A

PROJECT REPORT

ON

Eathena

SUBMITTED TOWARDS THE

FULFILLMENT OF THE REQUIREMENTS OF

Bachelor of Technology in

Computer Science & Engineering

By

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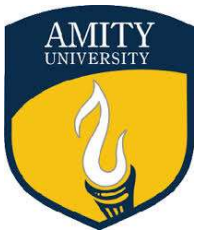

Amity School of Engineering and Technology

Department of Computer Science & Engineering

CERTIFICATE

This is to certify that the Project Entitled

Eathena

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is a bonafide work carried out by students under the supervision of **Dr. Poonam Mishra & Mr. Baidyanath Ram** and it is submitted towards the partial fulfillment of the requirement of Bachelor of Technology (Computer Science & Engineering) Dissertation Project.

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ACKNOWLEDGMENT

It gives us great pleasure in presenting the project report on ***'Eathena'****.*

We would like to take this opportunity to thank our project guides ***Dr, Poonam Mishra*** *and* ***Mr. Baidyanath Ram*** *for giving us all the help and guidance we needed. We are grateful for their kind support. Their valuable suggestions were very helpful.*

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In the end our special thanks to ***all the teachers and staff*** *for providing various resources such as laboratory with all needed software platforms, continuous Internet connection, for our Project.*

Niladitya Sen

Tanishq Prasanna

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PLAN OF PROJECT EXECUTION

	Month	Description	Start Date	Duration (days)
Phase 1				
	January	Ideation, brainstorming core features, assigning team roles, initial research	8/1/25	23
	February	UI/UX wireframes in Figma, finalizing tech stack, Open Food Facts API testing	1/2/25	20
		React Native + Expo setup, onboarding & dashboard UI creation	21/2/25	10
	March	Barcode scanner integration, Cloudinary upload setup, backend Express setup	1/3/25	15
		MySQL schema design, basic authentication with JWT	16/3/25	10
		ChatGPT prototype integration (system prompt personalization)	25/3/25	5
Phase 2				
	April	Meal Snap analyzer pipeline	1/4/25	15
		LangChain agent setup	17/4/25	10
	May	Full chat orchestration via LangGraph, memory embedding and context injection	1/5/25	10
		Final bug fixes, user testing, performance improvements	11/5/25	4

Table: Plan of Project Execution

TIME ESTIMATES

	Month	Description	Start Date	Duration
Phase 1				
	January	Ideation, brainstorming core features, assigning team roles	08/01/25	7 days
	January	Initial research on nutrition APIs and barcode standards	15/01/25	8 days
	February	UI/UX wireframes in Figma, defining user journeys	01/02/25	10 days
	February	Finalizing tech stack and Open Food Facts API testing	11/02/25	10 days
	February	React Native + Expo setup, onboarding & dashboard UI creation	21/02/25	10 days
	March	Barcode scanner integration and Cloudinary upload	01/03/25	15 days

	March	Express.js backend setup, MySQL schema design, JWT authentication	16/03/25	10 days
	March	ChatGPT prototype integration and system prompt personalization	25/03/25	5 days
Phase 2				
	April	Meal Snap analyzer pipeline (image upload to ChatGPT + display response)	01/04/25	15 days
	April	LangChain agent setup (prompt templates, tools, context)	17/04/25	10 days
	May	Full LangGraph chat orchestration, memory embedding	01/05/25	10 days
	May	Final bug fixes, UI polishing, user testing	11/05/25	4 days

Table: Time Estimates

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ABSTRACT

Eathena is an AI-powered personal nutritionist mobile application that delivers personalized diet guidance, food quality analysis, and real-time nutritional tracking. It addresses nutritional unawareness and promotes healthier food decisions using technologies such as food image recognition, barcode scanning, conversational AI, and custom dashboards. This app adapts to each user's preferences (vegetarian, vegan, non-veg), medical conditions (e.g. diabetes), fitness goals, and budget. It features a virtual persona that provides health insights, food facts, and AI-driven recommendations. The goal of Eathena is to offer a comprehensive, engaging, and accessible nutrition companion for fitness enthusiasts and health-conscious individuals.

Chapter 1

INTRODUCTION

1.1 Background

In today's fast-paced digital world, dietary-related health issues are becoming increasingly prevalent. Sedentary lifestyles, the rise in fast food consumption, and the abundance of processed foods have led to a global spike in health conditions such as obesity, diabetes, hypertension, and cardiovascular diseases. Despite the wealth of information available online, individuals often struggle to make informed nutrition decisions due to misinformation, lack of personalization, or simply the complexity of interpreting nutrition data.

Traditional diet planning typically requires consultations with nutritionists or use of generic meal plans that fail to accommodate individual preferences, goals, and medical conditions. This results in low adherence to diet plans, poor outcomes, and diminished motivation. Furthermore, most digital health solutions only address fragmented aspects of nutrition, such as calorie counting or product scanning, and do not offer a unified experience tailored to each user's lifestyle.

With recent advances in artificial intelligence, mobile computing, and natural language processing, there is a significant opportunity to build intelligent systems that deliver real-time, personalized nutrition advice at scale. This opportunity forms the foundation for Eathena—an AI-powered virtual nutritionist that supports users in making smarter food choices through a blend of conversation, visual recognition, and dietary tracking.

1.2 Overview

Eathena is an AI-driven mobile application designed to serve as a personal nutritionist for users seeking better control over their dietary habits. It combines multiple technologies—such as computer vision, barcode scanning, conversational AI, and data analytics—into a single, user-friendly platform. Eathena is built with the core intention of helping individuals achieve their health goals through personalized nutrition advice, intelligent tracking, and continuous engagement.

The app supports a variety of use cases including food recognition from images, scanning packaged food items for nutritional assessment, interactive conversations for diet queries, and a comprehensive dashboard that tracks macro and micronutrient intake. It accommodates users with different dietary preferences (vegetarian, vegan, non-veg), health conditions (e.g., diabetes, hypertension), and financial constraints.

Beyond just providing numbers and statistics, Eathena aims to foster awareness and learning. Users receive daily food facts, curated health news, and tailored suggestions to reinforce good habits.

By bringing together data science, machine learning, and practical nutrition knowledge, Eathena delivers a holistic solution that bridges the gap between modern lifestyles and healthy eating.

1.3 Problem Statement

Despite growing awareness around health and fitness, most individuals struggle to make informed dietary decisions due to a lack of accessible, personalized, and reliable nutritional guidance. Several key challenges contribute to this issue:

- Individuals often rely on generic diet plans that fail to consider personal factors such as age, medical history, allergies, fitness goals, and budget.
- Tracking daily nutritional intake, especially micronutrients, is time-consuming and error-prone when done manually.
- People frequently consume packaged foods without fully understanding the nutritional implications or the presence of harmful additives.
- While mobile apps exist for calorie tracking or barcode scanning, they are typically disjointed, lack conversational capabilities, and offer poor long-term engagement.

Furthermore, many people, particularly in developing regions, lack access to professional dietitians or affordable health consultations. This leaves a large population underserved when it comes to ongoing nutritional advice and goal tracking.

There is a need for a comprehensive, AI-based solution that not only evaluates food choices but also educates, adapts, and motivates users to maintain consistent healthy eating habits in a way that feels natural and personal.

1.4 Objective and Scope

The primary objective of the Eathena project is to design and develop an AI-powered mobile application that serves as a personal nutrition assistant—helping users improve their dietary

habits, achieve fitness goals, and make healthier food choices with minimal friction and maximum personalization.

The key objectives include:

- To provide personalized dietary recommendations based on user preferences, health conditions, fitness goals, and budget.
- To integrate barcode scanning functionality for instant nutritional evaluation of packaged food products.
- To enable AI-powered food image recognition to identify meals and estimate their caloric and nutritional content.
- To implement a conversational AI assistant that can answer nutrition-related questions, suggest meals, and educate users in real-time.
- To develop a user-friendly dashboard that helps track daily and weekly intake of macro and micronutrients.
- To engage users through daily health tips, food facts, and curated nutrition news to foster awareness and retention.

Scope of the Project:

Eathena will initially focus on Android and iOS platforms using a cross-platform mobile development framework (React Native). The backend infrastructure will support scalability and integration with external APIs (Open Food Facts, GPT-4, etc.). The system will cater to single users in the MVP phase, with a roadmap for social/community features in future iterations. The platform will also be designed with extensibility in mind—allowing future integration with wearable health devices and region-specific food databases.

By achieving these objectives, Eathena will offer a unified, intelligent, and engaging platform to improve nutritional awareness and empower individuals to make sustainable, health-positive lifestyle changes.

Chapter 2

LITERATURE REVIEW

S.No	Name	Website/Provider	Purpose in Project
1	Artificial Intelligence in Nutrients Science Research: A Review Jarosław Sak, Magdalena Suchodolska	https://doi.org/10.3390/nu13020322	Provides a foundation for understanding the impact and scope of AI in nutrient science and health monitoring.
2	The Role of Artificial Intelligence in Nutrition Research: A Scoping Review Andrea Sosa-Holwerda et al.	https://doi.org/10.3390/nu16132066	Highlights existing AI applications in personalized diet tracking and nutrition-based decision systems.
3	Artificial Intelligence Applications to Measure Food and Nutrient Intakes: Scoping Review Jiakun Zheng et al.	https://doi.org/10.2196/54557	Supports the design of food recognition and nutritional intake estimation components in Eathena.
4	NutrifyAI: An AI-Powered System for Real-Time Food Detection, Nutritional Analysis, and Personalized Meal Recommendations Michelle Han et al.	https://arxiv.org/abs/2408.10532	Serves as an architectural and functional reference for Eathena's meal detection and analysis engine.
5	NutritionVerse-Direct: Exploring Deep Neural Networks for Multitask Nutrition Prediction from Food Images Matthew Keller et al.	https://arxiv.org/abs/2405.07814	Provides insights into using deep learning for visual-based multitask nutrient estimation from images.
6	Open Food Facts API	https://world.openfoodfacts.org/data	Used for barcode scanning functionality and nutritional data retrieval from food packaging.
7	ChatGPT (OpenAI)	https://platform.openai.com	Powers Eathena’s AI assistant, answering queries, offering tips, and contextualizing nutrition advice.

8	LangChain	https://www.langchain.com	Enables orchestration of ChatGPT with custom tools, context, and user memory for personalized chat.
9	LangGraph	https://docs.langchain.com/langgraph	Handles memory graph-based interaction workflows to manage branching chat flows.
10	React Native Documentation	https://reactnative.dev	Forms the core of the cross-platform mobile app development stack used to build Eathena's UI.
11	Expo Documentation	https://docs.expo.dev	Supports quick mobile app deployment, device API integration, and development using React Native.

2.1 Literature Survey

1. **Artificial Intelligence in Nutrients Science Research: A Review**

   Sak and Suchodolska [1] provide a comprehensive review of how AI techniques such as machine learning, deep learning, and natural language processing are revolutionizing nutrient science. They emphasize the ability of AI systems to analyze large volumes of food and health-related data, personalize dietary interventions, and automate decision-making processes. This paper forms the conceptual foundation for Eathena's backend architecture where user-specific goals and nutrition data are processed through intelligent models for food suggestions and caloric feedback.

2. **The Role of Artificial Intelligence in Nutrition Research: A Scoping Review**

   Sosa-Holwerda [2] explores the current landscape of AI applications in nutrition research, particularly focusing on tools for behavior change, chronic disease prevention, and dietary recommendations. The review identifies conversational AI and recommender systems as crucial components in delivering tailored nutrition support. Eathena leverages these findings by integrating ChatGPT to simulate a contextual and empathetic nutrition coach, responding to user inputs and personal health goals in real-time.

3. **Artificial Intelligence Applications to Measure Food and Nutrient Intakes: Scoping Review**

   Zheng analyzes AI-based methodologies for estimating food intake using images, text, and user behavior. Their study categorizes image-based food recognition, barcode-based identification, and portion size estimation as practical AI applications in mobile health apps. These insights directly influenced Eathena's hybrid input architecture—supporting both barcode scanning and food image uploads—to enhance the reliability and flexibility of dietary tracking.

4. **NutrifyAI: An AI-Powered System for Real-Time Food Detection, Nutritional Analysis, and Personalized Meal Recommendations**

   Han [4] presents NutrifyAI, an end-to-end pipeline for food image analysis and nutritional suggestion using AI. Their model architecture includes food classification, nutrient prediction, and adaptive feedback loops for user-specific dietary planning. This system inspired the modular AI pipeline in Eathena that combines image input with contextual inference to deliver real-time macro and calorie estimations.

5. **NutritionVerse-Direct: Exploring Deep Neural Networks for Multitask Nutrition Prediction from Food Images**

   Keller et al. (2024) [5] demonstrate the effectiveness of deep neural networks for simultaneously predicting multiple nutritional attributes (calories, macros, and ingredients) from food images. Their multitask learning model achieves high performance on diverse datasets, highlighting the feasibility of visual-based nutrient analysis. Eathena draws from this model's approach to design its own food image classifier that provides estimates tailored to Indian food categories and user dietary preferences.

6. **Expo Documentation**

   Expo is an open-source platform built on top of React Native that simplifies the development and deployment of cross-platform mobile applications. According to its documentation, Expo offers built-in modules, hot reloading, asset bundling, and seamless integration with Expo Application Services (EAS) for over-the-air updates and cloud builds. In Eathena, Expo enabled rapid development and consistent behavior across Android and iOS without requiring native configuration. However, limitations arise when integrating unsupported native modules, sometimes necessitating ejection from the managed workflow.

7. **Open Food Facts API**

   Open Food Facts is a crowdsourced database of packaged food products, accessible through a public REST API. It provides nutritional information, ingredient lists, dietary labels, and barcode lookup functionality. Eathena utilizes this API to enhance its barcode scanning feature, allowing users to retrieve food metadata in real time. The open-source nature and wide product coverage make it highly valuable, though the quality of entries may vary depending on regional availability and user-submitted data.

8. **React Native Documentation**

   React Native is a popular open-source framework developed by Meta that enables developers to build native mobile applications using JavaScript and React. The official documentation provides comprehensive guidance on UI components, navigation, device APIs, and debugging tools. In Eathena, React Native forms the foundation of the mobile frontend, enabling a unified codebase across platforms and efficient use of reusable components. Challenges can occasionally occur with native dependencies or third-party library compatibility.

9. **ChatGPT (OpenAI API)**

   ChatGPT is a state-of-the-art conversational AI developed by OpenAI, based on the GPT-4 architecture. It supports multimodal input, including images, making it well-suited for context-aware dialogue and image reasoning. In Eathena, ChatGPT serves as the core intelligence for meal recommendations, health advice, allergy filtering, and food analysis from user-uploaded photos. It uses a system prompt to personalize outputs based on user data such as dietary preferences, allergies, and fitness goals. Its robustness and simplicity of API integration significantly enhance the app's conversational capabilities.

10. **Cloudinary API**

    Cloudinary is a cloud-based image and video management platform that provides tools for media uploading, transformation, optimization, and CDN delivery. Eathena uses Cloudinary to upload and host user-captured food images, which are then referenced in prompts to ChatGPT for nutritional analysis. Cloudinary ensures fast, reliable media access and supports advanced image manipulation if needed. Its scalability and simple API make it a suitable choice for real-time mobile applications.

11. LangChain

LangChain is a framework for building modular and multi-step LLM-powered applications. It allows developers to create agents that can reason through tasks, invoke external tools, manage context memory, and structure complex workflows. In Eathena, LangChain orchestrates the ChatGPT agent by embedding user-specific data into prompts and managing multi-turn dialogue with tool usage. It enables advanced use cases such as tool-calling, food lookup, and dietary filtering based on real-time input.

12. LangGraph

LangGraph is a graph-based extension of LangChain that facilitates the construction of stateful, event-driven workflows involving LLMs and external systems. It provides fine-grained control over conversation flow, branching logic, and asynchronous tool calls. Eathena uses LangGraph to manage conversational states, personalize user interactions, and trigger food image analysis or barcode-based lookups within the chat context. Its flexibility supports robust and scalable conversational agent design.

Chapter 3

SYSTEM ARCHITECHTURE

3.1 SYSTEM ARCHITECTURE

The system architecture of **Eathena** is designed with modularity, scalability, and extensibility at its core. It ensures smooth coordination between frontend interactions, AI-driven services, and external APIs. The architecture consists of the following major components:

1. Mobile Application (Frontend)

- Built using **React Native with Expo**, offering a unified codebase for both Android and iOS platforms.
- Enables key user interactions including:
    - Scanning food barcodes,
    - Uploading food images,
    - Chatting with an AI assistant,
    - Viewing personal diet summaries and progress dashboards.
- Communicates with backend services via **secure HTTPS endpoints**, with token-based authentication.

2. API Gateway and Authentication Layer

- Implemented using a **Node.js Express** server.
- Acts as the **central API gateway**, routing incoming requests to the appropriate modules (e.g., food analysis, chat assistant).
- Employs **JWT (JSON Web Tokens)** for user authentication and session management.
- Provides secure RESTful APIs to the mobile frontend, ensuring role-based access control and data integrity.

3. Barcode Lookup Module

- Integrates with the **Open Food Facts API** to fetch product-specific nutritional data from scanned barcodes.
- Extracts and parses key metadata such as:
    - Calories, protein, carbohydrates, and fats,

- Ingredient lists,
- Health ratings (if available).

- Returns structured nutritional insights to the frontend and also feeds this data into the AI assistant for more context-aware recommendations.

4. Food Image Analysis Module

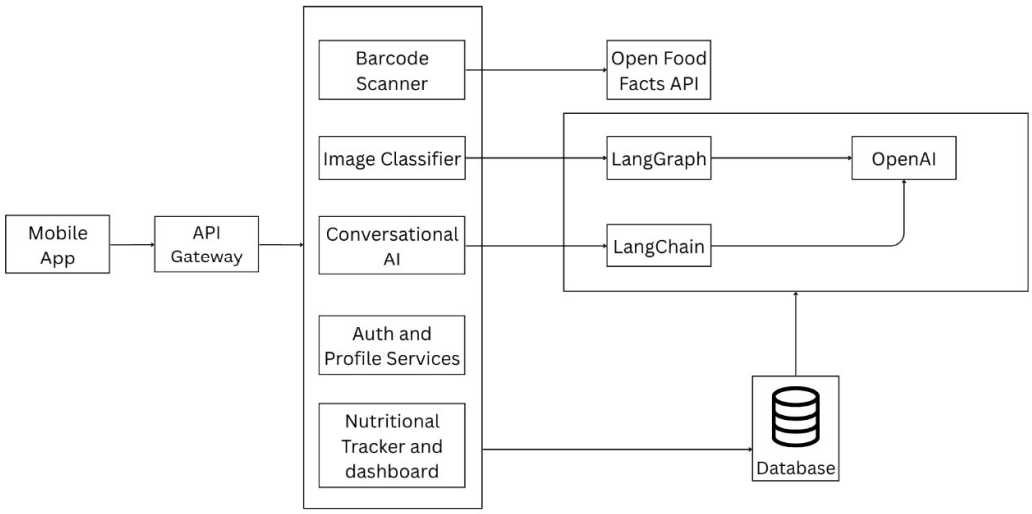
- Instead of using a dedicated on-device classifier, **Eathena uploads food images to Cloudinary**, which returns a public URL.
- The image URL is passed to **ChatGPT** using a multimodal prompt.
- ChatGPT analyzes the visual input and returns:
  - Descriptive captions of the food item,
  - Estimated nutritional values,
  - Suggestions for healthier alternatives or portion control.
- This cloud-based inference offloads the need for on-device ML models, improving performance and maintainability.

5. Conversational AI Engine

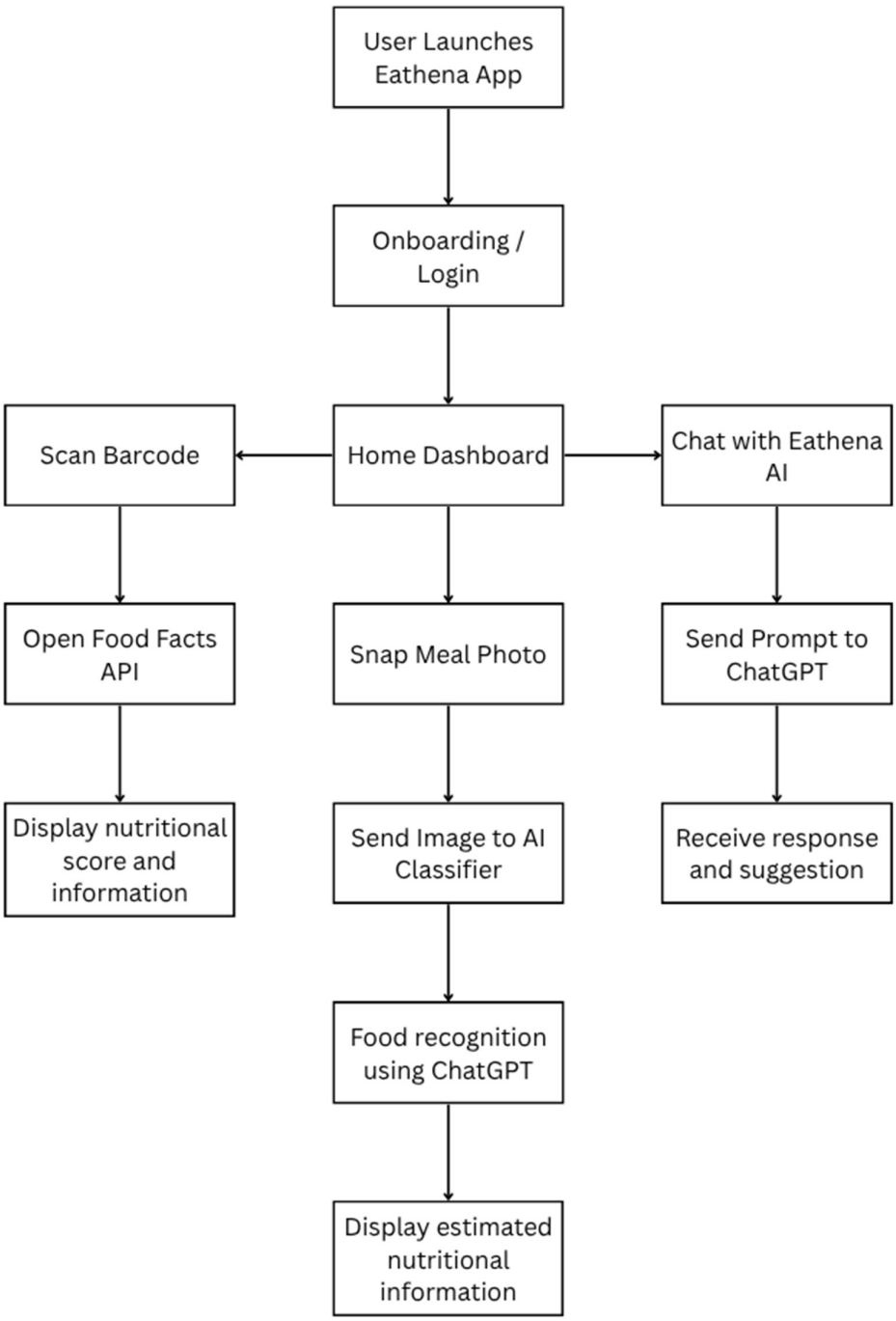
- Powered by **OpenAI's ChatGPT (via GPT-4 or GPT-4o API)**.
- Personalized using a **custom system prompt** that includes user profile data such as:
  - Age, height, current and goal weight,
  - Allergies and dietary preferences,
  - Activity levels or fitness goals.
- Uses **LangChain** and **LangGraph** to build intelligent agent workflows with memory, tool-calling (e.g., barcode lookup), and dynamic state transitions.
- Responds to user queries with meal suggestions, nutritional advice, and motivation tips in a personalized tone.

Design Considerations

- **Modular Structure**: Each component (chat, vision, lookup, auth) is independently scalable and testable.
- **API-First Design**: Simplifies integration of future services (e.g., wearables, regional food databases, fitness APIs).
- **Cloud-Centric Inference**: Offloads compute-heavy tasks like image understanding to OpenAI's API via cloud workflows.
- **Security**: Ensures all user interactions are authenticated, and data privacy is enforced throughout.



System Architecture


User Launches Eathena App
Onboarding / Login
Scan Barcode
Home Dashboard
Chat with Eathena AI
Open Food Facts API
Snap Meal Photo
Send Prompt to ChatGPT
Display nutritional score and information
Send Image to AI Classifier
Receive response and suggestion
Food recognition using ChatGPT
Display estimated nutritional information

User Flow

Chapter 4

DESIGN AND IMPLEMENTATION

4.1. DESIGN AND IMPLEMENTATION

The design and implementation of **Eathena** are structured around a modular, scalable, and user-centric architecture. The application leverages modern development frameworks, AI integration with ChatGPT, and thoughtful UI/UX principles to deliver a seamless and highly personalized experience in nutrition tracking and guidance.

Roles and Responsibilities

- **Tanishq Prasanna** – *Product Manager & Frontend Developer*

  Ideated the product, designed the user journey using **Figma**, built interactive prototypes, and developed key frontend components in **React Native with Expo**.

- **Niladitya Sen** – *Full Stack Developer*

  Designed and implemented the **backend API** in **Flask**, managed **MySQL** database integration, handled **JWT-based authentication**, and led **AI integration** using **ChatGPT**, **LangChain**, and **LangGraph**.

UI/UX Design

- Created detailed wireframes and high-fidelity prototypes using **Figma**.
- Adopted a minimalistic, accessible, and responsive UI that works on both Android and iOS.
- Mapped and iteratively tested user journeys, including:
  - Onboarding and goal setting
  - Barcode scanning for food
  - AI-driven food image analysis
  - Interactive nutrition assistant chat interface

Frontend Implementation

- **Framework**: React Native with Expo for cross-platform mobile support.
- **Key Screens Implemented**:
  - **Onboarding Screen**: Captures user data like age, weight, height, goal weight, dietary preferences, and allergies.

- **Dashboard Screen**: Displays nutrient rings, daily log, and progress metrics.
- **Barcode Scanner**: Enables scanning of packaged food barcodes to fetch nutrition data.
- **Meal Snap Analyzer**: Lets users upload food images for AI analysis.
- **AI Chat Screen**: Interfaces with ChatGPT for personalized dietary assistance.

- **State Management**: Achieved using **React Context API** and custom hooks for global state consistency.

Backend Implementation

- **Framework**: Express JS (Node JS)
- **Database**: MySQL, with tables for:
  - User profiles
  - Dietary preferences and restrictions
  - Meal logs and nutritional targets
- **Authentication**: Secure JWT-based system to protect endpoints and manage sessions.
- **API Gateway**: Node.js-based Express server for routing frontend requests to AI, database, and third-party APIs.

AI Integration

1. Food Image Analysis via ChatGPT

- Users upload food images via the app.
- Images are hosted on **Cloudinary**, and the public URL is sent to **ChatGPT (GPT-4-mini)** with a crafted system prompt.
- ChatGPT analyzes the image using its **multimodal capabilities**, returning:
  - Dish name
  - Estimated calorie and macronutrient content
  - Dietary suitability (based on user's profile)

- Eliminates the need for separate vision models like BLIP.

2. Barcode Nutrition Scanner

- Barcodes are captured and decoded in the app.
- Product metadata and nutrition details are fetched from the **Open Food Facts API**.
- The results are summarized and passed to **ChatGPT**, which:
    - Explains the nutrition profile
    - Suggests healthier or goal-oriented alternatives
    - Evaluates food compatibility with user goals

3. Conversational AI Assistant

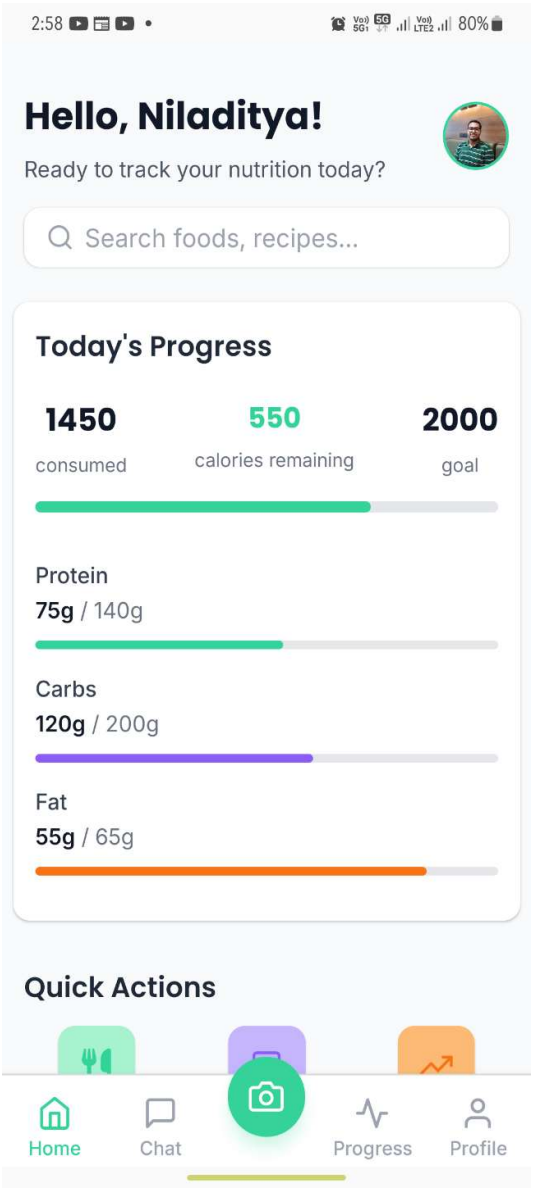
- Powered by **ChatGPT**, invoked via the LangChain API.
- **LangGraph** are used to orchestrate agents, memory, and API tools.
- Each conversation includes a **custom system prompt** with dynamic context:
    - Name, weight, age, goal weight, dietary type, allergy info, and recent meals
- ChatGPT provides:
    - Personalized food advice and explanations
    - Motivation and goal reminders
    - Q&A about food, fitness, and diet

Chapter 5

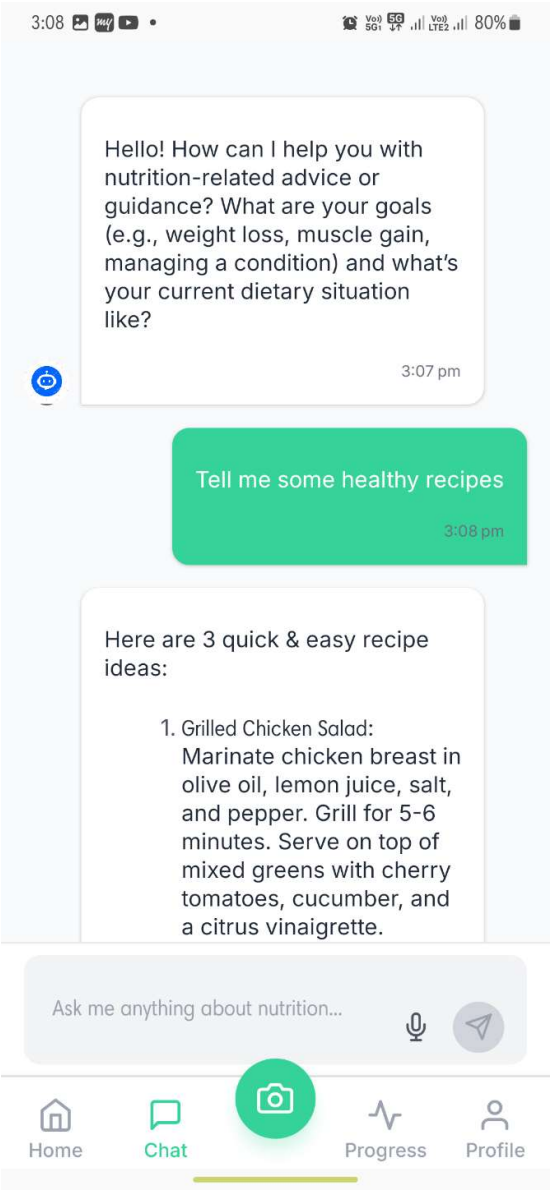
RESULT AND ANALYSIS

5.1 RESULTS AND ANALYSIS

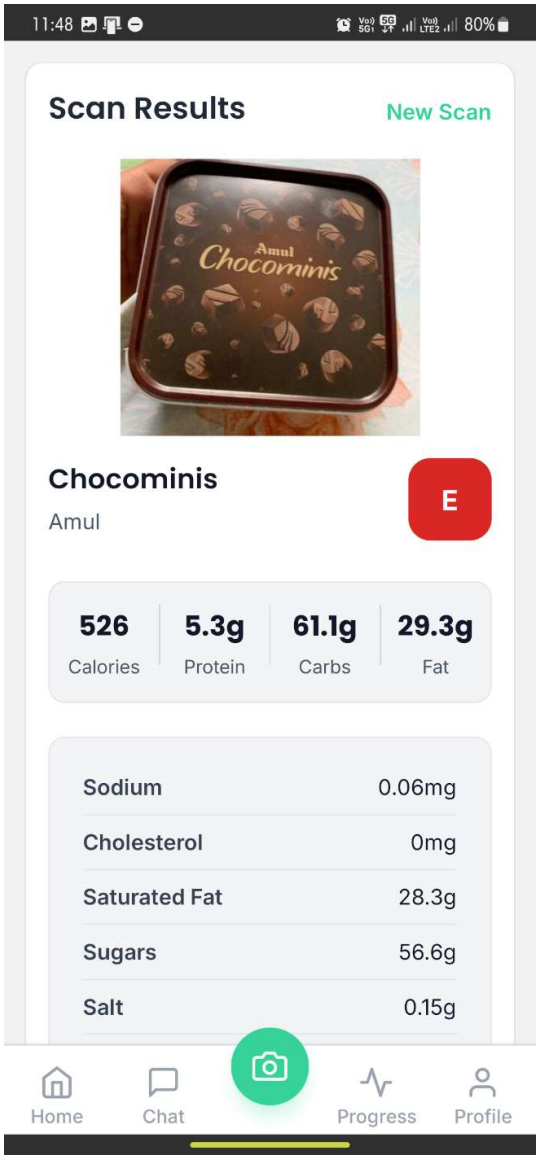
Dashboard



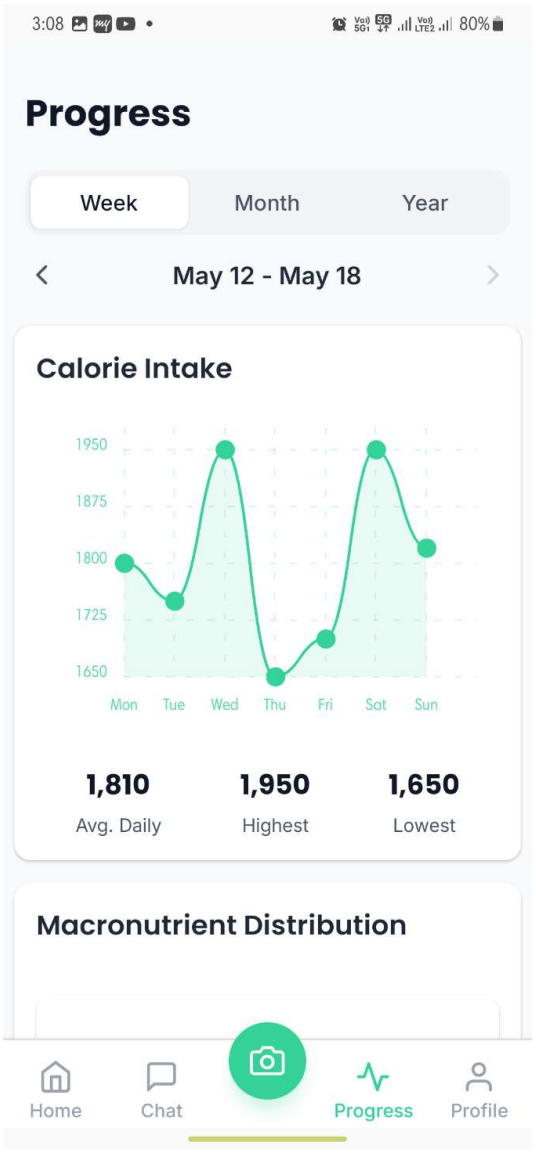
Conversational AI



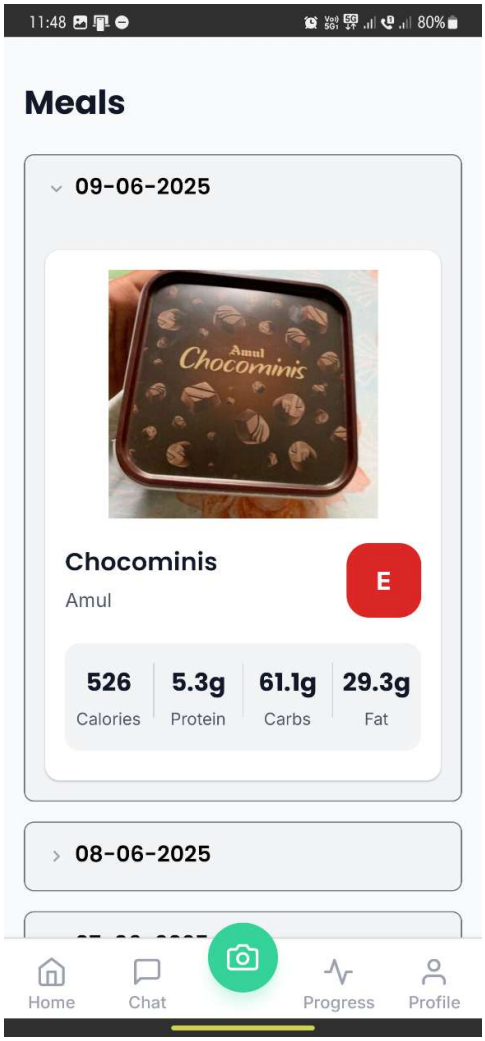
Barcode Scan



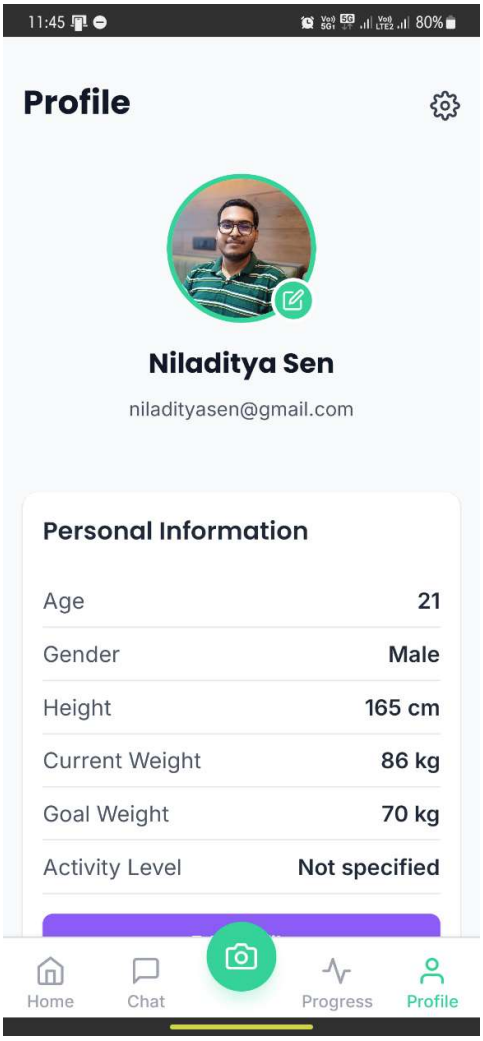
Progress



Meals



Profile



Chapter 6

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION AND FUTURE SCOPE

Eathena successfully integrates advancements in artificial intelligence, nutritional science, and intuitive user-centric design to deliver a comprehensive and intelligent mobile health companion. The application empowers users to make informed dietary decisions, track their nutritional intake, and receive real-time feedback tailored to their personal health goals and preferences. By leveraging AI-driven food analysis, barcode-based lookups, and an interactive conversational assistant powered by ChatGPT, Eathena transforms complex nutritional data into actionable insights in a seamless and accessible manner.

The modular architecture—built using React Native for the frontend and Express.js with MySQL for the backend—ensures cross-platform scalability, performance, and maintainability. Real-time barcode scanning, intelligent meal recognition from photos, and personalized AI guidance make the application not only technologically robust but also highly relevant in today's health-conscious digital ecosystem.

Furthermore, Eathena's prototype validates both its technical feasibility and practical utility. Through structured testing, feedback integration, and iterative improvements, the system has demonstrated the capability to serve as a valuable tool for individuals seeking to manage diet-related goals—be it weight loss, muscle gain, allergy avoidance, or general wellness.

As the prevalence of diet-related diseases continues to rise, tools like Eathena represent a crucial step toward accessible, AI-enhanced nutrition care. Future enhancements such as integration with wearables, real-time glucose monitoring, or region-specific food models can further extend its impact. Ultimately, Eathena exemplifies how technology, when applied thoughtfully, can drive meaningful change in personal health and lifestyle management.Future work includes:

- Integration with Apple Health, Fitbit, and glucose monitors.
- Advanced food recognition model with segmentation.
- Offline barcode database for improved performance.
- Regional language support and dietary tips.

Chapter 7

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REFERENCES

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