The Future of Farming: Machine Learning and IoT in Agriculture

Gaurang Gajjar Department of Electronics & Telecommunications Engineering
K.J Somaiya Institute TechnologyMumbai, India

Omkar Kadam Department of Electronics & Telecommunications Engineering
K.J Somaiya Institute TechnologyMumbai, India

Sandhya Deshpande Department of Electronics & Telecommunications Engineering
K.J Somaiya Institute TechnologyMumbai, India

Sunil Bodekar Department of Electronics & Telecommunications Engineering
K.J Somaiya Institute TechnologyMumbai, India

Abstract—**Smart farming is a new trend in agricultural technology that refers to the management of farms utilizing contemporary innovation to increase quality and quantity of agriculture products. The goal of the smart agricultural education service is to spread knowledge about farming. This agricultural information is predicated on current operations, agricultural output, and farmer field experience. The process pauses at this stage if the data is unavailable or unavailable but in a form that can be delivered to the end producer. The way farmers run their businesses is changing as technology does in many other sectors. Farmers now have more control over the planting and management of their crops thanks to new advancements in machinery, software, and genetics. The advancement of the agricultural sector has been greatly aided by smart farming technology. This speech provides a quick overview of Smart Farming Technology as well as various examples. The Internet of Things (IoT) idea supports resource management and other cost-effective farming tasks. Every sensor node positioned in the farming environment can easily be connected to using a wireless sensor network. Additionally,it can link with long-distance ranges using the wireless sensor network. It may gather data from the farming environment and analyze it in accordance with pre-defined values with the aid of a sensor network. IoT sensors, such as soil moisture sensors, temperature sensors, and water volume sensors, are employed by the proposed system to gather data. The proposedsolution includes a smart farm environment and a real-time monitoring system with a wireless sensor network for node connectivity, in accordance with the current system analysis**

Keywords— Agriculture, farming, machine learning, Internet of Things (IOT), crop, sensor nodes.

Introduction

Basic human requirements are provided for through agriculture. The need for agricultural output has grown over time, particularly in light of the growing global population and the requirement to ensure food security in various regions of the world. New farming techniques have been created as a result of technological advancements, gradually displacing some of the more widely practiced conventional farming techniques.

A farm management strategy known as "smart farming" employs contemporary technology to improve the quality and output of agricultural goods. This strategy makes use of smart technologies including the Internet of Things (IoT), data management, soil scanning, and GPS access, among others. All farmers, whether small-scale and large-scale, can benefit from smart farming since it gives them access to tools and technologies that maximize product quality and quantity while lowering agricultural costs. According to research done in 2015, there has been a significant 0.7% decline in the amount of land available for agricultural use.

With smart farming, you have the opportunity to efficiently monitor your farms' needs, utilize fertilizers and pesticides wisely and carefully, and modify how you employ specific farming techniques in order to produce better and healthier results.

Between large and small-scale farmers in both emerging and established countries, smart farming is anticipated to close the gap. Technology adoption in agriculture has greatly benefited from technological development, the expansion of the internet of things, and the arrival of smartphones.

METHODOLOGY

Soil Moisture Sensor

This digital soil moisture sensor[1] is simple to operate. Simply place the sensor into the soil, and it will be able to determine the amount of moisture or water present. When the soil's moisture content is high, it produces a digital output of 5V, and when it is low, it produces a digital output of 0V. The moisture threshold can be set using a potentiometer built inside the sensor. An LED signals the output when the sensor detects more moisture than the predetermined threshold, causing the digital output to spike. The production remains low when the soil moisture is below the predetermined level. A microcontroller can be linked to the digital output to detect the moisture content. The sensor also has an analogue output that may be used to measure the precise moisture content of the soil by connecting it to the ADC of a microcontroller. This sensor works well for sensing, water, water gardening projects, etc.

DHT11 Sensors Temperature and Humidity

Due to their low cost and high performance[2], these sensors are very popular among electronics hobbyists. Here are the main specifications and differences between these two sensors:

The more expensive model, the DHT22[4], obviously has greater specifications. While the DHT11 has a temperature range of 0 to 50 degrees Celsius with +-2 degrees precision, its temperature measuring range is -40 to +125 degrees

Celsius with +-0.5 degrees accuracy. Moreover, the DHT22 sensor offers a wider range of humidity measurement (from 0 to 100% with a 2-5% accuracy) than the DHT11 sensor (from 20 to 80% with a 5% accuracy).

ESP 8266

ESP8266 is a low-cost, Wi-Fi enabled microcontroller chip that can be used to connect devices to the internet. It was designed by Express if Systems and has gained popularity among hobbyists and professionals due to its low price and versatility.

The ESP8266 module [4] includes a microcontroller with built-in Wi-Fi capabilities, making it easy to add wireless connectivity to projects. It supports the IEEE 802.11b/g/n wireless standards and can operate in access point or station mode. It also has a TCP/IP protocol stack, which allows it to communicate with other devices over the internet.

ESP8266 can be programmed using a variety of languages, including Lua, C, and C++, and can be integrated with different development platforms such as Arduino IDE or Node MCU. It features a variety of input/output pins, including digital and analog pins, which can be used to interface with sensors, actuators, and other electronic components.

The ESP8266 module can be used in a variety of applications, such as home automation, smart farming, and IoT projects. It can be used to send data from sensors to cloud services or to control devices remotely over the internet. Its low cost and ease of use have made it a popular choice among makers and developers for adding Wi-Fi connectivity to their projects..

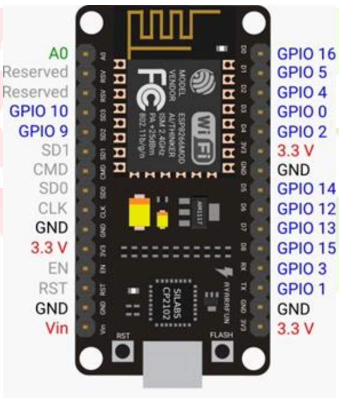

Figure 2: ESP 8266

Rainfall Sensors

A rainfall sensor, also known as a rain gauge or pluviometer, is a device used to measure the amount of precipitation that falls in a certain area over a certain period of time. It is commonly used in meteorology, agriculture, and hydrology to monitor rainfall patterns and help predict weather conditions.

Rainfall sensors come in different shapes and sizes,but most of them consist of a container or funnel that collects rainwater and a measuring system that records the amount of water collected.

Mechanical rain gauges work by measuring the amount of water collected in a container or funnel and then converting it into a readable value using a scale or ruler. Electronic rain gauges, on the other hand, use sensors such as a tipping bucket or a capacitive sensor to detect the amount of water collected and then transmit the data to a microcontroller or other device for further processing.

Machine Learning Algorithm

Random Forest[3] is a popular machine learning algorithm that is used for both classification and regression tasks. It is an ensemble learning method that combines multiple decision trees to improve the accuracy and generalization of the predictions.

The basic idea behind Random Forest is to create a forest of decision trees, where each tree is trained on a different subset of the data and using a random subset of features for each split. This random selection of features helps to reduce the correlation between the individual decision trees and makes the algorithm more robust to noise and overfitting.

BLOCK DIAGRAM

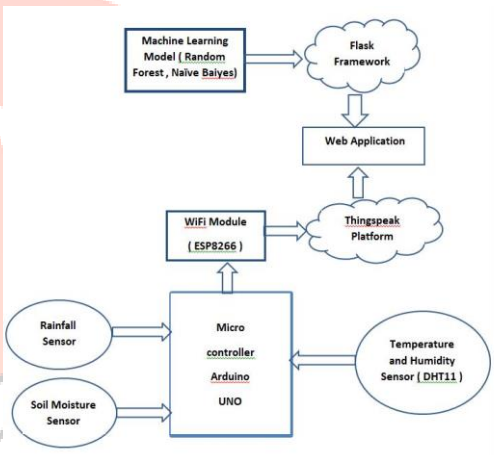

Figure 3: Block Diagram

We are using an Arduino UNO to connect multiple sensors namely Temperature and humidity sensor[2]. We can display these values on the LCD display.

Then the Arduino UNO is connected to a Wi-Fi Module i e ESP 8266 so that we can store the values received from sensor in a cloud database The values of sensors are displayed on the web application

The machine learning model designed is used on the web application and can be used to take input values and predict crops and the accuracy of the data.

ALGORITHM

Here is a high-level algorithm for taking sensor data, passing it to an Arduino, measuring the data, transmitting it to a Wi-Fi module (ESP8266), sending it to ThingSpeak, and finally using machine learning to suggest the best crop for that soil:

Set up the hardware: Connect the sensors (soil moisture, DHT11, rainfall) to the Arduino, and connect the Arduino to the ESP8266 Wi-Fi module. Make sure the sensors are receiving power and are properly wired to the Arduino.

Set up ThingSpeak: Create an account on ThingSpeak and create a new channel for your sensor data. Obtain the write API key for the channel.

Set up the software: Write the code in the Arduino IDE to read the data from the sensors, measure the data, and send it to the Wi-Fi module. Also, write code to transmit the data to ThingSpeak using the API key obtained earlier.

Connect to Wi-Fi: Connect the ESP8266 Wi-Fi module to the local Wi-Fi network and establish a connection to ThingSpeak.

Transmit data to ThingSpeak: Send the sensor data to ThingSpeak using the write API key obtained earlier. The data will be stored on the ThingSpeak platform for later use.

Collect data for machine learning: Collect a large amount of data over time from the sensors and store it in a database. This data will be used to train the machine learning model.

Train the machine learning model: Use the collected data to train a machine learning model to predict the best crop for a given soil condition.

Use the machine learning model: Once the model is trained, it can be used to predict the best crop for a given soil condition. When new sensor data is received, it can be passed through the machine learning model to generate a crop recommendation.

Display the crop recommendation: Display the crop recommendation on a website or other platform for the user to see. The user can then use this recommendation to make informed decisions about planting and farming practices

RESULT

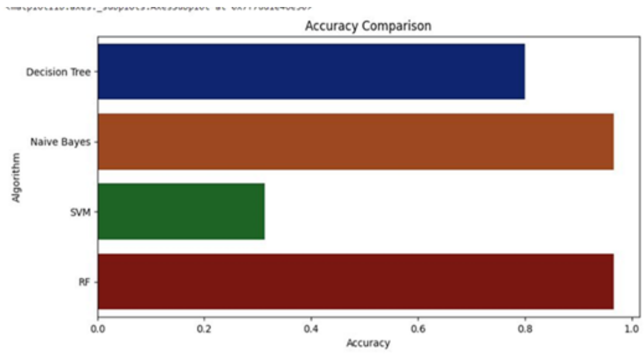

Figure 4: Accuracy Comparison

Figure 5: Moisture Senor reading

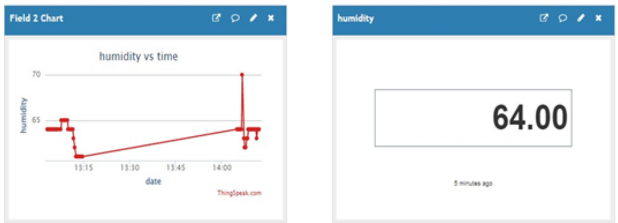

Figure 6: Humidity Senor reading

Figure 7: Temperature Senor reading

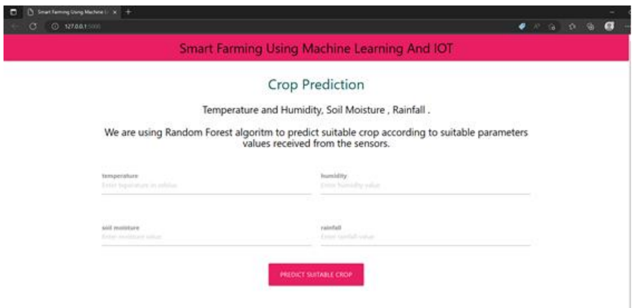

Figure 8: Website

CONCLUSION

IoT based Smart Agriculture for Monitoring of Temperature and Soil. Moisture has been proposed using Arduino. The project has high efficiency and accuracy in fetching the data of temperature and soil moisture. Smart farming education service disseminates to the farmers for the farming contents and perform farmers problem back to education service system for solution to help farmers make decision in farm management. That is smart farming education service which assists farmers to develop proficiency in the management of farms.

ACKNOWLEDGMENT

Omkar Kadam, Gaurang Gajjjar, Sunil Bodekar contributed equally for this paper and were guided by Prof. Sandhya Deshpande, K.J. Somaiya Institute of Engineering and Information Technology.

REFERENCES

[1] M. Chandraprabha, Rajesh Kumar Dhanaraj, " Soil Based Prediction for Crop Yield using Predictive Analytics," 2021 3rd International ConferenceonAdvancesinComputing,CommunicationControlandNetworking(ICAC3N),2021,pp.16,doi:10.1109/ICAC3N53548.2021.97257 58.

[2] Siddalinga Nuchhi. Vinaykumar Bagali and Shilpa Annigeri, " IOT Based Soil Testing Instrument For Agriculture Purpose," 2020 IEEE Bangalore Humanitarian Technology Conference (B-HTC), 2020, pp. 1-6, doi: 10.1109/B-HTC50970.2020.9297897.

[3] R Varun Prakash M Mohamed Abrith, S Pandiyarajan, " Machine Learning Based Crop Suggestion System," 2022 6th International Conference on Intelligent ComputingandControl Systems(ICICCS),pp.103107,doi:10.1109/ICICCS53718.2022.97883 14.

[4] M. Pyingkodi, N. Basir, K. Thenmozhi, K. Nanthini, M. Karthikeyan, Suresh Palarimath, V. Erajavignesh and G.Bala Ajith Kumar, " Sensor Based Smart Agriculture with IoT Technologies: A Review," 2022 International Conference on Computer Communication and Informatics(ICCCI),2022,pp.16,doi:10.1109/ICCCI54379.2022.97410 01.

[5] Siwakorn Jindarat, Pongpisitt Wuttidittachotti, " Smart farm monitoring using Raspberry Pi and Arduino" 2015 International Conference on Computer, Communications, and Control Technology(I4CT),pp.111-114,doi:10.1109/I4CT.2015.7219582 .

[6]https://thingspeak.com/.