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NEURAL NETWORK BASED VITAMIN DEFICIENCY DETECTION USING IMAGES

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ABSTRACT

Vitamin deficiencies pose a significant global health concern, resulting in various debilitating conditions. Detecting these deficiencies early on is crucial for effective intervention and prevention. This study presents a novel technique that uses image processing and neural networks to identify vitamin deficiencies. The system utilizes image analysis techniques to evaluate physical signs of deficiencies, such as abnormalities in the skin, nails, or eyes. Detailed images of these symptoms are collected and processed to extract relevant features. A convolutional neural network (CNN) is then utilized to classify these features and identify potential deficiencies. The neural network is trained on a comprehensive dataset of images representing different vitamin deficiencies, ensuring accurate and robust detection capabilities. To further enhance the system's performance, transfer learning and data augmentation techniques are employed. Experimental results demonstrate the system's effectiveness in accurately detecting vitamin deficiencies. Additionally, the non-invasive nature of image-based detection makes this approach convenient and accessible for widespread screening and monitoring, especially in resource-limited settings. In conclusion, this proposed methodology offers a promising solution for early detection and intervention of vitamin deficiencies, contributing to improved public health outcomes and overall well-being. This innovative approach bridges the gap between technology and healthcare, potentially revolutionizing the global fight against vitamin deficiencies.

Keywords: Vitamin Deficiency, Deep Learning, CNN.

I. INTRODUCTION

Vitamin deficiency is a significant health issue that arises from the failure to acquire the necessary spectrum of essential vitamins and minerals. Over 2 billion people worldwide suffer from vitamin deficiencies, with over 1.2 billion being zinc deficient and half a million dying each year. Iron deficiency causes anemia, resulting in over 100,000 deaths. In the UAE, over 90% of the population suffers from vitamin deficiencies. In the US, over 92% of the population suffers from at least one mineral or vitamin deficiency, despite the country not experiencing a starvation crisis. Nutrient-rich foods are often considered financially expensive, leading to nutrient-rich foods becoming more of a symbol of luxury rather than the standard of daily food intake.

Researchers have found that the soil itself is deficient in micronutrients, with the mineral content of vegetables like cabbage, lettuce, spinach, and tomatoes depleting from 400 milligrams to less than 50 milligrams. Even with a perfect diet, something is missing, with 50% of Americans deficient in vitamin A, vitamin C, and magnesium, 70% of elderly Americans, and 90% of Americans of color being vitamin D deficient. A survey of 100 university students found 67% of them unaware of having vitamin deficiency.

Approximately 2 billion people worldwide suffer from vitamin deficiencies; of these, more than 1.2 billion are zinc deficient, and each year, half a million of them die. Every year, an iron deficiency-related anemia claims the lives of about 100,000 people. Insufficient intake of vitamins affects about 90% of the population in the United Arab Emirates. More than 92% of Americans have at least one vitamin or mineral deficiency, even in the absence of a famine. Nutrient-rich foods are becoming less and less essential to a person's regular diet because of their high perceived cost and more of a status symbol.

Over two billion people worldwide suffer from vitamin insufficiency, with one in three children not receiving enough vitamins. Vitamin A deficiency affects 33% of young children under five, leading to low immunity and night blindness. Vitamin deficits often coexist with mineral shortages, with children and pregnant women being

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the most at risk. Common deficiencies include vitamin A, vitamin B, folate, and vitamin D. Supplementation programs have made diseases like scurvy and pellagra rare.

Vitamin deficiencies cause numerous health problems, as they hinder the intake of essential minerals and nutrition. It is challenging to measure nutritional requirements without medical advice, especially when people lack knowledge of the specific type of shortage they may be experiencing. Over 1.2 billion people worldwide suffer from zinc deficiency, with 500,000 passing away annually. Iron deficiency causes anemia that kills over 100,000 individuals annually.

In the UAE, vitamin deficiencies affect over 90% of the population. In America, over 92% of the population has at least one mineral or vitamin deficit. Nutrient-rich foods have become more of a luxury due to the availability of inexpensive, easily accessible junk foods. Researchers have discovered micronutrient deficiencies in soil, with magnesium, vitamin A, and vitamin C deficiencies affecting 50% of Americans, and vitamin D deficiency affecting 90% of Americans of color and 70% of older Americans.

II. RELATED WORK

A lack of vitamin A can cause a number of clinical symptoms, including growth abnormalities, xerophthalmia, and an increased risk of serious infections. Its existence has been known since antiquity, when experimental animal research and epidemiological observations conducted in the early 1900s confirmed its presence. The extent and effects of vitamin A insufficiency on the impoverished in low- and middle-income nations have been shown in recent clinical investigations, which have altered international health policy. Numerous stories have confirmed these results, underscoring the significance of treating vitamin A insufficiency. An early clinical indicator of cobalamin deficiency is glossitis with linear lesions, as reported in four cases without anemia or neurologic signs. Even in patients without anemia, measuring cobalamin levels is advised. Potential applications of image-based analysis for nutritional assessments are demonstrated by a machine learning system that uses facial photos to accurately detect vitamin D insufficiency. Using images of the tongue, researchers created a deep convolutional neural network architecture that can identify vitamin B12 deficiency with high accuracy, differentiating between healthy and deficient subjects.

III. MATERIAL AND METHODOLOGY

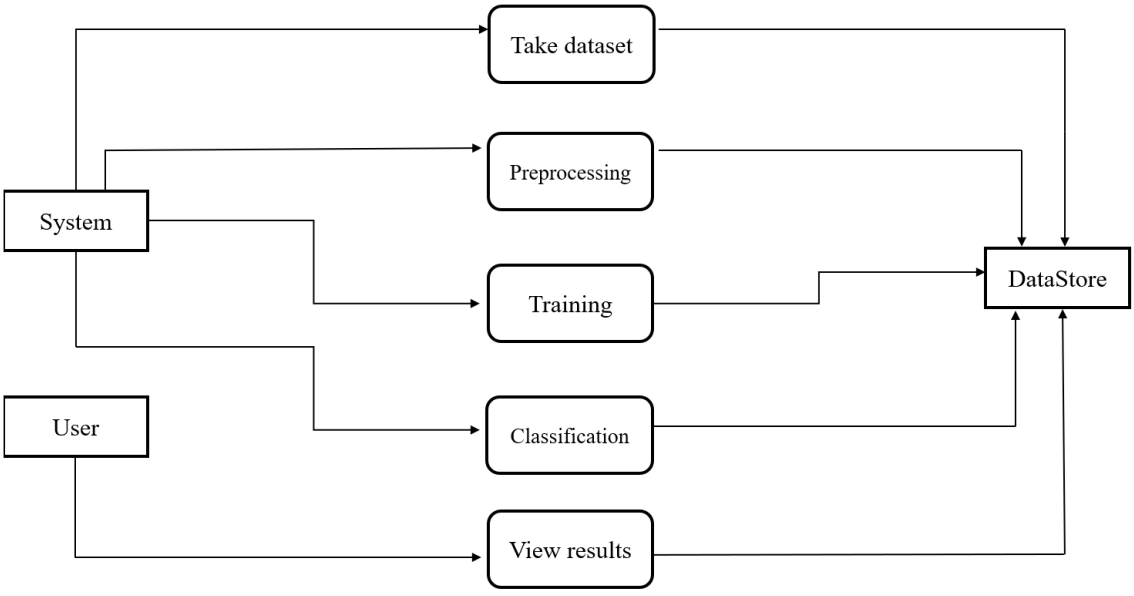

Fig 1: Data Flow Diagram

NasNetMobile is a convolutional neural network (CNN) architecture developed by Google's DeepMind. It's designed for image classification tasks, meaning it's trained to analyze and categorize images into different classes. In the context of detecting vitamin deficiency, NasNetMobile can be utilized as follows:

A. Data Collection: First, a dataset of images related to symptoms or indicators of various vitamin deficiencies is compiled. These images could include pictures of skin conditions, nails, eyes, or other relevant body parts affected by different deficiencies.

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B. Preprocessing: The preprocessing of dossier necessary handling gone dossier and excessive data . Missing dossier was controlled by first removing cases with important gone principles for most of the features. Instances accompanying any dossier features gone were suffused accompanying the most frequent happening profit each feature. Finally the structured dossier was the developing dataset holding 8000 images.

C. Training: NasNetMobile is trained on this dataset using a supervised learning approach. During training, the algorithm learns to recognize patterns and features in the images that are indicative of different types of deficiencies. For example, it may learn to associate certain skin discolorations or abnormalities with specific vitamin deficiencies.

D. Feature Extraction: The trained NasNetMobile model is then used to extract features from new images of individuals suspected of having vitamin deficiencies. These images could be captured using standard digital cameras or smartphones.

E. Classification: The extracted features are fed into the trained model, which then classifies the images based on the patterns it learned during training. The output of the classification process indicates the likelihood of the individual having a particular vitamin deficiency.

F. By leveraging NasNetMobile's capabilities in image classification, healthcare professionals can potentially streamline the process of identifying and diagnosing vitamin deficiencies, enabling earlier intervention and treatment. But it's vital to remember that even if NasNetMobile can help with the detection procedure, it should be used in conjunction with clinical expertise and other diagnostic methods for accurate assessment and diagnosis.

IV. ANALAZING ML ALGORITHM

One of the main aims of resolving different appliance knowledge algorithms was to find the best subspace of features unavoidable for vitamin deficiency detection. To do this, we completed activity all-encompassing data group, dossier combining, and development of forecasting models. We used following algorithms:

A. CNN:

A particular kind of deep learning model called a Convolutional Neural Network (CNN) is intended for processing and evaluating visual data, such as pictures. Its layers carry out convolution operations to extract features, such textures and edges, from the incoming data. These features are then passed through activation functions to introduce non-linearity, pooled to reduce spatial dimensions, and finally flattened into a vector. This vector is then processed by fully connected layers to produce the final output, which could be classifications or predictions. During training, the CNN adjusts its parameters through backpropagation and optimization algorithms to learn to recognize patterns and make accurate predictions. CNNs have become instrumental in tasks like image recognition, object detection, and classification, due to their ability to automatically learn hierarchical features from raw data.

B. ANN:

A computational model called an Artificial Neural Network (ANN) algorithm is modeled after the architecture and operation of biological neural networks, such as those found in the human brain. It is made up of layers of networked nodes called neurons. After receiving input signals and applying weights to them, each neuron uses an activation function to process the data and produce an output. An ANN's primary feature is its capacity to learn from data. During the training process, the network adjusts the weights between neurons to minimize prediction errors, effectively learning the underlying patterns and relationships within the data. ANN algorithms have found widespread application in various domains, including image and speech recognition, natural language processing, medical diagnosis, and financial forecasting. They excel at tasks involving pattern recognition, classification, regression, and clustering. Despite their power, ANNs require careful design, tuning, and training to achieve optimal performance, often involving experimentation with network architectures, activation functions, and optimization techniques.

C. InceptionRasnetV2:

The InceptionResNetV2 algorithm, a fusion of Inception and ResNet architectures, can be repurposed for detecting vitamin deficiencies through a process of fine-tuning and transfer learning. Initially trained on vast

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datasets for image recognition, the model's adaptability allows it to learn specific features associated with symptoms of different vitamin deficiencies. By curating a diverse dataset of images displaying various deficiency indicators, such as pale skin or brittle nails, and preprocessing them for compatibility, the model undergoes training where it adjusts its parameters to minimize the disparity between predicted and actual deficiency types. Post-training evaluation ensures the model's accuracy and generalization, while deployment into practical settings like mobile apps or medical devices facilitates real-time deficiency detection. Continuous validation by domain experts is crucial for ensuring clinical relevance, and periodic updates may be necessary to accommodate new data and evolving understandings of vitamin deficiencies.

D. NasneMobilet:

NasNetMobile is a convolutional neural network (CNN) architecture designed for image classification tasks. In the context of vitamin deficiency detection, NasNetMobile likely operates by analyzing images, such as photographs of individuals or specific body parts affected by deficiency symptoms, and extracting relevant features from these images. These features could include skin color, texture, and other visual cues associated with different types of deficiencies. By training on a dataset containing images labeled with corresponding deficiency types, NasNetMobile learns to recognize patterns indicative of various deficiencies. During inference, the algorithm processes new images and classifies them based on the learned patterns, thereby identifying potential deficiencies in individuals. The efficacy of NasNetMobile in this task depends on the quality and diversity of the training data, as well as the network's architecture and training parameters.

Table 1: Outcomes of each Algorithm

Algorithms	Accuracy
ANN	68.8%
CNN	62.7%
Inception	83.33%
Nasnetmobile	97.7%

V. RESULT

Login:

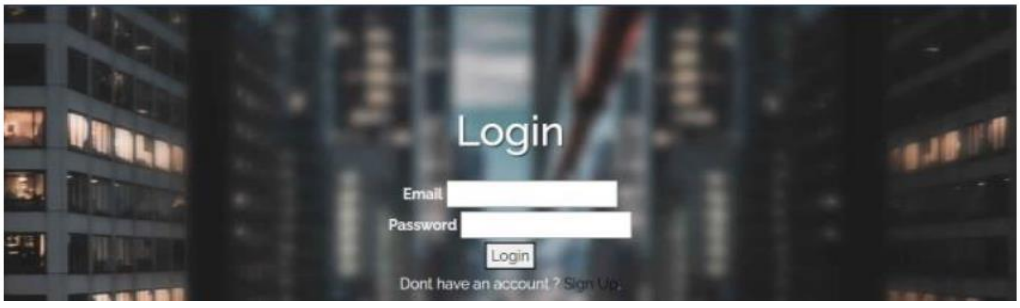

Fig 2: Login Page

Register:

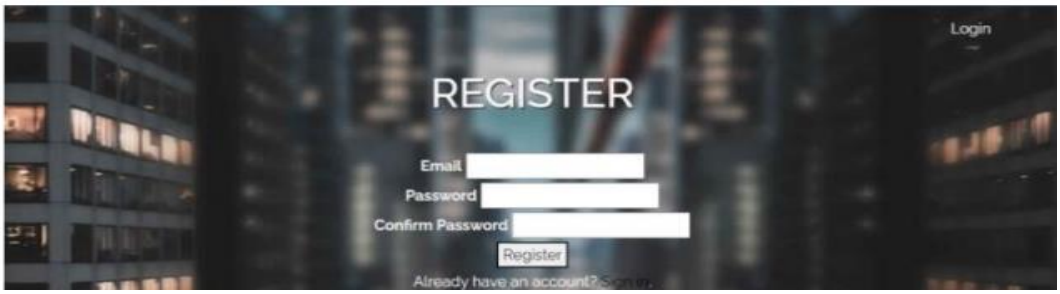

Fig 3: Registration Page

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Home:

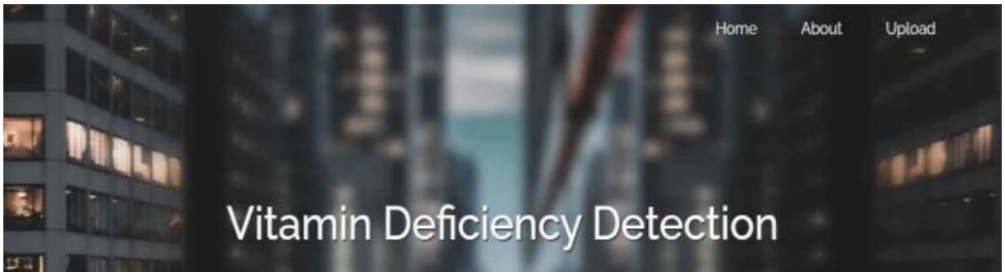

Fig 4: Home Page

Upload

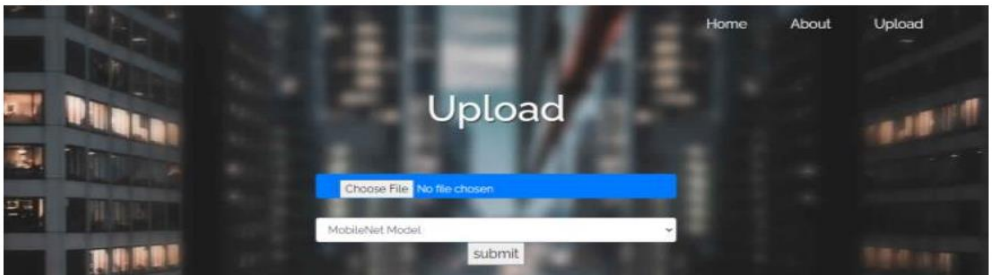

Fig 5: Upload Page

Fig 6: Result Page

VI. CONCLUSION

In summary, there are a number of benefits over current methods provided by the suggested project for vitamin insufficiency detection using image processing and CNNs. Through the utilization of computer vision and deep learning, the suggested system offers a non-invasive, precise, and easily accessible method for identifying and tracking nutritional deficits. The suggested approach is more convenient and comfortable for people because it does not require intrusive procedures, in contrast to conventional methods like blood testing and clinical evaluations.The technology also has the potential to be widely used because it can make use of widely accessible imaging devices, such as cellphones, which lowers the time and expense involved in specialized tools and laboratory testing. Multiple types of nutritional deficiencies can be detected by a computerized evaluation of visual cues in different body areas made possible by the use of CNNs and image processing techniques. This provides an in-depth analysis of nutritional status and extends the range of detection beyond specific nutrients.

Moreover, the suggested system offers real-time monitoring and detection, enabling early intervention and customized recommendations. Early detection of deficiencies allows people to take the right supplements or make educated dietary changes, which may slow the development of associated health issues. The suggested method leverages CNNs' extensive feature extraction and classification capabilities for high accuracy. The model is trained on a wide range of people with known weaknesses, which gives the system excellent accuracy in distinguishing between various vitamin deficiencies.

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