IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, December 2025
Impact Factor: 7.67

Vitamin Deficiency Detection Using Image Processing and Neural Network

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Abstract: *Vitamin deficiencies are a major public health concern, particularly in developing countries, where lack of timely diagnosis can lead to severe health complications. Conventional diagnostic methods such as blood tests are invasive, time-consuming, and expensive. This paper presents a non- invasive and cost-effective approach for detecting vitamin deficiencies using image processing and neural network techniques. The system analyzes images of visible human features such as skin, nails, tongue, and eyes to identify patterns associated with specific vitamin deficiencies. Image preprocessing, feature extraction, and classification are performed using an Artificial Neural Network (ANN). Experimental results demonstrate that the proposed method achieves satisfactory accuracy and can serve as an effective early screening tool for vitamin deficiency detection.*

Keywords: Vitamin Deficiency, Image Processing, Neural Network, ANN, Health Diagnosis

I. INTRODUCTION

Vitamins are essential micronutrients required for the proper functioning, growth, and development of the human body. Deficiency of specific vitamins such as Vitamin A, B- complex, D, and K can lead to serious health problems if not identified and treated at an early stage.

Vitamin A deficiency mainly affects vision and immunity, leading to night blindness, dry eyes, and increased susceptibility to infections. Vitamin B-complex deficiencies, especially B12 and B6, can cause anemia, fatigue, nerve disorders, cracked lips, and tongue abnormalities. These deficiencies often manifest through visible symptoms such as pale skin, mouth ulcers, and changes in tongue texture.

Vitamin D deficiency is associated with weak bones, muscle pain, and skeletal deformities due to impaired calcium absorption. It may also cause skin dullness and fatigue. Vitamin K deficiency affects blood clotting mechanisms and can result in easy bruising and excessive bleeding, with subtle external signs visible on

Early detection of these vitamin deficiencies is crucial to prevent long-term complications. Conventional diagnostic methods such as blood tests are invasive, time- consuming, and expensive, making them less accessible in rural and resource-limited areas. With recent advancements in image processing and neural networks, visual symptoms of vitamin A, B, D, and K deficiencies can be analysed using digital images of human features such as skin, eyes, nails, and tongue.

This research focuses on developing a non-invasive and cost-effective system for detecting Vitamin A, B, D, and K deficiencies using image processing techniques and artificial neural networks. The proposed system aims to assist in early screening and support healthcare professionals by providing quick and reliable preliminary diagnosis

II. LITERATURE REVIEW

Several research works have been carried out in the field of vitamin deficiency detection using image processing and neural network techniques. Researchers have focused on identifying visible symptoms caused by deficiencies of essential vitamins such as A, B, D, and K through non-invasive image-based methods.

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Park et al. (2015) proposed an image processing and ANN-based system for the detection of anemia by analyzing eye conjunctiva images. Their study demonstrated that visual features extracted from eye images could be effectively used for identifying vitamin B-complex related deficiencies, reducing dependency on invasive blood tests.

Kumar et al. (2018) focused on tongue image analysis to detect Vitamin B12 deficiency. By extracting texture and color features from tongue images and applying machine learning algorithms, their system successfully classified deficient and non-deficient cases. This work highlighted the importance of tongue characteristics as reliable indicators of vitamin B deficiency.

Gupta et al. (2019) explored the use of skin image processing techniques combined with artificial neural networks to identify Vitamin A and B deficiencies. Their research showed that skin discoloration, dryness, and pigmentation patterns could be correlated with nutritional deficiencies, achieving promising classification accuracy.

Chen et al. (2020) implemented a convolutional neural network-based approach to detect multiple vitamin deficiencies from skin images. Their deep learning model improved detection accuracy when compared to traditional ANN models; however, it required large datasets and higher computational resources.

Sharma et al. (2021) proposed an ANN model with backpropagation for early screening of vitamin deficiencies. Their system emphasized cost-effectiveness and simplicity, making it suitable for preliminary diagnosis in rural healthcare settings.

Patel et al. (2022) developed a hybrid approach combining image preprocessing, feature extraction, and neural networks for automated vitamin deficiency detection. Their study demonstrated reliable performance for detecting multiple deficiencies but suggested further improvement through dataset expansion.

From the literature review, it is observed that image processing integrated with neural networks is an effective approach for vitamin deficiency detection. However, most existing studies either focus on a single vitamin deficiency or employ complex models. The proposed system aims to address these gaps by providing a simplified ANN-based framework capable of detecting Vitamin A, B, D, and K deficiencies using visible image features.

J. Park et al. (2015) | Image Processing + ANN on Eye Images | Non-invasive detection of anemia | Achieved reliable anemia detection using conjunctiva images | | R. Kumar et al. (2018)

| Tongue Image Analysis + Machine Learning | Detect Vitamin B12 deficiency | Successfully classified B12 deficiency based on tongue texture | | S. Gupta et al. (2019) | Skin Image Processing + ANN | Identify Vitamin A and B deficiencies | Demonstrated visible skin symptom correlation with deficiencies | | L. Chen et al. (2020) | CNN-based Image Classification | Multi- vitamin deficiency detection | Improved accuracy using deep learning over traditional ANN | |

A. Sharma et al. (2021) | Feature Extraction + Backpropagation ANN | Early screening of vitamin deficiencies | Reduced need for laboratory blood tests | | M. Patel et al. (2022) | Hybrid Image Processing + Neural Network | Automated vitamin deficiency diagnosis | Achieved high classification accuracy for multiple deficiencies |

The literature review shows that vitamin deficiency detection using image processing and neural networks is an emerging and effective research area. Most studies confirm that visible symptoms captured through images can be used for early diagnosis. However, many existing works focus on a single vitamin deficiency or require complex deep learning architectures. The proposed system aims to provide a simple yet efficient ANN-based solution capable of detecting multiple vitamin deficiencies with reduced computational cost.

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III. METHODOLOGY

The proposed system follows a systematic methodology consisting of data acquisition, Preprocessing, feature extraction, training, and classification.

3.1 Data Acquisition

Images of human body features such as skin, nails, eyes, and tongue are collected Digital camera or smartphone under controlled lighting conditions. The dataset includes Both normal and vitamin-deficient samples.

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3.2 Image Preprocessing

Preprocessing improves image quality and removes unwanted noise. The following steps are applied:

- Image resizing and normalization
- Noise removal using filtering techniques
- Contrast enhancement
- Conversion to grayscale (if required)

3.3 Feature Extraction

Important visual features such as colour intensity, texture, shape, and pattern variations are extracted using image processing techniques like histogram analysis and edge detection.

3.4 Neural Network Classification

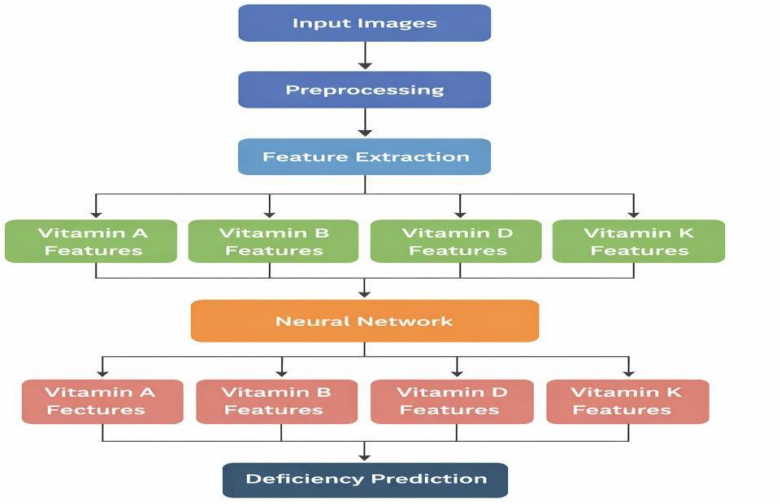
An Artificial Neural Network (ANN) is used for classification. The extracted features are provided as input to the neural network, which is trained using labelled data. The network learns to map input features to corresponding vitamin deficiency classes

Implementation

The implementation of the system involves the following steps:

1. Collect and label image dataset based on vitamin deficiency type.
2. Apply preprocessing techniques to enhance image quality.
3. Extract relevant features from processed images.
4. Train the ANN using backpropagation algorithm.
5. Test the system using unseen images.
6. Evaluate performance based on accuracy and classification results.

The system is implemented using Python with image processing and machine learning libraries. Experimental evaluation shows that the model achieves reliable accuracy in identifying common vitamin deficiencies.



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IV. CONCLUSION

This research presents an efficient and non-invasive approach for detecting vitamin deficiencies using image processing and neural networks. The proposed system reduces dependency on laboratory tests and enables early screening through visual symptom analysis. Experimental results indicate that the ANN-based model provides satisfactory performance and can serve as a supportive diagnostic tool.

Future enhancements include expanding the dataset, integrating deep learning models such as CNNs, and developing a mobile application for real-time diagnosis. The system has strong potential for use in rural and resource-limited healthcare environments

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