

CHAPTER 1. INTRODUCTION

1.1 Background

Health is a very important aspect and plays a crucial role in improving and supporting national development. In all places including Indonesia, eating habits greatly affect health outcomes. However, many people still do not understand the calorie and nutrient content of the food they eat so that there is often a calorie imbalance in all age groups, this is a challenge that must be overcome. According to the Ministry of Health of the Republic of Indonesia, around 40.6% of the population consumes less than 70% of the Recommended Dietary Allowance (RDA), which is the average amount of nutrients (such as calories, protein, vitamins, and minerals) daily needed to meet the nutritional needs of most (97–98%) healthy people in a certain age group and gender. Data from the Ministry of the Republic of Indonesia states in *Figure 1 Percentage of population consuming < 70% RDA* that the highest number of those observed consisted of school-age children (41.2%), adolescents (54.5%), and pregnant women (44.2%) [1,5].

Then the minimum daily calorie intake is 1,400 kcal, while data from the Central Statistics Agency (BPS), a non-governmental institution that provides statistical data needs for the government and the community, shows that many people still consume less than 1,400 kcal per day [23]. It can be seen in *Figure 2 the proportion of people who consume less than 1,400 kcal per day*, from the existing data, public awareness of fulfilling daily calories has improved quite a bit in 2017 but in 2018 and 2019 it still increased significantly. Poor eating habits can increase the risk of chronic diseases and worsen the nutritional status of the community [2]. In response to this, the World Health Organization (WHO) emphasizes the importance of a healthy lifestyle by consuming a healthy diet rich in fruits, vegetables, and whole grains, while limiting sugar, salt, and saturated fats which can support long-term health [7].

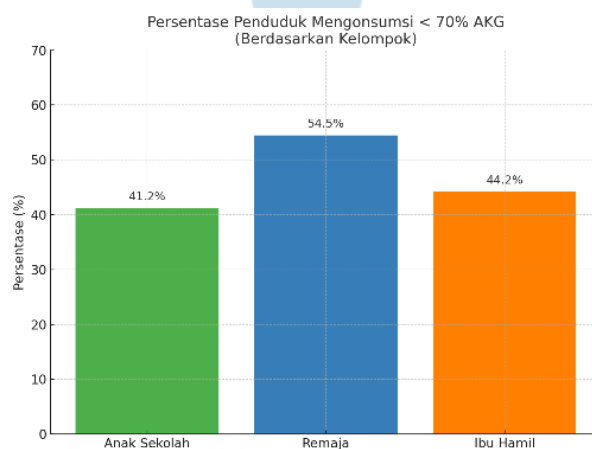


Figure 1 Percentage of population consuming < 70% RDA

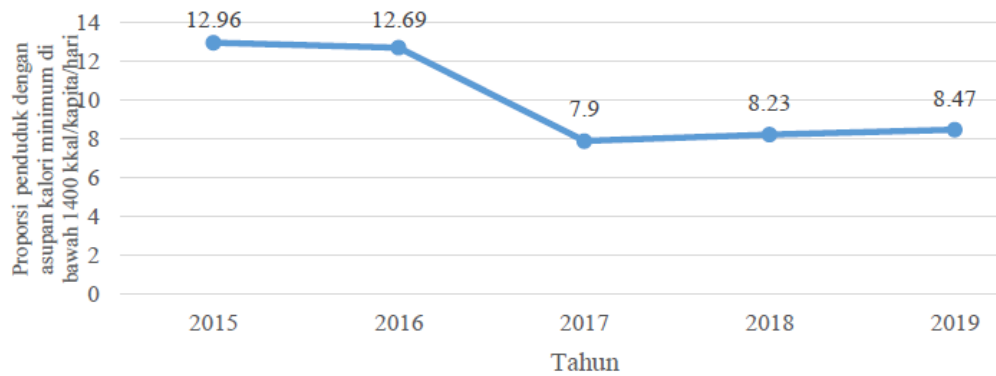


Figure 2 The proportion of people who consume less than 1400 kcal per day

In this digital era, technological advances in artificial intelligence (AI) have influenced various sectors and revolutionized many industries, including health management. As in this thesis, using Artificial Intelligence technology for mobile applications that have the main function of generating recipes and health management to store daily calorie and nutrient tracking history. AI mobile applications have emerged as effective tools to promote healthier lifestyles by enabling diet tracking and calorie monitoring [3,6,8]. For example, in *Figure 3 Boohee* in China, which offers basic calorie tracking and nutritional guidance, and in *Figure 4 MyFitnessPal* in the United States, a global leader in calorie and macronutrient tracking. However, these applications face limitations such as reliance on manual input and lack of local content for the Indonesian people [9,10].



Figure 3 Boohee

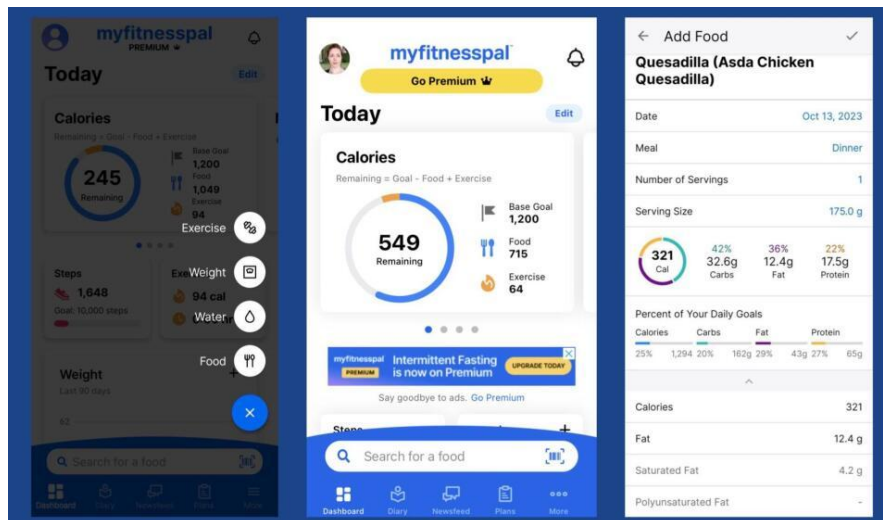
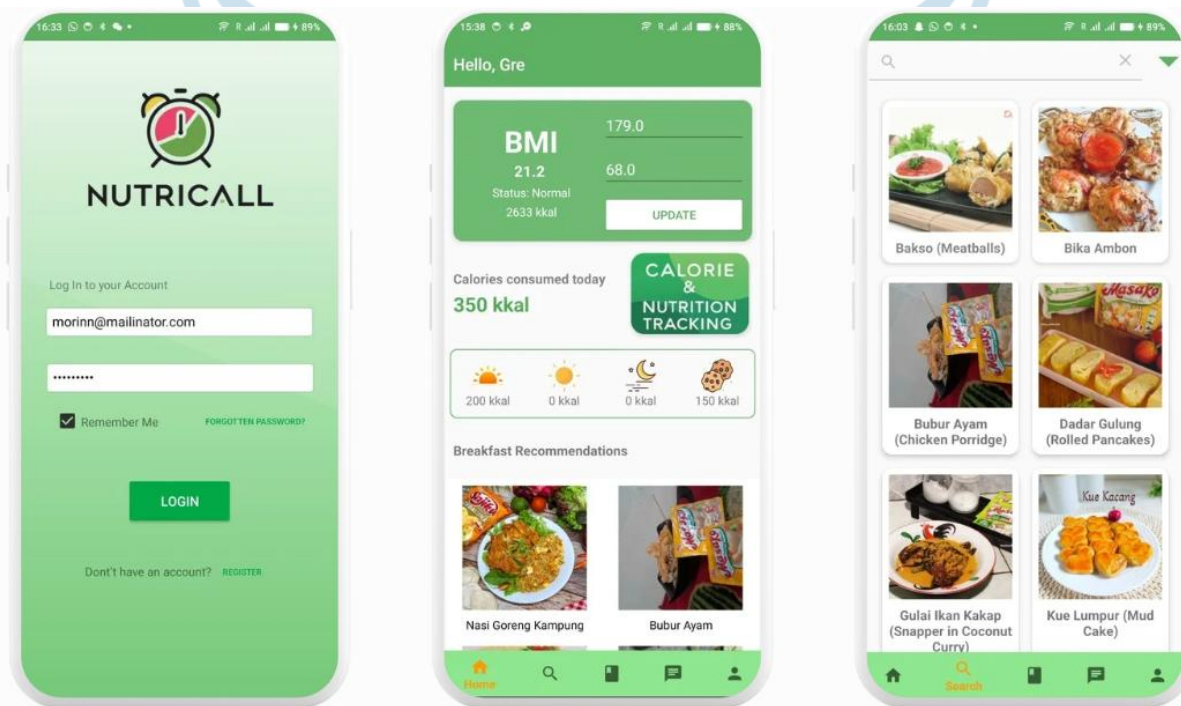


Figure 4 MyFitnessPal

Indonesia does not yet have a health management application that tracks calorie and nutrition history specifically designed to have recipes with local Indonesian food. Many Indonesians face difficulties in finding digital devices that match their daily food and nutritional goals. Realizing this gap, NutriCall in *Figure 5 NutriCall Application* was created to focus on the eating habits of Indonesian people from Indonesian foods. NutriCall is a mobile application powered by Gemini AI, aims to fill this gap by offering AI-generated Indonesian food recipes, detailed nutritional analysis, and calorie tracking, all integrated into the Firebase platform which has an easy-to-use Firestore feature for database input [18,19].



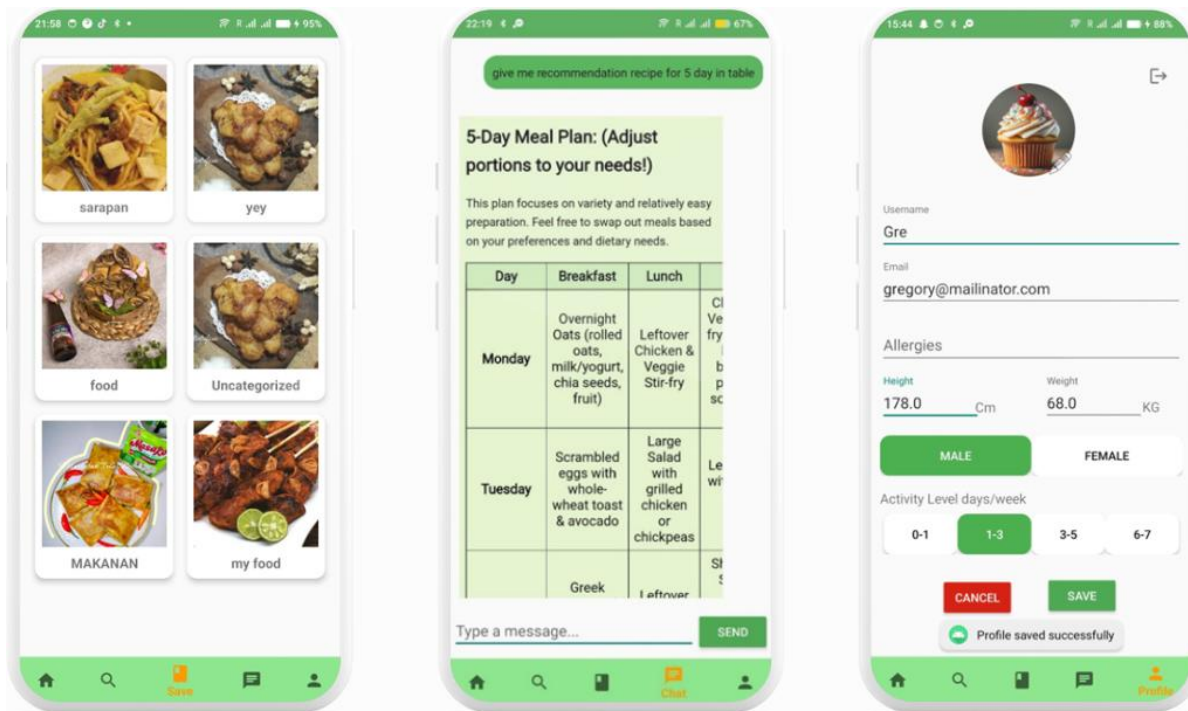


Figure 5 NutriCall Application

1.2 Significance of the Study

1.2.1 Problem Formulation

In countries with advanced technology implementation, there are many health applications assist with daily wellness management. For example, in China there is the 薄荷健康 (Boohee) application helps users track their diet and health, while in the United States, MyFitnessPal provides calorie monitoring and nutritional analysis. These both applications have significantly contributed to promoting healthier lifestyles [9,10].

However, despite the growing adoption of digital health solutions worldwide, Indonesia lacks a widely adopted, AI-driven dietary management application specifically tailored to local dietary habits. Existing health apps either fail to integrate advanced AI features for personalized recommendations or do not align with Indonesian food culture and eating patterns. Additionally, while applications like Boohee and MyFitnessPal offer valuable tools, they still have limitations in terms of usability and localization.

1.2.2 Problem Limitation

The development of an artificial intelligence based diet management application such as NutriCall in Indonesia faces various obstacles and limitations that need to be considered so that its implementation can be optimal and relevant to the local food context.

First, the **limited availability of local nutritional data** is a major challenge. Because most of the nutritional databases available on the internet come from Western food sources, which are dominated by European and American food compositions. This results in a lack of representation of typical Indonesian foods such as nasi uduk, rendang, gado-gado, or tempe orek in the database, so that the nutritional analysis carried out by the system is often inaccurate or even unavailable. The absence of integrated local nutritional standards also increases the challenge in providing recommendations that are in accordance with the eating habits of the Indonesian people [1][5].

Second, the reliance on **Gemini AI as the primary source** for recipe creation and analysis also has limitations, especially in the context of real-time image processing. Although Gemini AI is able to respond well to text input, its ability to recognize and analyze food images directly is still limited. This poses a challenge in providing a more interactive user experience, such as users being able to get an idea of what the food looks like. Therefore, additional integration with third parties that can provide food images is needed to support this feature more accurately and in real-time[4][19].

Third, the implementation of the daily nutrition tracking feature, which is one of NutriCall's leading values, still requires further development in order to provide maximum benefits for users. Currently, the application only relies on storing daily data from creating recipes to record food intake and estimate its nutritional and calorie content during the session. Although this approach is sufficient to provide an overview of the user's calorie and nutrient consumption, this method is not yet able to record all data in a structured manner. To overcome these limitations, integration with additional libraries is needed that allow automatic and real-time health data retrieval. By doing this integration, users can see their daily calorie and nutrient needs. [6][8][10].

Lastly, **user engagement** is a challenge in itself. Not all users are accustomed or comfortable with the process of recording food via mobile phones with the system, and some may still prefer conventional methods of meal planning such as direct consultation with a nutritionist or using a diet guidebook. Lack of education and digital literacy related to AI-based applications can also affect the interest and consistency of application use by users in the long term [7,9,20].

1.2.3 Research Purpose

This thesis aims to create the NutriCall application, a mobile application that integrates Gemini AI to increase nutritional awareness and help diet management for users in Indonesia. This application generates recipe suggestions that have nutritional and calorie values that can be tracked and stored in each user's profile history integrated with Firestore. The recipe recommendation based on three modes of user interaction: (1) ingredient based selection, users input available ingredients to receive suitable recipe suggestions; (2) text-based input, which allows users to input the full name of the dish and receive relevant recommendations; and (3) calorie based search, users define maximal target calorie value to align with their dietary goals. Each generated recipe is accompanied by detailed nutritional information, including caloric content per serving and macronutrient distribution (carbohydrates, proteins, fiber, and fats).

The second goal involves the implementation of a robust calorie tracking system. This includes the development of a meal logging function that allows users to input their food consumption manually or select from previously generated meals. Real-time calculations of daily caloric intake are provided to support users in achieving their nutritional targets. Furthermore, the system archives users' dietary records to facilitate longitudinal tracking.

The third objective is to enhance the user experience through a set of interactive and user-friendly features. An intuitive and accessible user interface is designed to simplify the processes of meal logging and recipe browsing. Community engagement is promoted by enabling users to comment on recipes, and fostering interaction. Additionally, a search functionality is implemented to allow users to efficiently locate recipes based on selected ingredients, calorie limits, or text input.

The ultimate goal is to ensure data security and resilience. User data is stored securely in Firestore so that data security and retrievability are fully guaranteed. Firebase Authentication is used to manage user identities and provides a secure login mechanism with email and password.

1.2.4 Research Benefits

One of the **practical benefits** of the NutriCall app is its potential to promote healthier eating habits and raise awareness of nutritional adequacy among users. The NutriCall app allows users to create recipes based on their calorie needs and track their daily intake. According to the World Health Organization [7], improving diet quality is essential to reduce the risk of non-communicable diseases. This is especially important in Indonesia, where data from the National Institute of Health Research and

Development [5] highlights the increasing prevalence of diet-related health problems. Previous studies have also highlighted the relationship between dietary intake and health status in the Indonesian population, especially among children [1]. In addition, by integrating diet monitoring features, the app offers a digital health tool that can contribute to national health improvement efforts.

From an **academic perspective**, this thesis contributes to the emerging field of AI applications in health-related mobile technologies. The thesis demonstrates how large language models (LLMs), such as Gemini AI [4][19], can be used in real-time nutrition recommendation systems. The use of advanced AI in mobile health applications has previously been explored in works such as NutriAI [11] and Chef Dalle [14], which demonstrated the feasibility and accuracy of AI in food recognition and meal preparation. Furthermore, this thesis builds on the scientific literature on mobile applications for diet tracking [6][21], which reinforces the role of AI-enhanced mobile platforms in promoting individualized health interventions and informing future academic research on intelligent health systems.

In terms of **technological advancement**, NutriCall addresses a specific gap in Indonesia's digital health ecosystem by offering a localized, user-centric solution. Despite the rising global use of mobile health apps like MyFitnessPal [10] and Boohee [9], the Indonesian market lacks applications that incorporate AI-driven, culturally tailored nutrition features. By leveraging Kotlin-based Android development [16][17] and integrating APIs for nutritional data [18], the application not only provides a modern interface but also aligns with sustainable mobile development practices. This localized approach ensures better usability and relevance for Indonesian users, while setting a precedent for future health technology innovations in Southeast Asia.

1.3 Literature Review

NutriCall leverages these insights by integrating AI-powered recipe generation with an easy-to-use interface tailored to Indonesian users, bridging the gap in existing solutions while addressing local dietary challenges. This section discusses research and applications relevant to NutriCall, with a focus on diet management applications, AI in nutrition tracking, and food image recognition and analysis.

1. Dietary Management Applications

Dietary management application that has been compared with the nutritional application with a comparison table that can be seen in Table 1 Literature Review Dietary Management Applications. In the table, NutriCall is compared with the Boohee, MyFitnessPal, Lifesum and Yazio applications and several advantages are obtained. Then this is a brief explanation of the Application being compared:

- **Boohee (薄荷健康):** Widely used in China, it provides basic calorie counting and nutrition guidance but lacks AI-driven recipe suggestions and personalized insights [9].
- **MyFitnessPal:** Globally renowned for its accuracy in macronutrient tracking, MyFitnessPal relies heavily on manual input and offers limited recipe integration [10].
- **Lifesum:** An application that provides dietary recommendations and meal tracking but does not generate AI-powered personalized recipes tailored to cultural dietary habits [20].
- **Yazio:** It does not leverage AI for automated nutritional assessments and recipe generation [21].

Table 1 Literature Review Dietary Management Applications

Feature	NutriCall	Boohee (薄荷健康)	MyFitnessPal	Lifesum	Yazio
Calorie Tracking	Automated via Gemini API that personalized per recipe and store to Firestore	Manual calorie tracker that have to search and input each food item.	Very accurate, large database, but mostly manual input (e.g., portion, meal time).	Integrated calorie and meal tracking.	Provides preset meal plans with calories already calculated.
Recipe Generation	AI-generated recipes from: ingredients, text, or calorie input	No AI-based generation	Limited recipe suggestions	Offers fixed meal plans, no dynamic generation	Meal suggestions only, not generated recipes
AI Integration	Gemini API for calorie analysis,	No AI integration	No AI integration	No AI use	No AI use

(Gemini or Similar)	recipe generation, and feedback				
Recipe Saving and Categorization	Yes, saved to Firebase Firestore with custom categories	No advanced save system	Can save meals manually	Save meals with history	Save meals, but limited sorting
Health Tracking & History	Tracks BMI, saved recipes, calorie history by user	Tracks weight and calories	Logs macros, weight, exercise	Logs habits, weight, mood	Logs calories, weight

2. AI in Nutrition Tracking

The use of AI in this application is very influential from the many AIs in circulation, the NutriCall application chooses to use Gemini AI. The selection of Gemini AI is based on the needs of the application for more detailed breakdown. The Gemini AI have a feature name CookBook an innovative AI-powered culinary assistant so the detail is more accurate, the existing comparison can be seen in Table 2 Literature Review Feature for AI. In the table, NutriCall is compared with OpenAI and DeepSeekAI. Then this is a brief explanation of the Artificial Intelligence being compared:

- **Gemini AI:** A cutting-edge AI platform capable of multimodal data processing, including image recognition and contextual analysis, making it ideal for generating personalized recipes with detailed nutritional breakdowns [4,11,19].
- **OpenAI:** Some nutrition applications have started integrating OpenAI models for chatbot interactions and automated diet suggestions, but they do not emphasize food image recognition and calorie tracking in the same way as NutriCall [4].
- **DeepSeek AI:** A powerful AI model that supports complex reasoning and contextual meal planning. It can analyze dietary trends and suggest structured meal plans [23].

Table 2 Literature Review Feature for AI

Feature	OpenAI	DeepSeek AI	Gemini AI
Recipe Generation	Limited (requires fine-tuning)	Yes (AI-driven)	Yes (AI-driven, personalized)
Nutritional Analysis	Limited	Yes	Yes (detailed breakdown)
Multimodal Processing	No	Yes (text & some image-based insights)	Yes (text, context, and detailed analysis)
Best Use Case	Chatbots, basic AI diet suggestions	Advanced AI-driven recipe & nutrition insights	Comprehensive AI-powered nutrition and recipe

3. Software Engineering Perspective

From the Software Engineering Perspective seen from the Development Frameworks, Programming Languages, Architecture Style and Deployment Environment. In Table 3 Literature Review Software Engineering Perspective, the NutriCall application is compared with several superior applications such as MyFitnessPal, Boohee (薄荷健康), Lifesum and Yazio.

Table 3 Literature Review Software Engineering Perspective

Application / AI Model	Development Frameworks	Programming Languages	Architecture Style	Deployment Environment
MyFitnessPal	Native iOS/Android, REST API	Java, Kotlin, Swift, Python (backend)	Microservices with cloud storage	AWS-based cloud infrastructure
Boohee (薄荷健康)	Native mobile (Android/iOS), Vue.js for web	Java, Kotlin, Objective-C	Monolithic (legacy), shifting to microservices	Alibaba Cloud (mainland China deployment)

Lifesum	React Native (cross-platform)	TypeScript, Node.js, Python	Modular monolith + microservices	Google Cloud Platform
Yazio	Native mobile (Android/iOS)	Java, Kotlin, Swiftx	Serverless architecture using APIs	AWS Lambda + Firebase
NutriCall	Native mobile (Android)	Java, Kotlin, Python (backend)	Microservices with cloud storage and Serverless architecture using APIs	Firebase

1.4 Schedule

The determination of the application creation time is divided into five main parts, namely research to find data that will be used for application needs, the design stage so that the application looks attractive and easy to use by users, development and testing carried out so that the application can run without obstacles and the last finalization for the last check. The weight of the length of work is determined from the weight of the main focus of developing the application, so that in the development section the time used is more than the other steps, for complete details can be seen in Table 4 Schedule.

Table 4 Schedule

No	Phase	Duration in weeks												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Research	■	■	■										
2	Design		■	■										
3	Development			■	■	■	■	■	■	■	■	■		
4	Testing										■	■	■	
5	Finalization													■

1.5 Organizational Structure of the Paper

This paper is organized into five main chapters. The first chapter, **Introduction**, provides background information on the research topic, formulates the research problem, outlines the limitations, and presents the objectives and benefits of the study. It also includes a review of related literature concerning AI-driven nutrition tracking applications and details the research timeline. The second chapter, **Software Requirements**, describes the tools and technologies employed in the project, such as Android Studio, Kotlin, Gemini AI, Retrofit, Postman, and Firebase. It also outlines both the functional and non-functional system requirements. The third chapter, **Methodology**, elaborates on the development process, including the system architecture, design decisions, and applied frameworks. This chapter also includes a separate section for requirements analysis, detailing data acquisition processes, dataset structure, preprocessing methods, and the evaluation criteria used to assess the system. The fourth chapter, **Implementation and Results**, focuses on the development and integration of the AI model, highlighting core functionalities such as recipe generation, nutritional analysis, and calorie tracking. It further presents performance evaluations of AI-generated outputs and system usability. Finally, the fifth chapter, **Summary and Conclusions**, summarizes the key findings and contributions of the research, evaluates the overall effectiveness of the NutriCall application, and offers suggestions for future improvements and possible expansions of the system.