International Journal of Engineering Research for Sustainable Development
Peer Reviewed International, Open Access Journal.
ISSN : / Website: https://ijersd.com / Volume 1 Issue 1 / February 2025

Original Article

# Vitamins Deficiency Detection Using Image Processing and Neural Network

**Prof. Ms. Shivani Pawar[1], Prof. Amit Bhosale[2], Prof. Sagar Patole[3]**
[1,2,3] AI & DS Engineering Department, PES's Collegeof Engineering, Phaltan, India

**Manuscript ID:**
IJERSD -2024-010105

ISSN: 2230-9578

Volume 1

Issue 1

Pp. 11-16

February 2024

**Submitted:** 31 Dec. 2024

**Revised:** 25 Jan. 2025

**Accepted:** 25 Feb. 2025

**Published:** 28 Feb. 2025

***Correspondence Address:***
*AI & DS Engineering Department, PES's Collegeof Engineering, Phaltan, India*
shivanidevkar05@gmail.com

Quick Response Code:

Web. https://rlgjaar.com

DOI:

DOI Link: https://doi.org/10.5281/zenodo.14538643



***Abstract***

*Our diets need to contain vitamins. A deficiency will develop if the right number of vitamins aren't consumed. In this study, this project introduces an artificial intelligence (AI) system for early vitamin insufficiency diagnosis. It is a free mobile application that uses the user's images of their eyes, lips, tongue, and nails to identify vitamin deficiencies instead of blood samples. The application will give users a report on any vitamin deficiencies they may have, along with recommendations for the right foods to increase their vitamin intake and fend off deficiencies. The software is trained to differentiate between images of healthy people's eyes, lips, tongue, and nails and those of those who are vitamin deficient. Early identification of vitamin deficiencies can stop serious problems like anemia, infectious illness deaths, maternal or perinatal deaths, and cognitive and physical development problems.*

***Key Words:*** *Deficiency, NLP, Fuzzy Membership Function, Vitamins, AI, Android Application, and Defuzzification. Artificial Intelligence, Deep Learning, Intelligent System.*

**Introduction**

Over two billion individuals worldwide suffer from vitamin insufficiency, an issue. According to the WHO, one in three kids do not get enough vitamins. Over two billion people worldwide suffer from vitamin insufficiency, which is a widespread issue. According to the WHO, one in three youngsters do not receive vitamins. A deficiency in vitamin A affects 33% of young children under the age of five. Low immunity and night blindness are symptoms of this condition. All ages are susceptible to vitamin deficits, which frequently coexist with mineral (zinc, iron, and iodine) shortages. Due to their demands for these substances and susceptibilities to their absence, children and pregnant women are the groups most at risk for vitamin deficiencies. Most common deficiencies relate to vitamin A, vitamin B, folate, and vitamin D. Supplementation programs have made diseases like scurvy and pellagra rare [1].

Numerous health difficulties that we face on a daily basis are highlighted by vitamin deficiencies. Many of these issues result from our inability to obtain the essential range of essential minerals and nutrition. It is challenging to effectively measure our nutritional requirements, particularly if people lack knowledge of the specific type of shortage they might be experiencing without medical advice. Vitamin inadequacies affect more than 2 billion people globally. More than 1.2 billion people worldwide suffer from zinc deficiency, and 500,000 of them pass away every year. Comparatively speaking, anaemia brought on by iron deficiency kills over 100,000 individuals annually. Locally, a wide range of vitamin deficiencies affect more than 90% of the UAE's population. Even while there is no widespread famine crisis, statistics collected on American soil reveal that more than 92 percent of the population has at least one mineral or vitamin deficit. Nutrient-rich foods have shifted from being the norm for daily food intake to more of a sign of luxury due to the widespread availability of inexpensive, easily accessible manufactured junk foods.

Micronutrient deficiencies in the soil have been discovered by researchers. Researchers from Canada discovered in 2003 that the mineral content of vegetables such as tomatoes, lettuce, spinach, and cabbage had decreased from 400 milligram's to less than 50 milligrams, demonstrating a regressive pattern of one nutrient's natural availability. Even if there were a perfect diet available for consumption, it's likely that something would still be missing [2]. Magnesium, vitamin A, and vitamin C deficiencies affect 50% of Americans, whereas vitamin D deficiency affects 90% of Americans of colour and 70% of older Americans. When asked whether they were aware of their vitamin deficit earlier this year, 67 precent of a sample of 100 university students responded "no."



***How to cite this article:***
*Shivani Pawar (2025), Vitamins Deficiency Detection Using Image Processing and Neural Network. International Journal of Engineering Research for Sustainable Development, 1(1), 14-19*

Although the sample size of this small study is insufficient to accurately represent the population [3], it may provide an estimate of the level of social awareness that exists in reality.

**Releted Work**

**Cynthia Hayat, Barens Abian -** this research consisted of 2 phases, which were training phase in which it generated ANN weight by using feed- forward of activation function, and testing phase in which the result of the previous stage was tested to obtain output.

**Bambang Lareno, Liliana Swastina, Husnul Maad Junaidi -** this paper focus to find a model of IT application that can be used for mapping the potential of malnutrition problems and the rate of utilization of posyandu. The result, the cross- platform information model developed is a web- based core system, with a mobile application-based support system.

**Anutosh Maitra, Rambhau Eknath Rote, Nataraj Kuntagod -** in this paper that malnutrition management requires an integrated digital approach – that not only looks at making data available, but also establishing relationships between various program indicators, overlaying that with socio- economic conditions of the region and family demographics.

**Sri Winiarti, Sri Kusumadewi, Izzati Muhimmah, Herman Yuliansyah -** the result of the decision will give 3 clusters on nutritional status is good nutrition, malnutrition and better nutrition. Mobile apps are used as a reminder of the nutritional value or ingredients contained in the packaging of food products while consuming food. The result of system testing for application of FCM algorithm in this mobile application obtained validation of 80%.

**Archana Ajith, Vrinda Goel -** This paper proposes a skin disease detection method based on image processing techniques. This method is mobile based and hence very accessible even in remote areas and it is completely noninvasive to patient's skin. The patient provides an image of the infected area of the skin as an input to the prototype.

**Kyamelia Roy, SheliSinha Chaudhuri -** The outer integument of the human body is skin. The skin pigmentation of human beings varies from person to person and human skin type can be dry, oily, or combination. Such a variety in the human skin provides a diversified habitat for bacteria and other microorganisms. Melanocytes in the human skin, produces melanin which can absorb harmful ultraviolet radiation from sunlight which can damage the skin and result in skin cancer.

**Sambit BAKHSHI -** In this paper, author propose an automated facial skin disease method using a pre-trained deep convolutional neural network (CNN). In the beginning, the images are regenerated using some pre-processing image techniques in order to augment the size of our database, collected from different sources and resized to fit the network. These images are then used for training and validation purposes.

**Tanzina Afroz Rimi -** This paper is a sandwich between picture handling strategies and machine learning. Where picture preparation has produced the picture which is being utilized by CNN to arrange the classes. The preparation information comprises five classes of the skin gives that have been talked about above. This project has 73% precision by actualizing our framework on the dermnet dataset of 500 pictures of various diseases. This will end up being an incredible achievement if the further enhancements are finished utilizing a bigger measure of the dataset.

**Shih-Hsiung Lee, Chu-Sing Yang -** this paper proposes an image preprocessing method, trying to segment different parts of nail: lunula and nail plate. In the data of poor image quality, the lunula may not be presented clearly. In order to maintain the nail image quality, this paper uses microscope to capture nail image. Besides lunula and nail plate, the nail details, such as free edge, cross striation and longitudinal striation, can be seen clearly in the image captured by microscope.

**Laura Safira, BudhiIrawan, Casi Setianingsih -** The dataset in this study is taken from Google and also some of the paper that discusses the nail abnormalities. Nail pictures obtained are different from any source. Therefore, the image should be cut just one finger. Because when detecting terry's nail, the disorder usually occurs in all the nails. So i can use one finger. The photos of a nail that has been doing the extraction characteristics using GLCM then will be done using KNN classification. In this case the class will be divided into two classes, healthy and Terry's.

**Hongfeng Li a, Yini Pan b, Jie Zhao c, Li Zhang d -** In this paper, author present a review on deep learning methods and their applications in skin disease diagnosis. I am first present a brief introduction to skin diseases and image acquisition methods in dermatology, and list several publicly available skin datasets. Then, I have introduced the conception of deep learning, and review popular deep learning architectures and popular frameworks facilitating the implementation of deep learning algorithms.

**Proposed System**

By eating a balanced diet that includes a variety of foods, as well as food fortification and supplementation when necessary, many deficiencies can be avoided. A blood test, such as a venous blood test or finger-prick blood test, can detect the majority of vitamin and mineral deficiencies [4]. In a finger-prick blood test using a lancet, you can pick your own finger and collect a blood sample, while in a venous blood test, a trained expert will use a needle to pierce a vein, typically in your arm, to collect a blood sample. In hospitals, these blood tests can be done or I can also order home vitamin and mineral test kits online and do it ourselves. The cost of venous blood tests and finger-prick blood in India is an average of Rs.1000 and Rs.800 respectively. Home vitamin and mineral test kits cost around Rs.8000. I have proposed a cost-free android application that can give instant results using users' images of body parts only and there is no need of blood samples for test.

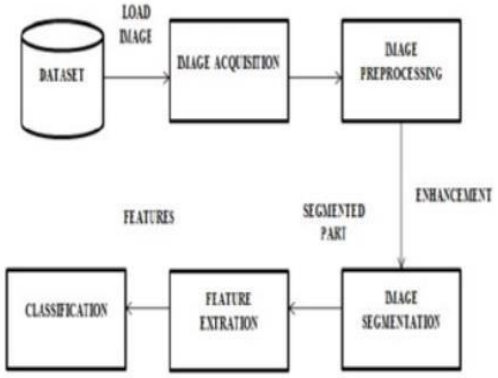


**Figure 1. Module of Vitamin Deficiency**

The modules in vitamin deficiency detection are image acquisition, image pre-processing, image segmentation, feature extraction, and classification.

**Image acquisition:** Image acquisition is the step where the vitamin deficiency images is taken as input.

**Image Pre-processing:** The aim of pre- processing is an improvement of the image data that suppresses unwanted distortions or enhance some image features are important for further processing.

**Image Segmentation:** Image segmentation is the process of partitioning a digital image into multiple segments.

Partitioning is done by k means clustering. Steps for K mean clustering:

- Randomly select 'c' cluster centers.
- Calculate the distance between each data point and cluster centers.
- Assign the data point to the cluster center whose distance from the cluster center is the minimum of all the cluster centers.
- Recalculate the new cluster center.
- Recalculate the distance between each data point and new obtained cluster centers [6].

**Feature Extraction:** The aim of feature extraction is to find out and extract features that can be used to determine the meaning of a given sample.

**Classification:** In this phase to detect and classify the vitamin deficiency, I am using the classifier that is a support vector machine.

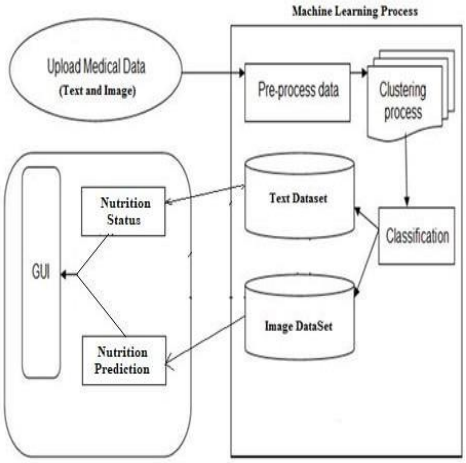


**Figure 2. Block diagram of Vitamin Deficiency**

**Proposed Methodology**

**An analysis:** A diet lacking in nutrients could cause some varied symptoms. These symptoms are the body's manner of human action potential victuals and mineral deficiencies. Recognizing them will facilitate regulating diet consequently. The symptoms of a biological process deficiency depend upon that nutrient the body lacks.

**AI and NLP:** [7] Natural language processing (NLP) may be a part of AI where we apply computational techniques to the analysis and synthesis of tongue and speech.

**Neural Network Training and Android Application:** A simple Android Application is often designed to prompt the user to capture photos of the mentioned organs. An intelligent application is often built to accumulate, process, analyze and extract the features of interest from these photos. to make a platform capable of this task, Machine Learning algorithms were wont to train a Neural Network for symptom detection.

**Fuzzy Membership Function and Defuzzification:** As multiple iterations of the Convolution Neural Network (CNN) are done using numerous photos containing the targeted attributes within the study mentioned earlier, the arrogance level of every extracted feature is fetched and fed during a Mamdani-based symbolic logic Membership Function built using PYTHON.

**Algorithm**

A. **Convolution Neural Network (CNN)**

The structure of CNN includes two layers one is feature extraction layer, the input of each neuron is connected to the local ready fields of the previous layer, and extracts the local feature. Once the local features are extracted, the positional relationship between it and other features also will be displayed. The other is feature map layer; each computing layer of the network is collected of an advantage of feature map. Every feature map is a plane, the weight of the neurons in the plane are same. The structure of feature plan uses the sigmoid function as activation function of the convolution network, which makes the feature map have shift in difference. Besides, since the neurons in the same mapping plane share weight, the number of free parameters of the network is decreased. Each convolution layer in the convolution neural network is come after by a computing layer which is used to find the local average and the second extract; this unique two feature extraction structure decreases the resolution.

B. **Convolution Layer**

Convolution is the first layer to extract features from an input image (leaf image). Convolution preserves the relationship between pixels by learning image features using small squares of input data. Convolution of an image with different filters can perform operations such as edge detection, blur and sharpen by applying filters i.e. identity filter, edge detection, sharpen, box blur and Gaussian blur filter.

C. **Pooling Layer**

Pooling layers would reduce the number of parameters when the images are too large. Spatial pooling also called subsampling or down sampling which reduces the dimensionality of each map but retains important information.

D. Fully Connected Layer

In this layer Feature map matrix will be converted as vector (x1, x2, x3, …). With the fully connected layers, then combine these features together to create a model.

E. **Softmax Classifier**

Finally, I have an activation function such as softmax or sigmoid to classify the outputs i.e. classify data.

F. **Algorithm Working**

**1. AI and NLP:**

Natural language processing (NLP) may be part of AI where we apply computational techniques to the analysis and synthesis of tongue and speech. within the medical field, patient records usually contain plenty of important data that professionals need to extract.

**2. Neural Network Training and Android Application**

A simple Android application is often designed to prompt the user to capture photos of the mentioned organs. An intelligent application is often built to accumulate, process, analyze and extract the features of interest from these photos.

***3.*** *Fuzzy Membership Function and Defuzzzification*

As multiple iterations of the Convolution Neural Network (CNN) are done using numerous photos containing the targeted attributes within the study mentioned earlier, the arrogance level of every extracted feature is fetched and fed during a Mamdani-based symbolic logic Membership Function built using PYTHON.

**Result and Disscussion**

A nutrient-deficient diet may result in a variety of symptoms. These signs and symptoms are the body's way of signalling nutrient and mineral shortages. Understanding them will make it easier to control diet accordingly. Depending on the nutrient that the body lacks, a biological process shortage manifests as different symptoms. There are some universals, though. They will consist of: broken nails mouth sores or fissures in the mouth's corners Having trouble seeing at night, having white growths on the eyes, and having red eyes sleek Tongue. The symptom often denotes anaemia if the nails are yellow.

According to a separate survey, about 28% of mouth ulcer patients had vitamin B1 (B1 vitamin), B complex (B2 vitamin), and vitamin B6 deficiencies (B6 vitamin). You might be able to detect any B6 deficiency in your mouth. The edges of your lips might be damaged and covered with scaly skin. Perhaps your tongue would enlarge. Your age has a major impact on how much vitamin B6 you need each day. Babies from 7 to 12 months desire nothing. daily dose of 3 milligrammes. As you get older, you want more. If you are over fifty, you need at least five times as much: one.7 milligrammes for males and one.5 milligrammes for women per day.Most of all, pregnant women want 1.9 milligrammes each day. Excessive secretion or dehydration will result in angular inflammation, a disorder that causes the corners of the mouth to crack, break, or bleed. But, it may also be brought on by a combined diet of too little iron and B vitamins, particularly B complex. For instance, insufficient intakes of fat-soluble vitamin are generally associated to a disorder called moon blindness, that impairs people's ability to ascertain in low lightweight or darkness. This is due to the fact that fat- soluble vitamins are essential for supplying visual purple, a pigment located in the retinas of the eyes that aids with night vision. The papillae, or little lumps on your tongue, start to disappear.

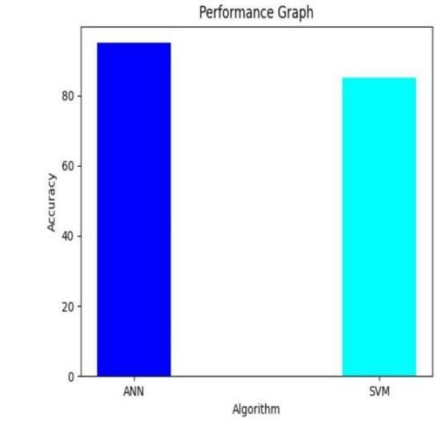


**Figure 3.** Performance Graph

G.

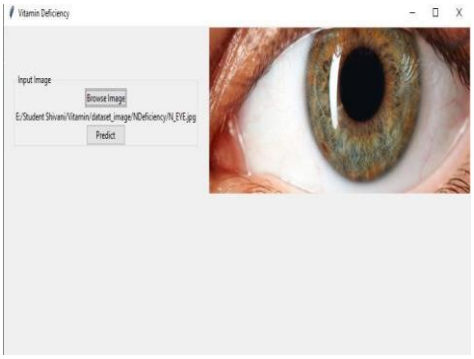


**Figure 4.** Input

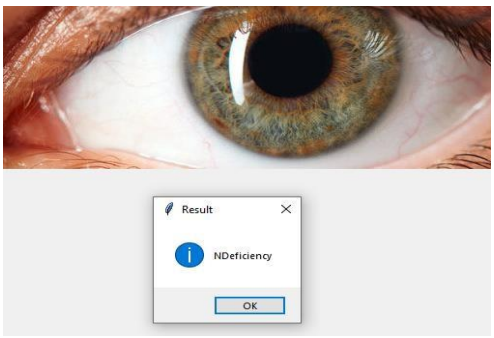


**Figure 5.** Output

**Conclusion**

An Android mobile application capable of providing a diagnosis of selected vitamin deficiency spectrum from photos of the user's tongue, lips, eyes, and nails using Artificial Intelligence has been implemented. The application used a combination of Machine Learning to achieve the extraction of certain features and attributes from the images and a Fuzzy Logic decision-making algorithm to specify the type of deficiency. After specifying the visual symptoms associated with each deficiency through pathological research, a Tensor Flow classifier was trained using a considerable number of labelled images of segmented symptoms for each organ individually with a minimum resolution of 439 x 335 pixels each. The classifier was installed into a simple GUI to provide offline functionality. The Defuzzification Rules of the Fuzzy Membership Functions have been adjusted in accordance with the commonality and the probability of the symptoms and can be updated by admins to improve the accuracy of the detection. Another layer of the decision-making algorithm displays a list of nutrients as well as compensational medications and supplementary products. The approach was verified by associate professors in oral medicine, and oral and maxillofacial surgery to be valid and acceptable. The test has shown the correct diagnosis corresponding to the symptoms. However, due to the limited access to images and profiles of cases with vitamin deficiencies, the application was not directly tested on patients. The application is a new approach that allows self-diagnosis in a short time without the need for a blood sample. The accuracy of the diagnosis can be exponentially improved by including more data with direct contributions from medical practitioners, researchers, and experts through exclusive access to the database. The proposed solution's capabilities are not limited to vitamin deficiencies, but they can be extended to include early detection of other health problems using more resources besides the camera. The application - named Vita-Cam - is

not a replacement for medical consultation, but it is a tool designed to boost the community's awareness of their missing nutritional needs and help them obtain a suitable diet, thus preventing further health complications caused by untreated vitamin deficiencies.

**Future Scope**

This state-of-the-art review looked at the impacts of vitamin deficiencies; their prevalence's in terms of population risks; methods used in the prevention and control of such deficiencies; political, social, and other factors; current coverage and progress; some emerging issues; and some conclusions. On the whole, there is likely to be continued progress, with an increased emphasis on women's health and nutrition, the elderly, and children and adolescents; indeed, an emphasis throughout life.

**Acknowledgement**

I wish to express my profound thanks to all who helped us directly or indirectly in making this paper. Finally I wish to thank to all our friends and well- wishers who supported us in completing this paper successfully I am especially grateful to our guide Prof. Dr. Sachin Bere for him time to time, very much needed, valuable guidance. Without the full support and cheerful encouragement of my guide, the paper would not have been completed on time.

**Acknowledgments**

I am Shivani Pawar & All Author's thankful to Prof. Dr. N. G. Narve, Principal, College of Engineering, Phaltan for granting permission to carry out the work.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

The authors declare that they have no conflicts of interest related to this research.

**References**

1. Cynthia Hayat, Barens Abian, "The Modeling of Artificial Neural Network of Early Diagnosis for Malnutrition with Backpropagation Method", 2018.
2. BambangLareno, LilianaSwastina, Husnul Maad Junaidi, "IT Application to Mapping The Potential of Malnutrition Problems, 2018.
3. AnutoshMaitra, RambhauEknath Rote, NatarajKuntagod, "Managing Child Malnutrition via Digital Enablement: Insights from a Field Trial", 2017
4. Sri Winiarti, Sri Kusumadewi, IzzatiMuhimmah, Herman Yuliansyah, "Determining The Nutrition of Patient Based on Food Packaging Product Using Fuzzy C Means Algorithm", 2017.
5. ArchanaAjith, VrindaGoel, "Digital Dermatology Skin Disease Detection Model using Image Processing", 2017.
6. Kyamelia Roy, SheliSinhaChaudhuri, "Skin Disease detection based on different Segmentation Techniques", 2019. Sambit BAKHSHI, "Deep convolutional neural network for face skin diseases identification", 2019.
7. TanzinaAfrozRimi, "Derm-NN: Skin Diseases Detection Using Convolutional Neural Network", 2020.
8. Shih-Hsiung Lee, Chu-Sing Yang, "An Image Preprocessing Method for Fingernail Segmentation in Microscopy Image", 2019.
9. Laura Safira, BudhiIrawan, CasiSetianingsih, K-Nearest Neighbour Classification and Feature Extraction GLCM for Identification of Terry's Nail, 2019.
10. Hongfeng Li a, Yini Pan b ,Jie Zhao c , Li Zhang d, "Skin disease diagnosis with deep learning: A review", 2021.