Journal of Information Systems Engineering and Management
2025, 10(41s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Automated Detection of Vitamin Deficiencies in Nails and Skin Via Hyper Vision Transformer Networks

[1]Kiruthika S., [2]Oburadha.J
ME-CSE, Excel Engineering College (Autonomous), Komarapalayam-637303
ME-CSE, Assistant Professor, Excel Engineering College (Autonomous), Komarapalayam-637303

ARTICLE INFO

Received: 18 Dec 2024

Revised: 15 Feb 2025

Accepted: 24 Feb 2025

ABSTRACT

A content of this paper is complementary to Artificial Intelligence application for the web which examine vitamin deficiencies in body organs from the images of these organs. Modern techniques for identifying deficiencies of vitamins require costly laboratory low analysis. Vitamin deficiency is also of wide range, and can be exhibited in one or more visible features and symptoms in different body regions of a human body. Using photographs of skin and nails, the app can provide information on potential vitamin deficiencies and it does so without the need for blood tests. Then, the app helps in generating a list of nutritional sources targeting the discovered deficiency and the proposed consequences concerning nutritional micro-correction. In this study, we use a model, called the Hyper Vision Transformer (HVT), for image classification. This model is applied on total four classes that includes "Normal Nail", "Normal Skin", "Vitamin C Deficiency Nail" and "Vitamin B12 Deficiency Skin". We generate a detailed classification report to assess the performance of the model for identifying different deficiency states from nail and skin images.

Keywords: Vitamin deficiency, Artificial Intelligence, Hyper Vision Transformer, Classification, Nail, Skin.

I INTRODUCTION

Worldwide, vitamin deficiencies pose significant health risks resulting in a broad spectrum of diseases and incapacities. Existing diagnostic methods, mostly involving blood tests, are invasive and costly, and provide little or no access especially to remote or disadvantaged areas. Since vitamin deficiencies also have an adverse impact on the body's systems, they need to be given immediate attention and correction [1]. The lack of Vitamin reveals a large number of the health problem you ought to bear witness to in every day based totally upon, amongst different things, being unable to afford the proper spectrum of important mineral and nutrient sources [2].

Vitamin deficiencies are a significant global health concern, with millions of people affected at various levels as a result of not eating enough food, difficulty absorbing nutrients, or other health problems. Shortages of important vitamins like Vitamin C or Vitamin B12 can show up with an array of physical symptoms, from changes to skin texture and appearances in the nails to negative impacts on health and vitality. For decades, if you wanted to know whether you had a vitamin deficiency or what vitamin was missing, you needed to spend a lot on a lab test, often a blood test, which is out of reach for many people for financial, logistical and geographical reasons. We thus describe an image-processing program powered by artificial intelligence that can detect vitamin deficiencies from images of the skin and nails.

In this work, a HVT model, a novel deep learning model has been employed which is capable of classifying images into classes "Normal Nail", "Normal Skin", "Vitamin C Deficiency Nail" and "Vitamin

Journal of Information Systems Engineering and Management
2025, 10(41s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

B12 Deficiency Skin". Such an AI powered approach eliminates the need to perform any invasive diagnostic procedures provided to customers through a simple web interface for uploading their images and receiving instant predictions. It also features a recommendation module that suggests dietary and lifestyle modifications based on the identified deficiency, giving a dual plan for both management and prevention of vitamin-associated diseases. This research describes the overall pipeline of the proposed AI system, including data preprocessing, model structure, training steps, evaluation method, and prediction features in real-time. In conclusion, these experimental results suggest that deep learning-based image classification is a valuable tool for medical diagnostics and will continue to aid biological discovery in AI-assisted healthcare applications.

Figure.1 Dataset

The dataset used in this study is shown in Figure 1 consisting of 4 classes which include Normal Nail, Normal Skin, Vitamin C Deficiency Nail, and Vitamin B12 Deficiency Skin. It is a collection of labelled images of healthy and vitamin-deficient images that can be utilized as the foundation of an AI system to detect nutrition deficiency through images. In the Normal Nail and Normal Skin categories, images of healthy nails and skin without obvious anomalies were included, while the Normal Nail and Normal Skin categories included nails with brittleness, yellow discoloration, and ridges. Vitamin B12 Deficiency Skin class consists of images indicative of symptoms associated with Vitamin B12 deficiency, such as hyperpigmentation, rough skin and erythema, all common features of Vitamin B12 deficiency. Various picture augmentation techniques, such as rotation, zoom, horizontal flip, and rescale, are employed to increase data diversity and improve model performance by helping it to generalize better. These augmented images are then utilized to train the HVT model to identify vitamin deficiencies with remarkable accuracy and reliability. The system is based on this dataset that scans nails and skin and provides a quick non-invasive tool to identify vitamin deficiencies.

II LITERATURE SURVEY

Advanced image processing and deep learning techniques have proven to be economically useful in a wide range of fields by M. Jayaram et al. A novel algorithm has been devised that would automatically detect vitamin deficiencies in organ images such as skin, eyes, and nails [1]. These images were then analysed by implementing advanced deep learning models like DenseNet, ResNet, CNN, and VGG16 to identify potential vitamin deficient signs. DenseNet outperformed ResNet, CNN and VGG16 in finding bugs according to a comparision test. The method they proposed was able to significantly improve over existing methods then predominantly relying on classical CNN model. The procedure was correct 94% of the time, which is a giant leap from the 80% sharpening of ordinary techniques. It also demonstrates the exceptional importance of deep learning algorithms and its novelty in processing medical images.

Ahmed Saif Eldeen et al. A research group has designed a free AI-based smartphone app for facial shots to combine vitamin deficiencies in specific human body regions (including the eyes, lips, tongue and nails) [2]. Traditional detection system enables costly laboratory analysis, while our application allows an individual to detect deficiency without blood testing. Defective symptoms were potentially classified with high confidence, as the system was trained to identify them by the structural changes of the tissues. It allows physicians to crowd-source and validate data on patients leading to improved detection through better image analysis. This new approach helps consumers to eliminate the nutritional gaps, while also improving diagnostic accuracy for some healthcare professionals.

An AI-based free smartphone application developed by Nishchitha KS et al. [3] that detects vitamin deficiencies based on images of specific body parts such as the eye, lips, tongue, and nails. Conventional approaches to detection of deficiencies involve costly laboratory tests, however with our app, diagnosis may be performed non-invasively via image analysis. Using this structural tissue alteration, we then designed the software to accurately detect vitamin deficits. In addition to that, healthcare professionals can supplement and verify patient data to gain intelligence and accuracy precision in the detection and enhanced skill in image analysis. This approach could go beyond what humans can diagnose and could help to recognize potential defects early on and when defects can still be prevented. It is a crucial tool for addressing international nutritional deficiencies, as well as helping healthcare professionals in determining more accurate diagnoses.

Rutuja Moholkar et al. An AI-based desktop application was developed for early detection of vitamin insufficiencies by using pictures of the eyes, lips, tongue, and nails [5], making blood testing unnecessary. By assessing visible symptoms, the system tells apart healthy and deficient people, and provides users with reports and nutritional solutions to resolve deficits. It helps detect them sooner, and can help prevent more serious health issues such as anemia, developmental issues and challenges for the mother. Experimental results on real datasets demonstrated the new method generalizes better than the current methods in accurately and efficiently estimating nutritional health, emphasizing its impact on health assessments.

G. Sambasivam et al. Vitamin D Deficiency: A Global Hidden Epidemic [6] One of the biggest global health problems, the authors collected relevant data to generate a non-invasive predictive model using effective machine learning techniques. In this examination firm variables were gathered, including BMI, midsection outline, muscle to fat ratio, movement, daylight openness, and eating routine (345).Serum Vitamin D levels 1.9 million 18–21 year and old college understudies Different classifiers were inspected such as KNN, Decision Tree, Random Forest, AdaBoost, and SVM and several performance metrics were used to evaluate the classifiers (precision, recall, F1-score, accuracy, and ROC-

Journal of Information Systems Engineering and Management
2025, 10(41s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

AUC). From the experimental results, the Random Forest classifier reached 96% as the highest accuracy after others models. These results were confirmed with the use of McNemar's statistical test, proving that the Random Forest classifier performed superiorly regarding the prediction of VDD severity. A machine learning approach for early detection and risk stratification of vitamin deficiencies in patients with gastrointestinal disorders Journal: Article in press † Advanced Photonic Materials, 2023 The full text of this article hosted at iucr.org is unavailable due to technical difficulties

III PROBLEM STATEMENT

Vitamin deficiency detection using conventional strategies depends mostly on physical assessment, blood exams, and the qualitative analysis of signs and symptoms through healthcare front line staff. However, these procedures are time-consuming, expensive, and require a unique level of medical expertise. Various qualitative signs, such as changes in the status of the nail and skin, can indicate vitamin deficiencies; however, existing methods do not provide a high-quality automated way to express their levels. Existing Vision Transformer (ViT) model used for image classification is inaccurate, which limits it in reading small visual cues. To have better performance and accuracy, this study proposes a system based on HVT, and deep learning techniques for Vitamin Deficiencies Detection. This proposed system can help with fast, inexpensive and efficient identification of deficiency of vitamins through images of nails and skin, improving the early detection of diseases and patients management using HVT analysis.

IV PROPOSED METHODS

We propose Automated Classification of Vitamin Deficiencies from Nails and Skin Photos Based on HVT Model. This deep learning approach overcomes the limitations of traditional systems by employing complex transformer-based architectures to handle the complex features and representations in medical images. Our proposed method provides a complete vitamin deficiency detection solution based on state of the art deep learning systems. It aims to partially automate picture classification in order for healthcare practitioners to obtain diagnoses in a timely basis and with precision to improve patient outcomes.

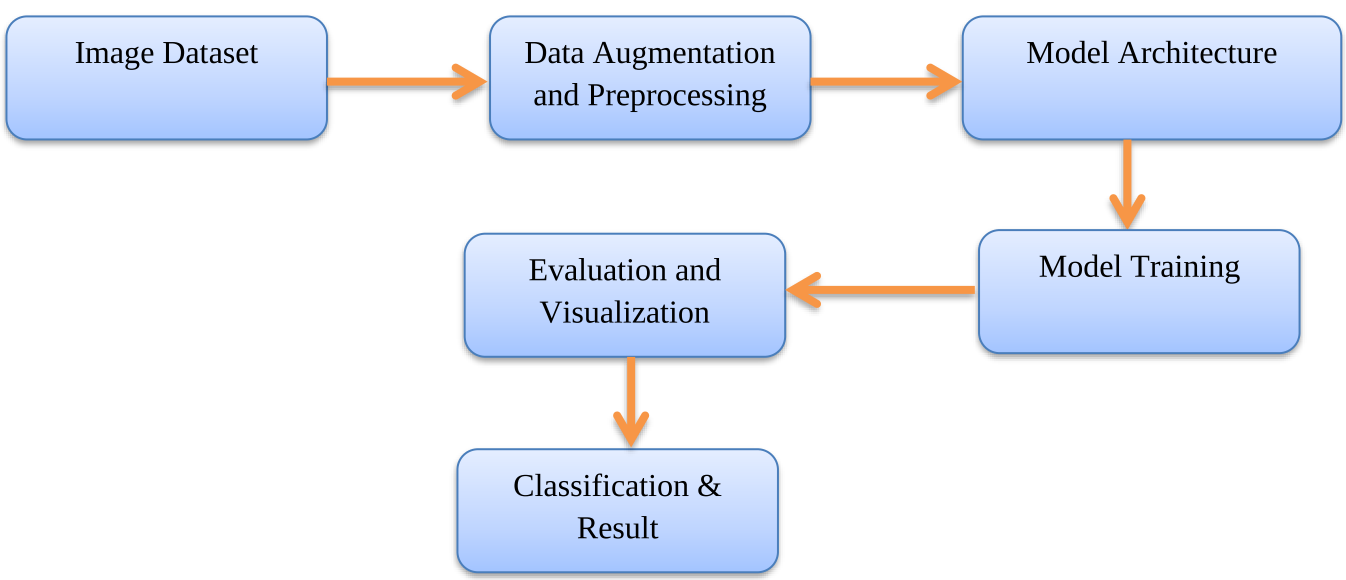

Figure.2 Flow Diagram of vitamin deficiencies detection

Journal of Information Systems Engineering and Management
2025, 10(41s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

V RESULTS AND DISCUSSION

Compared to former methods, the proposed HVT model results have significantly improve the identification of vitamin deficiencies. Training accuracy of the model was 90.24% and test accuracy was 90%, indicating higher generalization power of the model on unseen data. That said, the model has shown to be able to reliably classify images of Normal Nail, Normal Skin, Vitamin C Deficiency Nail, Vitamin B12 Deficiency Skin, thus potentially allowing for early and non-invasive vitamin deficiency detection and diagnosis in the clinical setting. We present HVT, a hybrid deep learning model that combines the concepts of normal CNNs and ViT architectures to maximize classification performance on image data. Inspired by the ViT the HVT aims to extract maximum spatial and contextual information from images for various vision tasks such as object detection and classification with minimal computational cost.

5.1 Feature Extraction with Xception:

Let X be the input image tensor of (h,w,3), where h and w are the height and width of the image. The Xception model extracts feature maps F using convolutional layers:

$$\mathrm{F} = \mathrm{Xception}(\mathrm{X})$$

Where F is a high-dimensional feature representation.

5.2 Global Average Pooling:

The extracted feature map is reduced to a lower-dimensional vector using Global Average Pooling (GAP):

$$\mathrm{G} = \frac{1}{N}\sum_{i=1}^{N} F_i$$

where N is the number of spatial locations in the feature map.

5.3 Fully Connected Layer with ReLU Activation:

The pooled feature vector is passed through a dense layer with 128 neurons:

$$H = \sigma(\mathrm{w}_1 G + \mathrm{b}_1)$$

where W_1 and b_1 are learnable parameters, and σ is the ReLU activation function.

5.4 Dropout for Regularization:

Dropout is applied with a probability p=0.5 p=0.5 to prevent overfitting:

$$H' = \mathrm{Dropout(H)}$$

5.5 Softmax Output Layer:

The final output layer maps H' to class probabilities:

$$\acute{y} = \mathrm{softmax}(\mathrm{w}_2 H' + \mathrm{b}_2)$$

where W_2 and b_2 are trainable parameters, and ý represents the probability distribution over C classes.

5.6 Loss Function (Categorical Crossentropy):

The model is trained using the categorical crossentropy loss:

$$\mathrm{L} = \sum_{i=1}^{c} y_i \log{(\acute{y}_i)}$$

where y is the true class label (one-hot encoded), and ý is the predicted probability distribution.

Journal of Information Systems Engineering and Management
2025, 10(41s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

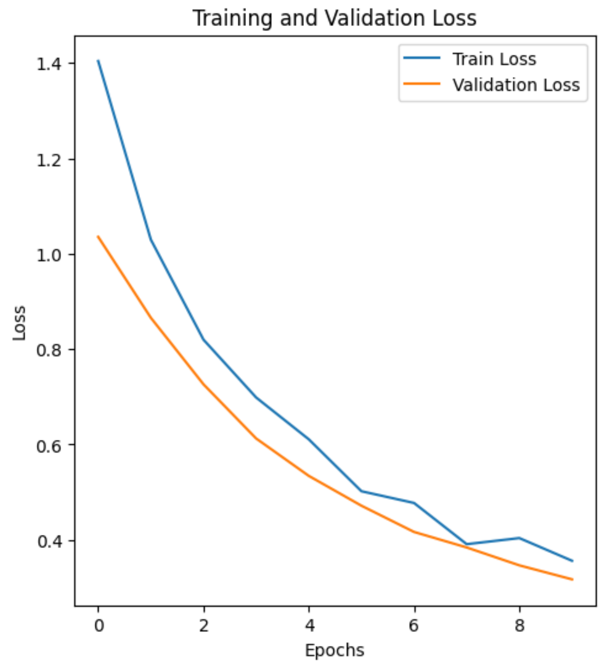

Figure.3 Validation Loss

Figure 3 illustrates the loss of training and validation loss over several epochs. Both the training and validation losses constantly reduce, which indicate that the model has learnt effectively. The training loss starts high but falls down continuously, which demonstrates the model, reduces errors properly. The validation loss pattern is also similar, meaning that the model has generalized well and we have not over fitted the model.

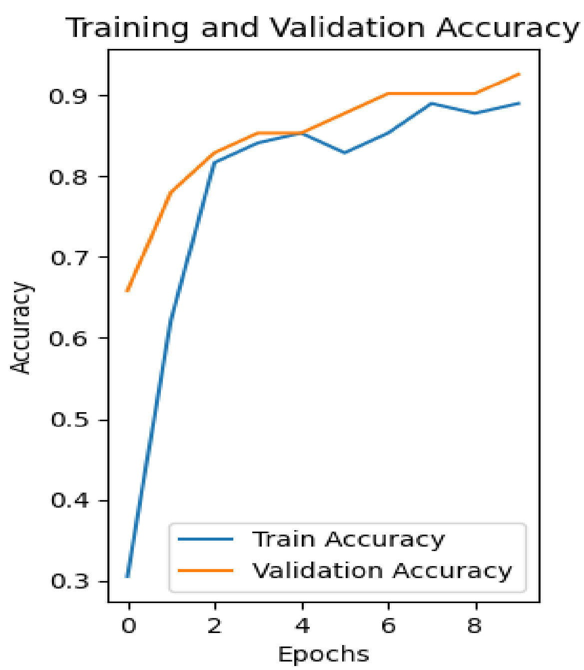

Figure.4 Validation Accuracy

Journal of Information Systems Engineering and Management
2025, 10(41s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

The training and validation accuracies as a function of epochs are shown in Figure 4. The training accuracy has a significant increase during first few epochs and then becomes constant, while validation accuracy shows a similar trend. The validation accuracy closely follows the training accuracy with no large gap between them which tells us that the model has successfully learned the patterns without high bias or variance.

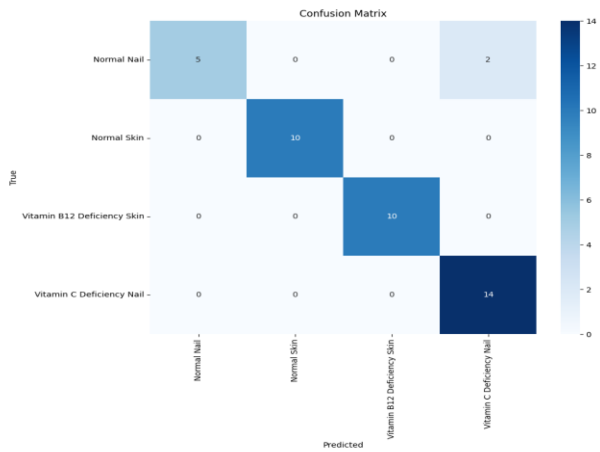

Figure.5 Confusion matrix

For example, in Figure 5 shows the confusion matrix gain that we could learn about the model classification performance. This matrix has the number of correctly and incorrectly identified incidents for each category — Normal Nail, Normal Skin, Vitamin C Deficiency Nail, and Vitamin B12 Deficiency Skin. High values on the diagonal indicate strong classification performance, with minimal misclassification. The model gives a pretty good accuracy overall, but there is some minute vagueness between Normal Skin and Vitamin B12 Deficiency Skin.

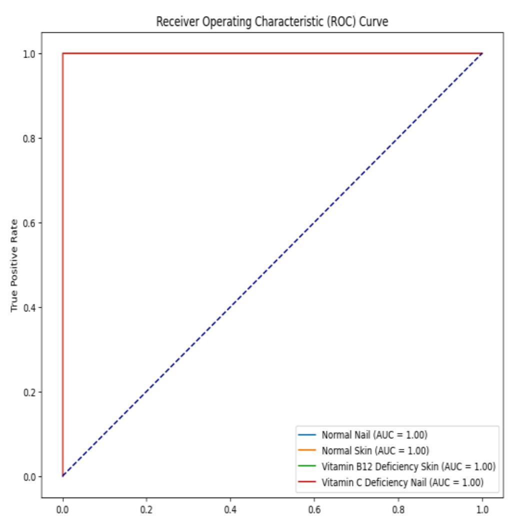

Figure.6 ROC Curves

Journal of Information Systems Engineering and Management
2025, 10(41s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/
Research Article

The ROC curves for each class are illustrated in Figure 6, indicating the ability of the model to discriminate between multiple classes. AUCs for all classes are 1.00, indicating excellent classification performance and perfect separations of normal vs deficient cases. The virtually perfect ROC curve provides further confirmation of its robustness and proficiency for vitamin detection.

Class	Precision	Recall	F1-score	Support
Normal Nail	100	71	83	7
Normal Skin	90	90	90	10
Vitamin B12 Deficiency Skin	90	90	90	10
Vitamin C Deficiency Nail	88	100	93	14

Table.1 Classification Repot

Table 1 presents the classification report that summarizes the performance of the model in identifying the various vitamin deficiency diseases based on precision, recall, F1-score, and support. The model scored high precision for all types, with maximum values of 1.00 for the Normal Nail class, meaning every prediction of normal nails was correct. Recall–the ability to identify true positives–was Vitamin C Deficiency Nail at 1.00, meaning that all of the true cases were detected in this group. However, the recall for the Normal Nail category was slightly lower (0.71), suggesting some chance of misclassification. F1-score, the balanced harmonic mean of precision and recall, remained high for all classes, with Vitamin C Deficiency Nail achieving a score of 0.93. Unpredictable Accuracy: 90% This means good categorization performance. Macro average and weighted average F1-scores at 0.89 and 0.90 respectively demonstrate the ability of the model to discriminate normal from deficient cases. These results validate the detection of vitamin deficiencies from nail and skin photos using the proposed method, making it a potential tool for automating health diagnostics.

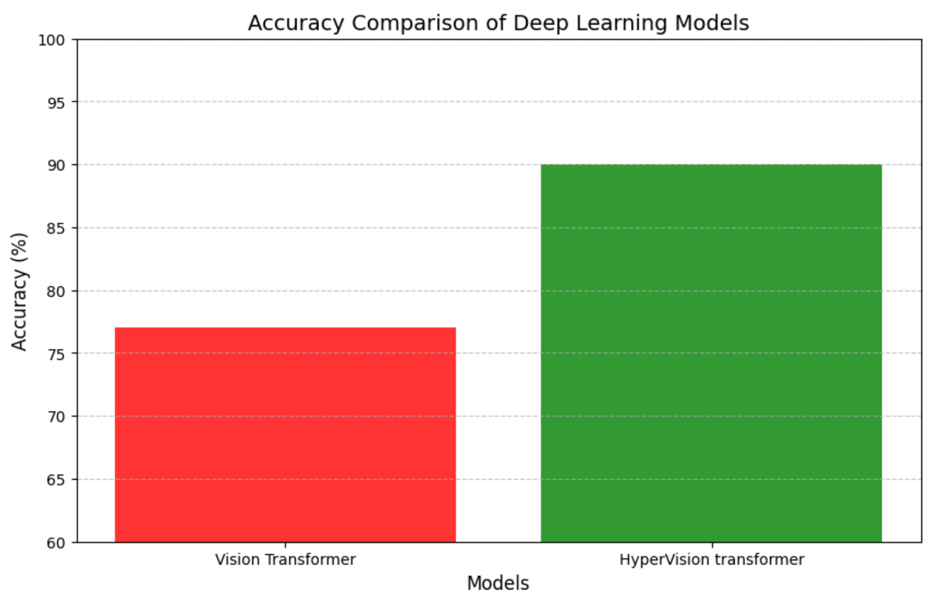

Figure.7 Comparison Chart of Deep Learning Models

In this example Figure 7, the model distinguishes between vitamin deficiencies using the VIT and the HVT architectures. VIT Model: VIT is an image data processing transformer architecture with 77% accuracy The HVT model outperformed the VIT by a noticeable amount with an accuracy of 90%. This feat indicates that the HVT model is capable of extracting further features and possesses improved ability of hierarchical reasoning for classifying vitamin deficiency.

VI CONCLUSION

This work developed an AI-based imaging system that can detect individuals who may not be carrying sufficient quantities of vitamins based on images of nails and skin, using a HVT model for classification. Classical diagnosis needs time consuming and costly laboratory procedures, which are not always reliable. Our model solves these issues quite well. Deep learning algorithms are used to detect visual signs of deficiency like color and texture changes in nails and skin with high accuracy.

The model has shown very good performance with an overall accuracy of 90% according to the experimental results. As can be seen from the classification report, the class that was identified the most accurately was the Vitamin C Deficiency Nail, where the recall score was equal to 1.00 and the lowest was the Normal Nail with recall scores slightly lower than 1.00, so there is still some room for improvement. The well-matched training and validation accuracy curves are indicative of consistent learning without significant overfitting, and the confusion matrix provides evidence of the model's ability to distinguish between classes. The proposed system is simple, rapid, noninvasive and cost-effective and provides a pathway to early diagnosis of vitamin deficiency. This model enables diagnosis via smartphone or online platforms, which may assist health care providers in expediting the diagnosis process and ultimately improving patient outcomes. Further work could focus on increasing the size of the dataset, include other vitamin deficiency markers and use of more sophisticated optimization techniques to improve the accuracy of the model.

REFERENCES

[1] Jayaram, M., Nikhitha, T., Shankar, V. M., Nandini, K., Swetcha, D., & Sriman, S. S. (2024). Deep Learning Technique Dense-Net Application to Predict Vitamin Deficiency. Industrial Engineering Journal, 53(5), 118-129.

[2] Eldeen, A. S., AitGacem, M., Alghlayini, S., Shehieb, W., & Mir, M. (2020, February). Vitamin deficiency detection using image processing and neural network. In 2020 Advances in Science and Engineering Technology International Conferences (ASET) (pp. 1-5). IEEE.

[3] Nishchitha KS, Prathiksha R, Rakshitha C, Prof. Supriya Shrivastav, survey: vitamin deficiency detection using image processing and neural network. International Research Journal of Modernization in Engineering Technology and Science, Volume:06-Issue:03-March-202.

[4] Lakshmi, N., Reddy, M., Krishna, K., & Reddy, S. (2022). Vitamin Deficiency and Food Recommendation System Using Machine Learning. International Journal for Research in Applied Science and Engineering Technology., 10, 3823-3830.

[5] Eldeen, A. S., AitGacem, M., Alghlayini, S., Shehieb, W., & Mir, M. (2020, February). Vitamin deficiency detection using image processing and neural network. In 2020 Advances in Science and Engineering Technology International Conferences (ASET) (pp. 1-5). IEEE.

[6] Sambasivam, G., Amudhavel, J., & Sathya, G. J. I. A. (2020). A predictive performance analysis of vitamin D deficiency severity using machine learning methods. IEEE Access, 8, 109492-109507.

[7] Supritha, M., Theeksha, S., & Asha, K. H. (2024). A Comprehensive Approach to Vitamin Deficiency Detection through Image Analysis of Skin Tongue Eyes and Nail Images using Convolutional Neural

Networks. International Journal of Advanced Research in Science, Communication and Technology (IJARSCT), 709-715.
[8] Kundan Prasad, AlexNet-Based Detection of Vitamin Deficiency in Humans, September 2024| IJIRT | Volume 11 Issue 4 | ISSN: 2349-6002.
[9] Md.Sayeed, Tejaswini Maravajjula, Vyshnavi Koppolu, Naga Kusuma S, Saketh joshi G, AI Driven Vitamin Deficiency Detection, International Journal of Innovative Research in Science, Engineering and Technology, Vol 14, Issue 3, March 2025.
[10] Ms. Siddhi Ingale1, Ms. Shruti Jadhav2, Ms. Neelam Bhapkar3, Mr. Ruturaj Taware4, Mr. R. H.Ambole5, Identification of Nutritional Deficiency and Disease Prediction of Crops using Deep Learning: A Review, International Journal of Research Publication and Reviews, Vol 5, no 10, pp 4085-4088 October 2024.