

A Survey on Soil Quality Testing using Sensors in Smart Agriculture for Crop Production and Maintenance using Internet Of Things (IOT)

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Abstract:

The concept of Smart Agriculture is becoming a reality as it evolves from conceptual models for the development of crop at different stages. Previously the agriculture is the cultivation of the plants which is used to sustain and enhance human life. Now a days the Smart Agriculture has come into the picture globally. Smart Agriculture is nothing but the usage of the resources in a smarter way. Resources include sustainable land usage, fresh water usage, and usage of pesticides and insecticides which increases the crop production and supports the farmers' income. Firstly the developed Sensor kit will be checking the Soil type and Soil Quality. Later the different tests are performed on soil such as bulk density test, respiration test, moisture test and it also needs to check the water quality. By considering the results obtained by the above tests the device suggests the crop for the farmer and it also helps him for the maintenance of the crop. To keep the services of Smart Agriculture the IOT plays a key role.

Keywords: Soil Quality, Decision Tree, Classifying

1.Introduction

In our country Utter Pradesh occupies first position in agriculture. Our country plays a key role in Agriculture for the crop production with the foremost food staples like Mirchi, Ground nut, Paddy, Jower, Bengal gram, etc. By using Smart Agriculture we can increase the production levels of the crop and Soil pollution, Air pollution can be decreased by using required levels of pesticides and insecticides.

In this paper we firstly check the Soil type and later the Soil Quality is to be tested using sensors. Here the quality of the soil

can be decided by considering different soil tests like bulk density test, respiration test, moisture test. The results obtained by the tests are to be considered and according to the results we suggest the farmer which type of crop is suitable for that particular soil. This can be done by using Decision tree algorithm. Later the crop maintenance is to be done such as giving fresh water to the crop at regular intervals by considering soil moisture. To maintain a healthy crop pesticides and insecticides should be used at a minimum level so that it does not affect the soil.

Decision tree is a classifier, which is a simple yet widely used classification technique.

It has three types of nodes

1. Root node: It has no incoming edges and zero or more outgoing edges.

2. Internal node: It has exactly one incoming edge and two or more outgoing edges.

3. Leaf or terminal node: It has exactly one incoming edge and no outgoing edges.

In decision tree, each leaf node is assigned a class label. The non-terminal nodes, which include the root and other internal nodes, contain attribute test conditions to separate records that have different characteristics.

Classifying a test record is straightforward once a decision tree has been constructed. Starting from the root node, we apply the test condition to the record and follow the appropriate branch based on the outcome of the test. This will lead us either to enter into an internal node, to which the condition is to be applied or a leaf node.

The paper has been organized in this way section 2 Soil Quality Tests, section 3 Implementation Strategy, section 4 Conclusion, References.

2. Soil Quality Testing

The Soil Quality Testing plays a key role in the Smart Agriculture, because based on the results obtained by the tests performed on the soil we suggest the crop to the farmer.

There are two fundamental ways to assess soil quality:

1. Take measurements periodically over time to monitor changes or trends in soil quality.
2. Compare measured values to a standard or reference soil condition.

Type of Soil	Crop
Black Soil	Cotton, Mirchi
Red Soil	Groundnut, Castor, Cotton
Sticky Black Soil	Cotton, Sugarcane, Paddy
Clay and Sandy Soil	Bengal gram
Sandy Soil	Coconut, Palm gardens

Table 1 Describes 5 types of Soil and Crop suggested for that particular Soil

In the Soil Quality Testing here we have three different tests such as

1. Soil Moisture test
2. Soil Respiration test
3. Soil Bulk density test

Soil Moisture test

Soil moisture test is to be performed first because it plays a key role in exchange of water and heat energy between the land surface and the atmosphere, through evaporation and plant transpiration. By considering the soil moisture test results we can perform the further tests like soil respiration test.

Soil Respiration test

Soil breathes! Soil respiration is an indicator of biological activity or soil life. This activity is as important to the soil ecosystem as healthy lungs are to us. However, more activity is not always better; it may indicate an unstable system (i.e., after tillage).

For efficient sampling, the soil respiration test is performed. The best time to run the soil respiration test is when soil moisture is at field capacity.

Soil Bulk Density test

The bulk density measurement should be performed at the soil surface and/or in a compacted zone. Measure the bulk density near the site of the respiration tests.

Bulk density is the weight of soil for a given volume. The greater the density, the less pore space for water movement, root growth and penetration and seedling germination.

After the completion of the three tests on the soil the results obtained by them

are used to decide which crop is suitable for that particular soil. This can be done by using decision tree algorithms. After sowing the seeds it regularly checks the soil moisture levels and if moisture levels decreases we need to supply fresh water to the field in required quantity. If water is not supplied to the field the moisture levels of the soil decreases, due to this seed germination cannot be done properly.

During the growth of the crop at different stages we need to give the pesticides according to its level of growth so that healthy crop can be maintained. The pesticides which we give to the crop should be given at minimum level because if we give a high level of the pesticide the crop may damage and it also effects the soil nutrients.

By using the Soil Quality Testing using Sensors in Smart Agriculture for Crop Production and Maintenance we can have an effective growth of the crop and the crop health can also be maintained. As we use less quantity of the pesticides the soil will not be affected and this also lowers cost in the crop production.

3.Implementation Strategy

1. HTML and CSS

Hypertext Markup Language (HTML) is a markup language used for creating web pages or other information to display in a web browser. The structured documents are created by using structural semantics for text such as headings, links, lists, paragraphs, quotes etc.

CSS (Cascading Style Sheets) is designed to enable the separation between document content (in HTML or similar markup languages) and document presentation. This technique is used to improve content accessibility, provides more flexibility and control in the specification of content and presentation characteristics. This enables multiple pages to share formatting and reduce redundancies.

2.PHP and Macromedia Dreamweaver

PHP (recursive acronym for PHP: Hypertext Preprocessor) is a widely-used open source general-purpose server side scripting language that is especially suited for web development and can be embedded into HTML.

Macromedia Dreamweaver is a web design and development application that provides a visual editor (colloquially referred to as the Design view) and a code editor with standard features such as syntax highlighting, code completion, and code collapsing as well as more sophisticated features such as real-time syntax checking and code introspection for generating code hints to assist the user in writing code. The Design view facilitates rapid layout design

and code generation as it allows users to quickly create and manipulate the layout of HTML elements. Dreamweaver features is an integrated browser for previewing developed web pages in the program's own preview pane in addition to allow content to be open in locally installed web browsers.

3. MySQL

MySQL is the most popular open source RDBMS which is supported, distributed and developed by Oracle. In the implementation we are using it to store Soil data which are of different types.

4.Weka Classifier and java

The WEKA (Waikato Environment for Knowledge Analysis) workbench is the state-of-the-art machine learning algorithms and data pre-processing tools. Data mining software WEKA is used to determine and predict result if any advantage would be gained in both interpretation of data set and time saving. The application of the data required for WEKA that some of pre-processing to be undertaken. Excel data set converted into CSV file format to allow them to be applied to WEKA. The data mining platform allowed and uses the number of data interpretations techniques including clustering, classifying and associate routines conducted after the pre processing stage.

JAVA is open source language. Here we use java library with WEKA classifier

for getting decision tree output come out by using classifier algorithms and then after we can use class method for implementation.

5. Soil Testing Database

The training dataset consisting of information about soil testing data. The data will be in the form of Microsoft Excel 2007 in CSV format and it have the details of each soil such soil type, soil quality etc. For ease of performing data mining operations, the data is filled into MySQL database.

4. CONCLUSION

The Smart Agriculture has to be used for an effective growth of the crop and by using it we can maintain the health of the crop. This is relatively a modern research field and it is expected to grow in future. There is lot of work to be done on this emerging area. Here we get a basic knowledge that how the soil quality can be tested and based on the tested results the kit suggests the crop to the farmer which helps for the better growth of the crop and crop production, in farming of the Smart Agriculture.

REFERENCES

1. Li Hang, Chen Houjin, Key technology and application prospect of the internet of things, Forum on Science and Technology in China, 2011.

2. Soil health: Concepts, Status and monitoring May2016, Indian Society of soil science.

3. A review of machine learning techniques using decision tree and support vector machine MadanSomvanshi 2016, ICCUBEA.

4. Ratings of soils for different parameters, Micronutrient, Soil Testing Laboratory, AAU.

5. Text book From Machine-to-machine to the Internet Of Things: Introduction to a New Age of Intelligence by Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnuskos, Stefan Avesand, David Boyle.

6. Text book of Data Mining: Practical Machine Learning Tools and Techniques (Morgan Kaufmann Series in Data Management Systems) 3rd, Kindle Edition.

7. Jun Wu, Anastasiya olesnikova, Chi-Hwa Song, Won Don Lee, The Development and Application of Decision Tree for Agriculture Data.

8. Xiangyu Hu, S. Q. (n.d.). IOT Application System with Crop Growth Models in Facility Agriculture. IEEE