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Smart Agriculture using Automation

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Abstract:- Farming practices in India could be revolutionizedby integrating the Internet of Things (IoT) with agriculture. IoT sensors can be used to gather information on soil moisture, temperature, and humidity, which can then be usedto help farmers choose the right crop and apply irrigation techniques. By using a microcontroller-based system, farmers can receive real-time data on soil conditions and adjust irrigation schedules accordingly, without having to manually monitor the crop. Moreover, the implementation of a recommendation engine that takes into account climatic factors and crop quantity can assist farmers in selecting the most appropriate crops for their specific conditions. By usinga content-based recommendation technique, the system can analyze the data collected by the sensors and provide farmerswith suggestions on which crops to grow, based on their suitability for the given climate and soil conditions This approach can be particularly useful in areas where water is scarce, as it can help farmers optimize their water usage and ensure that crops are being grown most efficiently and sustainably possible. With the help of the IoT and a recommendation engine, farmers can make data-driven decisions that can improve their crop yields, reduce water usage, and ultimately increase their profitability.

Keywords:- *IOT-based system, Machine Learning, Sensors, Recommendation system, Agriculture.*

I. INTRODUCTION

To assist Indian farmers in making educated decisions aboutwhich crops to plant, the suggested system for Smart Management of Crop Cultivation utilizing IoT and Machine Learning is a step in the right direction. By considering sensed parameters such as temperature and humidity, The method can forecast the crop that would grow best in a specific climate, taking into account other elements like soil type, farm location, and rainfall. This will enable farmers to optimize their crop production and maximize their profits. Machine learning algorithms can further enhance the performance of the proposed system by predicting the most suitable crop for a particular environment based on historical data. IoT applications in agriculture have a number of advantages. For example, it makes it possible for farmers to gather information on a variety of characteristics, including soil moisture, temperature, and humidity, all of which are essential for crop growth. Farmers can decide when to fertilize when to water, and when to harvest their crops by analyzing this data. IoT tools can also assist farmers in spotting pests and diseases and taking action before they seriously harm their crops. By analyzing data from past years, the system can identify which crops have performed well in a particular location and recommend them to farmers. This will help farmers avoid the risk of crop failure and maximize their profits. In conclusion, Indian agriculture could be transformed by the suggested system for Smart Management of Crop Cultivation utilizing IoT and Machine Learning. By providing farmers with predictive insights, the system can help them make informed decisions about which crops to grow, optimize their crop production, and maximize their profits. This will not only improve the livelihoods of farmers but also contribute to the overall growth of the Indian economy.

II. LITERATURE SURVEY

Both the economy and the existence of the Indian people depend on agriculture. The technique is designed to assist farmers in boosting agricultural productivity. The instruments used to investigate the soil include a pH sensor, a temperature sensor, and a humidity sensor.[2] Creating an efficient IoT-based smart irrigation system is anotheressential requirement for farmers in the agricultural sector. The system also incorporates sensors for temperature, humidity, and raindrops that have been updated to enable online remote monitoring of these variables. [3] India is a nation where agriculture is extremely important. This websitehas a feature that lets you manually or automatically regulatehow often plants are watered. Using a Raspberry Pi camera that provides live streaming to the webpage, the health of theplants is tracked. [4] Tensor flow and deep learning neural networks are used by this intelligent system to identify animals according to their hazard level as well as unauthorised human visitors to the farm and to promptly inform the farmer. The gadget comes with an android application that enables remote access and live video streaming surveillance. [5] For the production of crops, agricultural irrigation is crucial. The author of this paper claims that soil constitution is related to the availability of nutrients that plants need as well as the presence in soil of nutrients and chemical composition that exist in various ratios that are best for plants and soil organisms. The author also claims that providing the right amount of water to plants is the most important factor in ensuring that all other nutrients work as effectively as possible.

A. EXISTING METHOD

The existing automated drip irrigation system can irrigate only a single crop land. Soil moisture sensors sense the moisture level of a single crop and only that particular crop is irrigated. Crops are supplied with water above their requirement. Automated drip irrigation is carried out irrespective of the available water resource for the crop. The existing system doesn'thave the capability to make decisions to irrigate multi- crop land. Irrigation is carried out even if the available water level is insufficient and leads to incomplete irrigation of land. Water is wasted if the crop is irrigatedmore than its requirement. They often find it difficult tonotice plant diseases that directly affect the production rate. Using appropriate parameters like rain patterns, temperature patterns, soil structures, and other factors such as crop

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diseases makes it possible to yield accuratecrop prediction results.

B. DISADVANTAGES:

- In the existing system, they considered only a particular State and not all the states and other parameters.
- Relatively slower to build.
- Hard to Interpret
- Computationally expensive.
- Water is wasted if the crop is irrigated more than its requirement.
- Manual irrigation technique

C. GAP ANALYSIS

Our system is designed to automate tasks and reduce the workload for farmers while also providing effective monitoring. precision irrigation is a promising solution to the issue of water wastage in agriculture, and it has the potential to improve crop yields, conserve water resources, and reduce the environmental impact of farming. Our system also incorporates a decision-making algorithm to assist farmers in selecting crops that yield better results. Unlike other irrigation systems that waste water resources by using excessive amounts of water, our system utilizes moisture/humidity sensors to detect soil moisture levels. This allows for the automatic irrigation of crops with the appropriate amount of moisture, ensuring optimal growth conditions. Our approach is designed to overcome the limitations of traditional agricultural methods and improve crop yields while conserving water resources.

III. SYSTEM ARCHITECTURE

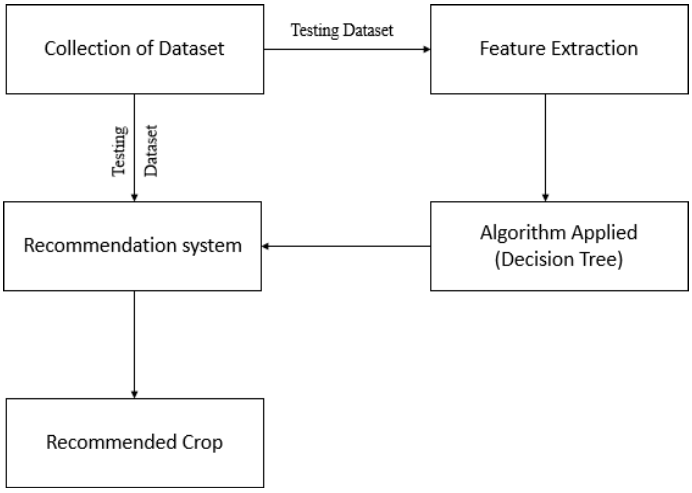

Fig. 1: Crop Recommendation Architecture

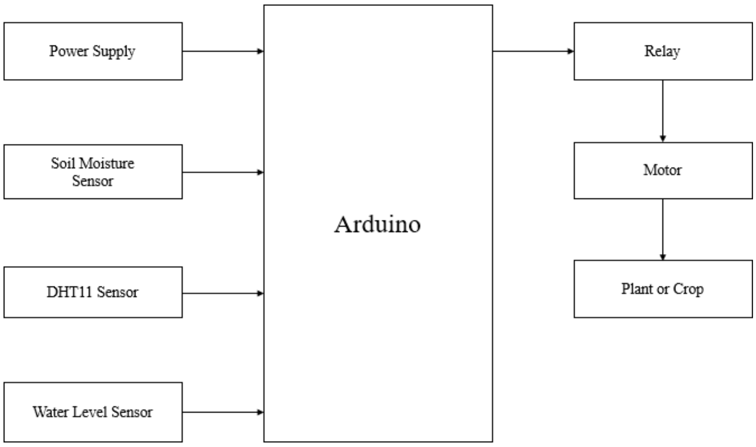

Fig. 2: IoT Architecture

Our project's structure and behaviour are defined using a conceptualization-oriented model called a system architecture. A system's architecture is a clearly defined and representative structure that is arranged to support the logic that underlies all of the system's structures and behaviours. Additionally, it shows how one process is dependent on another.It enables us to gain knowledge about our product in a style that makes it simple for us to relate to and comprehend the internal procedures, techniques, and stages of a system. "Fig. 3.1" and "Fig. 3.2" show the system architecture of our recommendation model and the internet of things model, respectively. The decision tree algorithm is used in the crop prediction model, and in the Internet of Things, sensors are used. The crop prediction model predicts the crop based on the soil moisture.

IV. PROPOSED METHOD

It sounds like the proposed approach involves using moisture/humidity sensors to automatically irrigate crops based on their water requirements, which are determined by assigning each crop a priority based on its minimum water requirement. Additionally, the project aims to recommend crops to farmers using a Decision Tree Classifier, taking into consideration factors such as crop yield in previous years, market trends, and the season of crop production. To achieve these goals, the project will involve preprocessing the data provided, preparing a model, and connecting it to a UI interface using Flask. This will allow farmers to receive recommendations based on various agricultural parameters, giving them insight into which crops are likely to yield the best results given the current conditions.

Overall, the proposed approach seems like it could be a useful tool for farmers looking to optimize their crop production and make informed decisions about which crops to plant based on a variety of factors. However, the success of the project will depend on the accuracy of the models used to make these recommendations, as well as the ability of the UI interface to effectively communicate this information to farmers in a user-friendly manner.

A. Module Identification

- *Data Collection:*

The process of gathering data is essential because the quantity and quality of the data can have a big impact on how well a machine-learning model performs. Various techniques can be used to gather data, such as web scraping and manual interventions. In the case of crop recommendation in India, a dataset from another source has been used. It is important to ensure that the data used is relevant and appropriate for the model being developed. Additionally, it is crucial to give proper credit and citations to the source of the data to avoid plagiarism.

$$E = -\sum_{i=1}^{N} p_i log_2 p_i$$

- *Dataset:*

The dataset contains 821 individual data points and consists of 14 columns, which are described below: The dataset was narrowed down to 7 features, which include the total numberof states in India, the amount of rainfall in mm, the total groundwater level, the temperature in degree Celsius, the number of soil types, the season suitable for crops, and the types of crops.

$$Gain = E_{parent} - E_{children}$$

- *Data Preparation:*

Gathering and preparing the data for training is the next step in creating a machine-learning model. This involves several tasks such as cleaning the data to remove duplicates, correcting errors, dealing with missing values, normalizing the data, and converting data types if necessary. Once the data is cleaned, it should be randomized to remove any effects caused by the order in which the data was collected or prepared. Techniques for data visualization can be used to find pertinent links between variables and spot any class imbalances that might skew the model's results. Finally, the data should be split into training and evaluation sets to ensure that the model can generalize well to new data. By following these steps, we can ensure that the model is trained on high-quality data and can make accurate predictions on new data.

- *Model Selection:*

A decision tree is a machine learning technique that represents a set of options and their potential outcomes using a tree structure that resembles a flowchart. Each leaf node represents a result, the branches serve as decision-making guidelines, and the inside nodes of the tree represent traits or attributes. Because of the transparency of their decision-making process and the ease with which people can comprehend and interpret their reasoning, decision trees are regarded as white-box algorithms. This is because the tree structure of the algorithm provides a clear and intuitive visual representation of how the decision-making process works. In contrast, black box algorithms like neural networks are more opaque, which means that it can be difficult to understand how they arrive at their decisions. Decision trees are non-parametric, which means they don't rely on assumptions about probability distributions, and they train more quickly than neural networks. High-dimensional data can be handled using decision trees with good accuracy, and their decision rules are typically expressed as if-then-else statements. The complexity of the decision tree model increases with the depth of the tree, as more complex rules are created. Information gain and Gini impurity are two popular methods used for selecting the best attribute at each node and determining the quality of splitting in decision tree models. A metric called entropy is used to quantify the impurity or unpredictability in a collection of observations. In the context of decision trees, entropy is used to determine the best feature or attribute to split the data at each node. The entropy of a group of observations is calculated based on the proportion of observations in each class, where a higher proportion of one class corresponds to higher entropy. A split that results in lower entropy is considered to be more informative and is therefore preferred when constructing a decision tree. Other metrics, such as Gini impurity or information gain, can also be used to determine the best split in a decision tree.

The amount of knowledge a feature imparts about a class is measured using information gain, which also aids in deciding the order of characteristics in decision tree nodes. The sub- nodes are referred to as child nodes, and the main node is referred to as the parent node. We can assess the quality of splitting in a decision tree and raise the model's precision by employing information gain.

- *Analyze and Prediction:*

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V. RESULTS AND DISCUSSIONS

To prepare the dataset, we first divided it into training and testing sets, which were used to generate and evaluate our crop suggestion prediction model. The dataset was sourced from anopen-source platform and contained a total of 821 data points,each with 14 columns of information. Once the model was trained using the training dataset, it was evaluated for its accuracy and minimum error. Based on the input data provided, the final model was then utilized to forecast and advise the best crops to be sown. Our model was able to achieve an accuracy of 90.07%, making it an effective tool for crop suggestion and decision-making.

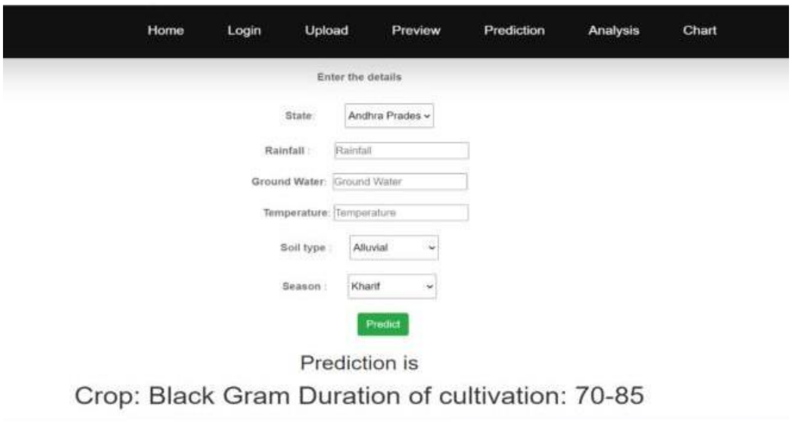

Fig. 3: Crop prediction

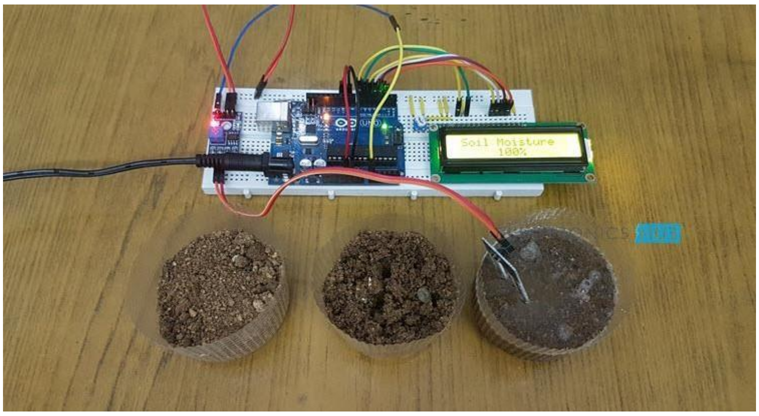

Fig. 4: IOT Connection

VI. CONCLUSION AND FUTURE SCOPE

The importance of crop management in agriculture is thoroughly examined in this paper. Modern technology is needed by farmers to efficiently produce their crops. Various agricultural factors have been analyzed using machine learning techniques. A review of the literature was done on several methods used in agriculture, including soft computing methods and blooming neural networks, which are important in making recommendations. Farmers' output can be boosted by using personalized and pertinent recommendations that take factors like production and season into account. To cut back on labor and use less water, agriculture monitoring is essential. Wireless sensors are used in several systems that have been created to track and forecast soil conditions for irrigation. Furthermore, crop forecasting has been done using machine learning approaches.

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