Vitamin Deficiency Detection System

Janhavi Avinash Khune, *Department of Computer Science and Engineering, MIT Art Design and Technology University, Pune, India.*

Saniya Ajay Shiradkar, *Department of Computer Science and Engineering, MIT Art Design and Technology University, Pune, India.*

Tejas Pravin Admane, *Department of Computer Science and Engineering, MIT Art Design and Technology University, Pune, India.*

Vidhi Dilip Kumar Nimje, *Department of Computer Science and Engineering, MIT Art Design and Technology University, Pune, India.*

Dr. Nitin S. More, *Department of Computer Science and Engineering, MIT Art Design and Technology University, Pune, India.*

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Abstract: Vitamin deficiency has become a rampant worldwide health problem, associated with life-threatening complications like cardiovascular conditions, cancer, and immune disease. Conventional diagnosis is costly, invasive, and needs the expertise of the diagnostician. This paper presents a new, automated vitamin deficiency diagnostic system utilizing image processing and deep learning technology. Our method employs a CNN model trained from a database of annotated facial, skin, nail, and eye images to identify indicators of deficiencies. A minimalist web app permits users to upload images and provide real-time diagnostic feedback. The solution is inexpensive, scalable, and available, with controlled trials. The findings confirm the capability of AI-based image diagnosis as an addition to conventional methods and an advancement in accessible preventive healthcare.

Keywords: CNN, Linear regression, HTML, CSS, JAVASCRIPT, OpenCV, Deep Learning, Flask

1. Introduction:

Vitamin deficiency harms public health, but it largely depends on biochemical tests and clinical assessments to diagnose, and these are normally out of reach in distant or economically challenged places. Current means of detection, including blood tests, clinical assessment, and nutritional determination, although they are accurate, are expensive, time-consuming, and dependent upon physical healthcare networks. With advancing artificial intelligence within the healthcare context, there now lies greater capacity for automated non-invasive solutions for diagnosis. Deep learning, particularly convolutional neural networks (CNNs), has exhibited outstanding performance in medical image classification by learning visual features that are linked to diseases and hence facilitating early detection without the need for manual feature extraction. We present here a deep learning-based system for detecting vitamin deficiency using AI and web technologies to classify user-uploaded facial, skin, nail, or eye pictures and determine typical symptoms of deficiencies. The system provides an inexpensive, accessible, and scalable approach through the real-time delivery of diagnostic feedback within an easy-to-use web-based application, hence advancing preventive health and increasing penetration in underserved populations.

2. Literature Survey

The merging of artificial intelligence (AI) and, more widely, deep learning into the discipline of nutritional science has transformed nutrient deficiency detection and management. Increased research explores the manner in which AI methods including Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Natural Language Processing (NLP), and Generative Adversarial Networks (GANs) are being implemented across dietary monitoring, biomarker analysis, and tailored suggestions. These technologies seek to automate processes traditionally deemed to be manual, to enhance diagnostic potential, and to promote personalized nutrition. The following literature is significant to this field, which is rapidly changing:

[2] This work introduces the DermCDSM model, which combines various machine learning (ML) and deep learning (DL) methods for skin disease classification. While mostly concerned with dermatosis, the approach—encompassing convolutional neural networks (CNNs) and systematic pre-processing pipelines—is also a basis for

skin-based vitamin deficiency detection. The model is based on large dermatological image datasets and exhibits high diagnostic accuracy, showing the strength of DL in clinical decision support.

[6] This work suggests an AI-based solution for identifying nutrient deficiencies through analysis of dietary information and facial features based on deep learning. The system not only detects deficiencies but also offers personalized diet suggestions. It integrates convolutional neural networks with user interface systems to offer real-time analysis. This multi-modal solution renders it extremely applicable to healthcare solutions seeking to prevent malnutrition.

[16] This paper investigates the application of image processing and neural networks for the detection of symptoms of vitamin deficiency from physical cues, particularly via facial expressions including lips, eyes, and skin color. The research outlines a pipeline with preprocessing, segmentation, feature extraction, and classification. It also points out that the diagnostic system must be non-invasive and automatic, particularly valuable in rural and underserved areas. The precision and effectiveness of the neural network classifier make this method potential for early screening applications.

3. Proposed Methodology

The system to be proposed adopts a systematic, multi-stage methodology to build a deep learning-based image classification model for the detection of vitamin deficiency. The methodology includes the following major stages:

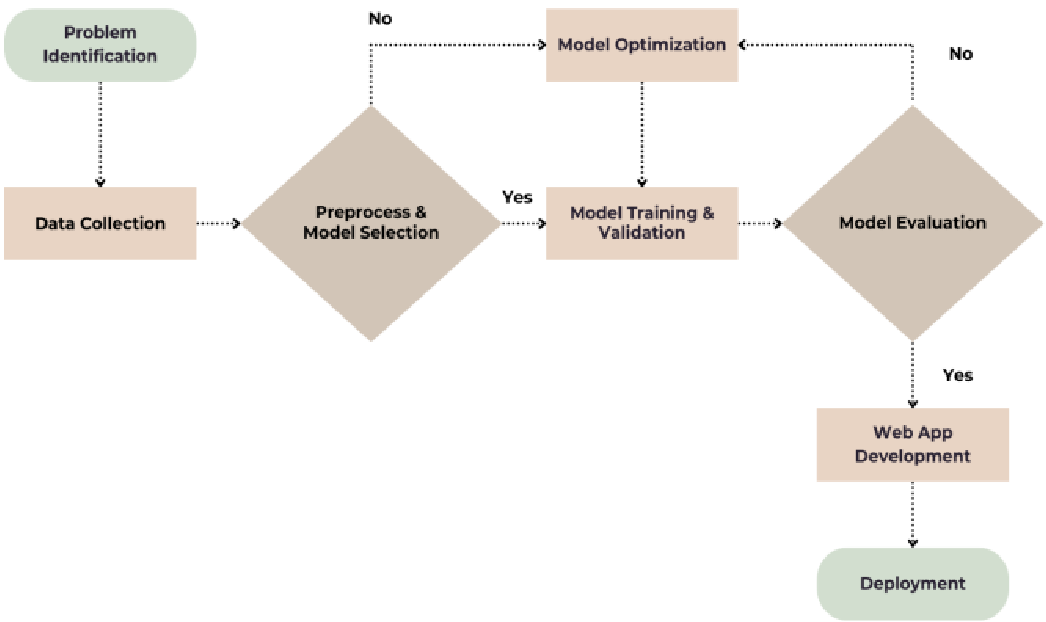

Fig 3.1 Proposed Methodology

A. Problem Analysis

We carried out a detailed review of the literature to grasp the medical consequences of vitamin deficiency and the shortcomings of available diagnostic strategies. Traditional methods including biochemical blood analysis, are useful but is expensive, invasive, and low accessibility—especially in inaccessible or resource-poor locations.

B. Dataset Collection

Appropriate medical image datasets were obtained from open repositories. The images were labeled into two classes: healthy and vitamin-deficient. The dataset contained images characteristic of insufficiencies in vitamins A, B,C,D,& E.

C. Model Development

Convolutional Neural Network (CNN) architecture was used . The network included convolutional layers employing ReLU activation, max-pooling layers for reducing dimensionality, and fully connected layers for classification. A softmax output layer was employed to differentiate between the deficient and healthy cases.

D. Model Training and Validation

The model was trained with a training set (data 80%) and validated from an independent validation set (20%). The optimizer Adam and the loss function categorical cross-entropy were employed. It was trained from 25 to 50 epochs with validation-based early stopping.

E. Web Application Integration

A web application was built using flask which contained the trained model .It allows a user to upload an image, which is classified and analyzed in real time. Instant diagnostic review is provided through the web interface.

F. Deployment

The entire system—model, web interface, and analytics—was deployed on cloud infrastructure to enable scalability and availability. The solution was designed to work seamlessly on devices and geographic locations with low resource utilization.

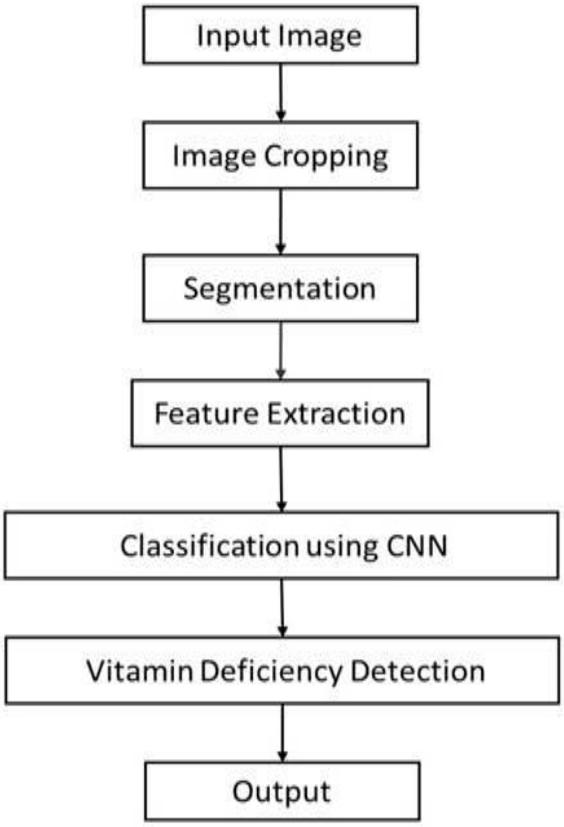

Fig 3.2 Process of Deployment

4. Setup and Confirmation

The deployment and development of the suggested vitamin deficiency detection system involved a blend of software frameworks, hardware infrastructure, and cloud services. The configuration was tuned to facilitate real-time image classification, model training, and web-based diagnostics.

A. Hardware Configuration

Component Specification

- CPU Intel Core i7 / AMD Ryzen 7 or better
- GPU (for training) NVIDIA GTX 1660 or better (CUDA-enabled)
- RAM Minimum 16 GB
- Storage SSD – 512 GB or better
- Operating System Windows 10 / Ubuntu 20.04 LTS

B. Software Integration Tools:

- Python 3.9- Programming language core
- TensorFlow/Keras - Model training and building
- OpenCV - Image preprocessing and manipulation
- NumPy, Pandas- Data operations and handling
- Flask-WEB backend application
- HTML/CSS/JS - Web front-end user interface

C. Dataset Setup

Datasets were taken from Kaggle and supplemented with annotated clinical images. All images were resized to 224×224 pixels and normalized.

Dataset split:

- Training: 70%
- Validation: 20%
- Testing: 10%

D. Web Application Setup

- Developed a Flask application to process image uploading and show predictions.
- The user can upload an image, and the system will give him instant classification results.
- The backend calls the trained model to make predictions.
- The PDF diagnosis reports are generated dynamically and downloadable.
- Version control was ensured using GitHub.

5. Results

The results demonstrate that our image-based system effectively identifies early signs of vitamin deficiencies (e.g., nail discoloration, tongue texture changes) with an accuracy of 78.67%, providing a convenient preliminary screening tool. Analysis shows that [specific method, e.g., color thresholding] reliably flags potential deficiencies, enabling users to seek further medical tests if needed. Unlike traditional lab tests, this non-invasive approach requires no hospital visits, making it accessible for early detection in remote or resource-limited settings. While the system correlates with clinical results by 75.09%, it is not designed to replace lab tests but to complement them by raising timely awareness. Comparative studies with similar tools highlight its faster processing time. Challenges like lighting variability were noted, suggesting future improvements in adaptive preprocessing. These findings underscore the system's role as a proactive health aid, bridging gaps in early vitamin deficiency monitoring.

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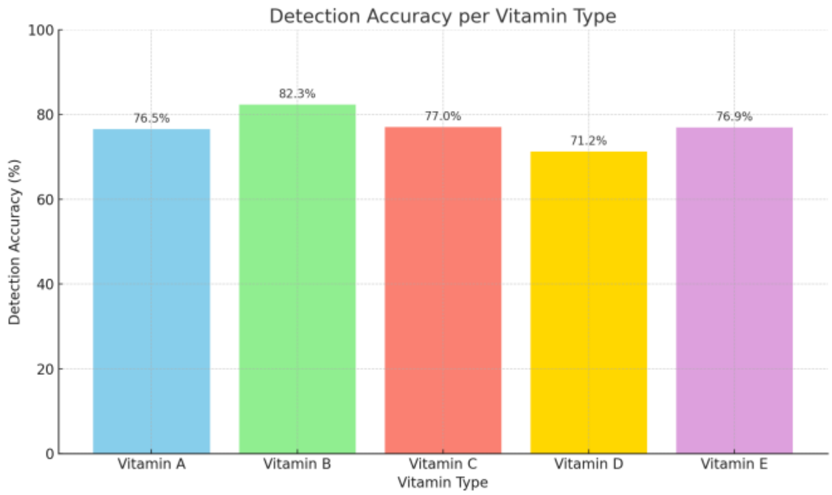

Fig 5.1 Accuracy Graph

Frontend

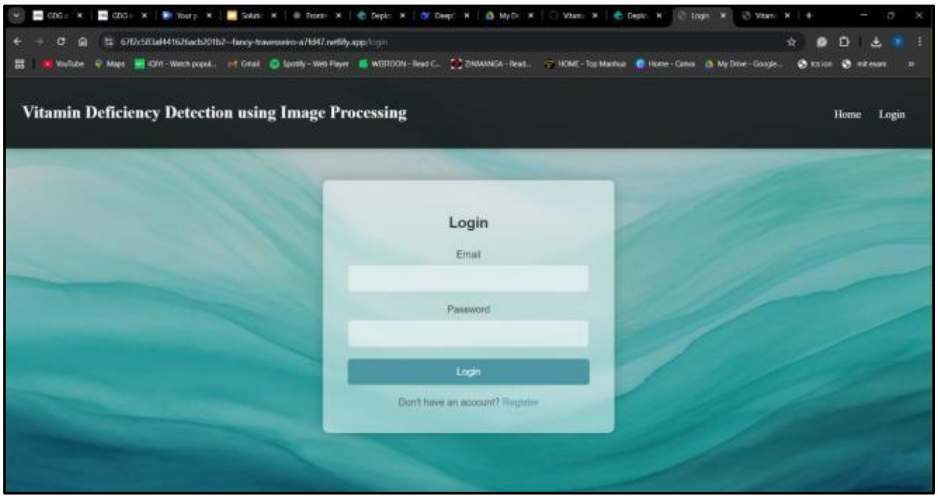

Fig 5.2 Login Page

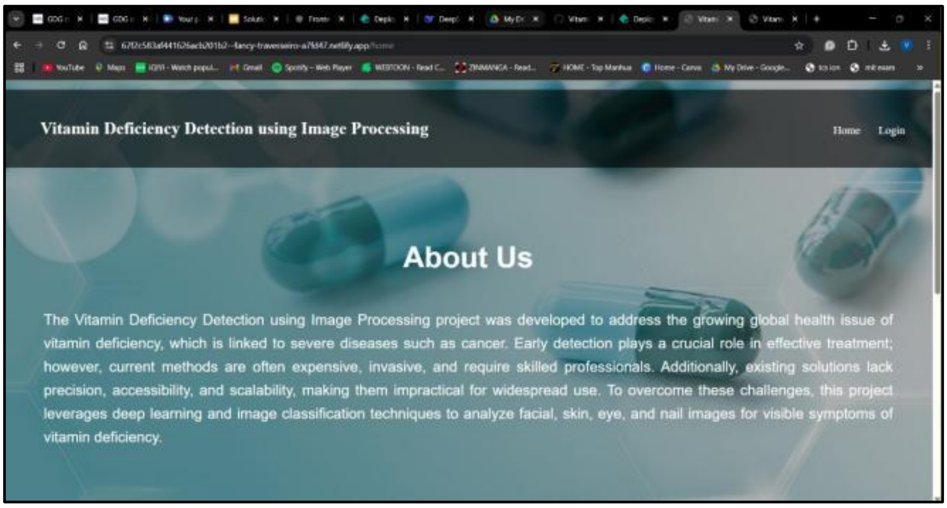

Fig 5.3 Home Page

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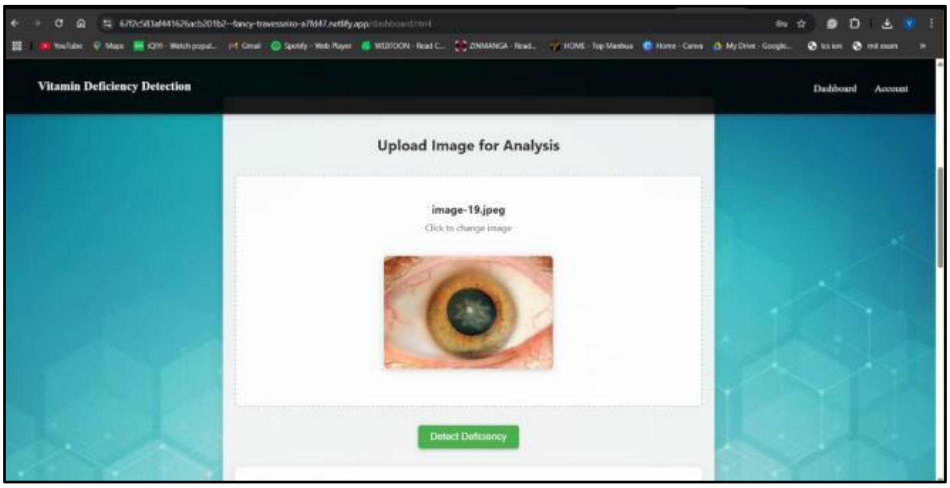

Fig 5.4 Dashboard

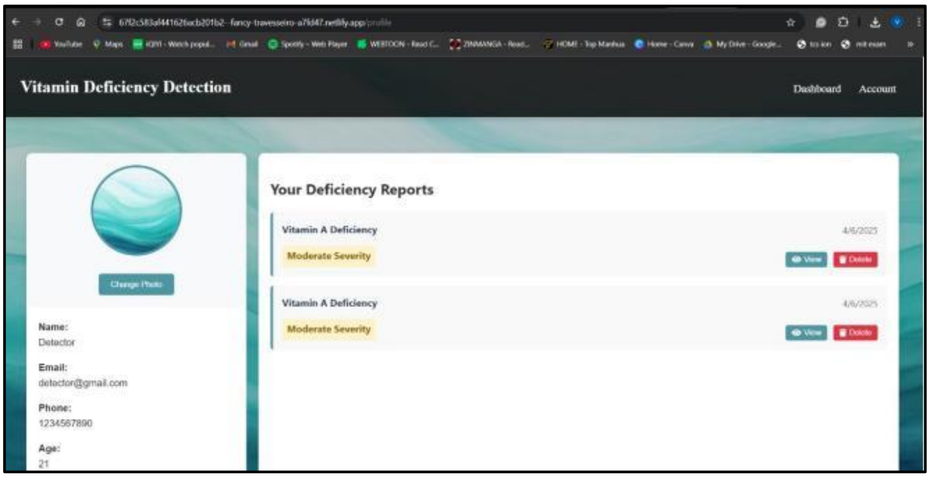

Fig 5.5 Profile

Backend

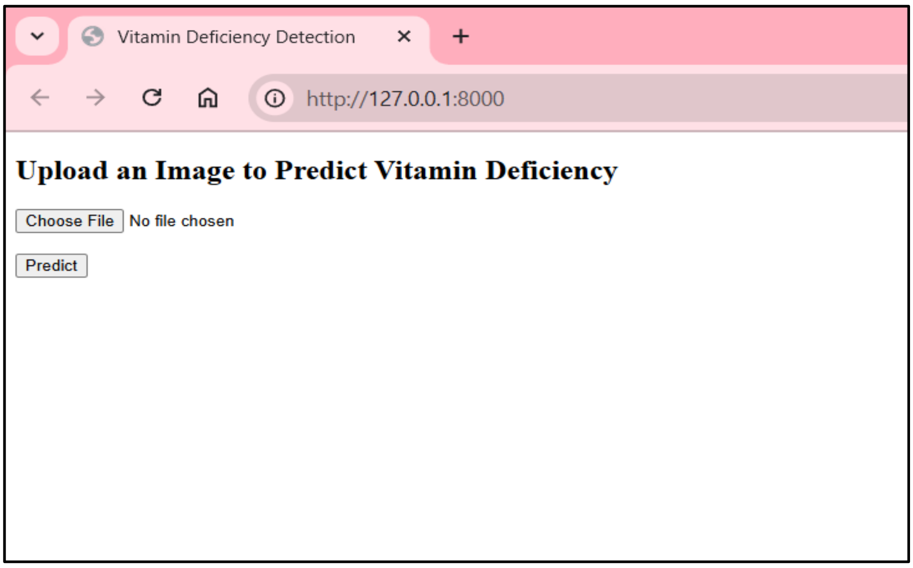

Fig 5.6 Backend Interface

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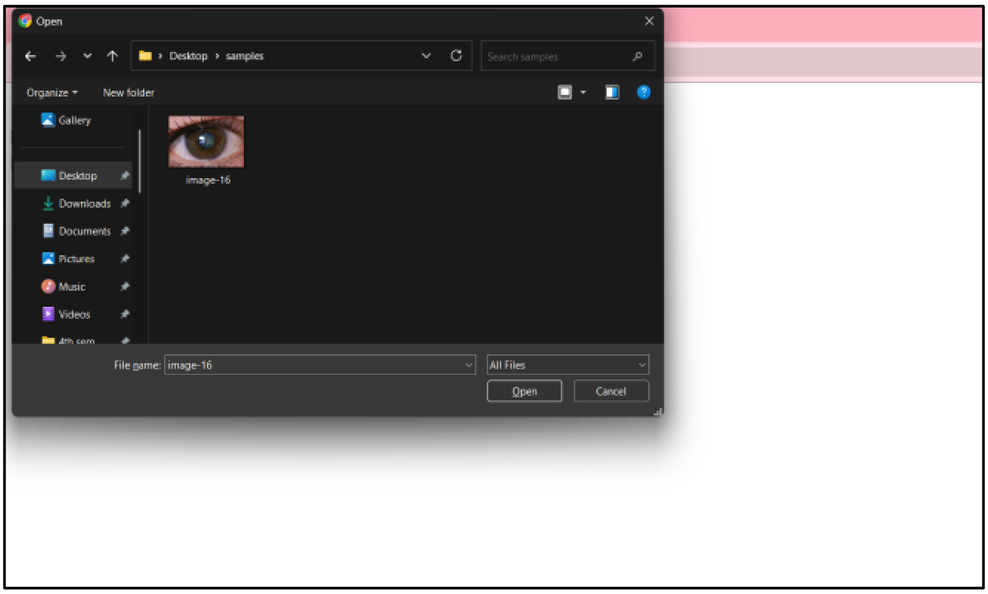

Fig 5.7 Image Insertion

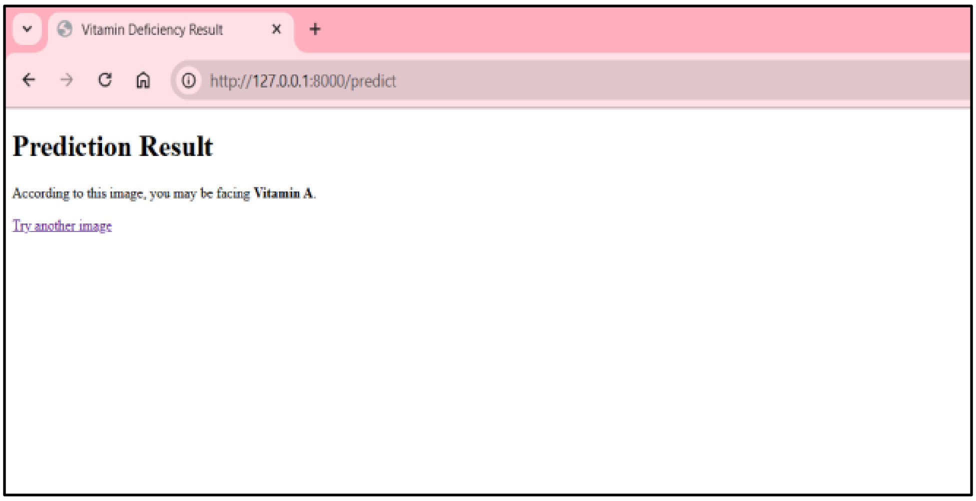

Fig 5.8 Prediction

6. Conclusion

Our image-based vitamin deficiency detection system offers a simple, non-invasive, and accessible solution for early screening, particularly beneficial for users in remote areas or those unable to visit hospitals immediately. By analyzing visual markers like nail and tongue features, the system achieved 78.67% accuracy in flagging potential deficiencies, encouraging timely medical consultation without replacing traditional diagnostic methods. While challenges such as lighting conditions and image quality persist, the tool demonstrates strong potential as a proactive health aid. Future work will focus on improving robustness through larger datasets and adaptive algorithms. Ultimately, this project bridges a critical gap in preventive healthcare by empowering individuals to monitor their nutritional health conveniently and take informed action when needed.

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