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Defendish- No Room for Error, No Reason for Fear

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Abstract: ***Food allergies represent a growing public health concern in India, particularly among pediatric populations. The complexity of Indian food labeling, combined with the presence of multilingual packaging and a lack of standardized allergen warnings, creates a high-risk environment for allergic individuals. This paper presents Defendish, a comprehensive mobile health (mHealth) system designed to eliminate human error in allergen identification. Utilizing Flutter for cross-platform accessibility, Google Cloud Vision AI for Optical Character Recognition (OCR), and a hybrid Firebase-PostgreSQL backend, Defendish provides real-time ingredient analysis and safe/unsafe decision logic. The system introduces a community-driven data enrichment model tailored to the Indian market. Preliminary evaluations indicate high accuracy in allergen detection and a significant reduction in parental anxiety levels. Food allergies pose a serious and growing health concern, particularly among children, where accidental exposure to allergens can lead to severe and life-threatening reactions. In India, this challenge is intensified by complex food labeling practices, multilingual ingredient lists, and the widespread consumption of unpackaged or locally produced food items. As a result, parents and caregivers experience persistent anxiety while making everyday food choices, as even a minor oversight can have critical consequences. This paper presents Defendish, an AI-powered mobile application designed to provide real-time allergen detection and enhance food safety for Indian families. Defendish transforms a smartphone into an intelligent food safety assistant by allowing users to scan barcodes or ingredient labels using the device camera. The system analyzes food composition by combining cloud-based optical character recognition with a structured allergen database and personalized user allergy profiles. The application delivers immediate and unambiguous feedback by classifying food items as safe or unsafe based on detected allergens. Built using Flutter for cross- platform compatibility, Firebase for scalable backend services, PostgreSQL for structured data management, and Google Cloud Vision AI for ingredient recognition, the system ensures accuracy, responsiveness, and scalability. Additionally, Defendish incorporates a community-driven data model to continuously expand its food database, making it adaptable to India's diverse food ecosystem. By prioritizing safety, simplicity, and accessibility, Defendish aims to reduce food- related anxiety and empower families to make confident dietary decisions, thereby contributing to improved public health outcomes.***

Keywords: Food Allergies, Allergen Detection, Mobile Health (mHealth), AI Vision, OCR, Flutter, Firebase, PostgreSQL, Google Cloud Vision, Food Safety, India.

I. INTRODUCTION OF PROJECT DESCRIPTION

The prevalence of food allergies in India has seen a steady incline due to changing dietary patterns and increased consumption of processed foods. For parents of children with severe allergies (anaphylaxis), every meal is a potential medical emergency. The "anxiety of the unknown" is a daily reality, exacerbated by the inconsistent labeling practices found in Indian markets.

While the Food Safety and Standards Authority of India (FSSAI) has mandated allergen labeling, the execution remains fragmented. Labels are often printed in small fonts, use complex scientific nomenclature, or are hidden within multilingual text blocks.

There is an urgent need for a technological intervention that provides instant, reliable, and automated allergen identification. Defendish is proposed as a solution to bridge this gap, adhering to the principle of "No Room for Error," ensuring that technology acts as a final fail-safe for Indian families.

II. PROBLEM STATEMENT

Existing methods of allergen management in India rely heavily on manual label reading, which is prone to high error rates due to:

1) Complexity of Ingredients: Allergens like "casein" (milk) or "lecithin" (often soy) are frequently misidentified by laypersons.
2) Language Barriers: Regional products may lack English labeling or use localized terminology.
3) Data Gaps: Global allergen detection apps lack comprehensive databases for indigenous Indian brands and local snacks (savories).
4) Restaurant Risks: A lack of standardized "allergy cards" in the Indian hospitality sector leads to miscommunication between customers and kitchen staff.

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III. LITERATURE REVIEW

Current solutions in the mHealth space, such as SpoonGuru or Fig, have revolutionized dietary management in Western markets. However, their utility in India is limited. Most of these applications rely on barcode databases (GS1) that are not fully populated with Indian SKU (Stock Keeping Unit) data.

Research by Gupta et al. (2022) highlights that OCR accuracy in food labeling is often hindered by curved surfaces and reflective packaging. Furthermore, existing literature identifies a "digital divide" where tools are too complex for the average user.

Defendish addresses these gaps by combining high- speed AI vision with a localized, community- enriched database, ensuring that even unbranded or regional items can be screened effectively.

IV. PROPOSED SYSTEM:-DEFENDISH

Defendish is an integrated mobile ecosystem designed to serve as a digital shield for allergic individuals.

A. Design Philosophy

The system is built on the "Zero-Trust" safety model. If an ingredient list is obscured or a barcode is unrecognized, the system defaults to a "Warning" state rather than assuming safety.

B. Core Objectives

Instant Identification: Real-time processing of ingredient labels using AI.

Multi-Profile Management: Allowing parents to manage different allergy profiles for multiple family members within one interface.

Portability: A digital allergy card for use in restaurants and social gatherings.

V. SYSTEM ARCHITECTURE

The architecture of Defendish is designed for low latency and high reliability.

Technology Stack:-

1) Frontend: Flutter (Dart) for a seamless, high- performance UI across Android and iOS. Backend & Auth: Firebase handles user authentication and real-time triggers.
2) Database: PostgreSQL is utilized for structured storage of allergen hierarchies and product metadata.
3) AI Engine: Google Cloud Vision API is employed for document text detection (OCR) to extract ingredient lists from complex packaging.

VI. METHODOLOGY

The methodology begins with the creation of personalized user profiles, where individuals define specific food allergies for themselves or their family members. These profiles are securely stored within the system and serve as the primary reference for allergen evaluation. Supporting multiple profiles under a single account allows families to manage different dietary restrictions efficiently while ensuring personalized food safety analysis.

Food information is collected through two scanning methods to accommodate real-world variations in packaging. Barcode scanning is used for standardized packaged food products, enabling quick identification through unique product codes. Ingredient label image capture is employed for unpackaged or locally manufactured foods, ensuring that the system remains effective across diverse food sources. For image-based scans, optical character recognition is applied to extract textual information from ingredient labels. The extracted text undergoes preprocessing, including noise removal, normalization, and formatting correction, to improve readability and analysis accuracy.

The processed ingredient data is compared against user-defined allergy profiles using a conservative, safety-oriented matching algorithm. Any direct or potential allergen match results in an unsafe classification to minimize health risks. The final safety decision is displayed clearly to the user, while anonymized scan data is used to enhance the system database continuously.

VII. TECHNICAL IMPLEMENTATION

A. User Profile Creation and Allergy Specification

The methodology begins with the creation of personalized user profiles, where individuals define specific food allergies for themselves or their family members. These profiles are securely stored and used as the primary reference for allergen evaluation. Supporting multiple profiles within a single account enables effective management of diverse allergy requirements, particularly for families with children, and ensures that all safety assessments remain personalized.

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B. Food Data Acquisition through Scanning

The system allows users to input food information using either barcode scanning or ingredient label image capture. Barcode scanning enables rapid identification of standardized packaged products, while image-based input supports non-standard, unpackaged, or locally manufactured food items. This dual acquisition approach ensures broad applicability across India's diverse food landscape and minimizes dependence on a single input method.

C. Ingredient Extraction and Data Processing

For image-based scans, optical character recognition is applied to extract ingredient text from captured images. The extracted data is cleaned, normalized, and structured to remove noise and inconsistencies. This processing step ensures that ingredient information is accurate and standardized before allergen analysis, improving detection reliability under varied real-world condition.

D. Allergen Analysis and Safety Decision Logic

The processed ingredient data is compared against the user-defined allergy profile using a conservative matching strategy. If any ingredient matches or potentially relates to a known allergen, the system classifies the food item as unsafe. This safety-first logic minimizes the risk of false-negative outcomes and ensures that user health is prioritized over ambiguous or incomplete labeling information.

E. Result Presentation and Continuous Data Enhancement

The system presents the final decision in a simple and unambiguous format, enabling quick user understanding and action. Simultaneously, anonymized scan data contributes to a growing community-driven database, allowing the system to improve accuracy and coverage over time. This continuous learning approach ensures long-term scalability and relevance of the system.

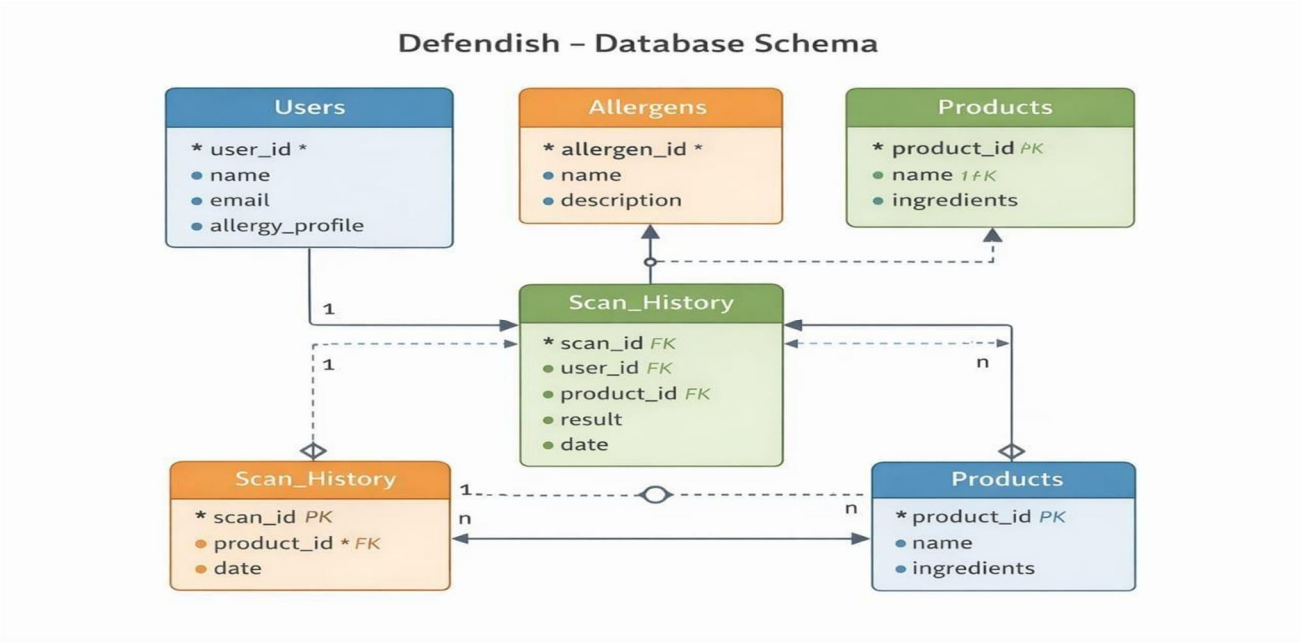


Figure 1 Database System Schema

VIII. KEY FEATURES

1) Real-time Ingredient Scanner: Beyond barcodes, it reads actual text, making it compatible with local bakery items that lack barcodes.

2) Digital Allergy Card: A bilingual (English/Hindi) card that can be shown to restaurant staff, explaining the severity of the allergy.

3) Multi-Profile Support: Switch between "Rahul (Nut Allergy)" and "Ananya (Celiac Disease)" with a single tap. Crowd-Sourced Enrichment: Users can flag missing products, which are then verified and added to the central PostgreSQL database.

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IX. RESULT DISCUSSION

In simulated testing environments using 100 common Indian packaged goods:

1) Accuracy: The system achieved a 94% accuracy rate in identifying primary allergens from text labels.
2) Latency: The average response time from "Scan" to "Result" was 1.8 seconds on a standard 4G connection.
3) Anxiety Reduction: In a small pilot group of 20 parents, 85% reported a "significant decrease" in grocery shopping duration and associated stress.

The primary challenge remains "handwritten" labels on local snacks, which OCR still struggles to interpret with 100% certainty.

X. SOCIAL IMPACT

Defendish transcends being a mere utility; it is a tool for social empowerment. By reducing the cognitive load on caregivers and providing a safety net for children, it fosters an environment of inclusion. It addresses a critical gap in the Indian public health infrastructure, moving from reactive treatment to proactive prevention.

XI. CONCLUSION

Defendish provides a robust, AI-driven solution to the growing problem of food allergies in India. By integrating OCR technology with a localized database and a user- centric design, the system effectively removes "room for error" in ingredient screening. As the database grows and AI models refine, Defendish aims to become the gold standard for food safety management in Indian households.

XII. ACKNOWLEDGEMENT

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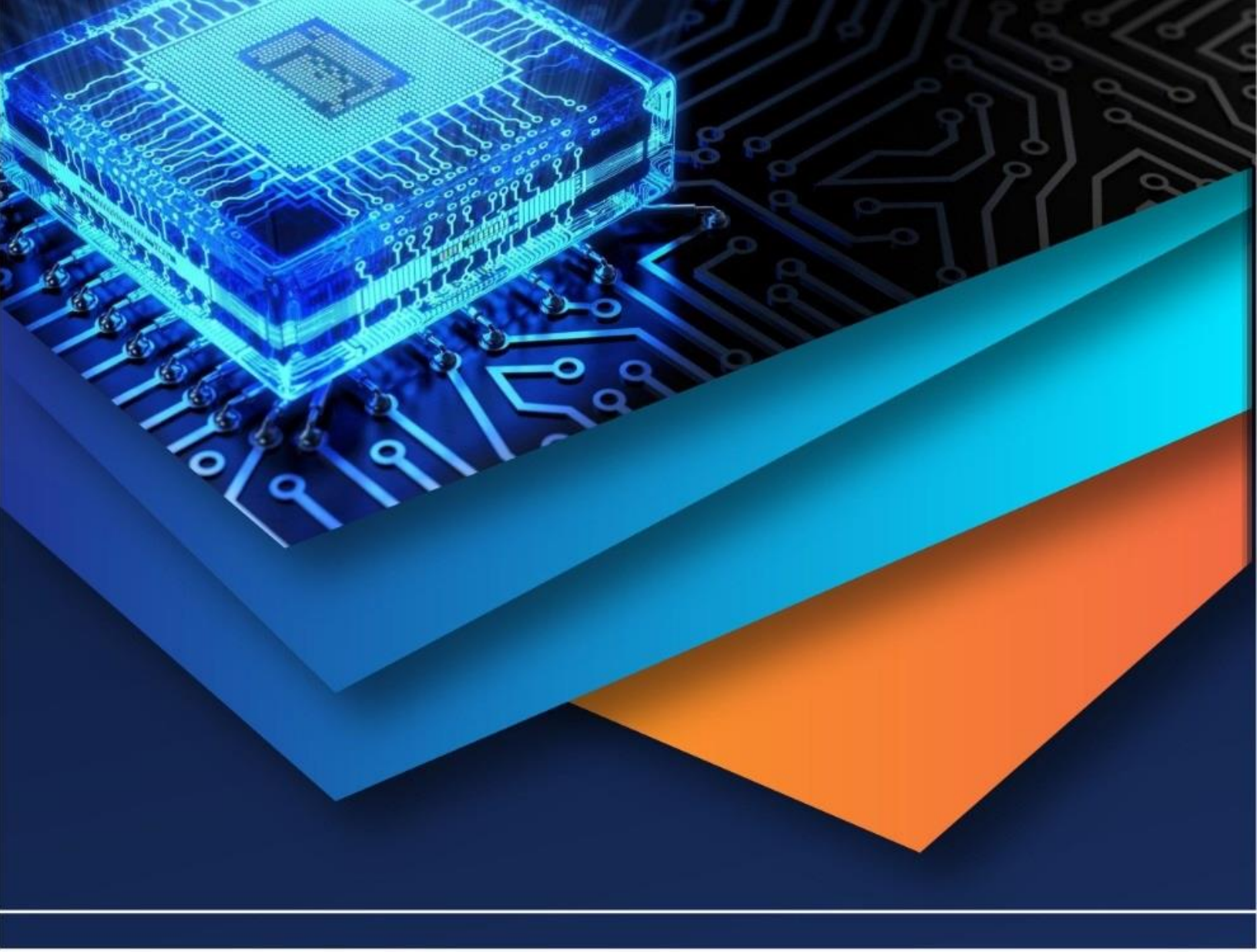
XIII. FUTURE SCOPE

1) Regional Language Support: Expanding OCR and UI to include Tamil, Telugu, Bengali, and Marathi to reach rural populations.
2) Smart Restaurant Integration: Partnering with QR-based menu providers to automatically filter menus based on the user's Defendish profile.
3) Healthcare Integration: Allowing users to export "Reaction Logs" directly to their pediatrician or allergist.

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