International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

Crop Growth Prediction Based on Environmental Factors Using IoT & Machine Learning

Tanvi D. Chaudhari[1], Sujeetkumar Singh[2], Harshada Barve[3], Sakshi Aher[4], Mr. Amol Gosavi[5]

[1, 2,3,4] UG Student, Batchelor of Computer Engineering, MET'S, BKC, IoE, Nasik, India.

[5]Assistant Professor, Department of Computer Engineering, MET'S, BKC, IoE, Nasik, India.

Abstract - Agribusiness growing rapidly day by day. As soil is an important factor in agriculture; Healthy soil is playing an important role in crop yield. Soil fertility level and its parameter measurement is a tedious task for farmers. It becomes challenging for farmers to fulfil the requirement of the living being. Some of the big challenges face by the farmers are Dealing with soil fertility issues as they are cultivating same crop year and year. As soil and its micronutrient is an important factor for agriculture. There are several kinds of soil. Each type of soil can have different kinds of features and different kinds of crops grow on different types of soils. Environmental factors like temperature, rainfall, soil pH and Humidity also affects crop growth.

In the proposed paper We developed a technique with the Internet of Things (IoT) and Machine Learning that enhance the soil problem. Which enhances farmer's position after taking all of these problems into consideration. IoT and Machine learning is a game-changer for the agricultural industry. With the advent of collected data from smart sensors and available standard datasets. We suggest the crop using machine learning algorithms and this precision technique.

Keywords: IoT, rainfall, pH, Humidity, Random Forest, Decision Tree, Machine Learning

1. Introduction

Identification of environmental parameters like temperature, humidity, wetness, and rainfall can be facilitated by integrating IoT with machine learning. The information gathered from smart sensors can be used to forecast crop growth and make fertilizer recommendations. In India, agriculture accounts for more than 60% of employment [3]. Agriculture is the foundation for the Indian economy's growth pace. Farmers and soil testers will find the suggested approach useful for predicting soil conditions and crop health monitoring.

2. Literature Survey

The costly and time-consuming traditional method was utilized to anticipate crop growth and the need for fertilizer. Several machine learning (ML) methods and models are now being utilized to solve categorization and prediction problems. The application of ML approaches also significantly helps professionals in the agriculture field handle their issues. The classification and regression methods are effective for predicting agricultural productivity. These models can be used for estimation, yield mapping, supply and demand matching, and general crop management [2]. Numerous irrigation systems based on IoT and ML have been created for monitoring and control applications. In physical, chemical, and biological activities, the temperature of the soil plays a significant impact. It is pertinent to many other scientific subjects, including soil science, agriculture, hydrology, meteorology, and environmental science [4]. The equilibrium of thermal energy between the atmosphere and the ground surface is influenced by soil temperature. Additionally, it modifies a number of crucial soil processes, including soil ventilation, transpiration and evaporation, plant growth and root development, and microbial activity. Because seeds only germinate at the proper temperature and within a specific temperature range, soil temperature plays a crucial role in agriculture [7]. It is necessary to classify soil by area.

3. Proposed Problem Statement

This paper presents a proposed model for crop growth prediction and fertilizer suggestion using Internet of Things and Machine Learning. With the advent of collected data from smart sensors and available standard datasets.

4. Proposed System Architecture

The architecture of the crop suggestion system contains collecting real-time data for prediction and building the prediction model for Decision Tree and Random Forest algorithm (RFA), a user interface for giving inputs and obtaining suggestions. The flow of the architecture starts from pre-processing. Once the pre-processing is made the dataset is undergone training using the Decision Tree and Random Forest algorithm for generating the crop growth suggestion prediction model. To the generated model test data is given for prediction. During testing the trained model is tested against random input values based on the accuracy rate and error value produced by the prediction model the weights are adjusted. This process is repeated until the error value is

reduced and the accuracy rate is improved. The GUI is used for gathering input from IoT sensors and the user, which is then given to the crop suggestion model for giving precision crop suggestion. The architecture of precision crop suggestion system is shown below in Fig1. involving training, testing, and prediction.

The aim of proposed system is to help farmers to cultivate crop for better yield.

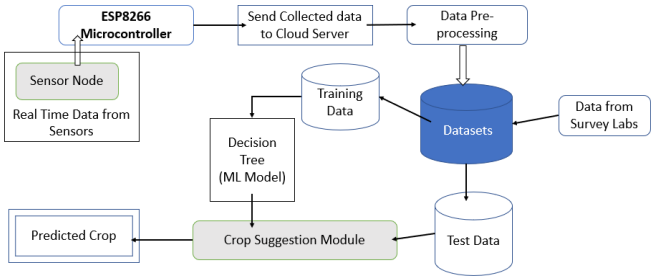

Fig.1. Proposed System Architecture

5. Proposed Methodology

Proposed methodology divided into two main methods, viz. IoT for Data Collection, Machine Learning for Classification and Prediction.

IoT for Data Collection: Firstly, it involves collection of data from the field area. The parameters such as N, P, K, pH, Soil Moisture, Temperature and Humidity are collected from the particular field area. The collected data is then stored and given as input to GUI. The water content in the soil is measured using soil moisture sensor.

Machine Learning for Classification and Prediction: Collected data then stored into database for further machine learning operations Like, Data Preprocessing, Classification, Feature Scaling and Suggestions/Prediction.

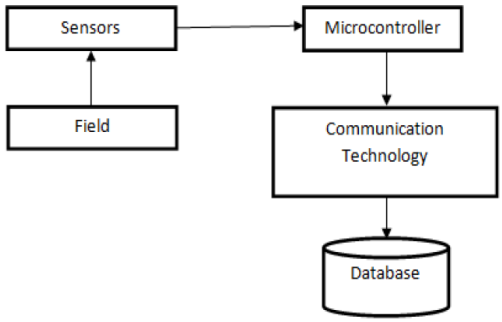

Fig.2 IoT Model for Data Collection

6. Algorithm

Decision Tree Algorithm

Decision Tree is a method for approximating discrete-valued target functions. The learned function is represented by a decision tree. A learned decision tree can also be re-represented as a set of if-then rules. Decision tree learning is one of the most widely used and practical methods for inductive inference. It is robust to noisy data and capable of learning disjunctive expressions. Decision tree learning method searches a completely expressive hypothesis. Avoids the difficulties of restricted hypothesis spaces. Its inductive bias is a preference for small trees over large trees. Decision Tree is a Supervised learning technique that can be used for both classification and Regression problems, but mostly it is preferred for solving Classification problems. It is a tree-structured classifier, where internal nodes represent the features of a dataset, branches represent the decision rules and each leaf node represents the outcome.

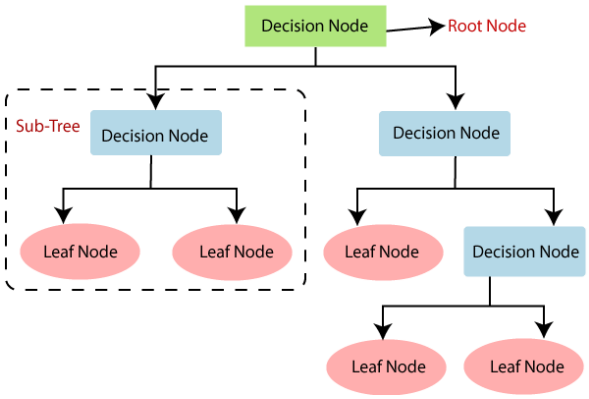

Fig 3: Decision Tree Algorithm.

7. Experimental Setup

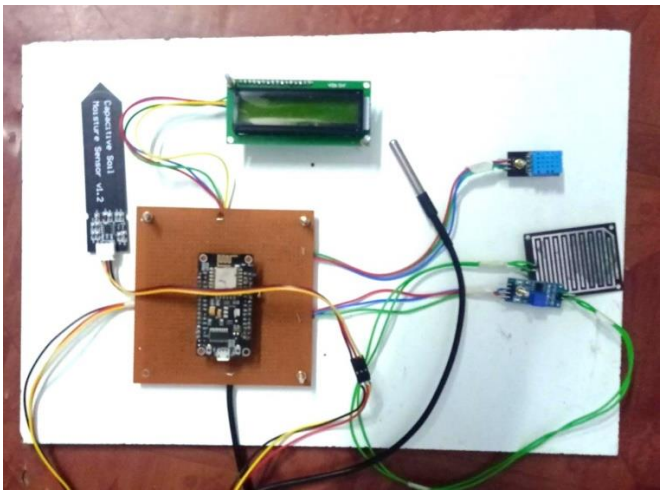

Fig.4 Proposed System Setup

8. Results and Working

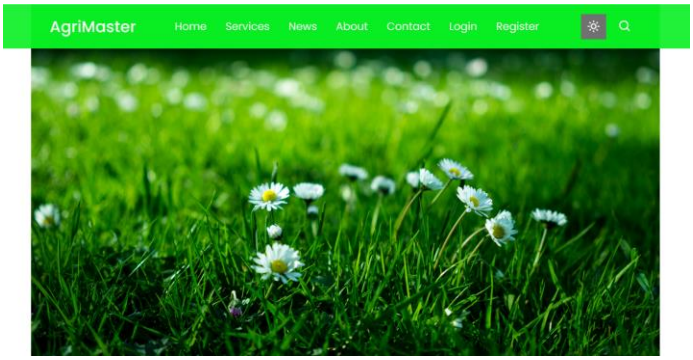

Fig.5. Web Application Home Screen

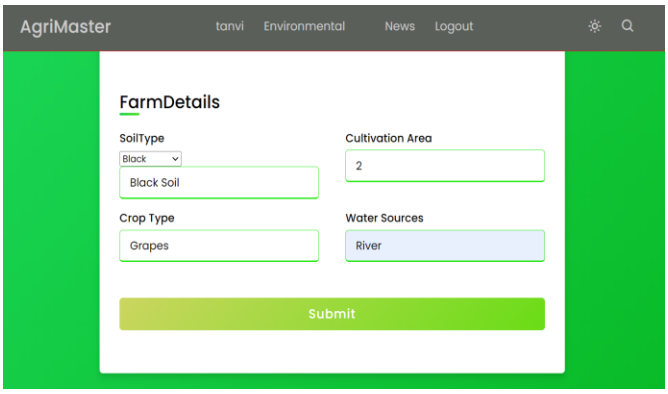

Fig.6. User Dashboard Farm Details

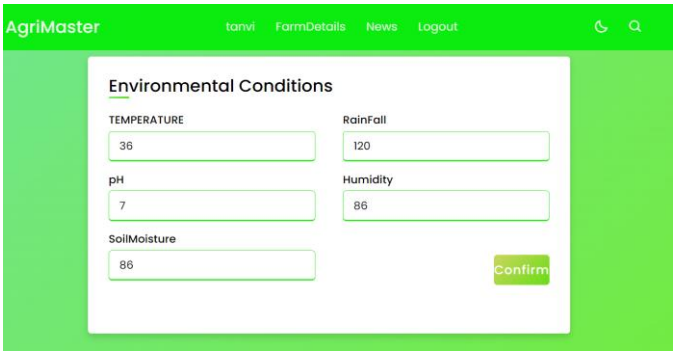

Fig.7. User Dashboard Data Collection

Real-time data Collection:

Data from farm filed collected by smart sensors and stored it into database. In this proposed system we are going to use google firebase for real-time data collection. Google Firebase provides cloud services that can be useful for remote data monitoring and retrieving. In this proposed system real-time data is compared with standard datasets available on Kaggle.

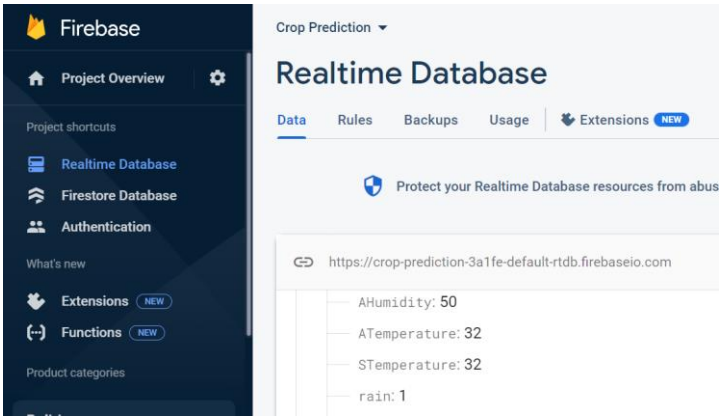

Fig.7. Real-time Data Collection

Conclusion

In this proposed system data collection for soil samples is done by smart sensors, after Appling machine learning algorithms it will produce the expected output in the form of crop suggestion and growth prediction.

REFERENCES

1] IoT-Driven Model for Weather and Soil Conditions Based on Precision Irrigation Using Machine Learning. Dushyant Kumar Singh, Rajeev Sobti , Praveen Kumar Malik , Sachin Shrestha , Pradeep Kumar Singh , and Kayhan Zrar Ghafoor, Research Article, Hindawi Security and Communication Networks Volume 2022, Article ID 7283975, 10 pages https://doi.org/10.1155/2022/7283975.

[2] Machine Learning Algorithm for Soil Analysis and Classification of Micronutrients in IoT-Enabled Automated Farms, T. Blesslin Sheeba, L. D. Vijay Anand , Gunaselvi Manohar, Saravana Selvan , C. Bazil Wilfred, K. Muthukumar, S. Padmavathy, P. Ramesh Kumar, and Belete Tessema Asfaw, Research Article, Hindawi Journal of Nanomaterials Volume 2022, Article ID 5343965, 7 pages https://doi.org/10.1155/2022/5343965

[3] Precision agriculture using IoT data analytics and machine learning Ravesa Akhter , Shabir Ahmad Sofi, Journal of King Saud University – Computer and Information Sciences 34 (2022) 5602–5618

[4] Soil Temperature Prediction Using Convolutional Neural Network Based on Ensemble Empirical Mode Decomposition, HUIBOWEN HAO, FANHUA YU, AND QINGLIANG LI, Received December 13, 2020, accepted December 24, 2020, date of publication December 30, 2020, date of current version January 8, 2021. Digital Object Identifier 10.1109/ACCESS.2020.3048028.

Fig.7. Environmental Condition

[5] Machine Learning Strategy for Soil Nutrients Prediction Using Spectroscopic Method, Janez Trontelj ml. and Olga Chambers, Sensors 2021, 21, 4208. https://doi.org/10.3390/s21124208

[6] Improving the prediction accuracy of soil nutrient classification by optimizing extreme learning machine parameters, M.S. Suchithra, Maya L. Pai, Available at www.sciencedirect.com INFORMATION PROCESSING IN AGRICULTURE 7 (2020) 72– 82

[7] Machine Learning and Soil Humidity Sensing: Signal Strength Approach LEA DUJIĆ RODIĆ, TOMISLAV ŽUPANOVIĆ, TONI PERKOVIĆ, and PETAR ŠOLIĆ (CORRESPONDING AUTHOR), University of Split, Croatia JOEL J. P. C. RODRIGUES, Federal University of Piauí (UFPI), Teresina - PI, Brazil and Instituto de Telecomuni cações, Portugal. Evaluation of California weather-based "smart" irrigation controller programs https://p2infohouse.org/ref/53/52030.pdf, Accessed: 24 Februry, 2020.

[8] Analysis and Prediction of Soil Nutrients pHNPK for Crop using Machine Learning Classifier: A Review. Mrs.Disha S.Wankhede, PhD Research Scholar Alliance University. Research Gate 2020

[9] Prediction Of Soil Quality Using Machine Leaning Techniques, T. Venkat Narayana Rao, INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 8, ISSUE 11, NOVEMBER 2019 ISSN 2277-8616.

[10] Random Forest Algorithm for Soil Fertility Prediction and Grading Using Machine Learning, Keerthan Kumar T G, Shubha C, Sushma S A, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075 (Online), Volume-9 Issue-1, November 2019.

[11] Soil Classification using Machine Learning Methods and Crop Suggestion Based on Soil Series, Sk Al Zaminur Rahman Kaushik Chandra Mitra S.M. Mohidul Islam, 2018 21st International Conference of Computer and Information Technology (ICCIT), 21-23 December, 2018.