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Godavari - Krishna Smart Agriculture Using - IoT, Cloud & Machine Learning

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ABSTRACT
The aim of this project is to develop a smart agriculture system that uses IoT, cloud computing, and machine learning algorithms for crop prediction and control. The system includes various sensors such as DHT11 for temperature and humidity, NPK sensor for soil nutrients, pH sensor, and rain gauge sensor to collect input data. The data is then processed using machine learning algorithms such as decision tree, random forest, Support Vector Machine, Gaussian Naive Bayes, and logistic regression to predict the most suitable crop. The collected data is sent to the ThingSpeak cloud platform for further analysis and record keeping. Additionally, the system includes a soil moisture sensor that automatically turns on a water pumping motor through a relay when the moisture level falls below the threshold value and turns it off when the moisture level exceeds the threshold. This project has the potential to increase crop yield and reduce water consumption by providing optimal growing conditions based on the analyzed data.

I. INTRODUCTION

Smart agriculture has emerged as a promising solution to overcome the challenges faced by farmers, such as low crop yield and water wastage. In India, where agriculture is the primary source of livelihood for a significant portion of the population, smart agriculture can play a vital role in enhancing the agricultural productivity of the country. The soil water potential is a critical factor that affects the growth of crops, and it is essential to maintain optimal soil moisture levels for high crop yield.

One of the significant challenges faced by farmers is predicting the most suitable crop to grow based on various environmental factors. Machine learning algorithms such as decision trees, random forests, SVM, Gaussian Naive Bayes, and logistic regression can be used to predict crop yields accurately. These algorithms can be trained on input data from sensors such as DHT 11, NPK, pH, and rainfall to predict the most suitable crop variety.

To implement a smart agriculture system, an IoT-based approach can be adopted, where sensors are used to collect data from the fields. The collected data is sent to a cloud platform, such as Thingspeak, where it is analyzed using machine learning algorithms to predict the crop. In addition, a soil moisture sensor can be used to control the water supply based on the moisture level in the soil, thereby minimizing water wastage.

In conclusion, the use of machine learning algorithms for crop prediction in smart agriculture can significantly benefit farmers by providing them with accurate information to make informed decisions about crop selection. The implementation of such a system can help increase crop yield, minimize water wastage, and ultimately contribute to the sustainable development of agriculture in India.

II. LITERATURE REVIEW

[1] Aashika Premkumar et al. (2018) proposed an IoT-assisted automatic irrigation system using wireless sensor nodes. The system is designed to optimize water usage and reduce human intervention in irrigation. [2] Les Levidowa et al. (2014) reviewed the prospects and difficulties of innovative practices for water-efficient irrigation. The authors discuss various practices, including the use of sensors, control systems, and decision support tools, to improve irrigation efficiency. [3] G. Ravi Kumar et al. (2018) proposed a smart irrigation system that uses sensors to monitor soil moisture and temperature and controls irrigation accordingly. The authors claim that their system can optimize water usage and improve crop yield. [4] P. Ramkumar et al. (2018) presented a smart water irrigation system that uses IoT technologies to monitor soil moisture and control irrigation. The authors claim that their system is energy-efficient and cost-effective. [5] García et al. (2020) provided an overview of the recent trends in sensors and IoT systems for irrigation in precision agriculture. The authors

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discuss various sensors used in smart irrigation systems and their applications in agriculture. [6] Rathika et al. (2020) reviewed automation in irrigation and discussed various technologies used in smart irrigation systems, including sensors, actuators, and control systems. The authors also discussed the advantages and limitations of these technologies. [7] Vasisht et al. (2017) proposed a data-driven IoT platform for agriculture called FarmBeats. The platform uses sensors and machine learning algorithms to collect and analyze data from farms and provide actionable insights to farmers. [8] R. Dash et al. (2021) proposed a machine learning-based classification system for crops using macronutrient and weather data. The authors claim that their system can accurately classify crops and provide insights into crop health and nutrient deficiencies. [9] N.K. Jadav et al. (2023) proposed a blockchain and artificial intelligence-empowered smart agriculture framework for maximizing human life expectancy. The authors claim that their framework can improve agricultural productivity and reduce food waste. [10] Y. Tacea et al. (2022) proposed a smart irrigation system based on IoT and machine learning. The authors claim that their system can optimize water usage and improve crop yield. [11] A. Dahane et al. (2021) proposed an IoT-based smart farming system using machine learning. The system uses sensors to collect data on soil moisture, temperature, and humidity and uses machine learning algorithms to predict crop yield. [12] E. Manjula and S. Djodiltachoumy (2021) proposed a deep learning-based algorithm for predicting the recommended crop variety based on soil nutrients. The authors claim that their algorithm can accurately predict the recommended crop variety and improve crop yield.[13] Authors presents an IoT-based smart agriculture system that uses machine learning techniques to optimize crop growth and yield. The system utilizes sensors to collect data such as temperature, humidity, soil moisture, and light intensity, which are then processed using machine learning algorithms to provide farmers with real-time recommendations on crop management. [14], the authors propose a crop prediction system that utilizes machine learning techniques to predict crop yields based on various factors such as weather conditions, soil moisture, and fertilizer usage. The system is designed to help farmers make informed decisions on crop planning and resource allocation.[15] Authors presents a system that aims to enhance crop production by using machine learning techniques to analyze environmental factors such as temperature, humidity, and rainfall. The system provides farmers with recommendations on the optimal planting times and crop varieties based on the analysis of these factors.

III. PROBLEM STATEMENT

The agriculture sector in India is a crucial backbone of the economy. However, despite the widespread adoption of automation in various industries, many farmers are still facing significant losses due to inadequate irrigation practices and the inability to accurately predict crop yields. This is where your project comes in, as it aims to utilize modern technology to provide real-time monitoring of soil moisture levels and optimize irrigation practices to increase crop yields and reduce losses. By addressing these critical issues in agriculture, your project has the potential to make a significant positive impact on the livelihoods of farmers and contribute to the growth of the economy.

IV. METHODOLOGY

The methodology for this project involves several steps:

Hardware Setup: The first step is to set up the hardware components, including the Arduino board, sensors such as DHT11, NPK, pH, rain gauge, and soil moisture sensor. The sensors are connected to the Arduino board, which is programmed to collect and process data from these sensors. Figure 1 represents the setup.

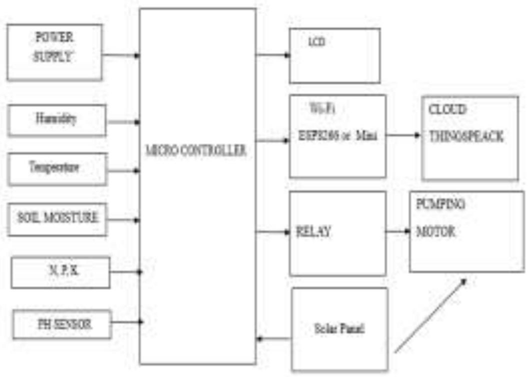

Figure 1

Data Collection and Transmission: The next step is to collect the sensor data and transmit it to the cloud using an ESP8266 chip. The ThingSpeak platform is used to record the data for further analysis.

Feature Selection: The collected data is preprocessed to remove any inconsistencies and missing values. The relevant features are then selected based on their importance in crop prediction.

Machine Learning Algorithm Selection

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and Training: The selected machine learning algorithms, including decision tree, random forest, SVM, Gaussian Naive Bayes, and logistic regression, are trained on the input data. The training is performed using a supervised learning approach where the historical data is used to train the algorithms.

Crop Prediction: Once the algorithms are trained, they are used to predict the most suitable crop based on the input data. The system selects the most accurate algorithm to make predictions based on the input data.

Irrigation Control: The system includes a soil moisture sensor to control the water supply to the crops. When the moisture level falls below a certain threshold, the water pumping motor is turned on via a relay, and it turns off when the moisture level reaches the threshold value.

Performance Evaluation: The performance of the system is evaluated using various metrics such as accuracy, precision, recall, and F1 score. The system is compared to traditional methods to demonstrate its efficiency in crop prediction and irrigation control.

V. RESULTS

Figure 2 demonstrates a prototype of an automated water irrigation system. The temperature sensor, humidity sensor, soil sensors, relay and motor are connected with the microcontroller. These sensors are used for sensing the various parameters of the soil, the motor is used for irrigation of the water to the land and the motor will be controlled by relay

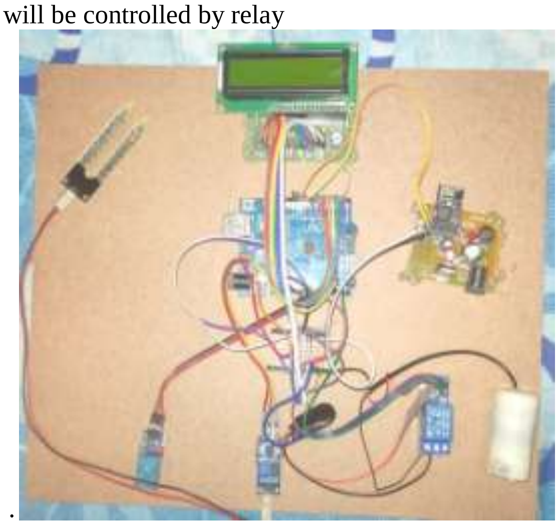

Figure 2 - Model

Figure 3 shows the data collected from sensors and stored in thingspeak cloud.

Fig 3 - Data in Thingspeak

Based on the data collected in thingspeak we train the algorithms and the accuracy is compared as shown in figure 4

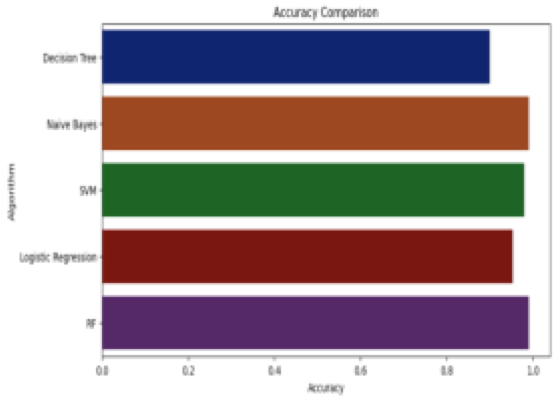

Figure – 4

By comparing the algorithms accuracy, we took Radon Forest for prediction of the crop.

Making a prediction

```
data = np.array([[104,18, 30, 23.603016, 60.3, 6.7, 140.91]])
prediction = RF.predict(data)
print(prediction)
['coffee']
```

```
data = np.array([[83, 45, 60, 28, 70.3, 7.0, 150.9]])
prediction = RF.predict(data)
print(prediction)
['jute']
```

Figure - 5

VI. CONCLUSION

The IoT-based system utilizing cloud computing and machine learning algorithms for crop prediction and irrigation control is a promising solution to address the challenges faced by farmers in achieving optimal crop yield and resource usage.

The system enables real-time monitoring of crucial environmental parameters and soil moisture levels, providing farmers with accurate information to make informed decisions on crop selection and irrigation management.

The integration of machine learning algorithms enhances the accuracy of crop prediction, taking into account multiple factors that affect crop growth and health. The system's automation of irrigation control ensures that crops receive water at the right time and in the right amount, reducing water wastage and preventing water stress in plants.

The system's scalability and ease of deployment make it a viable solution for both small and large-scale farming operations. It can significantly improve agricultural productivity and profitability while reducing environmental impact. Overall, the system has the potential to revolutionize the agricultural sector and contribute to sustainable food production.

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