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ENHANCED DEEP LEARNING MODEL FOR PREDICTING CHILD MALNUTRITION UNDER AGEFIVE USING CONVOLUTIONAL NEURAL NETWORK

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ABSTRACT:

The model for predicting child malnutrition status used various deep learning methods in an existing work. The data set features are directly applied into the model and capturedvalues for different outcome metrics such as Accuracy, Precision,recall and F1-Score.The outcome of metrics values are not meet the expected results. In the existing model, used fuzzy logic values (True, false) for all attributes. In the proposed work using Neutron sophism set domain which is used to solve the uncertainty issues in result prediction. The Neutrosophicset contains three components such as True, Indeterminacy and Falsevalue (T, I, F). The uncertainty issue is the biggest challenges in medical data analysis.In this proposed model each features converted into Neutrosophic values (T, I, F)then implement the convolutional neural network and using backpropagation algorithm to change the hyper parameter of weight values until the desired result will be achieved.Implementation of all features in the given dataset can leads the model into less accuracy. In this case the next proposed deep learning algorithm of L1 Regularization technique can be used to ranking the importance features which is used to eliminate the irrelevant features to improve the model accuracy.Top ranking features only considered for prediction of the result.After implementation of feature ranking algorithm,optimization algorithm is used to improve the accuracy value. Most swarm optimization algorithm can be implemented in deep learning model to get the better accuracy.In this proposed model using Dove swarm optimization algorithm to improve the accuracy value.In the dove swarm optimization tune the hyper parameter values such as weight and dove values to get the optimum results.

Keywords:
Neutrosophic, Regularization, Optimization, Uncertainty and Ranking

I.INTRODUCTION:

In recent years, malnutrition is a widespread problem in global level. The root cause of child malnutrition varies across the regions in every country because of various impacts like life style, food intake and environmental changes, maternal care and also motherhood care. In this research to predict the malnutrition status using some healthcare factors, socio-economicfactors and anthropometric parameters of preschool age 5 to under10 age of children and clinical sign parameters are considered to predict the best accuracy.

II.PROBLEM DECRIPTION FROM EXISTING WORK:

The existing research work of" A Deep Learning Approach to Predict Malnutrition Status of 0-59 Month's Older Children in Bangladesh" determining the malnutrition status using deep learning mechanism is one of the most powerful scientific ways to deal with. In this exploration, three classes have been trained separately with respect to the data and applied the model based on individual class on the trained data. But it is also possible to merge all the three class as a single class using Multiclass-Multilabel Classification.

In this existing work used ANN with accuracy 84.93%, 67.75%, 63.34% for wasting, underweight and stunting respectively.

In addition, the significant features have been analyzed again using backward elimination method on this predictive model. The feature which are $P<0.5$ (probabilistic value) considering statistically significant features and have a great impact on malnutrition otherwise the features are not a significant impact on malnutrition.

Existing model ANN used (probabilistic value) $p<0.5$ to rank the features.
Proposed model CNN used L1-Regularization method to rank the features.

III. RELATED WORKS

In this research work [1] taken input as speech signal and noisy data with uncertainty has to be trained and produced better result in test phaseby using CNN architecture to classify the data.

Bosc and Pivert [2]named the study as bipolar fuzzy relationswhere each input attribute is associated with pair of degree True and False value.The method of passing input as Neutrosophic value in deep learning architecture is used to improve the accuracy value by using COVID-19 x-ray dataset [3]. The problem of uncertainty can lead the method with less accuracy. To solve anuncertainty issue used multi criteria decision making in the study [4]. In this study to address the uncertainty, the decision maker used Neutrosophic set which include five different criteria for each patient to identify which type of malnutrition mostly occurred.

The Neutrosophic logic [5] can be used in more real time applications of medical diagnosis to solve the problem in disease prediction.neutrosophic logic used in survey analysis in social sciences [6] used Neutrosophic degree value True, Indeterminacy and False value to get the better accuracy. The study [7] found the most reasonable factor for causing malnutrition problem.The study [8] has proved that the Neutrosophic convolution neural network produced better result compared with convolutional neural network. The most of the medical dataset contains the data with vague,missing and inconsistent value and produced less accuracy in prediction. So, solve this inconsistent problem used Neutrosophic set logic to deal each attribute with True, Indeterminacy and False value [9]. The study [10] hasproposed the method of median filter to decrease indeterminacy value by using Neutrosophic logic.

Yin et al. [11] has used tree based machine learning model to identify the malnutrition in cancer patient. In this model took the pretreatment variables in decision tree model and finally found that the decision tree algorithm mostly used to predict the malnutrition.

The study [12] was used deep learning model to predict the child malnutrition under the age five. Here used Bangladesh Demographic and Health Survey 2014 that include the features such as Height-for-age z-score(HAZ), weight-for-age-zscore(WAZ) and weight-for-height-score(WHZ) for identify the malnutrition category of stunting, wasting and under weight. The data pre processing techniques used to remove the string and noisy data from the given n dataset. This study found that the tensor flow model is produced better result in child malnutritionprediction.

The model [13] was used AlexNet and Transfer learning to classify the given malnutrition dataset by using epochs, learning rate and mini batch value as inputwith the help of re-sized function to resize the images for adapted into the model.

The implementation of image processing and machine learning model [14] was used to prediction of BMI from facial images. In this model calculated obesity value by analyze the body weight and BMI value by using 50-layers residual network architecture to identify the malnutrition affected people.

The nature-inspired optimization paradigm with Moth-Flame optimization [15] was used to optimize the given data and identify the behaviour of humpback whales. Theparticle swarm optimization [16] algorithm was used to solve the optimization problem by using iterative operations.

The set-based particle swarm optimization framework [17] was extending the particle swarm optimization by redefine the structure in PSO for utilize the set operations. The study [18] proposed the model of feed-forward neural network to prove that purity value compared with convolutional back-propagation algorithm. The Generalized ant Colony algorithm [19] was proposed algorithm to optimizes the cloud resource allocation problem and produce the better results with unknown search spaces.Ant colony optimizationtechniques [20] was proposed to identify paths while food searching.

IV.PROPOSED WORK:

Phase 1:

The uncertainty issues can lead the solution in poorattaints.To resolve the uncertainty in child malnutrition prediction by enhancing deep learning model. The mathematical fuzzy set contains two degrees (True or False), the uncertainty cannot be resolved in implementation of fuzzy logic. Recently most of the applications considered uncertainty data point in classification. In this proposed model used neutrosophic set to solve the uncertainty issues with the help of True, Indeterminacy and False degree values.This model used Back propagation algorithm for train a model

a. Backpropagation Algorithm Implementation

Supervised Learning: Back propation is a supervised learning algorithm used for training artificial neural networks.
Objective: To minimize the error.
Feedforward Pass: To calculate the output.
Backward Pass: To update the weights based on the error gradient.
Error Calculation: Calculate the error between expected and actual output.
Gradient Descent: It uses gradient descent optimization to adjust weights.
Chain Rule:Calculate the gradients of the loss function with weight in each layer.
Activation Functions: ReLU activation function is used to calculate gradient descent value.
Learning Rate: It determines the weight in each iteration.
Phase 2:
Feature Selection:

Applied all features into the model can lead the model with less accuracy. In this proposed model use feature selection techniques to select the relevant features using feature selection method. Various feature methods are available like filter methods, wrapper methods and embedded methods. In this proposed work using embedded model for feature selection. Embedded model used Embedded methods using the techniques of regularization. This approach of feature selection uses Lasso (L1 Regularization). In this method, penalty is applied to the coefficients, and bringing down some coefficient to zero. Finally, what are all the features having zero coefficient, that can be removed from dataset.

Phase 3:

In this phase of work using optimization techniques to improve the accuracy value. Recently more optimization algorithms can be involved in solving the problems. But the results of DSO perform the best in time efficiency. Compared to other optimization algorithms, the DSO is inneed a time efficiency and it is an effective algorithm in solving optimization problems.While training the deep learning optimizers model, modify each epoch's weights and minimize the loss function. An optimizer is a function or an algorithm that adjusts the attributes of the neural network, such as weights and learning rates. Thus, it helps in reducing the overall loss and improving accuracy.

Classification Performance Analysis:

Table 1. The confusion matrix has four expected outcomes as follows.

True Positive (TP) is a number of anomalies and has been identified with the right diagnosis. True Negative (TN) is an incorrectly measured number of regular instances. False Positive (FP) is a collection of regular instances that are classified as an anomaly diagnosis FP. False Negative (FN) is a list of anomalies observed as an ordinary diagnosis.

Table1.Confusion Matrix.

	PredictedPositive	**PredictedNegative**
ActualPositive	TruePositive(TP)	FalseNegative(FN)
ActualNegative	FalsePositive(FP)	TrueNegative(TN)

Accuracy: Accuracy is the most important metric for the results of our deep learning classifiers, as given in (1).

Accuracy (%)=TP+TN / (TP+FP+TN+FN) -----> (1)

Table 2 represents comparison of Accuracy metrics with four proposed model of CNN, BNCNN, FBNCNN and OFBNCNN.

V. RESULTS:

MODEL/ METRICS	CNN	BNCNN	FBNCNN	OFBNCNN
ACCURACY	87.44%	93.42%	95.47%	98.09%

Table 2. Comparison of Accuracy with four model

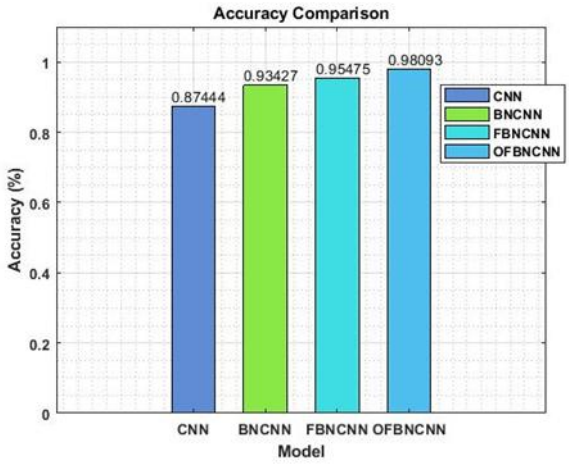

Fig. 1 Accuracy Comparison between four models.

Fig 1.represent that the AccuracyMetrics Comparison with Conventional Neural Network, Bipolar Neutrosophic Conventional Neural Network, Feature Weighted Bipolar Neutrosophic Convolutional Neural network and Optimized Feature Weighted Bipolar Neutrosophic Convolutional Neural network.

VI. DATASET DESCRIPTION:

To predict child malnutrition status, a comprehensive set of attributes is needed, capturing various factors contributing to malnutrition. These attributes can be grouped into anthropometric, dietary, socio-economic, health-related, and environmental categories. Below are the commonly used attributes:

Child age, weight, height

- Height-for-age (HAZ): Indicates stunting (chronic malnutrition).
- Weight-for-age (WAZ): Indicates underweight (general malnutrition).
- Weight-for-height (WHZ): Indicates wasting (acute malnutrition).
- Mid-upper arm circumference (MUAC): A quick indicator of malnutrition.
- Body Mass Index (BMI): For age-specific nutritional assessment.
- Head circumference (for infants): Measures brain growth and development.
- Daily calorie intake: Total energy consumption.
- Protein intake: Quantity of protein consumed daily.
- Micronutrient intake: Consumption of iron, zinc, iodine, vitamin A, etc.
- Parental education level: Especially the mother's education.
- Employment status of parents: Determines financial stability.
- Birth spacing: Short intervals may increase malnutrition risk.
- Community health services: Availability of support programs.
- Breastfeeding status:
- Exclusive breastfeeding duration.
- Current breastfeeding status.
- Haemoglobin levels: To detect anemia.
- Immunization status: Vaccination records.
- Birth weight: Low birth weight is a risk factor for malnutrition.

- Household income: Financial resources available for food and healthcare.
- Household food security: Availability of food at home.
- Maternal BMI (Body Mass Index): Nutritional status of the mother.
- Maternal haemoglobin levels: Indicator of maternal anemia.
- Age of the mother at childbirth.
- Vitamin A
- Vitamin D
- Vitamin B Complex
- Out of 27 features the 7 features (Parental education level, Employment status of parents, Birth spacing, Community health services, Household income, Household food security and Age of the mother at childbirth.) are having the weight related with zero values. So, these 7 features are irrelevant to make a prediction. Remaining non-zero value features, providing a ranked list of feature importance.

VII. CONCLUSION AND FUTURE ENHANCEMENT

The process of proposed model using Neutrosophic convolution neural network Truth Membership (T): The degree to which an element belongs to the set.Indeterminacy Membership (I): The degree of uncertainty or indeterminacy. Falsity Membership (F): The degree to which an element does not belong to the set. Each attribute or feature in the dataset is expressed as a triplet (T, I, F), where $T+I+F \leq 1$.After normalization technique, Transform each feature x into a Neutrosophic triplet (T,I,F).Here uncertainty issues can be resolved through Neutrosophic logic set. Import all features from the dataset can lead the model into poor accuracy so improve the model performance using feature selection algorithm. In feature selection algorithm using L1 Regularization techniques to eliminate the irrelevant features which the weight value close to zero. The optimization techniques of dove swarm optimization can be proposed here to improve the accuracy. In the optimization techniques, weight and bias can be updated for each dove to get better results. In the proposed model get the accuracy of 87.44% in CNN, 93.42% in BNCNN, 95.47% in FBNCNN and 98.09% in OFBNCNN.Finally, the dove swarm optimization produced better accuracy compared with another model.

In future implement the method to identify the most significant factors of causing child malnutrition with analyze of real dataset of child under age five.

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