International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Vitamin Deficiency Detection from eye Using Machine Learning

Krupa H T[1] , Sowmya D[2] ,Khushi M A[3], Sanjana K J[4], Spandana G L[5]

Department of CSE JNN College of Engineering,

Abstract **- Vitamin deficiencies affect millions globally, with over two billion people at risk. Early detection is crucial, yet one in three youngsters lacks proper vitamin intake. Addressing this, a novel machine learning-based approach, using eye images instead of blood samples, offers a free desktop application for vitamin deficiency detection. The software, trained to distinguish healthy and deficient eyes, provides users with comprehensive reports. Early identification of deficiencies can prevent anemia, infectious illnesses, and developmental issues. Real-world trials confirm the method's superior efficiency compared to previous approaches, marking a promising advancement in global health.**

Keywords**:** Machine Learning, Opthalmology, YOLO, Deep Learning, Image preprocessing , extraction, ultralytics.

1. INTRODUCTION

Vitamins, essential organic compounds vital for physiological functions like metabolism and immune health, are crucial elements in our diet. Insufficient intake can lead to deficiencies, resulting in various health issues. The global impact is significant, with over two billion individuals affected, particularly children and pregnant women. Early detection is paramount, as deficiencies can lead to a range of health problems. Proactive measures, such as regular health assessments and balanced diets, play a crucial role in mitigating risks. Timely identification enables targeted interventions, safeguarding individual health and well-being, while aiding in understanding underlying conditions for personalized nutritional interventions. Machine learning techniques, notably leveraging YOLO (You Only Look Once) for object detection, offer promising avenues for detection, leveraging datasets for training and testing to classify eye images, facilitating early diagnosis and intervention in assessing vitamin deficiencies and preserving eye health.

2. LITERATURE SURVEY

In this section, various papers have been presented with various Machine Learning techniques.

In [1] Vitamin Deficiency Detection Using Image Processing and Neural Network is done using the CNN, RF, a robust nonparametric statistical method combining Decision Trees, Bagging, and Random Subspace, emerged as the most resilient, particularly in varying training data size,
SVM efficiently separates data using hyperplanes, while OLR's performance suffers notably with reduced sample sizes. Notably, RF excels in accuracy even with smaller datasets, outperforming SVM in classifying data when training samples are limited.

In [2] Detecting vitamin deficiencies using image processing techniques and Convolutional Neural Networks (CNNs). This method involves image acquisition, preprocessing, and feature extraction using a pre-trained CNN, followed by classification based on learned patterns. this non-invasive approach offers promising avenues for detecting and monitoring vitamin deficiencies.

In [3] A model to predict vitamin deficiencies in psychiatric patients using machine learning and routine blood test results. The study demonstrates the efficacy of various classifiers in predicting deficiencies.

In [4] Paper proposes a GUI for organ photo capture, followed by intelligent software that uses machine learning, specifically Convolutional Neural Networks (CNNs), for symptom detection. The application combines machine learning and Fuzzy Logic decision-making to specify deficiency types based on visual symptoms.

In [5] deep learning algorithms are used specifically citing the notable successes achieved in various Natural Language Processing (NLP) tasks when compared to traditional approaches and paper introduces Convolutional Neural Networks (CNNs) and Long Short-Term Memory networks (LSTMs) as two prominent deep learning techniques.

In [6] The project implements a website for identifying vitamin deficiencies and recommending rich vitamin foods using machine learning techniques. It utilizes algorithms like KNN, classification, logistic regression, LDA, and SVC to predict deficiencies and suggest foods based on input values.

In [7] They introduced a system for Vitamin Deficiency Detection Using Image Processing and Artificial Intelligence, enabling self-diagnosis from tongue, nails, lips, and eye images. It employs Neural Network Training, Natural Language Processing, and Fuzzy Logic algorithms for symptom detection and classification.

In [8] The paper presents a comparative study of machine learning algorithms for detecting iron deficiency anemia using palm images. Methods include dataset gathering, image pre-processing, and model development with CNN, k-NN, Naïve Bayes, SVM, and Decision Tree algorithms.

In [9] The paper addresses the significance of Vitamin A deficiency (VAD) in lower-income countries, focusing on Ethiopia, and emphasizes the importance of assessing its prevalence through clinical and biochemical indicators. the impact of VAD on child mortality and the effectiveness of Vitamin A supplementation. The systematic review and metaanalysis focus on VAD in Ethiopian preschool children, using rigorous search methods to identify eligible studies and assessing evidence quality through GRADE criteria.

In [10] The paper introduces an automated system for eye disease recognition, combining facial detection, landmark extraction, and machine learning techniques. Using methods like HOG and SVM for face detection and DCNN for disease recognition.

In [11] The paper presents an approach to investigate visual symptoms related to vitamin deficiencies, focusing on body parts like the tongue, lips, nails, and eyes. Methodology involves integrating AI techniques such as NLP and Fuzzy Logic with Convolutional Neural Networks (CNNs) for image analysis.

In [12] The study focuses on developing an intelligent system to detect micronutrient deficiencies using deep artificial neural networks, including CNN, CNN-LSTM, and CNNGRU, in real-time circumstances. They classify deficiencies in iron, vitamin, or normal based on symptoms observed in eye, tongue, and nail images.

In [13] The article presents a machine learning-based system for vitamin detection and food recommendation using machine learning . The two phases of the Data Classification process are building the classifier or model and using the classifier for classification. Various algorithms are used in classification techniques. This is also known as Supervised Learning since a training dataset is utilized to build a classifier.

In [14] The study focuses on non-invasive anemia detection using palm images and machine learning. It employs CNN, kNN, Naïve Bayes, SVM, and Decision Tree. Results support machine learning's effectiveness for anemia detection, with CNN utilizing SGD optimization and ReLu activation, SVM employing sigmoid activation, and Decision Tree employing specific parameters.

Authors	Research focus	Remarks
Rutuja Moholkar, Mansi Kamble, et al. [1], 2023	CNN, RF, a robust non parametric statistical method combining Decision Trees, Bagging, and Random Subspace,	Risk of bias if the CNN model is trained predominantly on certain demographic groups.
Nuriye Sancar and Sahar S. Tabrizi [2],2023	Used multiclass classification OLR ,RF, and SVM.	When the model is applied to 25% of the data, the performance of OLR model for lowered.
Dr. R. Maruthamuthu, T. Harika [3],2023	Involves image acquisition, preprocessing, feature extraction using a pre-trained CNN, and classification based on learned part.	Is not directly focused on detecting specific deficiencies.
Hidetaka Tamune, Jumpei Ukita et al [4],2020	k-nearest neighbours, logistic regression, SVM, and random forest were trained.	The findings of this single-center retrospective study may have limited external generalizability.
Ahmed Saif Eldeen, Mohamed AitGacem et al. [5],2020	Combination of Machine Learning to achieve extraction of certain features and attributes from images and Fuzzy Logic decision-making algorithm to specify the type of deficiency .	Limited access to images and profiles of cases with vitamin deficiencies

Authors	**Research focus**	**Remarks**
K.V. Satyanarayana, Gangireddy Pujitha et al. [6],2023	KNN Algorithm Classification Algorithm ,Logistic Regressions ,Linear Discriminant Analysis, SVM	Time consuming and yet not user friendly.
Dr. Arati Dandavate1, Priyanka Gore et al [7],2021	Neural Network Training to detect symptoms and Natural Language Processing to extract features	Cannot be extended to detect other health problems.
Peter Appiahene, Justice Williams Asare et al.[8],2023	CNN, k-NN, Naive Bayes, SVM, and Decision Tree.	Age Group Limitation, The Naïve Bayes algorithm assumes independence in classifiers, which might not hold true in real-world scenarios.
Zekariyas Sahile, Delelegn Yilma et al [9],2020	The systematic review and meta analysis focus on vitamin A deficiency (VAD) in Ethiopian preschool children, identified through rigorous search methods	Limits us to do intensive subgroup analysis.
Ashrafi Akram and Rameswar Debnath [10],2022	System utilizes two classifiers: a Deep Convolution Neural Network (DCNN) and SVM. Face detection employ Histogram Oriented Gradient and a linear SVM classifier.	The system's ability to generalize across diverse datasets and real-world scenarios remains uncertain
Mr. Harshavardhan J R, Vaishnavi M et al [11],2023	AI, NLP, and Fuzzy Logic Integration, .CNNs process images, and confidence levels integrate into a Fuzzy Logic Membership Function. Defuzzification provides deficiency identifications.	Misdiagnosis due to reliance on visual symptoms from photos
T. Kalavathi Devi, K.N. Baluprithviraj et al.[12],2023	Detects micronutrients deficiency through deep artificial neural network and learning techniques, namely CNN and CNN–LSTM, CNN-GRU in realtime circumstances.	Requires collecting a huge amount of images of eye conjunctiva, nail beds and tongue of patients and extracting features from them.
Mrs. N. Naga Lakshmi, M. Jagadeesh Reddy et al.[13],2022	The two phases of Data Classification process are building the classifier or model and using the classifier.Supervised Learning	Less accuracy rate.
Pallavi, Bijit Basumatary, Rahul Shukla et al.[14],2023	Employs CNN, kNN, Naïve Bayes, SVM, and Decision Tree. Results support machine learning's effectiveness for anemia detection.	The quality of the mobile phone camera, and the distance of taking an image is drawback.

Table -1: Summarization of Various Authors

3. CONCLUSION

This paper outlined a survey of vitamin deficiency from eye using machine learning . It also outlined the different approaches and techniques in various survey papers as reference points by various authors considering its advantages, and also some key challenges are discussed here. After studying various Machine Learning algorithms, it was found that cnn based algorithm are best suited for our proposed model. This survey effort will provide a better understanding of algorithms which will be used to develop the model to find the accurate medical benefit.

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