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Research Article

Soil Monitoring and Crop Yield Prediction Using Machine Learning

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Abstract: Internet of Things (IoT) is a quickly developing innovation and the field of IoT is broadening its wings in all of the zones today. With the movement in PCs like Arduino the advancement is accomplishing the ground level with its application in cultivating. In this work, we have illustrated and realized observing of soil quality by using Arduino, different Sensors and Android application. Soil quality boundaries utilized in this work are temperature, soil dampness level Ammonia and carbon content. Sensor securing is led by Arduino is utilized as information handling gadget just as worker. Android phone is utilized as the terminal gadget. To improve profitability of agribusiness through astute homestead the executives, the information breaking down should be very much investigated and handled ML calculations could be applied to additional upgrade application knowledge and usefulness. In this article we audit existing methodologies have been made to the savvy agribusiness and cultivating dependent on IoT and ML independently. Additionally, we propose novel ideas that how might ML-IoT can be mixed in such applications.

Keywords: Internet of Things (IoT), Temperature, Sensors, Wi-Fi, Internet, Smart Farming Machine Learning (ML).

1. Introduction

Agricultural business is definitely a direct result of the way that the country's reasonable development in total national output (Gross domestic product) will rely on the practical improvement of farming, which utilizes over 60% of India's population. The rural turn of events, not with-standing, has neglected to keep up its supported development. Even though the nation has the most elevated irrigable land size proportion on the planet; is one of the world's biggest makers of homestead products; farming development during the 1990s decreased provincial destitution to 26.3 percent by 1999/00.Since at that point, the poor development has become a significant reason for worry for India's rice yield, except for sugarcane, potato and tea, the equivalent is valid for most other products.

Other than making methods like more prominent public interests in agriculture; upgrading interests in provincial framework, especially in rustic streets and charge; improving water managements, fortifying the agribusiness advertising and handling of farm items to give some examples, a genuine activity must be taken to make the farmer mindful of the nature of his territory, which must be accomplished by soil examining.

The numerous supplements fundamental for crop creation incorporate Nitrogen, Phosphorus, Potassium, Sulphur, Hydrogen and so forth. There are not in every case enough of these supplements in the dirt for a plant to develop strongly. Cautious soil testing is fundamental for a precise manure suggestion. An example should mirror the general ripeness of the field so an investigation precisely addresses the supplement or mineral status of the dirt. An exact assessment will bring about more productive manure use which will cause a dramatically expansion in the harvest yield and diminish cost and natural harm, which is our plan.

2. Benefits of IoT in Agriculture

The following are the benefits of IoT in Agriculture:

1) IoT empowers simple assortment and the board of huge measure of information gathered from sensors and with incorporation of distributed computing administrations like fields maps, distributed storage and so on, information can be gotten to from any place and wherever empowering live checking and start to finish network among every one of the gatherings concerned.

2) IoT is viewed as key part for smart cultivating similarly as with precise sensors and brilliant equipment's, farmers can expand the food creation by 70% till year 2050 as portrayed by specialists.

3)With IoT creations expenses can be diminished to a wonderful level which will thus build productivity and maintainability.

4) With IoT, productivity level would be expanded regarding use of Soil, Water, Composts, Pesticides and so on

5) With IoT, different variables would likewise prompt the security of climate and environment.

3. Benefits of Machine Learning in Agriculture

The following are the benefits of Machine Learning in Agriculture:

1. Machine Learning helps to implement efficient work without making unnecessary waste.
2. Machine Learning can be very useful in management of soil quality, by understanding the dynamics present in the eco system.
3. It can be used for plotting the yield and estimation of fertilizers for crops.
4. It can be used for monitoring the crop Quality and inform the user immediately if anything affects the crop quality.

4. Smart Agriculture Using IoT

The below given details provide the various benefits that are obtained due to the usage of IOT in agriculture that's used in the project.

1) Crop and Yield Management

ML based yield planning could apply in farming dependent on gathered information over IoT network through yield observing associated through GPS. The gathered date which uncovers the yield outcomes will be planned dependent on the sorts of farmland. Aside from that, ML frameworks along with IoT can use to anticipate and improve the yields in agribusiness. Farmers depend principally on rural specialists to decide. Farmers and others utilize these frameworks with no information on PC use. ML framework can be utilized for crop creation. This is an information building framework that produces data utilizing existing information. This empowers farmers to settle on monetarily stable harvest the board choices. Different such frameworks have been created considering the accomplishment of master frameworks. The Internet of Things assumes a significant part in agricultural business. Related works shows that ML frameworks can be based on the IoT and can make suggestions on the utilization of information gathered continuously.

2) Soil Management

ML-based methodologies can be applied to the soil board. Soil information can be gathered from remote sensor hubs conveyed nearby. At that point, gathered information can be taken care of into ML calculations to foresee and break down soil properties or order the sorts of soil utilizing administered ML calculations. More over most regularly utilized ML algorithms, K-nearest neighbour, Support Vector Regression (SVR), Naive Bayes, and so on can be utilized to foresee soil dryness dependent on precipitation and evaporative hydrology information.

3) Water Management

A few frameworks have been executed on controlling water supply for an agricultural field just as investigating the water quality through ML. It tends to be created utilizing intelligent frameworks that distinguish ground boundaries, for example, soil dampness, soil temperature, and natural conditions utilizing IoT sensors. At that point, utilize a similar information to foresee open air relative dampness. Moreover, we can utilize similar AI and IoT frameworks to control water temperature and change in accordance with encompassing temperature in better way.

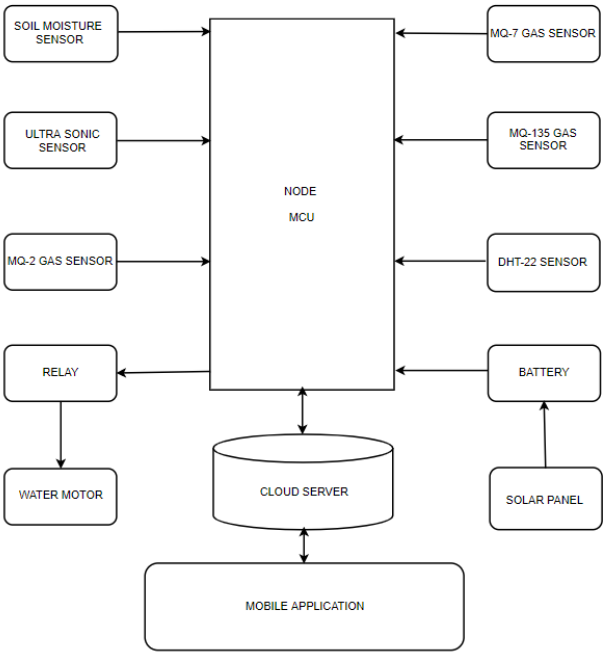

Figure 1. Block Diagram

5. Implementation

In our Smart IoT Agricultural Stick development various section are implement. Such as IOT, Machine learning Model Selection and app development.

A. IOT

The ESP8266 is an easy to understand and minimal effort gadget to give internet availability to your ventures. The module can work both as a Passageway (can make area of interest) and as a station (can associate with Wi-Fi), subsequently it can without much of a stretch get information and transfer it to the internet making Internet of Things as simple as could be expected. It can likewise bring information from internet utilizing Programming interface's consequently your undertaking could get as well as upload any data that is accessible in the web, along these lines making it more intelligent. Another energizing component of this module is that it tends to be customized utilizing the Arduino IDE which makes it much easier to understand. We use ESP 8266 to upload our output of our sensor data to the cloud database server. The figure 1 displays the block diagram which consist of the work flow of the circuit.

By using node MCU we can monitor and control various sensors such as DHT 11 sensor for detect environmental temperature and humidity. Analog Soil moisture sensor is used for detection of the soil moisture. The MQ-135 Gas sensors are used for identifying the presence of NH3 as well as CO2. The MQ-2 is used to identify Hydrogen, methane and carbon monoxide in the surrounding atmosphere.

We acquired data from our sensor and we control our solenoid motor using node MCU to irrigate our agriculture field automatically using 5v relay which is powered by solar panel.

B. Machine Learning

The data are collected from the cloud database server which was uploaded by our node MCU. For our convenience we convert comma separated file(csv) to pandas data frame.

We have to split the dataset into two arrays one is deciding factor of the result (independent variables) and the other one which is the result of the data(dependent variables). Next step is to understand the data provided from our IOT devices.

For understanding purpose, we have to visualise the data using matplotlib. Then we have to take care of missing data and abnormal data which was entered by our sensor malfunction and it should be removed from our dataset.

Missing data is filled with mean and median in some cases.

For making our data more convenient to our model we have to scale the data in range of 0 to 1 using sk learn. Then split our dataset into train set and test set with split ratio of 4:1.

We choose SVR (support vector regressor) model for our data which perform well with our dataset. SVR which draws the hyperplane in the dataset and find the margin with larger size with the help of support vectors. With the help of that hyperplane, we can find out the dependent variable (yield). For calculating the performance of our SVR model we use MSE Mean square error. Then we find the accuracy of our model for both training set and test set to find out our model doing any overfitting to training dataset. Then we predict our real time sensor data by using the SVR model. Then we upload our result to a database which is then fetched by application that displays the result to our users' devices which has the capability to access the internet.

In case if we have a large amount of data to fit our model, we can switch support vector regressor to ANN artificial neural network with one neuron in the output layer to find the respective yield of that instance of the data provided by out IOT.

C. Mobile Application

The results and the output which are sent to the cloud server through the machine learning model and node MCU are being collected and their result values are being displayed though the custom-built mobile application. Figure 2 App interface that displays various data's that are being collected.

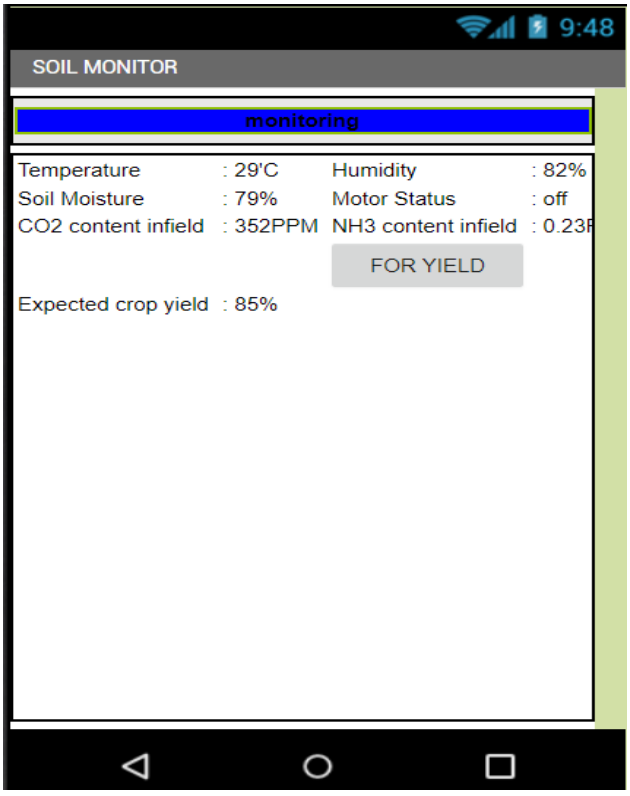

Figure 2. App Interface

6. Working

The connections are made like the above given figure Block Diagram. Then it starts to upload its data to the cloud sever that can be obtained in the form of csv file. Then these data are being executed. The execution stage incorporates different stages like gathering information from IoT, planning the ANN model, engineering of the carried-out model, preparing the pre-handled information, testing the prepared model, limiting the mistake rate

by learning rate, picking the best actuation works, and improving the exactness with the assistance of inclination plummet and backpropagation.

Harvest and yield management, yield observing and forecast in agriculture assumes indispensable part by offering data to the client to make definitive activity and accordingly lessening loss Decision Tree based appraisal of the yield creation under various kinds of various natural conditions is predicted from investigation of grain misfortune and anticipating the impact of a few agricultural boundaries in the degree of misfortune bring about by applying decision tree calculation are examined in the convolution neural organization (CNN) to perceive and check the crop's yield based upon the annual climatic condition, humidity level and the presence of gases.

The Figure 3 prototype display's the various component that collects data and process it to the server. Similarly, the figure app display's the output collected by the sensor and it gets displayed in the user's mobile phone.

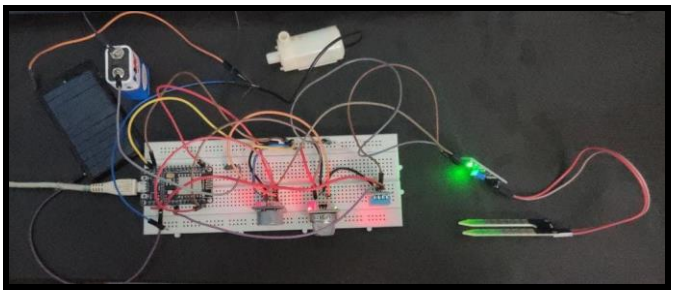

Figure 3. Prototype

7. Result and Discussion

IOT-ML based agricultural business is the following development in keen rural and smart cultivation. Applying Machine Learning (ML) calculations to information produced from different contributions from framers with the assistance of the farming IoT can make the framework more brilliant and give complete data and make expectations. In this investigation, we examine existing ML applications in farming, from interaction to results, each with its own qualities and shortcomings. Afterward, in light of the fact that most ML applications required constant information to prepare prescient calculations, ideas were made to carry out new applications on the IoT. Farming techniques are advancing into reality by applying ML to sensor information. Artificial Intelligence framework that gives more extravagant ideas and bits of knowledge to resulting work choices and activities with a scope of conclusive creation upgrades. Later on, this reach will be normal and empower more extensive utilization of ML models.

8. Conclusion

While an IOT is the following enormous thing in the advanced agricultural farm management process by applying AI calculation to the information produced from the various contributions of a homestead set up with the assistance of IoT makes the framework more insightful, gives unequivocal data and predicts the impending result. In this examination different AI calculation were investigated, each have their own upsides and downsides from the interaction to the result. This implies that the client needs to see each demonstrate prior to applying them to their application to get best out of the model utilized. For instance, Decision Tree however being exact can show a decline in precision when there might be absent and anomalies in the datasets yet irregular random forest edges here with better exactness. ANN however being exceptionally intricate and has a high preparing time, yet is presumably the steadiest model for uncorrelated information. SVM has a long preparing time however it increases in better execution, the preparation time frame can be diminished by improving the information quality.

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