportunities in supporting the management of eating patterns and diet programs. Android-based diet applications are increasingly popular because they are easily accessible, practical, and able to help users monitor food intake in real-time. Mummah et al. (2019) reported that users of food recording applications have a higher level of diet compliance because the recording process is faster and equipped with reminder features.

To support this need, computational methods such as Decision Tree can be used to generate more accurate food recommendations. Gupta & Sharma (2021) stated that Decision Tree has good classification performance in food recommendation systems because of its simple structure, easy to understand, and capable of mapping relationships between diet parameters. However, a fundamental weakness in most current diet applications is that they only focus on calorie deficit calculation without considering medical conditions or disease history (Vasiloglou et al., 2020).

Based on these needs, the author developed the Smart Diet Assistant application, an Android-based application that provides a Food Diary feature for recording daily food as well as a healthy menu recommendation feature based on the Decision Tree algorithm. This application is designed to help users control eating patterns more regularly, monitor calorie intake, and obtain menu recommendations that suit their health conditions.

LITERATURE REVIEW

Healthy Diet Patterns

A healthy diet is a food consumption pattern that meets the needs of balanced nutrition to maintain body function, increase energy, and prevent disease. According to the Ministry of Health of the Republic of Indonesia (2021), a healthy diet includes the fulfillment of carbohydrates, proteins, fats, vitamins, minerals, and fiber in amounts appropriate to body needs. Research by Hu et al. (2020) showed that regular and controlled eating patterns can reduce the risk of obesity, type 2 diabetes, and heart disease.

Food Diary

A Food Diary is a recording system used to record all types of food and beverages consumed by a person within a certain period. Burke et al. (2015) found that routine food recording can increase awareness of eating habits and help control body weight. In Smart Diet Assistant, the Food Diary feature is used to record food names, meal times, calorie amounts, and consumption dates.

Recommendation System

A recommendation system is a system designed to provide the best suggestions or choices to users based on their preferences, needs, or behavioral patterns. Ricci et al. (2015) stated that recommendation systems can improve user experience and satisfaction through providing relevant, personal, and individualized recommendations. In this study, the recommendation system functions to provide healthy food menu suggestions based on user dietary pattern data, processed using the Decision Tree algorithm.

BMI, BMR, and TDEE

Three main metrics are used as the basic reference for calculation in this system. Body Mass Index (BMI) is a simple indicator to monitor the nutritional status of adults, calculated by dividing body weight (kg) by the square of height (m). BMI = Weight (kg) / [Height (m)]^2. For Asian populations including Indonesia, the overweight threshold starts at 23.0 (Kemenkes RI, 2019). Basal Metabolic Rate (BMR) is the minimum amount of energy expended by the body for vital functions, calculated using the Mifflin-St Jeor equation, considered the most accurate method for predicting BMR in modern individuals (Amirkalali et al., 2008). Total Daily Energy Expenditure (TDEE) is obtained by multiplying BMR by the physical activity factor: TDEE = BMR × Activity Level.

Table 1. BMI Classification for Asian Populations

Nutritional Status Category	BMI Value Range (kg/m²)
Underweight	< 18.5
Normal (Healthy Weight)	18.5 - 22.9
Overweight	23.0 - 24.9
Obesity Grade I	25.0 - 29.9

(Source: Kemenkes RI, 2019; WHO Western Pacific Region)

Decision Tree Algorithm

Decision Tree is one of the decision-making methods that uses a tree-like structure for classification. The main components include root node, internal node, branch, and leaf node. In Smart Diet Assistant, the Decision Tree algorithm is used with a rule-based approach because menu recommendations are determined based on clear conditions without requiring large dataset training (Abdelhalim, 2016). The algorithm uses BMI value to determine weight status, and BMR/TDEE values to determine daily calorie needs. If BMI $\geq$ 23.0 (Overweight), the system reduces the TDEE target by 500 kcal (calorie deficit). If BMI $<$ 23.0 (Normal), the system sets the target according to TDEE for maintenance.

Diet-Related Diseases

The system focuses on three medical conditions with high prevalence in Indonesia: Gastritis (Maag), Diabetes Mellitus, and Dyslipidemia (High Cholesterol). For Gastritis patients, the system recommends food with a soft texture, avoiding spicy, acidic, and gas-producing foods. For Diabetes patients, the system applies the 3J principle (Jadwal/Schedule, Jumlah/Amount, Jenis/Type) from PERKENI (2021), recommending low glycemic index menus and limiting simple carbohydrates. For Dyslipidemia patients, the system applies the TLC (Therapeutic Lifestyle Changes) method, limiting saturated fat intake and increasing soluble fiber consumption (Kemenkes RI, 2019).

RESEARCH METHOD

This research uses an application development approach with the following stages: (1) identification of system requirements including user data, medical conditions, and needed features; (2) system design covering MVVM architecture, Room Database data flow, and Decision Tree logic rules; (3) implementation using Android Studio, Kotlin, Jetpack Compose, and Room Database; and (4) testing using Black Box Testing method and User Acceptance Testing (UAT) with 27 respondents. The system architecture applies the MVVM (Model-View-ViewModel) pattern to separate data processing logic from the user interface. The Repository component manages data from the Room Database and passes it to the ViewModel for processing, before displaying results to the user through Compose UI.

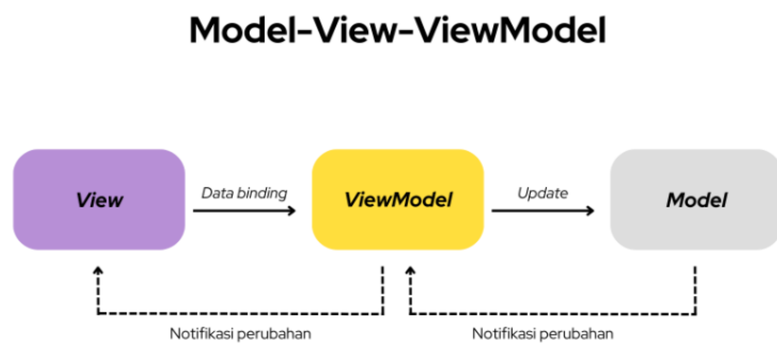

Figure 1. MVVM Architecture of Smart Diet Assistant

The Decision Tree algorithm flowchart shows the sequential decision logic from user input, through BMR/TDEE calculation and BMI determination, to disease-based menu selection to produce personalized diet recommendations.

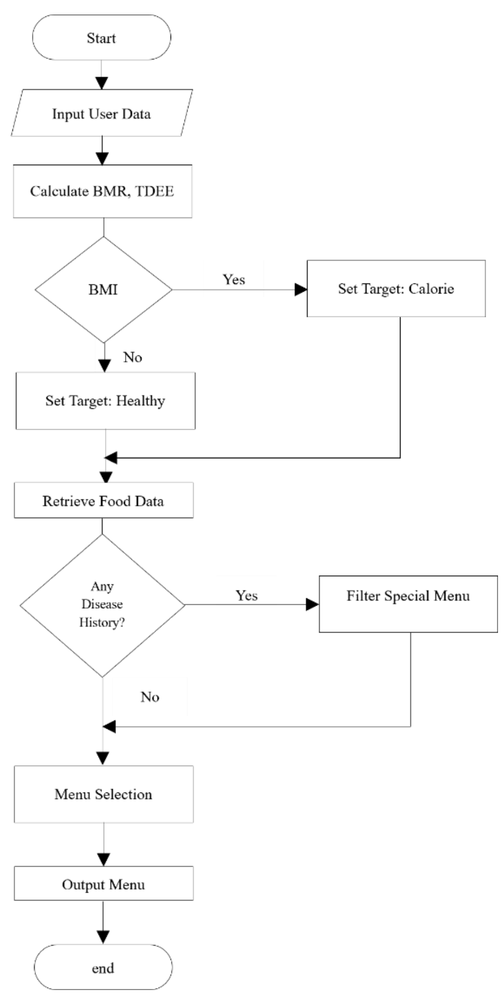

Figure 2. Decision Tree Algorithm Flow

Algorithm Simulation (Manual Calculation)

Scenario 1 - Overweight User with Gastritis (Male, 90 kg, 170 cm, Age 25, Light Activity):

BMR = (10×90) + (6.25×170) – (5×25) + 5 = 1,842.5 kcal

TDEE = 1,842.5 × 1.2 = 2,211 kcal

BMI = 90 / (1.70^2) = 31.1 → Obese (BMI > 23)

Target = 2,211 - 500 = 1,711 kcal → Soft Texture Menu (Gastritis)

Scenario 2 – Normal User, No Disease (Female, 50 kg, 160 cm, Age 22, Light Activity):

BMR = (10×50) + (6.25×160) - (5×22) - 161 = 1,229 kcal

TDEE = 1,229 × 1.2 = 1,475 kcal

BMI = 50 / (1.60^2) = 19.5 → Normal (BMI < 23)

Target = 1,475 kcal → Balanced General Nutrition Menu.

RESULTS AND DISCUSSION

System Implementation

Implementation Environment

System implementation was carried out in the development environment defined in the research methodology. The application was developed using Android Studio as the Integrated Development Environment (IDE), Kotlin as the primary programming language, Jetpack Compose for user interface design, and Jetpack DataStore and Room for local data persistence. The implementation environment specifications are presented in Table 1.

Table 1. Research Components

No	Component	Specification
1	Programming Language	Kotlin 1.9.0+
2	UI Framework	Jetpack Compose
3	Architecture	MVVM (Model-View-ViewModel)
4	Local Database	Jetpack DataStore / Room
5	IDE	Android Studio Otter
6	Target SDK	Android 13 (API 33)

User Interface (UI) Implementation

The user interface of Smart Diet Assistant is designed to facilitate user access to all available features. The interface is made simple, tidy, and easy to understand so that users can fill in profile data, view daily calorie targets, record food, and monitor food consumption history conveniently.

A. Input Data Page : This page is the initial gateway of the system where users enter anthropometric data (Weight, Height, Age, Activity Level) and select disease history. Input validation is applied to ensure no empty (null) or zero fields, to avoid division-by-zero errors in the BMI formula.

B. Dashboard Recommendation Menu : This page displays the results of Hybrid Decision Tree logic processing, showing Nutritional Status, Daily Calorie Target, and Food Menu List adjusted to the user's disease condition. Recorded data includes food name, weight, portion size, and calorie count.

C. Food Diary Page : This page serves as a monitoring tool for daily food consumption. Users can view consumed food entries via the Add Food button. Each food item is displayed in a list with calorie information. The page also shows the daily calorie target, total calories consumed, remaining consumable calories, and a Progress Bar for visual tracking.

D. Weekly Calorie Graph : This page provides a long-term evaluation and monitoring feature, visualizing calorie intake history for the last 7 days using a Bar Chart. A green bar indicates successful calorie management (deficit/normal), a red bar indicates calorie surplus, and tapping a bar (shown in orange) reveals detailed food data consumed on that day.

Decision Tree Algorithm Implementation

The Decision Tree algorithm is the core of the proposed solution. It generates diet menu recommendations by classifying user conditions based on profile attributes through conditional branching (tree-based decision making). Attributes used include name, age, gender, body weight, height, and disease history all obtained directly from user input. If a user has a specific disease history, the system immediately directs the decision process to a specialized diet menu recommendation. If the user is healthy, the system proceeds to the general healthy menu. Weight and height are treated as numeric (continuous) attributes, compared against predefined thresholds in the Decision Tree rules to determine subsequent decision branches.

System Testing Results (Evaluation)

System testing aimed to evaluate the performance and feasibility of the implemented application prototype. Testing was divided into two main stages: (1) Functional Verification, to ensure all application features and functions operate according to technical specifications; and (2) User Validation (User Acceptance Testing/UAT), to measure user acceptance, ease of use, and user perception of the developed application.

Functional Verification (Black Box Testing)

Functional testing was performed to ensure every component of Smart Diet Assistant operates according to designed specifications using the Black Box Testing method, focusing on system function conformance based on inputs and outputs. Testing was conducted in two iterations.

A. First Iteration Testing (Bug Findings) : Initial testing of main features revealed several functional failures as shown in Table 2.

Table 2. Functional Testing Results (First Iteration - Bugs Found)

No	Test Scenario	Expected Result	Actual Result	Status
1	Profile Input Validation: User saves profile without entering age	System displays error message and data is not saved	Application crashes unexpectedly (force close)	FAILED
2	Menu Recommendation: User requests recommendation after filling in profile	System displays menu recommendations based on user data	Menu recommendations do not appear	FAILED
3	Food Diary Storage: User saves daily food record	Data is saved and can be retrieved	Data is not saved after the application is closed	FAILED

B. System Fixes (Bug Fixing) : Based on the FAILED findings in Table 2, the following fixes were applied: (1) adding input validation in the ViewModel to ensure all profile data is filled before saving; (2) fixing the Decision Tree algorithm call logic so recommendations are only generated after all user attributes are complete; and (3) fixing the local database storage mechanism so food diary data is saved permanently and displayed correctly.

C. Second Iteration Testing (Passed) : After fixing the system, re-testing confirmed all functions operate according to design specifications. Results are shown in Table 3.

Table 3. Functional Testing Results (Final Iteration - Passed)

No	Test Scenario	Expected Result	Actual Result	Status
1	Profile Input Validation: User saves complete	System saves profile data without error	Profile data saved successfully	PASSED

	profile (age, gender, weight, height)			
2	Menu Recommendation: User requests recommendation after complete profile	System displays diet menu recommendations based on user attributes	Menu recommendations displayed successfully	PASSED
3	Food Diary Storage: User saves daily food record	Food diary data is saved and can be retrieved	Data saved and displayed correctly	PASSED
4	Disease Influence: User selects a specific disease	System provides a specialized diet menu recommendation	Menu recommendations match the disease condition	PASSED
5	Profile Update: User changes body weight or height	System updates calorie estimation results	Calorie estimation recommendation updated successfully	PASSED
6	Data Persistence: Application is closed then reopened	Profile and food diary data remain stored	Data remains stored	PASSED

Functional Verification Conclusion: All six test scenarios PASSED (100%). All main features of Smart Diet Assistant user profile management, food diary recording, and diet menu recommendation based on the Decision Tree algorithm operate correctly and in accordance with the design. The system is declared stable and ready to proceed to User Acceptance Testing (UAT).

User Validation (User Acceptance Test - UAT)

UAT was conducted to validate the usability and effectiveness of Smart Diet Assistant from the user's perspective in supporting easy management of eating patterns. Data was collected from 27 respondents from the general public with diverse backgrounds in age, gender, and occupation. Respondent demographics are presented in Table 4.

Table 4. User Validation Demographics

Variable	Category	Total (N=27)	Percentage
Gender	Male Female	11 16	40.7% 59.3%
Age Range	17–25 years 26–35 years	15 12	55.6% 44.4%
Occupation	Student / University Student	11	40.7%

	Employee	9	33.3%
	Housewife	4	14.8%
	Laborer	3	11.1%
Diet App Experience	Have used a diet app before	18	66.7%
	Have never used a diet app	9	33.3%

UAT Results Analysis and Discussion

Usability Analysis

Usability analysis aims to evaluate the interface quality, ease of use, and application interaction of Smart Diet Assistant from the end-user perspective. Usability is an important factor because a diet application that is difficult to use tends to be abandoned by users, regardless of its recommendation algorithm quality. Measurement was conducted using a UAT questionnaire involving 27 respondents. Results are presented in Table 5.

Table 5. Usability Analysis of Smart Diet Assistant

Usability Aspect	Representative Question	Avg. Likert Score (1-5)	Percentage (%)	Category
Layout & Navigation	The application display and menu navigation are easy to understand	4.59	91.85%	Very Good
Profile Data Input	The process of filling in profile data (age, gender, activity) is easy	4.89	97.78%	Very Good
Food Diary	Daily food recording is easy and not confusing	4.41	88.15%	Very Good
Calorie Information	Calorie value information is displayed clearly	4.85	97.04%	Very Good
App Interaction	The application response feels fast and stable during use	4.41	88.15%	Very Good
Overall Average		4.63	92.59%	Very Good

Motivation Impact Analysis

This section evaluates user perceptions of the impact of using Smart Diet Assistant in increasing awareness and motivation to maintain a healthy diet, as well as assessing the effectiveness of the Decision Tree algorithm in providing appropriate diet menu recommendations. Results are presented in Table 6.

Table 6. Motivation Impact Perception Analysis

Motivation Impact Aspect	Representative Question	Avg. Likert Score (1-5)	Percentage (%)
Recommendation Suitability	The menu recommendations match my condition and needs	4.70	94.07%
Ease of Decision Making	The application helps me determine my daily diet menu	4.41	88.15%
Dietary Awareness	The application increases my awareness of healthy eating patterns	4.67	93.33%
Diet Motivation	The application motivates me to maintain my diet consistently	4.37	87.41%
Overall Average		4.54	90.74%

UAT results in Table 6 show that Smart Diet Assistant achieved an average motivation impact score of 4.54 (90.74%) in the Very Good category, indicating that the Decision Tree algorithm generates diet menu recommendations perceived as relevant by users. The score on the ease of decision-making aspect confirms that the application serves as an effective aid in determining daily diet menus, functioning not only as a food recorder but also as a diet decision support tool capable of increasing user motivation to maintain healthy and consistent eating patterns.

Limitations and Development Suggestions

Limitations: (1) The Decision Tree rules are static and rule-based, without the ability to automatically update the decision tree structure based on user data; and (2) nutritional information and menu recommendations use static data without connection to an externally updated nutrition database.

Development Suggestions: (1) Integrating a continuously updated nutrition database API so that menu recommendations become more contextual; (2) conducting long-term evaluation with extended usage duration to determine the application's impact on changes in eating habits and diet consistency; and (3) adding features such as meal reminders, diet progress visualization, and advanced personalized recommendations to increase user engagement and sustainability.

CONCLUSION

Smart Diet Assistant has been successfully developed and implemented as a decision support system capable of helping the general public record daily food intake (food diary) and obtain diet menu recommendations according to user characteristics. The Decision Tree algorithm was successfully applied to generate diet menu recommendations based on user attributes including age, gender, weight, height, and health conditions. The mechanism of rule-based decision branching was proven to run systematically and consistently. Based on UAT results with 27 respondents, the application achieved a usability score of 92.59% and a motivation impact score of 90.74%, both in the Very Good category, confirming that the application is feasible and beneficial as a digital support medium in building healthy eating habits.

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