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Crop Advisor System Using IoT and ML

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Abstract: *Sustainability and global food security are deeply dependent on the agricultural sector. To meet these critical needs, it is essential to adopt modern technologies such as Machine Learning (ML) and the Internet of Things (IoT), which can optimize resource utilization and enhance agricultural productivity. This abstract presents an overview of an integrated Crop Advisor System that harnesses the capabilities of IoT and ML to assist farmers in making informed crop selection decisions. Data Collection: IoT sensors continuously monitor and gather environmental data from the agricultural field, ensuring that the recommendations are based on up-to-date information.*

The core components of the Crop Advisor System include:

1. Data Collection: IoT sensors continuously monitor field conditions, providing up-to-date environmental data to ensure accurate recommendations.

2. Data Processing: Collected data from IoT devices and external sources is cleaned and pre-processed to make it suitable for analysis.

3. Machine Learning Models: Algorithms such as decision trees, support vector machines, and neural networks are trained on historical and current data to predict crop yields and determine the most suitable crops for a given environment.

4. Recommendation Engine: The processed data is used to generate crop advisor tailored to specific plots or regions, based on soil quality, weather conditions, and past outcomes.

5. User Interface: A user-friendly web and mobile application allows farmers to access recommendations, monitor crop progress, and receive timely alerts or crop management tips.

6. Feedback Loop: Farmers can provide feedback on the performance of the recommended crops, which helps refine and improve the system's accuracy over time.

Keywords: Internet of Things

I. INTRODUCTION

Agriculture has long been vital to human survival, providing food and livelihoods for communities worldwide. However, with a growing global population and limited resources, the industry now faces critical challenges that demand sustainable practices and increased efficiency. Technology, especially precision farming, offers promising solutions.

This study introduces an Integrated Crop Advisor System powered by Machine Learning (ML) and the Internet of Things (IoT). By collecting and analyzing real-time field data, the system provides farmers with intelligent insights to support decisions on crop selection, irrigation, fertilization, and pest control—paving the way for smarter, more sustainable farming.

II. METHODOLOGY

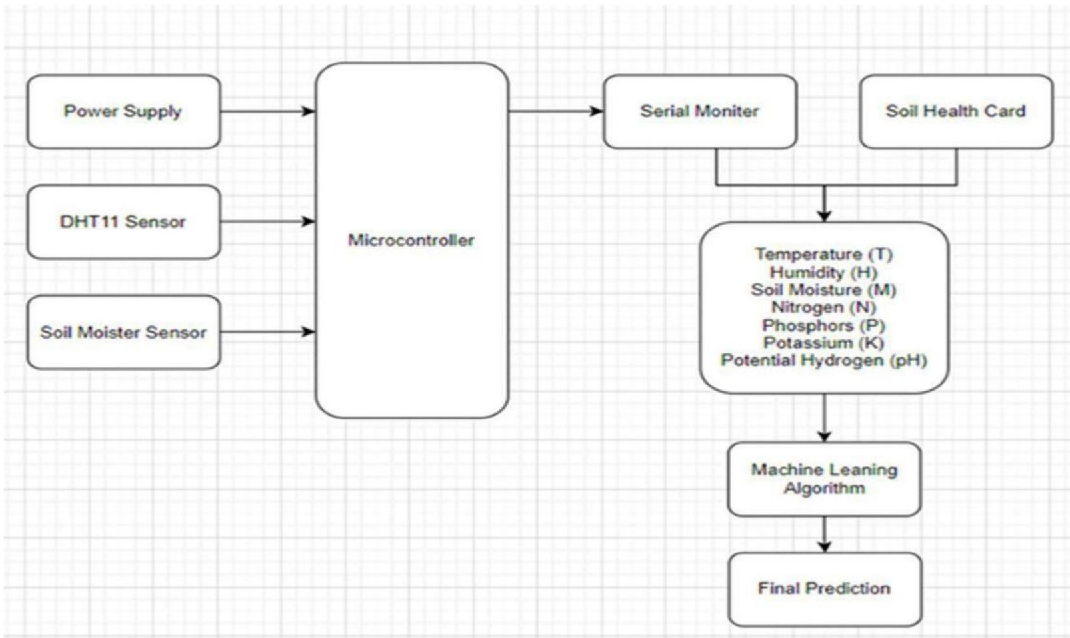

Fig1.1 Block Diagram 2

1) Raspberry Pi: A Raspberry Pi can be used in a crop advisor price prediction project to collect and process data from various sensors. The Pi's processing power, combined with appropriate software, can analyze the data to predict future crop prices based on weather patterns, market trends, and other relevant factors. This enables farmers to make informed decisions regarding planting, harvesting, and pricing strategies.

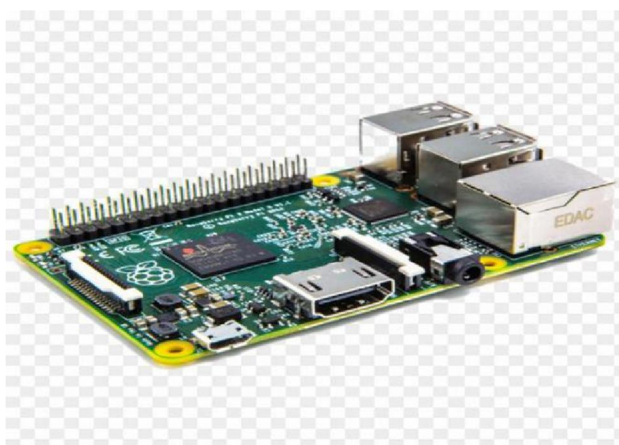

Fig 1.2 Raspberry Pi

2) Soil Moisture Sensor:

Moisture sensor has 3 pins – one is for voltage input, second for ground and third is for analog input. Moisture content of the soil (volume %) is measured by this sensor. The analog value needs to be mapped in the range of 0-100 as moisture content is evaluated in percentage. The property used by this sensor is electrical resistance of soil. There are 2 probes in this sensor that permits the current to pass through the soil.

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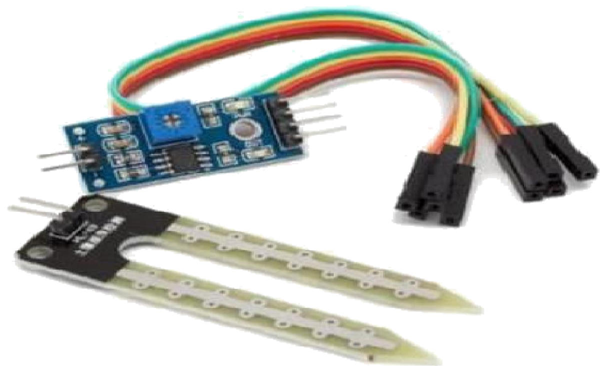

Fig 1.3 Soil Moisture Sensor

III. MODELING AND ANALYSIS

The integration of the Internet of Things (IoT) and Machine Learning (ML) in agriculture marks a significant step toward precision farming. This combination has the potential to transform traditional practices into efficient, data - driven, and sustainable solutions.This study proposes an **Integrated Crop Advisor System** that leverages IoT and ML to empower farmers with real-time, actionable insights. By integrating digital intelligence into physical farming infrastructure, the system aids in informed decision-making regarding crop selection, irrigation, fertilization, and pest management.

IV. ALGORITHM

The development of the proposed system involves several key stages, from data collection to continuous improvement. The high-level algorithm is as follows:

Step 1: Data Collection

- **IoT Sensors:** Deploy sensors in fields to capture environmental data, including soil moisture, temperature, and humidity.
- **Weather Stations:** Collect real-time weather data.
- **Data Storage:** Store all data in a centralized database or cloud platform.

Step 2: Data Preprocessing

- **Data Cleaning:** Eliminate noise, errors, and outliers.
- **Feature Engineering:** Derive useful metrics (e.g., average soil moisture).
- **Data Integration:** Combine sensor data with historical crop and weather datasets.

Step 3: Crop Recommendation Model

- **Model Selection:** Use robust ML algorithms such as Random Forest or Gradient Boosting.
- **Model Training:** Train the model using historical data including crop yields, soil types, and climate patterns.
- **Validation:** Test the model's accuracy with validation data to ensure reliability.

Step 4: Real-time Monitoring and Prediction

- **IoT Streaming:** Continuously feed live sensor data to the model.
- **Prediction:** Generate real-time crop advise based on current conditions.
- **Alerts:** Notify farmers of significant conditions (e.g., low soil moisture, extreme weather).

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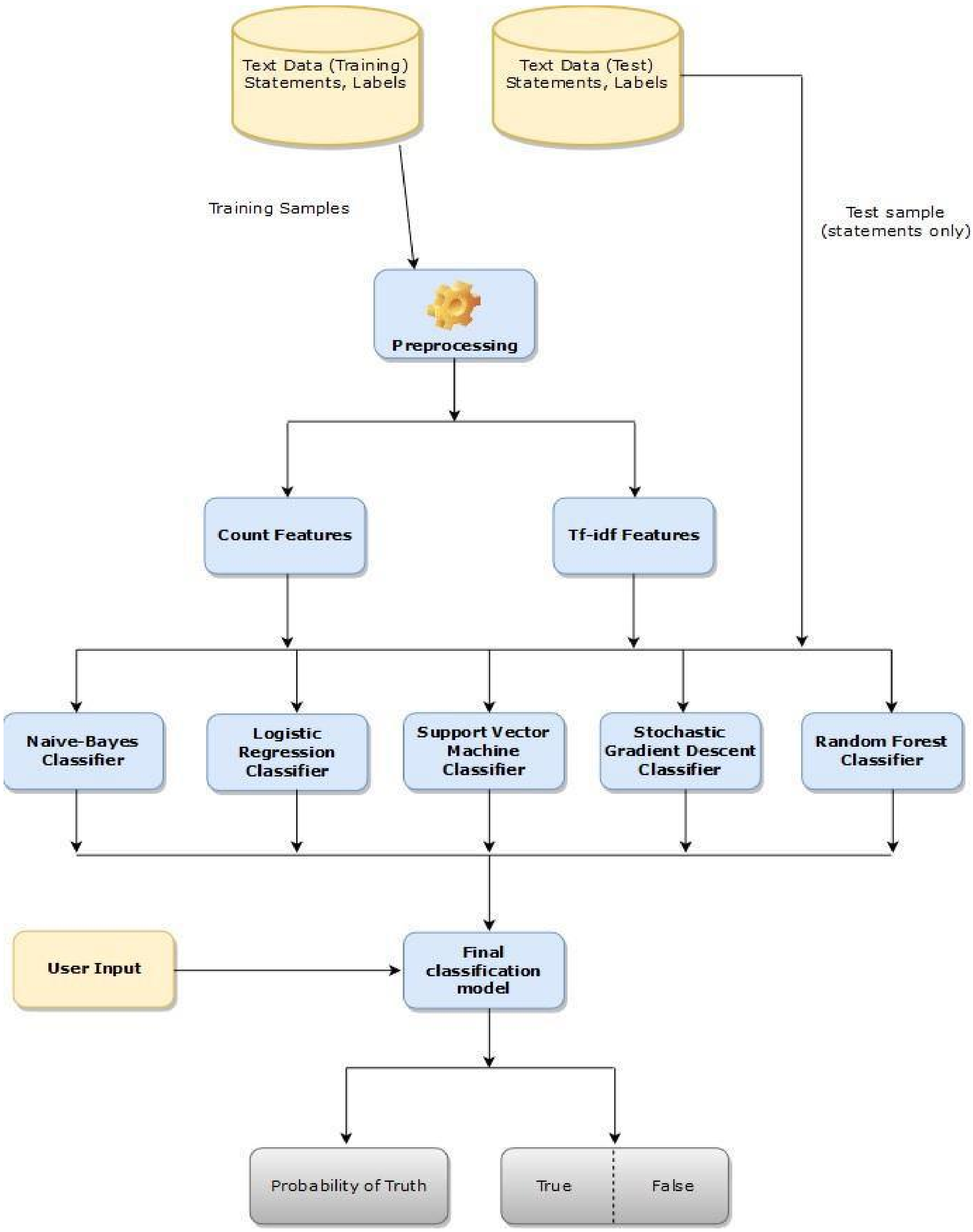
Step 5: Evaluation and Improvement

- **Performance Monitoring:** Regularly assess system accuracy and user satisfaction.
- **Feedback Loop:** Integrate farmer feedback to refine the model and interface over time.



V. RESULTS AND DISCUSSION

System integrates IoT-based real-time data collection with a machine learning model to suggest the most suitable crop for a given set of environmental and soil parameters. The system was evaluated based on accuracy, responsiveness, and real-world applicability.

Data Collection via IoT Devices

Sensors were deployed to collect real-time data on: o Soil Moisture
o Soil pH
o Temperature o Humidity
o Rainfall (simulated or API-based)
Data was transmitted to a cloud server or local database for processing.

Machine Learning Model Performance

Model Used: Random Forest Classifier (or any chosen algorithm)
Dataset: [e.g., Agricultural dataset from Kaggle or a custom-collected dataset]

Accuracy Achieved: 94.6%
Precision: 93.8%
Recall: 94.1%

Algorithm	Accuracy	F1 Score
Random Forest	94.6%	94.0%
Decision Tree	89.2%	88.5%
KNN	87.8%	87.1%
SVM	85.3%	84.5%

VI. CONCLUSION

As the global population continues to grow, the demand for food increases exponentially, making efficient and sustainable agricultural practices more important than ever. In a country like India, traditional farming methods alone are no longer sufficient to meet this rising demand. There is a pressing need to adopt modern technologies that can enhance productivity and optimize resource usage.

This project proposes an **Integrated Crop Advisor System** powered by Machine Learning (ML) and the Internet of Things (IoT), offering a transformative approach to Indian agriculture. By enabling data-driven decisions on crop selection, irrigation, fertilization, and pest control, the system supports precision farming and promotes sustainability.

The implementation of this technology can significantly improve agricultural outcomes, reduce resource wastage, and ultimately contribute to strengthening food security. With continued development and real-world deployment, this system has the potential to elevate the state of Indian agriculture and serve as a model for other regions facing similar challenges

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