

Crop Prediction Using Machine Learning with Internet of Things and Embedded systems

V.Meghana¹, T. Sushmitha², R. Dhanalakshmi³, Dr. S Raj Kumar⁴

UG Scholar^{1,2,3}, Associate Professor⁴

Department of Electronics and Communication Engineering
Malla Reddy Engineering College for Women (Autonomous),
Hyderabad, Telangana-500100,

meghanavobilineni@gmail.com¹, sushmitha11212003@gmail.com²,
dhanurayala2020@gmail.com³, sraj.tce@gmail.com⁴

ABSTRACT

Machine learning applications are having a great impact on the global economy by transforming the data processing method and decision making. Agriculture is one of the fields where the impact is significant, considering the global crisis for food supply. This research investigates the potential benefits of integrating machine learning algorithms in modern agriculture. The main focus of these algorithms is to help optimize crop production and reduce waste through informed decisions regarding planting, watering, and harvesting crops. This paper includes a discussion on the current state of machine learning in agriculture, highlighting key challenges and opportunities, and presents experimental results that demonstrate the impact of changing labels on the accuracy of data analysis algorithms. The findings recommend that by analyzing wide-ranging data collected from farms, incorporating online IoT sensor data that were obtained in a real-time manner, farmers

can make more informed verdicts about factors that affect crop growth. Eventually, integrating these technologies can transform modern agriculture by increasing crop yields while minimizing waste. Fifteen different algorithms have been considered to evaluate the most appropriate algorithms to use in agriculture, and a new feature combination scheme-enhanced algorithm is presented.

INTRODUCTION

Agriculture is a vital element that has a significant role in nourishing the world's growing population. To keep pace with the increasing demand for foodstuffs, farmers need to make the best use of them to reap output while minimizing losses. Forecasting and examining reap growth is a serious part of modern agriculture, and machine learning has become a powerful tool to achieve this goal line. Smart farming, or precision agriculture, is a modern farming conduct that utilizes recent technology to optimize reap production and minimize waste. Smart farming aims to

increase reaper output while minimizing using resources such as water, fertilizer, and energy illustrates IoT and machine learning-based crop analysis and prediction processes. Over the years, numerous elements and technologies have been integrated into the architecture of a smart farm, such as sensing and monitoring systems, Internet of Things (IoT) sensors, data analytics and Artificial Intelligence (AI), precision agriculture techniques, remote monitoring and control, automated systems, livestock management systems, cloud computing and big data storage, energy management, and farm management software, to enhance farming practices and boost productivity. In smart farming, the Internet of Things is considered one of the key contributing technologies used. IoT sensors can be utilized to monitor soil moisture, temperature, and other environmental aspects, and the gathered data from the IoT sensors can be used to define the best time to plant, water, and harvest reaps. By using IoT sensors, farmers can guarantee that the reaps receive the right amount of water and nutrients, which can improve their quality and yield.

LITERATURE REVIEW

The authors in focused on crop prediction and yield by studying soil quality, considering that soil properties have a major effect on crop production. The authors

studied different soil properties, such as NPK (Nitrogen, Phosphorous, Potassium) levels, temperature, rainfall, moisture, PH value, and humidity. Comparative analyses concern three machine learning algorithms: Naive Bayes, Logistic Regression, and Random Forest. Moreover, the authors conducted a comparison between these algorithms concerning accuracy. A crop production model proposed in aims to manage the produced crop using machine learning algorithms to help farmers in developing countries who are still using traditional methods and cannot recognize the correct market value of their products. The proposed system is based on three scenarios; firstly, choosing the best crops based on the farmer's location; secondly, providing guidance on soil preparation; and thirdly, providing the best way of crop marketing from farmer to consumer. The authors applied Support Vector Regression; Voting Regression techniques; Random Forest Regression algorithms; and proper real climate, weather, and soil data.

EXISTING SYSTEM

The traditional methods practiced by people may result in huge wastage of water. Hence, the concept of robotized farming has been developed. The technological advancements began to increase the efficiency of production remarkably thus, making it a reliable

system. The knowledge of properties of soil determines the water supply to be driven in a smart way. In previous system we are using pic micro controller which has no Wi-Fi module and no digital pins

DISADVANTAGES

- IOT and ML application not possible
- Less accuracy.

PROPOSED SYSTEM

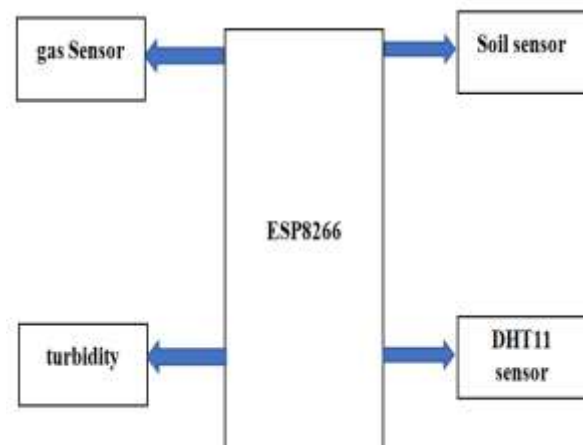
In this work, we used 15 different machine learning algorithms to model agriculture data, which recommend to farmers the most suitable crops to produce on the farm. Tabular data are used in this work for classification of the crop data. Data are collected from the Kaggle database, which is an online platform for scientists to share their research data [58]. The data-set includes several features, such as ratio of Nitrogen content (N), temperature, pH value of the soil, rainfall, humidity, ratio of Phosphorous content (K), and ratio of Potassium content (P) in the soil. The crop prediction data-set has 2200 records, which have 22 crop labels, such as apple, banana, rice, coffee, cotton, black gram, watermelon, chickpea, coconut, grapes, jute, kidney beans, grape, lentil, and orange. The data-set includes several features, such as the ratio of Nitrogen content (N), temperature, pH value of the

soil, rainfall, humidity, ratio of Phosphorous content (K), and the ratio of Potassium content (P) in the soil. Sixty-seven percent of the data is used in training, and the rest of the data are used for testing. shows accuracy values and error rates for the algorithms considered. Bayes Net, Naive Bayes Classifier, Hoeffding Tree, and Random Forest algorithms yield the best accuracy. The DT algorithm yields 88.50%, and the rest of the classification algorithms have more than 90% accuracy.

ADVANTAGES

- we are using NodeMCU microcontroller esp8266 in which Wi-Fi module and for IoT applications.
- We using machine learning for predicting crop production.

BLOCK DIAGRAM



HARDWARE REQUIRED

- DHT11.
- Soil sensor.

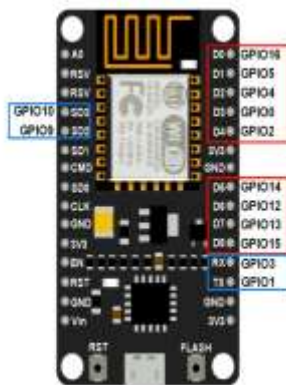
- Turbidity
- Gas
- esp8266

SOFTWARE REQUIRED

Arduino ide

HARDWARE DESCRIPTION

Node MCU.



The **ESP8266** is a very user friendly and low cost device to provide internet connectivity to your projects. The module can work both as a Access point (can create hotpots) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making **Internet of Things** as easy as possible. It can also fetch data from internet using API's hence your project could access any information that is available in the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user friendly.

DHT11 Sensor



DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

Gas Sensor



Ideal sensor for use to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity

combined with a quick response time. The sensor can also sense ISO-butane, propane, LNG and cigarette smoke.

Turbidity



Turbidity is the measure of relative clarity of a liquid. It is an optical characteristic of water and is a measurement of the amount of light that is scattered by material in the water when a light is shined through the water sample.

Soil Sensor



This Dampness Sensor can be utilized to recognize the dampness of soil or judge on the off chance that there is water around the sensor, let the plants in your nursery connect for human assistance. They can be very to utilize, simply embed it into the dirt and afterward read it. With assistance of this sensor, it will be feasible to cause the plant to remind you: Hello, I'm parched now, if it's not too much trouble, give me some

water. This Dampness Sensor utilizes the two tests to go current through the dirt, and afterward it peruses that protection from get the dampness level. More water makes the dirt direct power all the more effectively (less obstruction), while dry soil conducts power inadequately (more opposition).

SOFTWARE DESCRIPTION

Arduino IDE is an easy-to-use Incorporated Improvement Climate custom fitted for programming Arduino microcontroller sheets, offering a clear point of interaction reasonable for fledglings and specialists the same. It works on code composing with highlights like grammar featuring and auto-finish while giving admittance to an immense library of code models and works. It enables seamless code compilation and uploads to a variety of Arduino-compatible boards, fostering a supportive community that shares resources and knowledge and supporting multiple operating systems. With highlights like a library the executives and rendition control mix, Arduino IDE works with proficient venture improvement, customization, and joint effort. Persistently refreshed and improved, it stays a critical instrument for making a wide cluster of electronic ventures, from fundamental models to multifaceted implanted frameworks.

APPLICATIONS

1. Expanded Effectiveness: Upgrade rural practices given information-driven bits of knowledge, boosting yield while limiting asset utilization.
2. Risk Moderation: Early recognition of peculiarities permits proactive measures against dangers like irritations and antagonistic climate, diminishing harvest misfortunes.
3. Improved Independent direction: Admittance to exact yield forecasts work with informed choices, prompting further developed ranch the board and productivity.

CONCLUSION AND FUTURE SCOPE

Our research highlighted the significance of incorporating machine learning algorithms and IoT sensors in modern agriculture to optimize reaping production and reduce waste through informed decision-making. This study identifies the challenges and opportunities associated with integrating these technologies in agriculture. It presents experimental results that demonstrate the impact of changing labels on the accuracy of data analysis algorithms along with accuracy, error values, build, and test time for each classification algorithm. The findings suggest that analyzing wide-ranging data collected from farms, including

real-time data from IoT sensors, can enable farmers to make more informed decisions about factors that affect harvest growth. Despite the challenges associated with deploying machine learning in agriculture, our results achieved so far are very promising in that machine learning approaches will become increasingly crucial for production predictions in agriculture in the future. In this experiment, crops were investigated according to general characteristics using different machine learning algorithms, and valuable results were obtained by making predictions in cases where certain crop types are unknown or cannot be easily identified. Our work indicated that appropriate feature selection is critical to achieve better accuracy in machine learning algorithms while analyzing agricultural data. Using the Temperature, Humidity, pH, and Precipitation features in the dataset, it achieved the highest accuracy, reaching 97.05% with Bayes Net and 97.32% with Random Forest. This research provided valuable insights into the potential benefits of these technologies in modern agriculture, and further research and development in this field could help optimize crop production, reduce waste, and improve food security globally.

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