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Research Article

Predictive Analysis of Monitoring System to Enhance Crop Yield using LSTM Deep Learning Technique

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Abstract

Farming is the back bone of agriculture where there is lot of challenges faced by farmers. When agriculture deals with the various steps as per methodologies for increasing productivity such as testing the soil type, seed sowing, irrigation and so on, the process takes a several attention to regularize the growth in better manner such as development of planting, protection for fertilizing etc. A prediction system utilizing a deep learning technique is proposed with multilayer perceptron (MLP) for classification prediction and also from observations of soil type to increase the dimensionality. The benefit of using the deep learning technique Long-short term memory (LSTM) is to maintain the observation during the rate of learning which has the mapping relationship to avoid the indirect mapping of features during sequence connection from agriculture dataset. Based on the interrelationship between the previous knowledge that has trained from the aspects of soil quality, the system predicts the plan propagation. The accuracy level is compared with the CNN technique where the natural growing of crops is increased based on the planting after the germination. LSTM extracts features, as number of values can be mentioned for input and avoids single step classification during the training of data.

***Keywords**:* MLP, LSTM, Agriculture, CNN, Prediction, feature extraction, soil.

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1. Introduction

Among the various works carried in the field of deep learning, research works are being focused towards many methodologies. These techniques help people in understanding the knowledge of work carried out in this research domain [1]. Both enterprises as well as researchers in the field of biomedical are being benefitted at the same time. Smart farming [2] [3] helps in handling the

issues pertaining to production in agriculture such as production rate, impact due to environment as well as sustainability. Due to increase in population, production of food also keeps on increasing to maintain availability as well as food quality [4]. In order to achieve these, various sustainable methods needs to be used in farming.

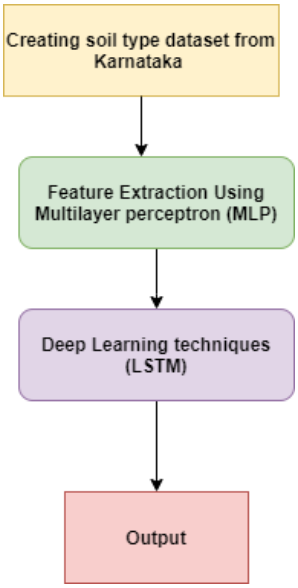

Figure 1: Process of Feature Extraction using MLP and LSTM

The ecosystems in agriculture have to be understood clearly by means of monitoring as well as analysis of several phenomena [5]. ICT methods are also used while managing farms which may either be large in size of smaller in size [6]. The management also depends on the data obtained from satellites or drones that provide wider view of the agricultural locations in detail [7]. This methods has several benefits while collecting data about these geographical regions.

Remote sensing data contains large volume of images in it. In the domain of agriculture, analyzing the images became one of the most important area for research [8]. Several techniques available for analysis of images include classification, detecting anomalies and so on. Among the methods available for sensing the data, remote sensing is based on satellite images along with hyperspectral imaging [9]. SAR stands for Synthetic Aperture Radar along with NIR camera [10] are being utilized in larger numbers. Analysis of images is also performed by machine learning methods such as K-means [11] or Support Vector Machine and so on. Other methods include regression analysis, polarization and more.

Recent researchers are much attracted towards deep learning which belongs to the field of machine learning and has more similarities with the Artificial Neural Networks. Here the data is represented in an hierarchical way using several convolution. As a result of this learning abilities increases thereby increasing the performance along with precision also.

The paper is organized as follows, Section 2 deals with Deep Learning and its methods, Section 3 discusses the proposed system, Section 4 explains the results obtained and Section 5 concludes the paper.

2. Deep Learning

The extension of machine learning is deep learning where the model complexity is important and data gets transformed because of representing data in a hierarchical manner. This representation goes through various abstraction levels. Feature learning is one of the main benefit while using deep learning methods. Raw data is analyzed and features are being extracted automatically where the composition of features at the low level together constitute the features at the higher level. Problems that are complex can easily be solved used deep learning methods and also provide parallelization. DL models can reduce the errors along with increasing the accuracy with the help of datasets that are large in size. The components constituting the DL methods as shown in Figure 2. LSTM and MLP are two important models in deep learning.

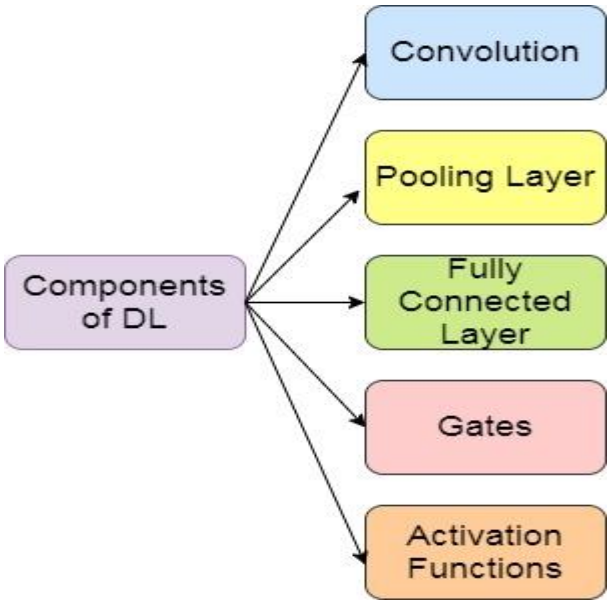

Figure 2. DL components

2.1 Multi Layered Perceptron (MLP)

MLP neural network varies in its structure because of several lags in time and based on these structures, generation of various models is possible. One of the models used frequently in research work includes the feed forward network. It consists of many layers as follows,

a) Input Layer: Inputs of model are being introduced.
b) Intermediate Layer: 0,1 or more in number
c) Output Layer: Trained network results are provided

Based on the problem complexity, the architecture in network gets differentiated by number of layers and neurons that are being hidden. In case of hidden layers, the grid takes the value from 0 to 4. On the other hand, for the hidden neurons values are obtained from the formulas taken. This formula considers the input and output size along with the original size of the sample. Back propagation technique is used for training the neural network in MLP. Propagation of errors is through network and in case of hidden layers they are being adapted. This is used for the process of learning which trains ANN also.

2.2 Long-Short Term Memory (LSTM)

The RNN stands for Recurrent Neural Networks and one of its architecture which is mainly used in time sequence is LSTM. Also dependencies that are of long range is yet another feature of LSTM. Memory blocks are being introduced towards the layer that is hidden and the temporal state is being stored here for the network. Gates that are available in the network are the units that take care of the information flow. Forget gate was incorporated for the purpose of controlling the flows in case of input that is not further divided as segments. Peephole connection is found among the cells that are internal and with the gates. This helps in better understanding of the time taken for the production of outputs.

2.3 Dataset

There are quantities which vary according to the fertility measurement and the photosynthesis plays the importance to maintain these levels from various villages, Karnataka district, Tamil Nadu.

As OC are in need of high percentage and total measurement differs according to the threshold values other patterns can be analyzed. To apply logistic regression indirectly based on the features N_2O that has to be in high and also prefers for development of crop, human activities and so on. According to climatic changes and temperature the soil fertility shows interest on P_2O_5. These classification takes the required consistent input for pattern mapping as hidden layers are equally depends on feature for MLP neural network. Table 1. Have features for showing the multiple perceptron that have time delay due to its range and hidden layers are also based on tanh activation function.

Table 1 : Parameters used to elaborate the Multilayer perceptron(Neural Network) - soil type model

Features	Limit	Parameters	Range
time delay in feedback	1 to 3	multiple neuron	1 to 10
No.of hidden layers	1 to 3	Activation	tanh

Table 2.shows the features according to the hidden units and the delay rate caused by its rate of understanding the pattern from the three different classes. Due to underfitting of features the drop time also monitored and used with the formulation deep learning technique as logistic regression (LR).

Table 2: Parameters used to elaborate the LSTM – soil type model

Features	Limit	Parameters	Range
Hidden units	1 to 900	understanding drop time	1 to 40
Learning rate	0.001 to 0.004	Formulating	Logistic Regression (LR)

3. Proposed System

We have used dataset from Karnataka state(India) as the period of 2019-2020 and input has been Based on The classification issues for soil features which are grouped in the present work such as soil OC,P_2O_5,pH and K_2O. The terms to understand the predictive analysis for scheduling is to use classifier based on the parameters using tanh classifier. According to the economy form the Karnataka for soil type such as loamy soil and sandy soil for fertilizing and farming to increase the productivity. During the year 2019 to 2020 the maximum consumption of seeds based on agriculture is been increased as the proportion also increased. When the Forecasting along with production using the multilayer perceptron and long short term memory neural network for importance of accuracy. When there is high accurate prediction modeling which are gradually changes according to the variation of sustainability.

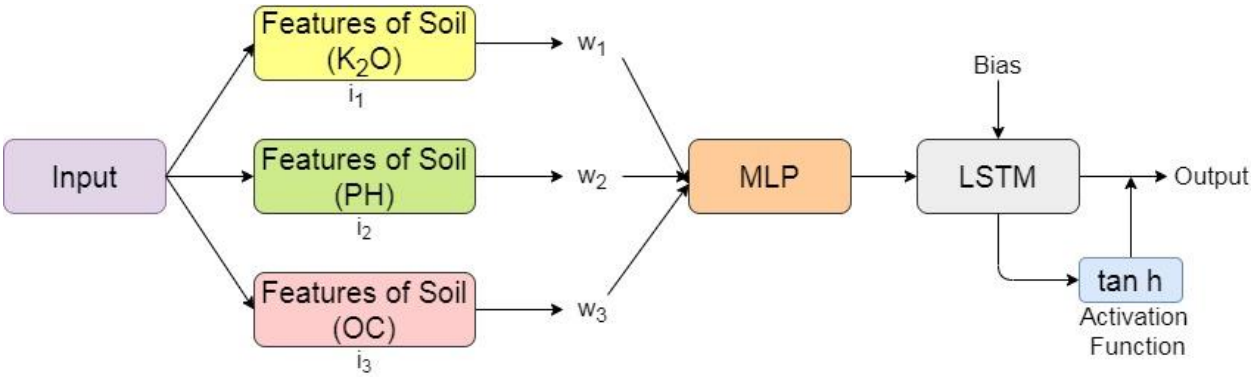

Figure 2: Proposed system for predicting crop yield cultivation using deep learning techniques

The proposed method which looks into the soil type for the year 2019-2020 which takes the dataset that was obtained from agriculture situated in Karnataka. Based on the privileges we considered the dataset as two subsets. The top subset which has data that can be implemented for training the prediction models MLP, LSTM. The bottom subset consisting of remaining data that implemented from 2020 for validating process.

Since the data contains the pH level of soil,K2O, P2O5 that are define as fertility indices and set of various classes are used to predict the soil type. As the data has been extracted from the soil dataset resulting from the various aspects training, testing and validation has to monitored and updated. Based on the comparison of mean square error and improved results from root mean the predicted results can be compared as actual gives the sample representation in slower due to many hidden layers.

4. Results and Discussion

Number of features according to the pattern per class from the subset is classified. These labels from the features are according to the need of farming based on the seeds. When the problem changes its pattern and analyzed the classes based on three types of results for each patterns namely shallow, average and high. There are nutrients that help for fertilization depending on the OC (90%-92%) that provides the healthy nature for soil. As the activities which made ecosystem dependency of growing crops, classes along with patterns are monitored.

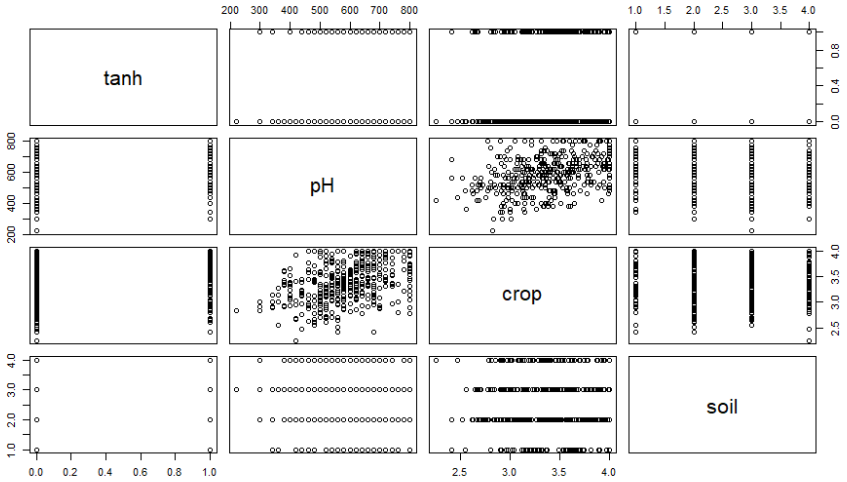

Figure 3. Intervals based on tanh classifier

List of patterns and the input which takes sequence order and the results from trained LSTM can find the irrigation modeling along with the ecosystem, Based on RMSE and MSE the consistent multilayer are tested for its accuracy level according to the subsets previously determined. When the structure relies on the gate used on the weight that gets from the input layers and forget gate interconnected based on the bias get variant.

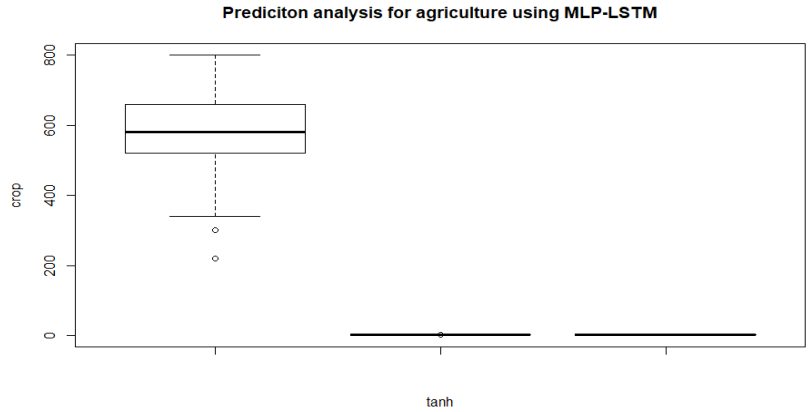

Figure 4. Crop yield using feature extraction using LSTM

During the pattern usage for high class we gets the result of 92 accuracy rate and less mean square rate as better results compared with the existing results. When there is shorter interval that remains less changes and the improved values according to the regular update which maintains the bias to develop the adequate knowledge on basis of soil type pH values and pattern matched.

5. Conclusion

Necessary analysis for balancing the nutrients and need of soil type selection based on the farming time has been identified by deep learning techniques. Even though Machine learning gives the accurate rate of learning rate based on many techniques there is less productivity

according to the ratio using the cultivation samples. We proposed the Multilayer perceptron neural network and also to increase the growth of parameters for fertility we used LSTM method also. According to the hidden units and increasing activation function tanh classifier gives more accuracy of 92% compared to sigmoid classifier. In the approach there have various ecosystem dependency interactive which helps to improve the agriculture.

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