Automation is agriculture using IOT and Machine Learning

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Abstract: Agriculture is one of the most essential and widely practiced occupations in India. Agriculture is largely dependent on the soil parameters like humidity, temperature, moisture and with time the crop productivity in agriculture will increase. By using remote e sensing systems like IOT systems we can produce generous amount of data and by using different machine learning algorithms such as decision tree, random forest etc. Then we can analyze the information generated from the sensors and help the farmers to recommend the most suitable crops to grow in a particular farm based on various parameters

Keywords: Precision Agriculture, Crop Recommendation, Machine Learning, Data Analytics, Prediction, Arduino, Temperature sensor, IOT, Soil moisture sensor and humidity sensor.

1.INTRODUCTION

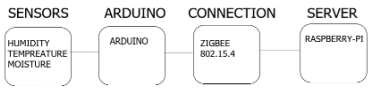
Agriculture – Agriculture is one of the most important and practiced by the wide amount of population in India and it has played a major role in developing our country. Out of total land space in India 60% is being utilized for agriculture which feeds the 1.2 billion population in the country. With the help of machine learning and IOT we are proposing a model which recommends the farmers to grow the best crop based on the soil parameters like P, K, N (Potassium, Phosphorus, Nitrogen) and the PH values predicts suitable crop that can be grown on that land. Thus, helping farmers take more precis decision for crop cultivation

IOT – IOT devices and sensers like Temperature sensor, Soil moisture sensor and humidity sensor etc. can be used to gather the data from the soil and based on this data by performing different machine learning algorithms we can predict which crop is more suitable to grow in a particular region and even

inform the farmer with the requirement of water for the crops which would help us in saving our natural resources.

- **Machine Learning** - - Machine learning is basically a part of artificial intelligence which is focused on building different applications that learn from data and improve their accuracy in the model over time without being programmed to do so. Examples of machine learning are - Netflix, YouTube, and Spotify, Google search, Facebook, Twitter, Siri and Alexa.and many more. There are different kinds of machine learning algorithms and many are published each day, and they can be typically grouped by either supervised learning, unsupervised learning, semi-supervised learning. In our model we will use different supervised machine learning algorithms to predict and obtain highest accurate model for crop recommendation model in agriculture.

2.PROPOSED SYSTEM



In this system we have collections of sensors array that are connected to the Arduino through wireless network and sends data to the Arduino on any change in value using ADOV protocol. The Arduino is connected to Raspberry-pi which acts like a server and even stores data in it and proses the data through the machine learning models and produces results.

2.1 TECHNICAL REQUIREMENTS

Moisture Sensor – Soil moisture is needed for the measurement of volume content of water present in the soil. Since the traditional method includes collecting the soil sample, drying it and then weighing the sample but with soil moisture sensor it predicts the water content based on parameters.

It contains two forks in soil with an amplifier unit and LM393 comparator. Connections are as follows: We have to connect the forks with amplifier and then plug in the ground. Attach a power supply of 5V and ground it. A0 gets connected to analog pin and D0 with digital pin. Other wires from amplifier gets attach to the Arduino board.

Temperature Sensor – The TMP36 is a temperature sensor which is compatible with Arduino UNO. It has a range from 50°C to 125°C with an accuracy of 0. 1°C.The main purpose of selecting this device is that its low cost. This sensor has a chip located inside them, so they need to be handled with care. We have to provide a power supply ranging from 2.7V to 5.5V.

These sensors don't have mercury in them neither they have thermistors. They work on the principal that if temperature increase than the voltage across diode also increases which is called as rate. If we amplify the voltage, we can get an analog signal which is proportional to temperature.

Humidity Sensor –It is basically used for measurement of moisture and the temperature if the air.

Humidity can be represented as:

$$\frac{ratio\ of\ moisture\ in\ air}{Highest\ amount\ of\ moisture\ in\ air\ at\ that\ temp}$$

Their principal is that change in electric current or the temperature in air. The humidity sensor is classified in three types:

1. Capacitive
2. Resistive
3. Thermal

All of the sensor works on the basic principle that is temperature and moisture in the air change.

Capacitive sensor has a thin metal oxide strip between its two electrodes. The electrical capacity changes with change in humidity. Capacitive sensor can measure the humidity from 0 to 100%, this is the only sensor which has full-range of measuring device up to 0%. This is the reason why they are widely used.

Resistive sensors work on principle of electrical impendence of atoms with the help of ions in the salt, which detects the humidity change.

Thermal sensor has two sensors attached to it, one of the sensors measures the dry nitrogen and other ambient air. The difference between both the values is termed as humidity.

Arduino - Arduino is an open-source platform which is used hardware and software like raspberry Pi. Arduino boards can read inputs like light of sensor, finger on button or twitter messages. It consists both microcontroller (hardware) and integrated development environment (IDE)which runs on PC. And used to upload code on physical board.

Arduino Uno board contains digital input/output 14 pins, its analog i/p pins are 6. In the Arduino board, there are 4 Arduino boards and shields that are fit in top of board to provide additional capability like connection internet, motor controller etc. But Arduino UNO is most used over Arduino products. Because Arduino UNO connects via USB port so it can used to supply the board and can act as shield device to connect to the board to computer system.

Raspberry-Pi - The creator Ebben Upton's wants to create a device that its cost will be low and that device will improve programming skills or teach them and also it is created so that we can understand its hardware at the university level.

Raspberry Pi is actually credit card sized computer and for good means it is created for education. And the Raspberry Pi foundation recommends the python language.

But some people says that it is slower that modern laptops but also it can provide all expected abilities at low power consumption or with low space.

Recently the Raspberry Pi 4 model B is launched. It is a fast processor compare to the old version that is raspberry Pi 3.

It has 3.0 USB ports and Ethernet chip with PoE capability. It got an updated 64-bit quad core processor running at 1.4 GHz. For working with raspberry Pi with SD card in it, we have to be prepared with Linux OS installed.

Zigbee - Zigbee is a protocol used for communication which has IEEE standard 802.15.4 and used for high level protocols of communication. Its primary purpose is to create PAN which is small and low power radio waves, which can be used for automating home and agriculture and any other small-scale projects. Therefore, Zigbee is a lower power ad hoc wireless protocol.

The technology that is used by Zigbee is simpler and cost effective as compared to other networks like WAN, PAN, LAN etc. The applications are as follows light switch, energy monitor, traffic management and it require low rate to transfer data.

Range of Zigbee is 10-100 m, that depends on power output and environmental features. ZigBee can transfer data to long distance with the use of mesh topology by connecting nearby devices. It is used in low data transfer rate application that has a long-lasting battery. It has a speed of 250kilobits/s and used for transferring data from sensor to devices.

2.2 ALGORITHM

Distance vector routing algorithm – This protocol is used for determining the distance between themselves and destination. Out of available routes the most convenient route for sending data across network is selected and data is sent from hop to hop. For the establishment of routes, the router exchange information with neighboring routers.

The respective information contains routing table, hop count for a particular destination network. Router which implements distance vector routing protocol depends on data supplied to them by other routers. The protocol makes updates in routers

routing table and conclude the route on which packet will be forwarded by the hop. Distance is cost of reaching a particular node. Least cost route between any of the two node is nothing but the route having least distance.

Updating are carried out from time to time in which whole or some part of routing table is forwarded to the routers. As soon as the routers receive the information they update their routing table and also notify the neighbors about it.

2.2 DATASET

The dataset used for crop recommendation model is a agricultural dataset obtained using iot devices. This dataset consists of the following Data fields
N - ratio of Nitrogen content in soil

- P - ratio of Phosphorous content in soil
- K - ratio of Potassium content in soil
- temperature - temperature in degree Celsius
- humidity - relative humidity in %
- ph - ph value of the soil
- rainfall - rainfall in mm

All the above fields used can help us in Precision agriculture. Thus helps the farmers to get informed decision about the farming strategy.

3. Machine Learning Algorithms Used

3.1 Decision Tree Algorithm

Decision tree algorithm is basically a supervised machine learning algorithm mainly used for classification problems/models but can be used in both regression and classification. In this algorithm, data is split into two parts. For example, a person with salary more than 12000 will go to left part and if the person is having salary less than 12000 then he will go to the right part of the node then if there is a further division then again, the two nodes will be divided and at last there will be no node if there is no division.

3.2 Random Forest Algorithm

Random forest algorithm is basically a collection of decision trees algorithm. In this algorithm based on different types of trees the tree with accurate tree is selected from the bunch of the trees and then we obtain the accuracy from the tree. We can choose any number of trees we want but choosing the right number of trees is important or else there will be less accuracy and a less accurate model will be created

3.3 Logistic Regression Algorithm

It is not a regression algorithm but a classification algorithm. It is quite a popular machine learning algorithm. Basically, we use it in order to approximate discrete values based on the data provided Anything above threshold value will be considered as 1 and anything below threshold value will be considered as 0. It basically uses sigmoid function in its algorithm and is mostly preferred for such kind of models.

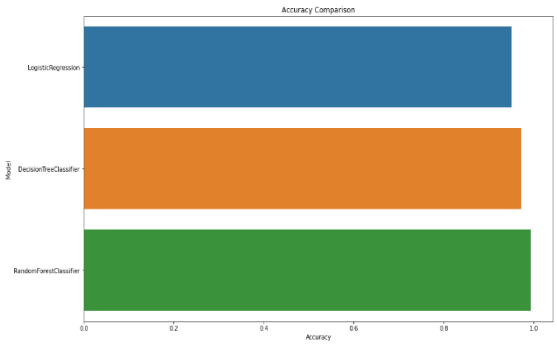
In other language, it predicts the probability between 0 and 1 for a model in a given dataset. Some people also call this algorithm as the **logistic regression** algorithm.

In our crop recommendation model using the above machine learning algorithms the obtained accuracy (in which random forest algorithm has the highest accuracy of all) of –

Logistic Regression = 0.9504132231404959

Decision Tree = 0.9724517906336089

Random Forest =0.9931129476584022



4. Results

We can now easily predict different types of crops in agriculture based on the parameters that can be grown in the region where a farmer lives. According to proposed model and data collected using various sensors we can help farmer whether he should increase supply of water to plants or he should decrease amount of water that he is supplying to the plants for their better growth and they do not damage due to excessive supply of water.

5.Conclusion

This paper consist of automation system for smart agriculture using IOT and machine learning. Which will help farmer to earn more profit, and also will help them to save the water and use it only when needed, he would also gain the knowledge of some new crops.

By using old data and current data we can predict almost 100% good crop prediction using the system for more accuracy of the result, and even alert the farmer about need for water supply depending upon the data received from sensors.

For giving farmer much more insight into the market and value of different crops, we analysis the past data. By using ML algorithms for enhancing the accuracy of the system, farmer can know more about the crops that may never have been introduced.

As maximum types of crops will be covered by this system, so farmer will have more options to plant in the farm and as price wise he can have choices.

6. Future scope

By using IOT protocols and ML algorithms, we can get more accuracy for finding the profitable crops in that weather, in that season and time.

But in the future, we can enhance these methods or algorithms by using robots. In the near future, the application of robotics will become vast enough that we can use it in farming.

The robots can be used for planting crops, fertilization, seeding etc. and if the workers are completing these works, they will take 20 to 25 days but by using robots we can speed up things that only one robot will do that work in half time limit.

By improving the IOT protocols, ML algorithms as well as AI configurations, we can add a human voice to communicate with the worker or farmers that will make them understand more.

So applying the new concepts we can enhance the systems in the future.

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