



Vitamins Deficiency Detection Using Image Processing and Neural Network

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Abstract—Our diets need to contain vitamins. A deficiency will develop if the right number of vitamins aren't consumed. In this study, we introduce 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.

Keywords- 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.

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 milligrams 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. 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 percent of a sample of 100 university students responded "no." Although the sample size of this small study is insufficient to accurately represent the population, it may provide an estimate of the level of social awareness that exists in reality.



RELEATED WORK

AnutoshMaitra, RambhauEknath Rote, Nataraj Kuntagod, “Managing Child Malnutrition via Digital Enablement: Insights from a Field Trial”, 2017, 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, “Determining The Nutrition of Patient Based on Food Packaging Product Using Fuzzy C Means Algorithm”, 2017, 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%.

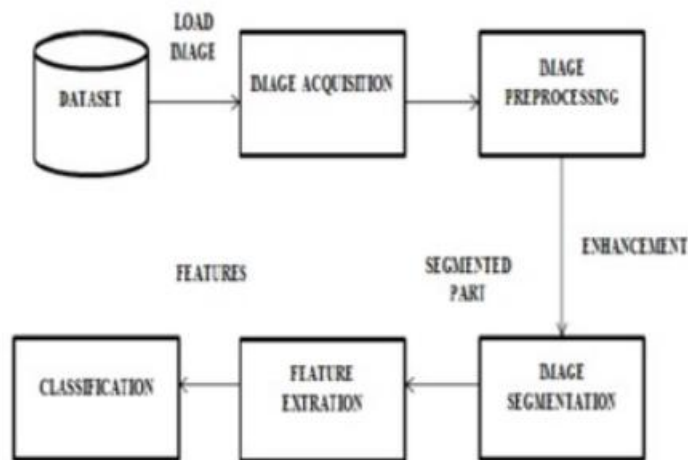
ArchanaAjith, VrindaGoel, “Digital Dermatology Skin Disease Detection Model using Image Processing”, 2017, This paper proposes a skin disease detection method based on image processing techniques. This method is mobile based and hence very accessible even in remote areas and it is completely noninvasive to patient’s skin. The patient provides an image of the infected area of the skin as an input to the prototype.

Transverse grooves of the nails, designated as Beau's lines, were observed in a patient with malignant lymphoma given chemotherapy. Beau's lines disappeared in the treatment-free intervals. This observation supports the concept that these lines are the result of the suppressed growth of the nail matrix caused by antimetabolic drugs.

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. 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 we 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. We 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.



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 pomegranate leaf image 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.

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 plant leaf diseases, we are using the classifier that is a support vector machine.

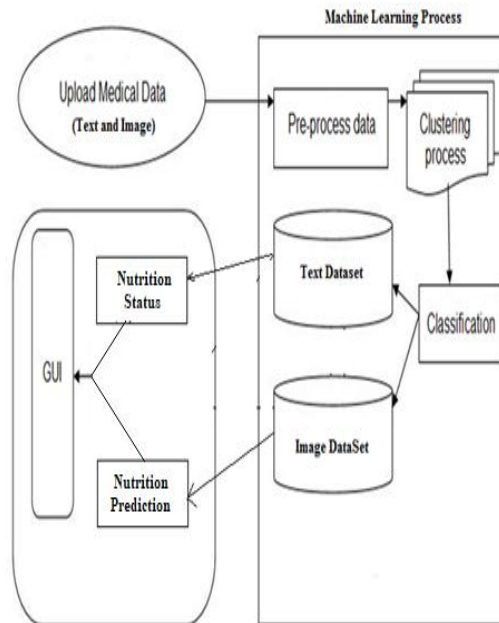


Fig 1. Block diagram

Algorithm

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.

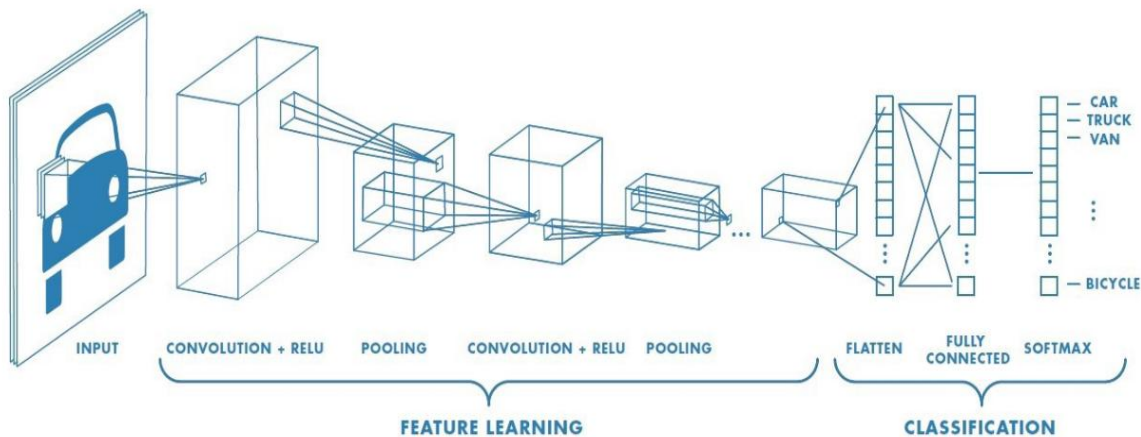


Fig. CNN Layers



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.

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.

Fully Connected Layer

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

Softmax Classifier

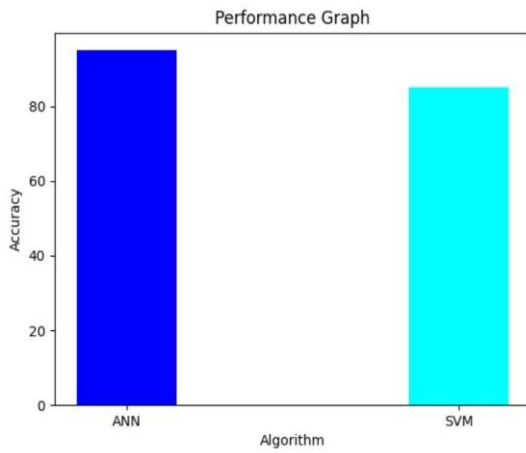
Finally, we have an activation function such as softmax or sigmoid to classify the outputs i.e. classifydata.



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.



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 TensorFlow classifier was trained using a considerable number of labeled 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 prevalences 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.

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