Project Specifications Report

1. Introduction

1.1 Description

Project Title:
NutriGame: AI-Based Nutrition Tracking and Recommendation System with Chatbot, Social Sharing, and Gamification

NutriGame is a mobile application developed to make healthy eating easier and more engaging. The system allows users to track their daily nutrition and calculate calorie values according to their personal goals. Users can log their meals manually or use Artificial Intelligence (AI) object detection to automatically estimate calories from food photos.

Beyond tracking, NutriGame focuses on motivation through social interaction and gamification. Users can add friends, participate in daily challenges and share their experiences within the challenge group. Additionally, to encourage daily consistency, the app features a "streak" system that increases every day the user logs their meals. Completing these challenges and goals earns users "badges" as rewards for their achievements.

Furthermore, an AI-powered chatbot offers psychological support to help users stay positive on their journey. The project aims to create a supportive environment where users can improve their health through technology and community. [1], [2], [3]

1.2 Constraints

1.2.1. Economic Constraints

The project operates under strict budget limitations as a student-led initiative with no external funding. The primary cost drivers are:

Cloud Infrastructure:
- *CockroachDB* [4] is used for database management and currently provides up to 40 GB of storage within its free-tier plan.
- *Cloudflare R2* [5] is used for file storage and provides up to 10 GB of storage within its free-tier limits.

Estimated Cost: Based on current system requirements, the infrastructure is expected to operate within these free-tier resources, resulting in an estimated cost of $0/month.

AI Services & Deployment:

- While fine-tuning the image recognition model, we will use H100 GPUs [6] provided free of charge by TOBB ETU for students.
- *Hugging Face Spaces* (Free tier) [7]: Food recognition model deployment using GPU-based inference
- *Gemini API* (Free tier) [8]: Chatbot functionality with 60 requests/minute limit

App Deployment:

- We plan to use the free-tier offerings of *Render* [9] and *RunCloud* [10] during the initial phase. If these resources prove insufficient, we will evaluate their paid plans. Render's entry-level plan costs approximately $25/month, while RunCloud offers more cost-effective options starting at around $10/month, making it the preferred alternative from a cost perspective.
  Estimated Cost: $0-25/month depending on traffic

Sustainability Plan: If user base exceeds free-tier limits, the app may introduce optional premium features (e.g., unlimited AI analyses, advanced meal planning) rather than mandatory subscriptions to maintain accessibility for all users.

1.2.2. Social Constraints

The inclusion of social features introduces a constraint regarding privacy and visibility. While users can interact with friends, they may not want to reveal sensitive personal details, such as their weight or specific food logs. Therefore, the system design is constrained to include strict privacy settings, allowing users to control exactly what information is visible to their friends versus what remains private.

1.2.3. Environmental Constraints

The application's environmental constraints primarily involve resource efficiency, device compatibility, and physical operating conditions. The system is optimized for modern mid-range smartphones, targeting approximately 200 MB of storage for initial installation (up to ~300 MB with cached data) and up to ~400 MB of RAM during peak usage when the camera and AI features are active. To minimize battery consumption and prevent excessive device heating, background processes are limited and intensive operations such as AI-based food recognition are performed on-demand rather than continuously. The accuracy of the "Image-Based Logging" feature is constrained by environmental factors. Optimal performance requires adequate lighting conditions and a camera resolution of at least 2 MP, with 8 MP or higher recommended for best results. Performance may degrade with blurry images, extreme angles, or cluttered backgrounds. To optimize storage and network usage, the system applies image compression and downscaling before processing, allowing the AI model to operate efficiently regardless of the original image resolution.

1.2.4. Ethical Constraints

- While the AI provides psychological support, strictly speaking, it cannot replace a licensed therapist. The system is constrained to offer motivational support only and must not attempt to treat clinical depression or eating disorders.
- To protect user privacy, personal identifiable information will not be sent directly to external AI services. A pre-processing filter will be implemented to anonymize data before it is processed by the AI.
- Must comply with GDPR [11] and KVKK [12] regulations, including explicit user consent for data collection.

1.2.5. Health and Safety Constraints

AI must be constrained to avoid giving dangerous medical advice disguised as nutritional support.

1.2.6. Technical and Design Constraints

- **Device Requirements:** The application requires a smartphone with a camera, a minimum of 4 GB RAM (to support AI processing), and Android 11.0 (API Level 30+) or iOS 14+.
- **Connectivity:** The system supports offline caching for basic navigation, but core features (AI recognition, Cloud Sync) require a stable internet connection.
- **Scalability:** The initial cloud infrastructure and backend (running on up to 4 active nodes) are designed to support up to approximately 1,000 concurrent users.

1.2.7. Temporal Constraints

The project must be completed within a strict 3-month timeline by a 4-person development team:
Month 1: Requirements analysis, architecture design, dataset preparation.
Month 2: Core feature development (meal logging, AI recognition, meal planning).
Month 3: Testing, bug fixing, UI polishing, and deployment preparation.

1.2.8. Operational Constraints

- **AI Dataset Limitations:** Food recognition models may underperform with culturally specific or rare dishes not present in the training dataset.
- **API Rate Limits:** Food Database API monthly request limit and Hugging Face model inference rate must be respected to avoid service interruptions.

1.3 Professional and Ethical Issues

In this project, we recognize our responsibilities regarding user safety, data privacy, and social well-being [13].

- **Data Privacy and Anonymity:** We respect user privacy by implementing a pre-processing filter that anonymizes personal data before sending it to any AI service. This ensures that sensitive information is never exposed during the image recognition or chatbot processes.
- **Non-Medical Chatbot**: We explicitly define NutriGame as a supportive wellness tool rather than a medical device. We will include clear disclaimers stating that the AI chatbot offers motivational advice only and does not replace professional medical diagnosis or treatment.

- **Mental Health Awareness:** We design our gamification and streak features to promote balanced, healthy lifestyles. We carefully avoid mechanics that could encourage obsession, extreme dieting, or unhealthy eating behaviors.
- **Transparency and Honesty:** We maintain professional integrity by clearly informing users that AI-based calorie estimations are approximations. Users are always given the option to manually verify and correct the data to prevent misleading results.
- **Regulatory Compliance**: The application is designed to comply with GDPR and KVKK regulations. Users must provide explicit consent before any data collection begins. Users retain the right to access, modify, or permanently delete their personal data at any time through the app settings.
- **Third-Party Data Disclosure**: Food images are processed through Hugging Face Spaces, and chatbot queries are handled via Gemini API. No personally identifiable information (PII) is transmitted to these services. Nutritional data is sourced from the publicly available Food Databases.
- **Age Restriction**: The application is intended for users aged 13 and above. Parental consent is recommended for users under 18.

2. Requirements

- **R-01** – The system shall generate recommended calorie intake plans based on the user's goals.
- **R-02** – The system shall allow users to log meals using three methods: manual search (users can search for foods in the provided database), natural language input (users can add new foods with nutritional values to the database), and photo upload.
- **R-03** – The system shall estimate calories by recognizing food items from uploaded photos.
- **R-04** – The system shall analyze food descriptions entered by the user and retrieve corresponding nutritional values (e.g., protein, carbohydrate, fat, calorie) from the system’s database.
- **R-05** – The system shall track information related to water intake, weight changes, mood, as well as daily calorie intake and burned calories.
- **R-06** – The system shall provide gamification elements by awarding points when users achieve their daily goals.
- **R-07** – The system shall store user profile information, including age, gender, weight, height, goals, dietary preferences, and avatar.
- **R-08** – FR-08 – The system shall track and store users' data including daily meals, mood entries, weight records, and achievements.
- **R-09** – The system shall access the mobile device’s camera to allow users to take and upload food photos.
- **R-10** – The system shall allow users to interact with each other.
- **R-11** – The system shall allow users to upload and share their own recipes in their profile.
- **R-12 –** The system shall allow users to register and authenticate using email or username/password.
- **R-13 –** The system shall maintain daily login streaks and display streak count to users.

- **R-14 –** The system shall award badges upon completing specific achievements.
- **R-15 –** The system shall allow users to permanently delete their accounts and all associated data.
- **R-16 –** The system shall provide push notifications for daily reminders and challenge updates.
- **R-17** – The system shall allow users to edit or delete previously logged meals.
- **R-18** – The system shall allow users to view a daily and weekly nutrition summary.
- **R-19** – The system shall allow users to add other users as friends.
- **R-20** – The system shall allow users to create challenges and invite selected friends.
- **R-21** – The system shall allow invited users to accept or reject a challenge request.
- **R-22** – The system shall allow users to share challenge-related posts within the app.
- **R-23** – The system shall reward the winner(s) of a completed challenge with badges or points.

Performance Requirements

- Under normal network conditions (≥10 Mbps), the system must return food image analysis and calorie estimation results within 10 seconds.
- Basic database queries must complete in ≤ 3 seconds.
- The architecture shall support at least 150 concurrent active users without performance degradation (initial).
- The system shall handle up to 5,000 requests per day reliably.
- Monthly uptime shall be maintained at ≥ 90%.
- The acceptable API error rate shall not exceed 1% of total requests, excluding user input errors.
- In case of a system failure, automated recovery shall restore service within 6 hours.
- The system must be able to process at least 10,000 food images per month without exceeding computational or storage limits.
- Image uploads of up to 5 MB must complete in under 3 seconds under standard broadband conditions.

3. References

[1] K. R. Schneider, J. J. Liu, and A. A. Voida, “Retention and Engagement in Mobile Health Apps: A Longitudinal Study of User Behavior,” Journal of Medical Internet Research, vol. 26, no. 1, p. e56897, Jan. 2024. [Online]. Available: https://www.jmir.org/2024/1/e56897

[2] J. M. Rabin and B. C. Bock, "Desired features of smartphone applications promoting physical activity," Telemedicine and e-Health, vol. 17, no. 10, pp. 801-803, Dec. 2011.

[3] S. Sardi, A. Idri, J. Fernández-Alemán, and A. Toval, "The effectiveness of gamification in mHealth apps: A systematic review," Journal of Biomedical Informatics, vol. 71, pp. 31-48, 2017.

[4] “CockroachDB Cloud,” Cockroach Labs. [Online]. Available: https://www.cockroachlabs.com/product/cockroachdb-cloud/ (accessed Jan. 24, 2026).

[5] “Cloudflare R2 Storage,” Cloudflare. [Online]. Available: https://www.cloudflare.com/products/r2/ (accessed Jan. 24, 2026).

[6] “NVIDIA H100 Tensor Core GPU,” NVIDIA. [Online]. Available: https://www.nvidia.com/en-us/data-center/h100/ (accessed Jan. 24, 2026).

[7] “Hugging Face Spaces,” Hugging Face. [Online]. Available: https://huggingface.co/spaces (accessed Jan. 24, 2026).

[8] “Gemini API Documentation,” Google. [Online]. Available: https://ai.google.dev/ (accessed Jan. 24, 2026).

[9] “Render Cloud Application Platform,” Render. [Online]. Available: https://render.com/ (accessed Jan. 24, 2026).

[10] “RunCloud Hosting Control Panel,” RunCloud. [Online]. Available: https://runcloud.io/ (accessed Jan. 24, 2026).

[11] “General Data Protection Regulation (GDPR),” European Union. [Online]. Available: https://gdpr.eu/ (accessed Jan. 24, 2026).

[12] “Kişisel Verilerin Korunması Kanunu (KVKK),” T.C. Kişisel Verileri Koruma Kurumu. [Online]. Available: https://www.kvkk.gov.tr/ (accessed Jan. 24, 2026).

[13] E. Mattila, P. Saarni, S. Salminen, et al., "Emotional eating, depressive symptoms and self-compassion in university students: A population-based study," Appetite, vol. 68, pp. 66-72, 2013.