Computing Project Proposal

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Arogya AI: An Intelligent Mobile Health and Nutrition Coach for Sri Lanka

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**Module:** Final Year Computing Project

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# Abstract

This document proposes the development of "Arogya AI," an innovative Android mobile application designed to serve as a personalized health, fitness, and nutrition coach for the Sri Lankan population. The project addresses the growing challenge of lifestyle-related health issues in Sri Lanka by providing an accessible, culturally relevant, and free-to-use digital tool. The application will leverage the power of advanced, free-tier generative AI models (Google Gemini) to offer a suite of integrated features. Core functionalities include personalized diet plans based on local cuisine, an AI-powered workout coach, and real-time nutritional analysis of food via the device's camera. All user data, profiles, and progress logs will be securely managed using **Google Firebase (Cloud Firestore)** as the backend database. The proposed solution aims to empower users to make informed health decisions and provide support in both English and Sinhala. This proposal outlines the project's background, objectives, scope, technical architecture, and a detailed 6-week project management plan

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# Chapter 1: Introduction

## 1.1. Project Background and Motivation

Sri Lanka, like many developing nations, is undergoing a significant epidemiological transition. There is a noticeable shift from communicable diseases to non-communicable diseases (NCDs) such as diabetes, cardiovascular conditions, and obesity, largely driven by changes in diet, lifestyle, and rapid urbanization. According to the World Health Organization (WHO), NCDs account for a substantial portion of mortality in Sri Lanka. A primary contributing factor is the lack of accessible, affordable, and personalized health and dietary guidance that is contextually relevant to the local population.

While a plethora of health and fitness applications exist globally, they often fall short in the Sri Lankan context. Their dietary recommendations are typically Western-centric, their food databases rarely include local cuisine, and they lack multilingual support, particularly in Sinhala. This creates a significant barrier to adoption and effectiveness for the average Sri Lankan. This project is motivated by the need to bridge this gap by leveraging cutting-edge, freely available technology to create a health coach that understands the unique cultural and dietary landscape of Sri Lanka.

## 1.2. Problem Statement

The primary problem is the lack of a free, personalized, and culturally aware mobile health application for Sri Lankans. This core problem can be broken down into several key challenges:

1. **Lack of Personalized Guidance:** Generic diet and fitness plans are often ineffective. Professional nutritionists and personal trainers are unaffordable for a large segment of the population.
2. **Cultural Disconnect:** Global fitness apps do not recognize common Sri Lankan foods (e.g., kottu, string hoppers, various curries), making calorie tracking and diet planning impractical.
3. **Language Barrier:** Most high-quality health apps are available only in English, limiting their accessibility.
4. **Low Health Literacy:** There is a need for a tool that can educate users about their health metrics (like BMI) and the nutritional content of their daily meals in a simple, understandable way.

This project aims to solve these issues by creating a single, integrated mobile application that acts as a knowledgeable and accessible health companion.

## 1.3. Project Aim and Objectives

**Aim:** To design, develop, and deploy a free-to-use, AI-powered Android application that provides personalized diet plans, workout coaching, and nutritional analysis tailored to the Sri Lankan user, within a 6-week development timeframe.

**Objectives:**

1. To develop a secure user authentication and profile management system using **Google Firebase** to store user data like age, height, weight, and health goals.
2. To implement an AI module using the Google Gemini API that analyzes user data to generate personalized, 7-day diet plans with a focus on Sri Lankan cuisine.
3. To integrate the device's camera with the Gemini Vision model to create a feature that can identify Sri Lankan food items from a photo and estimate their nutritional value.
4. To build a conversational AI chatbot that functions as a fitness coach, capable of creating customized workout plans based on user preferences in both English and Sinhala.
5. To design an intuitive progress tracking system that allows users to lose weight and receive AI-generated motivational feedback.
6. To ensure the application is user-friendly, with a clean interface and dual-language support (English/Sinhala).

## 1.4. Scope of the System

The scope of this project is defined to ensure its successful completion by a solo developer within the intensive 6-week timeline.

**In-Scope:**

* User registration (Email/Password) and profile creation.
* Calculation and display of Body Mass Index (BMI).
* Generation of diet and workout plans via the Gemini API.
* Image-based food recognition for nutritional estimation.
* A text-based chat interface for the AI workout coach.
* Weight logging and display of progress.
* Language switching between English and Sinhala.

**Out-of-Scope:**

* Real-time personal training or video analysis.
* Integration with wearable devices (e.g., smartwatches).
* Community features (e.g., social sharing, leaderboards).
* Paid/premium features or subscription models.
* iOS version of the application.
* Management of complex medical conditions or prescription information.

## 1.5. Justification for the Project

This project is highly relevant and justified on several grounds:

* **Social Impact:** It directly addresses a pressing national health issue by promoting healthier lifestyles through an accessible and free tool.
* **Technological Innovation:** It involves the practical application of modern technologies, including mobile computing, cloud services (**Firebase**), and generative AI (Gemini), which are highly relevant skills in the current IT industry.
* **Feasibility:** The project relies exclusively on freely available, well-documented, and powerful tools, making it financially viable and technically achievable for a solo student project within a 6-week timeframe.
* **Personalization:** By focusing on Sri Lankan culture, cuisine, and language, the application offers a unique value proposition that is currently missing in the market.

# Chapter 2: Literature Review

## 2.1. The Rise of Mobile Health (mHealth) Applications

The proliferation of smartphones has catalyzed the growth of the mobile health (mHealth) industry. Applications like MyFitnessPal, Noom, and Fitbit have demonstrated the immense potential of using mobile technology to empower users to track their activity, diet, and health metrics. A study by Zhao, Freeman, and Li (2016) found that mHealth interventions can be effective in promoting behavior change, particularly for weight management and physical activity. However, these applications often operate on a subscription model and feature food databases that are heavily skewed towards Western diets, limiting their utility in diverse cultural contexts.

## 2.2. The Impact of Generative AI in Personalized Healthcare

The recent advancement of Large Language Models (LLMs) and generative AI, such as Google's Gemini, is revolutionizing personalization at scale. These models can process vast amounts of text and generate human-like, context-aware responses. In healthcare, this technology is being explored for tasks ranging from clinical documentation to patient education (Thirunavukarasu et al., 2023). For this project, the Gemini model's ability to understand nuanced prompts—such as a user's health profile, goals, and dietary preferences (e.g., "Sri Lankan, vegetarian")—is critical for generating truly personalized and actionable diet and workout plans without requiring a pre-built database.

## 2.3. Computer Vision for Nutritional Analysis

The concept of estimating nutritional information from food images is an active area of research. Early systems relied on complex image segmentation and object recognition models. For instance, the Food-101 dataset spurred the development of deep learning models for food classification (Bossard, Guillaumin, & Van Gool, 2014). However, building and training such models from scratch is resource intensive. The advent of powerful, pre-trained multimodal models like Gemini, which can analyze images and text simultaneously, democratizes this capability. This project will leverage this state-of-the-art technology to provide an easy-to-use food logging system, a significant improvement over manual data entry.

## 2.4. Digital Health Landscape in Sri Lanka

Digital health adoption in Sri Lanka is growing, with several platforms emerging, primarily for doctor channeling (e.g., Doc990). While these services have improved access to medical consultations, there is a noticeable gap in preventative health and lifestyle management tools. A report by the Ministry of Health, Nutrition & Indigenous Medicine highlights the need for digital solutions to combat the rise of NCDs. "Arogya AI" is positioned to fill this gap by focusing on the preventative aspect of health through daily diet and exercise management.

## 2.5. Identification of the Research Gap

The literature review identifies a clear gap: there is no comprehensive, AI-powered mobile health application that is specifically designed for the Sri Lankan context. The novelty of this project lies in the **synthesis** of three key elements:

1. **Hyper-localization:** A focus on Sri Lankan food, culture, and language.
2. **Generative AI:** Using a powerful LLM to provide dynamic, personalized content instead of relying on static databases.
3. **Accessibility:** Offering this advanced functionality completely free of charge.

This project will be one of the first to create a practical implementation of a multimodal AI health coach for the Sri Lankan market.

# Chapter 3: Methodology and System Design

## 3.1. Development Methodology: Agile (Scrum)

Given the tight 6-week schedule, an Agile approach is essential. The project will be broken down into six 1-week "sprints."

* **Weekly Sprints:** Each week will have a clear goal (e.g., "Complete User Authentication"). This ensures consistent, measurable progress.
* **Prioritization:** Core features (MVP - Minimum Viable Product) will be prioritized and built first to ensure a functional application is ready early.

This iterative approach allows for rapid development, flexibility, and early detection of issues, which is critical for a short-duration project.

## 3.2. System Architecture

The application will follow a client-server architecture, where the Android app is the client and Google's cloud services (Firebase, Gemini) act as the backend.

**Diagram Description:**

1. **Client (Android App):** The user interacts with the UI. It handles user input, camera functions, and rendering data.
2. **Firebase (Backend-as-a-Service):** This is the core backend for our application.
   * **Firebase Authentication:** Handles all user sign-up and login processes securely.
   * **Cloud Firestore:** This is our **primary database**. All user data (profile, weight logs, preferences) is stored and retrieved from here.
3. **Gemini API (AI Service):** The Android app makes direct, secure HTTPS API calls to the Google Gemini API endpoint to access the AI functionalities.

## 3.3. Technology Stack and Database Choice

|  |  |  |
| --- | --- | --- |
| **Category** | **Technology / Service** | **Justification** |
| **Platform** | Android | Dominant mobile OS in Sri Lanka. |
| **IDE** | Android Studio | Official and free IDE for Android. |
| **Language** | Java | Robust, well-established language for Android. |
| **AI Model** | Google Gemini 2.5 Flash API | Powerful, multimodal, with a generous free tier. |
| **Database** | **Google Cloud Firestore** | It is a scalable, real-time NoSQL database with a comprehensive free plan, perfect for mobile app backends. |
| **Authentication** | Google Firebase Authentication | Secure, easy to implement, and free. |
| **Networking** | OkHttp | Efficient library for making API calls. |
| **UI/UX** | Android XML Layouts | Provides a modern and responsive UI. |

## 3.4. Database Design (Cloud Firestore)

The NoSQL data structure in Firestore is based on collections and documents.

* **Collection: users**
  + Each user will have a unique **Document** with their userId as the key.
  + **Fields:** email, name, age, height\_cm, weight\_kg, goal, preferred\_language.
* **Sub-collection: weightLog** (nested under each user's document)
  + Each weight entry will be a separate **Document**.
  + **Fields:** weight\_kg, timestamp.

This structure is secure as Firestore's security rules can be configured to allow users to only read and write their own data.

## 3.5. User Interface (UI) and User Experience (UX) Design

The UI/UX will prioritize simplicity and clarity. A simple bottom navigation bar will provide easy access to the main features: Home, Diet Plan, Workout, and Profile. A guided onboarding process will help new users set up their profiles quickly.

# Chapter 4: System Features and Functionalities

## 4.1. User Onboarding and Profile Management

* **Functionality:** Allows users to create a secure account and manage their personal information.
* **Workflow:**
  1. New users are presented with a screen to register using their email and a password.
  2. Firebase Authentication handles the creation of the user account.
  3. Upon first login, the user is guided through an onboarding process to enter their name, age, height, weight, and fitness goal.
  4. This information is saved as a new document in the users collection in Cloud Firestore.
  5. Users can edit this information later from their Profile screen.

## 4.2. Health Profile Analysis (BMI & Goal Setting)

* **Functionality:** Calculates the user's BMI and provides a basic health assessment.
* **Workflow:**
  1. Using the height and weight from the user's profile, the app calculates the Body Mass Index (BMI) using the formula: BMI = weight (kg) / (height (m))^2.
  2. The app displays the BMI value along with the standard WHO category (e.g., Underweight, Normal weight, Overweight).
  3. This information is used as part of the context sent to the AI for generating plans.

## 4.3. AI-Powered Personalized Diet Planner

* **Functionality:** Generates a customized 7-day meal plan.
* **Workflow:**
  1. The user navigates to the "Diet Plan" section.
  2. The app constructs a detailed prompt using data from the user's Firestore document.
  3. **Example Prompt:** "Act as a nutritionist. Create a 7-day detailed weight loss diet plan for a 30-year-old male from Sri Lanka, weighing 80kg and 175cm tall. The plan must use common, affordable Sri Lankan foods. Include breakfast, lunch, and dinner for each day with estimated portion sizes. Format the response clearly."
  4. An API call is made to the Gemini model.
  5. The returned text is parsed and displayed in a clean, day-by-day format.

## 4.4. "Snap & Track" Food Recognition

* **Functionality:** Analyzes a photo of a meal to estimate its nutritional content.
* **Workflow:**
  1. The user taps a button to log a meal, which opens the camera.
  2. After taking a picture, the image is processed and sent to the Gemini Vision API.
  3. **Example Prompt:** "Analyze this food image. Identify the items on the plate, which are likely Sri Lankan dishes. Provide an estimation of the total calories, protein, carbohydrates, and fats."
  4. The AI's response is displayed to the user, who can confirm and log the meal.

## 4.5. AI Workout Coach (Conversational)

* **Functionality:** Provides workout plans through a chat interface.
* **Workflow:**
  1. The user opens the "CoachAI" chat screen.
  2. The user types a request, e.g., "Give me a home workout for beginners" or "mata gedara karanna puluwan workout ekak denna".
  3. The app sends this message to the Gemini API with a system instruction.
  4. **System Instruction:** "You are a friendly and encouraging fitness coach. Respond to the user's request. If the user writes in Sinhala, you must respond in Sinhala."
  5. The AI's response, containing a structured workout plan (exercises, sets, reps), is displayed in the chat bubble.

## 4.6. Progress Tracking and AI-Powered Feedback

* **Functionality:** Allows users to lose weight and receive motivational messages.
* **Workflow:**
  1. From the Profile screen, the user can enter their current weight. This is saved to the weightLog sub-collection in Firestore.
  2. The app can display a simple graph showing weight change over time.
  3. Once a week, the app can trigger an AI check-in. It calculates the weight change from the logs.
  4. **Example Prompt:** "The user lost 1.2kg this week. Write a short, positive, and encouraging message for them to stay motivated."
  5. This personalized message is shown to the user as a notification or on the home screen.

## 4.7 Functional and Non-Functional Requirements

This section provides a detailed breakdown of the system's requirements, categorized into functional (what the system *does*) and non-functional (how the system *is*).

### 4.7.1 Functional Requirements

The functional requirements define the specific operations the "Arogya AI" application must be able to perform.

|  |  |  |
| --- | --- | --- |
| **Requirement ID** | **Feature** | **Description** |
| **FR-01** | User Registration | A user must be able to create a new account using an email address and a password. The system shall validate the email format and ensure the password meets minimum complexity requirements. |
| **FR-02** | User Authentication | A registered user must be able to log in to the application using their credentials. The system shall maintain the user's session until they explicitly log out. |
| **FR-03** | Profile Management | An authenticated user must be able to create, view, and update their health profile, including name, age, height (cm), weight (kg), and fitness goal (e.g., weight loss). |
| **FR-04** | BMI Calculation | The system must automatically calculate and display the user's Body Mass Index (BMI) based on the height and weight provided in their profile. |
| **FR-05** | AI Diet Plan Generation | The system must be able to send the user's profile data to the Gemini AI API and receive a personalized 7-day diet plan. The generated plan must be displayed in a readable, day-by-day format. |
| **FR-06** | AI Workout Coach | The system must provide a chat interface where a user can send text-based requests for workout plans. The system shall forward these requests to the Gemini AI API and display the formatted response from the AI coach. |
| **FR-07** | Food Recognition | A user must be able to activate the device camera from within the app, capture an image of a meal, and submit it for analysis. The system shall send the image to the Gemini Vision API and display the estimated nutritional information (calories, protein, carbs, fat). |
| **FR-08** | Weight Logging | An authenticated user must be able to log their current weight. The system shall store each entry with a timestamp in the Firestore database. |
| **FR-09** | Progress Viewing | A user must be able to view a history of their logged weights, presented in a simple list or graphical format. |
| **FR-10** | Language Switching | The user must be able to switch the application's interface language between English and Sinhala. This must also change the language of interaction with the AI coach. |

### 4.7.2 Non-Functional Requirements

The non-functional requirements define the quality attributes, performance benchmarks, and constraints of the system.

|  |  |  |
| --- | --- | --- |
| **Requirement ID** | **Category** | **Description** |
| **NFR-01** | **Performance** | - Key screens and lists must load in under 3 seconds on a standard 4G connection. - AI-generated responses (diet/workout plans) should be displayed within 10 seconds of the request being sent. |
| **NFR-02** | **Security** | - All communication between the app and backend services (Firebase, Gemini) must be encrypted using TLS.- User passwords must be hashed and managed by Firebase Authentication.- Firestore security rules must be configured so that a user can only access and modify their own data. |
| **NFR-03** | **Usability** | - The application must follow Google's Material Design 3 guidelines for a consistent and intuitive user experience.- The user interface must be responsive and adapt correctly to different Android screen sizes and densities.- Navigation must be simple and predictable, primarily through a bottom navigation bar. |
| **NFR-04** | **Reliability** | - The application's core functionality should have an uptime of 99%, contingent on the availability of Google's Firebase and AI Platform services. |
| **NFR-05** | **Compatibility** | - The application must be compatible with Android versions 8.0 (Oreo) and above, covering the vast majority of active devices in Sri Lanka. |
| **NFR-06** | **Data Integrity** | - The system must ensure that data entered by the user (e.g., weight, height) is stored accurately in the database without corruption or loss. |
| **NFR-07** | **Scalability** | - The backend architecture (Firebase) must automatically scale to handle an increasing number of users without degradation in performance. |

# Chapter 5: Project Management (6-Week Plan)

## 5.1. Project Plan and Timeline (Gantt Chart)

The project is planned over an intensive 6-week period.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Task** | **Week 1** | **Week 2** | **Week 3** | **Week 4** | **Week 5** | **Week 6** |
| **1. Planning & Setup** | ████ |  |  |  |  |  |
| **2. User & Profile Foundation** |  | ████ |  |  |  |  |
| **3. AI Diet Planner Feature** |  |  | ████ |  |  |  |
| **4. AI Workout Coach Feature** |  |  |  | ████ |  |  |
| **5. Food Recognition & Tracking** |  |  |  |  | ████ |  |
| **6. Testing & Finalization** |  |  |  |  |  | ████ |

**Weekly Breakdown:**

* **Week 1: Planning & Core Setup.** Finalize requirements, design mockups, and set up the Android Studio project with full Firebase integration (Auth and Firestore).
* **Week 2: User & Profile Foundation.** Build the user login, registration, and profile management screens. Ensure data is correctly saved and retrieved from Firestore.
* **Week 3: AI Diet Planner.** Build the UI for the diet plan section and integrate the Gemini API for generating and displaying personalized meal plans.
* **Week 4: AI Workout Coach.** Implement the chat interface and integrate the Gemini API to function as a conversational fitness coach.
* **Week 5: Food Recognition & Tracking.** Integrate the camera for food image capture, connect to the Gemini Vision API for analysis, and build the weight logging feature.
* **Week 6: Finalizing & Reporting.** Conduct thorough integration testing, fix bugs, apply final UI polish, and prepare the final report and presentation.

## 5.2. Resource Requirements

All resources required for this project are free of cost.

* **Hardware:** A standard laptop capable of running Android Studio. An Android smartphone for real-world testing.
* **Software:** Android Studio IDE, Git for version control.
* **Services:** Google Firebase (Spark Plan), Google AI Studio (for Gemini API key).

## 5.3. Risk Analysis and Mitigation Strategies

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Risk Category** | **Description** | **Likelihood** | **Impact** | **Mitigation Strategy** |
| **Time Risk** | The **6-week timeline is highly aggressive** for a solo developer. | **High** | **High** | **Strictly adhere to the defined scope (MVP).** Avoid adding new features. Prioritize core functionality to ensure a working product is ready. |
| **Technical Risk** | Gemini API response format is inconsistent, breaking the UI. | Medium | High | Implement robust error handling. Create prompts that explicitly ask for a structured output (e.g., JSON format). |
| **Technical Risk** | Inaccurate nutritional analysis from the Vision model. | High | Medium | Clearly label the feature as "experimental" and the results as "estimates." Do not present it as medical advice. |
| **Data Risk** | Security of sensitive user health data. | Low | High | Use Firebase's built-in security features. Implement strict Firestore security rules. |

## 5.4. Testing Strategy

* **Unit Testing:** Individual functions will be tested weekly as they are developed.
* **User Acceptance Testing (UAT):** The app will be tested by a small group of peers at the end of Week 5 to gather feedback before the final week.

# Chapter 6: Conclusion

## 6.1. Expected Outcomes

The successful completion of this project will result in a fully functional Android application, "Arogya AI," which will:

* Serve as a proof-of-concept for hyper-localized, AI-driven health solutions.
* Provide a valuable, free tool for the Sri Lankan community to manage their health and wellness.
* Demonstrate the developer's proficiency in mobile application development, cloud services, and the integration of modern AI APIs.

## 6.2. Limitations and Future Enhancements

* **Limitations:** The nutritional analysis is an estimation and not a medical-grade measurement. The advice given by the AI is for informational purposes and is not a substitute for professional medical advice. The app will be dependent on an internet connection to function.
* **Future Enhancements:**
  + Integration with wearable fitness trackers.
  + Barcode scanning for packaged food items.
  + A community feature for users to share progress and tips.
  + Video tutorials for exercises suggested by the AI coach.

# Acknowledgements

I would like to extend my sincere gratitude to my project supervisor, MR Chathura, for his invaluable guidance, encouragement, and insightful feedback throughout the planning and development of this project proposal. Their expertise and support have been instrumental in shaping the vision and scope of "Arogya AI."

I would also like to thank my family and friends for their constant support and understanding during this demanding academic period. Their encouragement has been a great source of motivation.

Finally, I acknowledge the developers and communities behind the open-source and free-tier technologies, such as Google's Android, Firebase, and Gemini teams, whose work makes innovative projects like this accessible to students and individual developers.

**HD in Computing & Software Engineering**

***CSE5015 Computing Project Proposal Approval Sheet***

*Student Use only;*

|  |  |  |  |
| --- | --- | --- | --- |
| Group Name | Viranya - Solo Project | Attempt No | 1 |
| Title of the project | Arogya AI: An Intelligent Mobile Health and Nutrition Coach for Sri Lanka | | |
| System platform | Web Application Desktop Application  Mobile Application ……………………………… | | |
| Technology | Java, Android Studio, Google Firebase (Firestore & Authentication), Google Gemini API, Android XML | | |
| Programming methodology | Structured System Analysis and Design Methodology  Object Oriented Analysis and Design Methodology | | |
| SDLC | Agile (Scrum) Methodology | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Student No | CL/HDCSE/CMU/126/14 | Full Name | Viranya Gangamina Aththanayake |
| Lead Developer, System Architect, UI/UX Designer, QA Tester | | | |

**System Functionality:**

|  |  |
| --- | --- |
| **Function** | **Description** |
| User Authentication | Secure user registration and login using email/password via Firebase Authentication. |
| Personalized Diet Plans | AI generates 7-day diet plans tailored to user's goals and focused on Sri Lankan cuisine. |
| AI Workout Coach | A conversational chatbot (powered by Gemini) that provides custom workout routines on demand. |
| Food Recognition | Uses the phone's camera to identify food and provide an estimated nutritional breakdown (calories, protein, etc.). |
| Progress Tracking | Allows users to lose weight over time and view their progress. Provides AI-powered motivational feedback. |
| Health Profile | Users can manage their personal data (height, weight, age, goal) and the system automatically calculates their BMI. |
| Multilanguage Support | The application interface and AI interactions are available in both English and Sinhala. |

***Official use only***;

**Status:** **Approved / Rejected**

**Date of the status:** ………………………………

**Approved by:**

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Approval Status: **Approved / Rejected**

Date of the Status: …………………………..

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