Available online @ https://jjem.jnnce.ac.in
https: www.doi.org/10.37314/JJEM.SP0235
Indexed in International Scientific Indiexing (ISI)
Impact factor: 1.395 for 2021-22
Published on: 08 December 2024

Machine Learning Techniques for Identification of Malnutrition in children

Roopa D M[1], Mr. Santhosh S G[2]

1 Student, Dept of MCA, JNN College of Engineering,
2 Associate Professor, Dept of MCA, JNN College of Engineering,
Shivamogga-577201, Karnataka India
Email: roopa.dm194@gmail.com, Email: santhoshsgrao@jnnce.ac.in

Abstract

Malnutrition poses a threat to world health, particularly in underdeveloped nations where early identification is essential. In order to detect malnutrition. This research integrates Convolutional Neural Networks (CNNs) with critical parameters like age, weight, and height. Users upload images, which CNN analyses to find features that might point to a person's nutritional status. Along with age, weight, and height, these factors are applied to classify persons as either malnourished or healthy. A user must first upload an image for the system to function, after which CNN examines the image to look for obvious indicators of malnutrition. These factors are integrated with anthropometric information, and a classification algorithm is used to evaluate the nutritional status. The system aims to detect malnutrition in children, assisting individuals and healthcare providers in mitigating the impacts of malnutrition through automated implementation rather than relying on manual processes.

Keywords: *Malnutrition, Convolutional Neural Network, Machine Learning, Artificial Intelligence.*

1. Introduction

Malnutrition is a major worldwide medical issue, especially in underdeveloped nations where timely and precise diagnosis is essential for successful treatment because they only use anthropometric data like age, weight, and height. Traditional approaches for detecting malnutrition frequently lack accessibility and precision in an effort to improve malnutrition identification. This study presents a novel method that blends convolutional neural networks with crucial anthropometric data. Users upload pictures of themselves and the network analyses them to find visual signs of malnutrition. After that, age, weight, and height are added together with these visual characteristics to create a whole evaluation. The project's ultimate goal is to assist medical professionals in early diagnosis and intervention for better health outcomes among vulnerable groups by creating a scalable, user-friendly system that is appropriate for environments with limited resources.

2. Literature Survey

[1] Shyleshwari M Shetty et al., (2024) "Prediction of malnutrition in children using machine learning. "The paper talks on how computers can support find out if kids are not eating That can lead to issues later. They use smart methods to gather lots of information about food and health to spot issues early and give help fast. Other studies also use computers to predict if kids might have nutrition problems and to see what food they eat using cameras. By combining different health data, like records and nutrition info, they try to improve how we find and manage nutrition problems early. Overall, using computers This strategy can genuinely support kids with nutrition issues. A. R. Lakshminarayanan et al., [2] talks about a new computer system that looks at pictures to quickly see if kids are eating well or not. This concept originates from other studies that use computers to understand food and

kids' health. Some studies looked at predicting nutrition problems with computers, while others focused on using computers to see what food people are eating from pictures. Lakshminarayanan et al.'s paper is special because it uses a fancy computer system called a convolutional neural network to analyze pictures fast and give accurate information about kids' nutrition. Sakshi Sachdeva1 et al., [3] They looked at things like the baby's weight, height, age, and gender to predict this. Other studies have also used computers to predict health problems in babies, focusing on nutrition. This research is important because it helps doctors and caregivers catch nutrition issues early on and offer the right help. Md. Toufiq Zumma et al., [4] The paper uses methods like decision trees, support vector machines (SVM), k-nearest neighbors (KNN), gradient boosting machine (GBM) classifiers, and random forest algorithms to analyze survey data and predict childhood malnutrition rates. Firewood H Bitew et al., [5] This study used computers to find out why some little kids in Ethiopia don't eat well. They looked at a big survey and found that some factors like clean water, anemia, age, weight at birth, and mom's health can affect this. They suggest that giving families clean water, enough food, and helping moms be healthier could help more kids stay healthy in Ethiopia. Neha Kadam1 al., [6] uses a technology called TensorFlow to check if kids are malnourished by looking at their pictures. They teach a computer program using images of kids who are sick, and then the program compares new pictures to see if the colors match. If they do, it means the child might be malnourished. Dezhi, X et al., [7] paper talks about using a method called rule-based classification, along with Agent Technology, to build a system that can spot malnutrition in children. They're also checking if having more rules makes the system better at making decisions about malnutrition. Mrs. Snitha Shetty et al.,[8] This paper examines how lifestyle changes and diet affect people's nutrition, causing issues like malnutrition. It focuses on using technology to study these connections and find ways to improve public health by understanding malnutrition better. Prof. Kirti Y. Digholkar et al.,[9] This study looks at using image processing techniques to detect malnutrition in children under 6. They use digital images of children's faces and train machine learning algorithms, especially Convolutional Neural Networks (CNNs), On a broad dataset of labeled images showing children with different nutritional states. The algorithms learn visual signs like sunken cheeks or puffy eyes that indicate malnutrition. This method is quicker and less invasive than traditional measurements like height and weight. It could be especially useful in places with limited resources. The aim is to catch malnutrition early and improve child health. Sangita Khare et al.,[10] This study explores using machine learning models to detect malnutrition in children under five in India. They gathered data from India Demographic and Health Surveys and compared different machine learning methods. They found that automated machine learning and deep learning models were the most efficient and accurate in predicting malnutrition factors. This research can help in better prevention and treatment of malnutrition in young children.

3. Proposed Methodology

To detect malnutrition in children using image classification alongside parameters such as age, weight, height, and gender. Scope: Categorize images of children into three groups: healthy, overweight or obese, and stunting or wasting.

3.1 Data Collection

Gather a dataset of labeled images of children, along with related metadata (age, weight, height, and gender), from reliable medical databases, healthcare organizations, or publicly accessible datasets.

3.2 Graphical User Interface (GUI)

A GUI is created in MATLAB for taking inputs from the user as shown in Fig 2, for performing operations and for displaying the results.

Input: 1. Child image, 2. Gender, 3. Age (in months), 4. Weight (in kg), 5. Height (in cm).

Figure 1. Graphical User Interface for Malnutrition Detection

3.3 Data Preprocessing

Normalize pixel values to a range of [0, 1] by dividing by 255, which helps in faster convergence during model training by standardizing the input scale. Apply data augmentation techniques such as shear transformations, zoom operations, and horizontal flips to enhance dataset variability and robustness. Standardize metadata by normalizing age, weight, and height data to ensure they are on a comparable scale.

3.4 Convolutional Layer:

We use a Convolutional Neural Network (CNN) to analyze images because it excels at detecting details. We also include extra details like age and weight to help the model make more accurate predictions. In a Convolutional Neural Network (CNN) model for Malnutrition detection, several types of layers are commonly used

Image Input Layer: This layer takes in images sized 150x150 pixels with 3 color channels (RGB) and feeds them into the model.

Conv2D Layers: These layers use filters to detect features like edges and textures in the image. The ReLU activation adds complexity to help the model learn better.

MaxPooling2D Layers: These layers shrink the size of the feature maps to make processing faster and prevent overfitting by making features less sensitive to changes in size and position.

Flattening Layer: This layer turns the 2D feature maps into a 1D vector so that it can be processed by the next layers.

Metadata Input Layer: This layer takes extra information like age, weight, height, and gender, and adds it to the model's inputs to improve accuracy.

Fully Connected Layers for Metadata: These layers process the extra information and convert it into a format that can be combined with the image data.

Concatenate Layers: This layer combines the image data and the metadata so the model can use both types of information together.

Dense Layer: This layer has 512 units to work with the combined data, using ReLU for better learning.

Dropout Layer: This layer randomly drops some units during training to prevent overfitting.

Output Layer: This final layer uses the SoftMax function to give probabilities for each class (healthy, overweight or obese, stunting or wasting), making sure the total of all probabilities equals 1.

3.5 Model Training: Train the model on the prepared and augmented dataset over several epochs. Use a part of the data for validation to check performance on new data. Save the best model during training using a Model Checkpoint to keep the version with the lowest validation loss.

3.6 Model Evaluation:

Assess if the model accurately detects malnutrition from the image and metadata. If malnutrition is identified, further determine its severity or stage.

Detection:

If the model identifies a child as malnourished, it will further classify the type of malnutrition (e.g., stunting or wasting) and show detailed results on the user interface. This includes confidence scores for each category, presented clearly and concisely to help users easily understand the child's nutritional status.

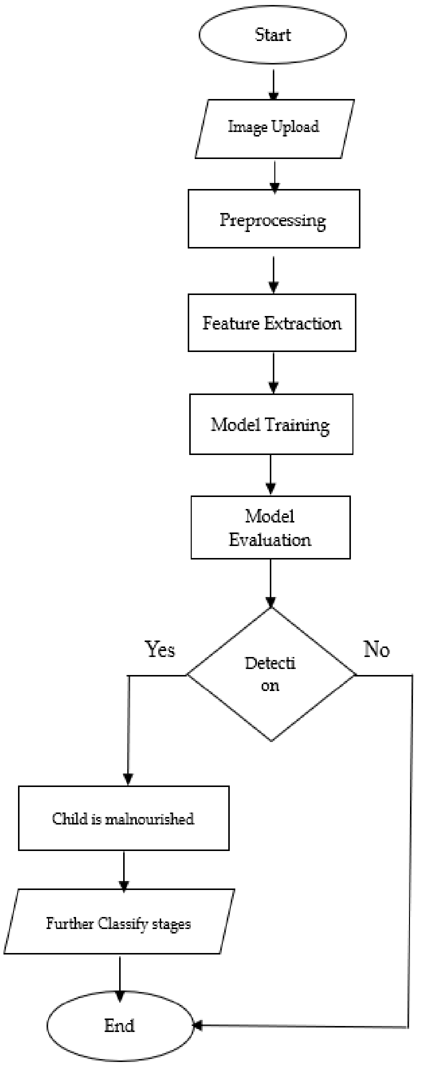

Figure 2. Flowchart

4. Experimental Result

The outcome of This approach is a instructed machine learning model that can accurately determine whether a child is healthy or malnourished if it is malnutrition it define stages like stunning, wasting and overweight by analyzing both their photograph and their numerical data (age, height, weight). The model extracts important features from the child's image, such as visible signs of malnutrition, and combines this information with their age, height, and weight to make a more informed decision. When tested, the model shows good performance in correctly classifying children as either healthy or malnourished, demonstrating its effectiveness in real-world scenarios. This approach helps healthcare specialists and caregivers Rapidly pinpoint children who could need nutritional interventions.

Figure 3. Output for Detection of malnutrition

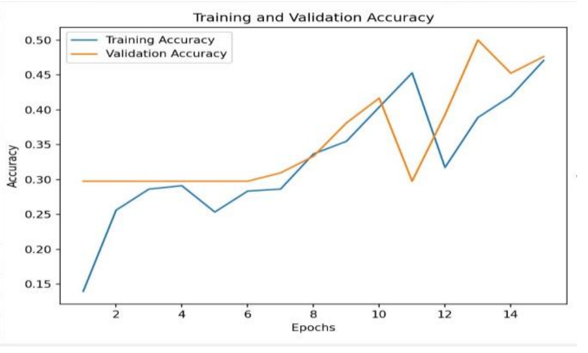

Figure 4: The graph shows the model's learning progress over time.

This graph shows that how well the model learns over time, with both training and validation accuracy improving and fluctuating as it trains.

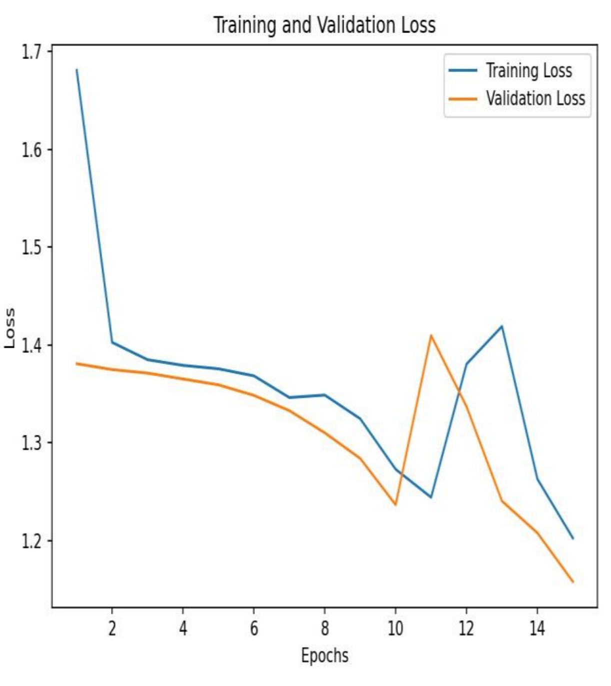

Figure 5: The graph shows the model getting better as it trains.

the graph shows how the training and validation loss decrease over time, indicating that the model is improving its performance as it learns.

5. Comparative Analysis

Our proposed methodology contains more accuracy than other proposed systems. We can see the difference in the below table

Author	Technology Used	Accuracy and Limitations
Smith et al. (2022)	CNN with Data Augmentation	90% Requires extensive data augmentation; computationally intensive; may overfit to augmented data.
Current Application	Convolutional Neural Network (CNN)	85%-95% relies on image quality and optional additional data for comprehensive analysis.
Johnson et al. (2021)	Transfer Learning with Pre-trained CNNs	88% Performance depends on the quality of pre-trained models; may require extensive fine-tuning.

6. Conclusion

In summary the methodology of combining image data with numerical parameters like age height and physical markers for malnutrition in children is a encouraging approach by lever-aging machine learning techniques such as convolutional neural networks Convolutional networks for extracting image features and dense layers for processing numerical data a model Can undergo training to accurately classify child as healthy or malnourished this holistic approach not only considers visual indicators of malnutrition But also considers key numerical factors related to progression and development the resulting model has the capacity to assist medical experts in early detection and intervention for vulnerable child progressively improving their overall health results continued research and refinement of this methodology can further optimize its impact and applicability in medical environments

7. References

1. Shyleshwari M Shetty, Swathi S, Upasana Chandrashekar3, Vaishnavi Kashyap4, Vibha V S 5 (2024) "Prediction of malnutrition in children using machine learning ", International Advanced Research Journal in Science, Vol. 11, Issue 4, Retrieved April 2024.

2. A. R. Lakshminarayanan, Pavani B, Rajeswari v "Malnutrition detection using Convolutional Neural Network", International conference on Bio Signals, Images, and Instrumentation (ICBSII), Retrieved March 2021.

3. Sakshi Sachdeva1, Pooja Dewan1, Dheeraj Shah1, Rajeev Kumar Malhotra2 and Piyush Gupta1," Mid-upper arm circumference v. weight-for-height Z-score for predicting mortality in hospitalized children under 5 years of age", Cambridge University Press, Retrieved April 2016, pp 2513–2520.

4. Md. Thoufiq Zumma et al., (2024) "Early Detection of Childhood Malnutrition Using Survey Data and Machine Learning Approaches", Retrieved May 2024.

5. Fikrewold H Bitew et al., (2021) "Machine learning algorithms for predicting undernutrition among children under five in Ethiopia using machine learning (ML) algorithms", Public Health Nutrition, Retrieved October 2021, pp 1-29.

6. Kadam, N., Dabhade, V., Baravkar, R., Saravade, V., Mankar, C. (2019). "Detect Malnutrition in Underage Children by using TensorFlow Algorithm of Artificial Intelligence", International Research Journal of Engineering and Technology (IRJET) Vol. 06, Issue 12, Retrieved Dec 2019.

7. Dezhi, X, Gamage Upeksha Ganegoda" Rule Based Classification to Detect Malnutrition in Children", International Journal on Computer Science and Engineering, Vol. 11 January 2011.

8. Mrs. Snitha Shetty[1*], Lavita Gloria Lobo[2], Monisha D[3], Nidhi K, Sanjana Shetty (2021)" A Survey on Detection and Diagnose of Malnutrition ", Ijraset Journal for Research in Applied Science and Engineering Technology, Retrieved May 2022, pp 2321-9653.

9. Prof. Kirti Y. Digholkar, Sonali Khadase, Shraddha Sonekar, Pooja Darade," Malnutrition Detection using Deep Learning and Machine Learning", International Engineering Research Journal (IERJ), Volume 3, Issue 4 Page 6539-6541, retrieved February 2021

10. Sangita Khare1, S Kavyashree1, Deepa Gupta2*, Amalendu Jyotishi2(2017) Investigation of "Nutritional Status of Children based on Machine Learning Techniques using Indian Demographic and Health Survey Data, Procedia Computer Science", Retrieved 22- 24 August 2017, pp 338-349

11. Omer F Beser, Fugen Cullu Cokugras, Tulay Erkan, Tufan Kutlu, Rasit V Yagci "Evaluation of malnutrition development risk in hospitalized children Nutrition "Volume 48, Retrieved April 2018, Pages 4- 40.