National Conference on
"Role of Engineers in Nation Building" organized by VIVA Institute of Technology, Mumbai
(6th and 7th March 2020)
International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March-2020]

Survey on IOT Based Smart Cultivation: A Crop Recommendation System

Aditya Joshi[1], Aakash Sugdare[2], Shivam Patil[3], Prof. Saniket Kudoo[4]

[1]Department of CSE, MUMBAI University, MUMBAI-32
Email: adityajoshi612@gmail.com
[2]Department of CSE, MUMBAI University, MUMBAI-32
Email: aakashsugdare01@gmail.com
[3]Department of CSE, MUMBAI University, MUMBAI-32
Email: patilshivam945@gmail.com
[4]Department of CSE, MUMBAI University, MUMBAI-s32
Email: saniketkudoo@gmail.com

Abstract*—Agriculture plays a very crucial role in the economy and employment, especially in India. Each year many crops get damaged due to a lack of optimal climatic conditions to support crop growth. The common problem existing among the Indian farmers is that they sometimes don't choose the right crop based on their soil and environmental conditions. They follow old farming techniques without realizing the fact that crop output is dependent on the present conditions such as present-day weather and soil conditions. Due to this, the farmers face a serious setback in productivity. Hence, the proposed system for recommending crops which will be cost effective as well as very efficient, will make use of Crop data, soil related data and environmental related data which will be collected from various sources. An optical transducer will be used to measure and detect the presence of Nitrogen (N), Phosphorus (P) and Potassium (K) of soil.*

Keywords—Agriculture, Cloud, Crop, Environment, Farmer, IOT, ML, Sensors

I. INTRODUCTION

[1]India is a country where agriculture and related industries are the major source of living for the people. Agriculture is a major source of economy of the country. About 50% of India's population depends on farming. Different types of crops are cultivated in various parts of India due to different climatic conditions of different parts of the country, fertilizer capacity of land, the size of the lands, different soil conditions[1]. The crop production depends on whether condition (e.g. temperature, rainfall, humidity) & soil characteristics of a particular region. Farmers sometimes may not choose the right crop for the present condition and due to this the farmer lose important production of crops. They still rely on intuition and previous knowledge for selecting crops. The proposed crop recommendation system helps in selecting right crop for a particular condition. Hence, the proposed system for recommending crops uses crop specific characteristics along with soil and environmental conditions and predicts the crop for a particular area and for a specific month using machine learning and IOT. The proposed system will give accurate suggestions for crops to be grown which will enhance the production in an agricultural field. Ensemble technique is used which combines the output of multiple learners on same data to give an accurate final prediction. [2]Various sensors are used which collect data in real time about parameters that include pH value of soil, moisture, temperature, Nitrogen Phosphorus and Potassium (NPK) levels in the soil and also the moisture level[2]. These collected values are then sent to machine learning algorithms which are trained for giving accurate crop prediction.

II. LITERATURE REVIEW

R. Varghese et.al. [1], describes the proposed system will estimate the amount of water present in the soil in real time, detect the humidity level and temperature using different sensors.It uses cloud for predicting future conditions by applying machine learning algorithms to past data

International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March-2020]

M.Masrie et.al. [2], an optical transducer is developed to measure and to detect the presence of Nitrogen (N), Phosphorus (P) and Potassium (K) of soil. It contains three LED's and photodiode sensor as a light detector. Nutrients present in the soil absorbs light from LED's and photodiode sensor convert remaining light as a reflector. The system uses Arduino Microcontroller which converts the output into the digital display. It gives output as High, Medium or Low.

Suhas et.al. [3], here the proposed system predicts the rice crop yield for a particular year for a particular area using the regression techniques. The proposed system uses a multiple linear regression model and the decision tree regression model to predict the crop yield. Various parameters like water Evo transpiration, temperature, previous year yield etc. are used to train the machine learning model. Once the model is trained, it will predict the rice crop yield for that particular area.

Divya J et.al. [4], different types of sensors like pH sensor, temperature sensor and humidity sensor has been used to test the soil conditions. Depending on the results farmer can cultivate the suitable crop according to the soil conditions. The values which are obtained through the sensors are sent to the administrator through the Wi-Fi and through the mobile application the suitable crops are given to the farmers based on the soil conditions. Automatic irrigation system getsstarted, if the current soil temperature is high. Using the web camera, image is capture and it is sent to the administratorfor suggesting the pesticides for the disease of the crop.

Y. Gandge et.al. [13], different types of data mining methods are used for prediction of crop yield. The accuracy of the crop yield prediction depends on how accurately the features of the soil have been extracted from the large amount of dataset. Various algorithms/models have been used to predict the crop yield like Decision tree, SVM, etc. In this paper, the algorithms/models have been applied on only historical data, the improvement can be done in this field using the different types of sensors.

Z. Doshi et.al. [14], Most of the farmers follows ancestral farming patterns and norms withoutknowing the fact that good yield of crop depends upon the present environmental and soilconditions. This paper tries to help the Indian farmers to take the correct decision about the best crop which can be grow according to the sowing season, geographical location of the farm, soil conditions as well as environmental conditions.

M. Mokarrama et.al. [11], the system agro-ecological and climate data at upazila level. Systemfirst defects the user's location, then it selects some top upazilas and recommends some top cropswhich can be grown in that specific upazilas. Architecture of this system consists of fourmodules 1) Location detection module, 2) Data analysis and storage module, 3) Similar locationdetection module, 4) Recommendation generation module. Location detection module detects thelocation of the user. In data analysis and storage module different information and data hasstored. Similar location detection module identifies top-n similar location with the help of datastorage module and similarity calculation algorithm. Finally, on the basis of top–n location, top-kcrops are recommended for that particular area.

D. Pudumalar et.al. [9], in agricultural field, Data mining is used for analyzing the different biotic andabiotic conditions. The problem of not choosing best crop can lead to a serious loss in productivity.This problem can be resolved using precision agriculture. Precision agriculture is a newtechnique of farmingwhich uses research data of different soil parameters and suggests the right crop to the farmers. Thiscan be used to reduce the wrong choice of a crop and can be helps to increase the productivity and net worth. This problem is solvedby proposing a suggestion system through an ensemble technique with majority votingtechnique using different types of machine learning algorithms like Random tree, CHAID, K-Nearest Neighbor and Naive Bayes torecommend a crop for that specific area with high accuracy and efficiency.

S. Rahman et.al. [5], Machine learning is an emerging and challenging field in Agriculture. Inthis paper, the proposed system predicts soil series with land type and based on predictions thesystem will suggest suitable crops in that specific type of the soil. Various types of machine learningalgorithms like weighted k-Nearest Neighbor (k-NN), Bagged Trees, and Gaussian kernelbased Support Vector Machines (SVM) are used for classification of the soil. Experimental resultsshow that the proposed SVM based method performs better than many existing methods.

International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March-2020]

N. Gandhi et.al. [7], Food production in India is largely dependent on the Rice yield, so itbecame very important to maximize the rice yield prediction in India. Machine learningtechniques can be used to increase the rice yield in India which can help the farmers andother Stakeholders in better decision making in order to increase the net worth. This paper usesWEKA tool on the dataset of 27 districts of Maharashtra state, India for predictions. Theproposed system used various parameters like precipitation, minimum temperature, averagetemperature, maximum temperature and reference crop evapotranspiration, area, production.

R. Kumar et.al. [6], Many researchers predict the yield of crop depending on the soil conditions,climatic conditions, etc. But if there is more than one option to cultivate a crop at a time forlimited land resources, then selection of crop is difficult. Theproposed system can be used to solve problem of selecting a right crop named Crop Selection Method (CSM) in order to increase the net yieldrate of crop and subsequently it helps to increase the economic growth of the country. Theproposed system uses different machine learning algorithms like Artificial Neural Network(ANN), Support Vector Machine (SVM), Gradient Boosted Decision Tree (GBDT), etc.

A. Araby et.al. [8], The Internet of Things (IoT) and cloud is going to be the future of many industries. It canalso be useful in Agriculture field. The cloud computing is the home and destination of the data which addsintelligence for precision agriculture. In this paper, the proposed system uses sensing network togather the data of crops, then fed the data into machine learning algorithm to get the output.Various sensors have been used to sense the soil conditions like humidity sensor, moisturesensor, etc.

R. Rajak et.al. [10], Because of not choosing proper crop based on their soil necessities theproductivity gets affected. This issue can be resolved using precision agriculture technique. This technique isdifferentiated by the soil database collected from the farmer's farm, crop database provided by agricultural experts,achieving the values of parameters such as soil form soil testing lab dataset. The proposed systemuses ensemble model using Support Vector Machine (SVM) and Artificial Neural Network(ANN) as learners to predict crop yield.

M. Paul et.al. [12], for some previous years, the crop yield prediction had been implemented by considering the farmer'sprevious experience for a particular site and a crop. But sometimes the farmers prediction could be wrong, sothe productivity could be decreased. The proposed system helps for the proper selection of cropsfor cultivation. The system uses data mining techniques to predict the category of the soil dataset. The system make use ofvarious types of machine learning algorithms like Naive Bayesand K-Nearest Neighbor for prediction.

III. ANALYSIS TABLE

Sr. No.	Title	Advantages	Disadvantages	Technology Used	Accuracy
1	Soil Classification using Machine Learning Methods and Crop Suggestion Based on Soil Series[5]	The proposed system predicts soil series and provides suitable crop yield suggestion for that specific soil.	Sometimes class imbalance problem occurs	Several ML algorithms are used such as K-NN, Bagged Trees & SVM	92.93%
2	Crop Selection Method to Maximize Crop Yield Rate using Machine Learning Technique[6]	It solves crop selection problem and improve net yield rate of crops	Accuracy is not up to the mark.	Random Forest, ANN, SVM,K-NN, GBDT, Decision Tree Learning	Accuracy depends on predicted value of influenced parameters.

International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March-2020]

3	Rice Crop Yield Prediction in India using Support Vector Machines[7]	Greater crop productivity &decrease the loss due to unsuitable conditions	It's difficult for farmers to Remain productive and sustainable with changing climates.	Support vector machine (SVM) &WEKA	78.76%
4	Smart IoT Monitoring System for Agriculture with Predictive Analysis[8]	MQTT protocol is used for communication between sensors and cloud.	High cost of components.	IoT and Machine learning algorithm like SVM	99.7%
5	Crop Recommendation System for Precision Agriculture[9]	It increases productivity and acquire profit.	Less number of features are used.	Voting technique, Random tree, CHAID, K-NN & Naïve Bayes	88%
6	Crop Recommendation System to Maximize Crop Yield using Machine Learning Technique[10]	It helps farmers to increase the productivity & prevent soil degradation in cultivated land.	Size of dataset is small.	SVM, Naïve Bayes, Multi-layer Perceptron (ANN), Random forest	-
7	RSF:A recommendation system for farmers[11]	The system works with different agro-ecological and agro-climatic data, utilizing the seasonal information.	Not all sub-regions are covered.	Variety of databases such as crop growing period, thermal zone, physiographic and seasonal.	80%
8	Analysis of Soil Behavior and Prediction of Crop Yield using Data Mining Approach[12]	RapidMiner 5.3 is used which provides an integrated environment for ML, data mining and predictive analysis, etc.	The proposed system uses small dataset.	Naive Bayes and K-Nearest Neighbor methods are used.	-

IV. CONCLUSION

The system makes use of Machine Learning along with IOT. Based on soil and environmental characteristics along with crop specific condition requirements, the system predicts the crop which is suitable to grown in that area. The Ensemble technique used, can combine different machine learning algorithms and produce one predictive model. The model also fetches the levels of NPK (Nitrogen, Phosphorus and Potassium)from the soil using optical transducer. If present conditions of the selected region are not suitable for a specific crop, then the system will inform the farmer about the crop specific conditions which should to be met for cultivating that particular crop.The system will solve the right crop selection problem and will give maximum profit to the farmers and will also have a positive impact on the economy of the agriculture sector.

ACKNOWLEDGEMENTS

We would like to express a deep sense of gratitude towards our mentor for his constant encouragement and valuable suggestions. The work that we have been able to present is possible because of his timely guidance and support.

International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March-2020]

REFERENCES

[1] R. Varghese and S. Sharma, "Affordable Smart Farming Using IoT and MachineLearning an AI powered cost-effective solution to improve traditional farming", IEEE, 2018.

[2] M. Masrie, M.Syamim, A.Rosman, R. Sam and Z.Janin, "Detection of Nitrogen, Phosphorus, and Potassium (NPK) nutrients of soil using Optical Transducer", IEEE, 2017.

[3] Suhas L, Sangamesh,P. kumar and Supriya B, "Rice crop yield prediction using machine learning techniques", IEEE, 2019.

[4] Divya J,Divya M and Janani V, "IoT based Smart Soil Monitoring System for Agricultural Production", IEEE, 2017.

[5] S. Rahman, K.Mitra and S.M. Islam, "Soil Classification using Machine Learning Methods and Crop Suggestion Based on Soil Series", 21st International Conference of Computer and Information Technology ICCIT, 2018.

[6] R. Kumar, M.P. Singh, P. Kumar and J.P. Singh, "Crop Selection Method to Maximize Crop Yield Rate using Machine Learning Technique", IEEE, 2015.

[7] N. Gandhi, L. Armstrong, O.Petkar and A. Tripathy, "Rice Crop Yield Prediction in India using Support Vector Machines", 13th International Joint Conference on Computer Science and Software Engineering JCSSE, 2016.

[8] A. Araby, M. Elhameed and N.Magdy,"Smart IoT Monitoring System for Agriculture with Predictive Analysis",8th International Conference on Modern Circuits and Systems Technologies MOCAST, 2019.

[9] D. Pudumalar, E.Ramanujam ,R. Rajashreeń and C.Kavyan,"Crop Recommendation System for Precision Agriculture", IEEE, 2016.

[10] R. Rajak, A. Pawarand M.Pendke, "Crop Recommendation System to Maximize Crop Yield using Machine Learning Technique",International Research Journal of Engineering and Technology IRJET, 2017.

[11] M. Mokarramaand M. Arefin,"RSF: A Recommendation System for Farmers", IEEE, 2017.

[12] M. Paul, S. Vishwakarma and A.Verma, "Analysis of Soil Behaviour and Prediction of Crop Yield using Data Mining Approach", IEEE, 2015.

[13] Y.Gandge, Sandhya,"A Study on Various Data Mining Techniques for Crop Yield Prediction", IEEE, 2017.

[14] Z. Doshi, S. Nadkarni, R. Agrawal, N. Shah, "AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms", IEEE, 2018.