CS4044D-- MACHINE LEARNING REPORT

Crop Prediction Using ML

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1. Project Summary:

Machine learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. The proposed machine recommends a suitable crop given the parameters like atmospheric humidity, temperature, soil moisture, soil pH, latitude, and longitude. The system builds up a Decision Tree Classifier Model, which helps us decide which crop to grow for the given data.

GPS sensor modules integrated with some advanced platform (like NodeMCU) into a portable kit. This kit is installed on the farm to gather the respective data of the soil. The data gathered is transferred in real-time to the firebase database for storage and further processing.

The system can be extended to the mobile application to help the farmers by uploading the agriculture area's data. The efficiency of the model is limited by the amount of precision in the information (like soil pH, moisture, humidity, etc.) provided. The pre-processing of data could hence be improved, and a lot more features can be extended, thus significantly contributing towards agricultural welfare worldwide.

Collection of more valid details of soil class, contours using the image of the agricultural area can greatly accelerate the efficiency of work. The Image Preprocessor can be used to remove the noise from the image (unwanted area). This could then ease the work of Image Classifier Evaluator, to predict the soil class with improved accuracy. Superpixel (collection of pixels) could have been used instead of an individual pixel.

2. Objectives:

This project aims at predicting the crop yield at a particular weather condition and thereby recommending a suitable crop for that field. It involves the following steps.

- Collect characteristic soil data for agricultural crop monitoring.
- Using the GPS sensor, collect latitude and longitude values and get the last few years records of weather conditions.
- Classify agricultural land based on soil type, moisture content, weather conditions, pH value, organic nitrogen, etc.
- Analyze crop patterns with the help of past records and map them with calculated data.
- Monitor crop yield and find ways to increase it.
- Recommend profitable crops for each land type.

3. Input Required:

The atmospheric humidity, temperature, soil moisture, soil pH are sent as it is to the database. The latitude and longitude sent by the GPS module are retrieved in the form of which part they fall under. And this is used to retrieve rainfall data for that region. These are the datasets used for predicting the Suitable Crop.

For training our model, we need features as (temperature, humidity, pH, rainfall) and label as (crop suitable for those features).

Link to our training and testing datasets is as follow:

URL: https://github.com/giriadarsh/Crop-Prediction-Using-MachineLearning/blob/master/data.csv

4. Expected output and outcome of the Proposal:

Agriculture is the backbone for a developing economy like India, and there is an enormous need to maintain agricultural sustainability. Hence it is a significant contribution towards the economic and agricultural welfare of the countries across the world.

- The proposed machine recommends a suitable crop given the parameters like atmospheric humidity, temperature, soil moisture, soil pH, latitude, and longitude.

- Farmers can know what crop to cultivate and what price at which the crops should be sold to earn a reasonable profit for the farmers.

- They can also view the necessary nutrients and fertilizers that the crop would need for its healthy growth.

- Any drastic change in the environmental factors could be notified to the farmers immediately.

- After the predicted data gets reflected in the firebase database, the farmers can view it in their mobile application.

5. State of the art:

Agriculture plays very important role in India's economy. More than 50 percent of the rural households depend on agriculture as their principal means of livelihood, according to some report. Agricultural exports makes up around 10 percent of the country's exports and are the fourth-largest exported principal commodity category in India. Here are some applications of artificial intelligence (AI) which are currently in use or under development.

5.1. The AI sowing app:

A pilot project in Andhra Pradesh on the southern coast of India offers a hint of what is becoming possible. In an area of small,subsistence farms where farmers have always relied on a combination of ancient traditions to decide when to plant, Microsoft is working with the nonprofit International Crop Research Institute for Semi-Arid Tropics (ICRISAT) to enable farmers to take advantage of the power of AI to increase yields. Last year, i.e., 2019, ICRISAT received a Microsoft AI for Earth grant to support the continued development of AI solutions that focus on sustainable agriculture in developing parts of the world.

The AI Sowing App draws on more than 30 years of climate data, combined with real-time weather information, and then uses sophisticated forecasting models powered by Azure AI to determine the optimal time to plant, the ideal sowing depth, how much farm manure to apply, and more. That information is then shared with farmers through text messages that they receive on a basic feature phone.

https://youtu.be/GSvT940uS_8

5.2. AI for Precision Farming:

NITI Aayog have partnered with IBM to develop a crop yield prediction model using AI to provide real-time advisory to farmers. IBM's AI model for predictive insights to improve crop productivity, soil yield, control agricultural inputs and early warning on pest/disease outbreak will use data from remote sensing (ISRO), soil health cards, IMD's weather prediction and soil moisture/temperature, crop phenology, etc. to give accurate prescriptions to farmers. The project is being

implemented in more than 10 Districts across the States of Assam, Bihar, Jharkhand, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh.

https://www.youtube.com/watch?v=hhoLSI4bW_4

https://niti.gov.in/writereaddata/files/document_publication/NationalStrategy-forAI-Discussion-Paper.pdf

5.3. AI-based predictive analytics — Greenhouse Guardian:

This artificial intelligence is part of a Bosch technology solution called Greenhouse Guardian. Developed specifically for agriculture, Greenhouse Guardian is a databased early-warning system that alerts farmers about the potential risk of crop infection. The hardware of the system consists of wireless sensors that measure temperature, humidity, and other conditions in the greenhouse which affect crop development and provide the intelligence needed to detect the risk of infection, not only in one particular crop like tomatoes but also in other greenhouse crops. The readings by the sensors are uploaded to the Bosch IoT cloud in a data package.

https://www.bosch.com/stories/greenhouse-guardian-ai-in-

agriculture/ https://youtu.be/abJS4v-UX7A

5.4. AgVerdict:

AgVerdict combines field-specific data with their agronomists' knowledge for a strategic decision-making toolkit to help farmers make better decisions and increase productivity. Whether it's planning for crop rotation, selecting hybrids or varieties, managing crop inputs or soil fertility, or scouting fields in season, it uses AI to grow more.

https://agverdict.com/

6. Origin of Proposal:

Agriculture plays a pivotal role in the global economy of the country. Due to the increase in population, there is constant pressure on the agricultural system to improve the productivity of the crops and to grow more crops. Looking into these agricultural issues, and the power of machine learning, it is the best time to use Machine learning in agriculture to improve the productivity and quality of the crops in the agriculture sector. Once the idea makes its momentum in this field, more new ideas can be added into it, enhancing the model.

7. Scientific Rationale and Importance of the Proposed Work:

It's important also to understand that machine learning, like other technologies, is a part of a process, not a stand-alone solution. Our proposed model, in many ways providing practical applications that align with existing agricultural operations.

Farmers can easily decide which crop to cultivate, enhancing productivity and profitability. They can make pre-arrangements about crop requirements such as pesticides, irrigation facilities, soil maintenance, etc.

8. Methodology:

For training our model, features such as (temperature, humidity, pH, rainfall) and label (crop suitable for those features) are used.

=>Data Pre-processing:

- The first categorical variables are converted into dummy/indicator variables.
- Standardization of features by removing the mean and scaling unit variance.

  The standard score of a sample ‘x’ is calculated

  as $Z= (x-u) / s$

  where ‘u’ is the mean of training samples and ‘s’ is the standard deviation.

=>Spitting of Dataset for training and testing:

- Splitting our datasets into a random train and test subsets.

=>Decision Tree Classifier:

- A decision tree classifier is used to classify the given feature into a suitable label (output or required crop).
- The quality of split is based on Gini impurity.

=>Accuracy Score:

- An accuracy classification score is used for measuring the accuracy of our model.

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