Crop Recommendation System Using IOT and ML.

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Abstract: For there to be sustainability and global food security, the agriculture industry is essential. It is now essential to integrate contemporary technologies like machine learning (ML) and the Internet of Things (IoT) to maximize resource usage and increase agricultural productivity. An overview of a comprehensive crop recommendation system that uses IoT and ML to help farmers choose crops wisely is given in this abstract.

Our system uses Internet of Things (IoT) sensors and devices to gather data in real-time on a range of environmental characteristics, such as temperature, humidity, light intensity, and soil moisture. This data is sent to a central cloud platform, where machine learning algorithms are used to process and evaluate it. The machine learning approach considers past data, regional weather predictions, and soil properties to produce customized.

Key components of our Crop Recommendation System include:

1. 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.
2. Data Processing: Data from multiple sources, including IoT devices and external data providers, are processed and cleaned to prepare it for ML analysis.
3. Machine Learning Models: Various ML algorithms, such as decision trees, support vector machines, and neural networks, are trained on historical data to predict crop yields and optimal crop selections based on current conditions.
4. Recommendation Engine: The ML model generates crop recommendations tailored to specific fields or plots, considering factors like soil health, weather forecasts, and historical performance.
5. User Interface: The system offers an intuitive user interface accessible via web or mobile applications, allowing farmers to view recommendations, track the progress of their crops, and receive alerts or suggestions for crop management.
6. Feedback Loop: Farmers can provide feedback on the recommended crops and their outcomes, which can be used to further improve the accuracy of the system over time.

With the help of data-driven insights, we hope to equip farmers with the knowledge they need to choose crops that will maximize yields, waste minimally on resources, and boost total agricultural output. In a constantly evolving agricultural world, we address the urgent demand for efficient and sustainable farming techniques by using the power of IoT and ML. This technology has the power to transform agricultural methods, support environmental sustainability, and increase global food security.

I. INTRODUCTION

For millennia, agriculture has been the foundation of human civilization, giving innumerable communities all over the world food and a means of subsistence. With the world population continuing to rise in the twenty-first century, the agriculture industry is facing previously unheard-of difficulties. There has never been a more urgent need for sustainable methods, greater food production, and resource conservation. With the potential to bring in a new era of precision farming, technology appears as a ray of hope in this situation.

The use of machine learning (ML) and the Internet of Things (IoT) in farming techniques is one such technical advancement leading to this agricultural revolution. This collaborative strategy could make conventional farming a data-driven, effective, and long-term undertaking.

In order to transform agriculture, this study presents an Integrated Crop Recommendation System that makes use of ML and IoT. This technology attempts to deliver farmers data-driven insights so they may make informed decisions regarding crop selection, irrigation, fertilization, and pest management by seamlessly integrating digital intelligence with physical farming infrastructure.
II. LITERATURE REVIEW

1) “Enhancing precision agriculture by internet of thing and cyber physical systems. Authors: Roberto Fresco, Gianluigi Ferrari, Published in 2018”

This paper explores all the cutting-edge challenges and solutions required to implement the digital agriculture framework, intended as the evolution from Precision Farming to connected, knowledge-based farm production systems, in a context where digital technologies are first-class elements for the automation of sustainable processes in agriculture.

2) S. Siva Chandran, K. Balakrishnan, and K. Navin's "Real Time Embedded Based Soil Analyzer"

In this paper, Real time embedded based soil analyzer is used to do analysis of various soil nutrients parameters with the help of the pH value and the, soils Electrical Conductivity (EC). Depends on the pH value, The availability of various nutrients is calculated, adding today's technology towards agricultural fields, a cost-effective Real Time Embedded Based Soil Analyzer is to be designed with a rapid and dependable automated system that uses the pH value to analyses various soil nutrients.

3) “Farmer’s Handbook on Basic Agriculture, A holistic perspective of scientific agriculture by Dr. P. Chandra Shekara, Dr. N. Balasubramani, Dr. Ajit Kumar, Bakul C. Chaudhary, Dr. Rajeev Sharma”

An Organization of Ministry of Agriculture, Government of India brought this paper Farmer’s Handbook on Basic Agriculture out to impart technical knowledge on Basic Agriculture to farmers to provide holistic perspective of scientific Agriculture. The first chapter, "General circumstances for crop cultivation," discusses the basic needs of farmers and the farming industry by offering basic information of Good Agricultural Practices (GAP) and raising farmers' awareness of essential elements in crop choices and cropping patterns.


In this paper authors have presented a precision agricultural management integrated system architecture for monitoring vegetation condition of potato crop based on Cyber Physical System architecture and design technologies. The proposed system allows farmers to follow the evolution of certain parameters of interest and take appropriate decisions in order to increase agricultural productivity. Finally, the concept presented in this paper have represented the start for others researchers like us in the field of precision Agriculture.

5) “Smart Farming Prediction Using Machine Learning by S.R. Rajeswari, Parth Khunteta, Subham Kumar, Amrit Raj Singh, Vaibhav Pandey. Published on 7 May, 2019”

In this paper, authors explored the machine learning concepts that can help in improving agriculture. This paper studies various machine learning algorithms which can be used for agriculture data

6) “Artificial Intelligence in Agriculture by, Arka Bagchi Associate Consultant, Mindtree”

In this article, it is discussed that how AI can change the agriculture landscape, the application of drone-based image processing techniques, precision farming landscape, the future of agriculture and the challenges ahead. AI-powered solutions will not only allow farmers to do more with less, but they will also increase crop quality and speed up the time it takes for products to reach market.

III. ARCHITECTURE

Incorporating the Internet of Things (IoT) and machine learning (ML) into farming methods is one such technical advancement leading to this revolution in agriculture. This collaborative strategy has the capacity to convert conventional farming into an efficient, data-driven, and sustainable enterprise.

This research presents an Integrated Crop Recommendation System that will transform agriculture by utilizing the Internet of Things and machine learning. With this approach, farmers will be able to make data-driven decisions on crop selection, irrigation, fertilization, and pest management by seamlessly integrating digital intelligence with physical farming infrastructure.

1. Data Acquisition Layer:
   - IoT Sensors: Deploy various IoT sensors in the agricultural field to collect real-time data. These sensors can measure parameters like soil moisture, temperature, humidity, light intensity, and crop health.
   - Weather Data: Integrate with external weather APIs or weather stations to collect current and forecasted weather data, including rainfall, temperature, and wind speed.

2. Data Preprocessing:
   - Clean and preprocess the collected data to handle missing values, outliers, and noise. Data preprocessing also involves data normalization and transformation.

3. Data Storage:
   - Store the preprocessed data in a reliable database system, such as SQL or NoSQL databases, for easy retrieval and analysis.
4. Crop Database:
   - Maintain a comprehensive database of crop information, including growth requirements, ideal soil conditions, and historical crop performance data.

5. Machine Learning Models:
   - Develop ML models for various tasks:
     - Crop Selection: Use historical data and ML algorithms (e.g., decision trees, random forests, or deep learning models) to recommend suitable crops based on soil conditions, climate, and historical crop performance.

IV. ALGORITHM

There are various processes and elements involved in creating an integrated crop recommendation system that integrates machine learning and the Internet of things. A high-level algorithm to get you going is as follows:

Step 1: Data Collection
   - IoT Sensors: Deploy IoT sensors in the agricultural fields to collect data. These sensors can measure soil moisture, temperature, humidity, and other relevant parameters. Use IoT devices like weather stations to collect weather data.
   - Data Storage: Store the collected data in a centralized database or cloud storage for further processing.

Step 2: Data Preprocessing
   - Data Cleaning: Remove outliers and errors from the collected data.
   - Feature Engineering: Create relevant features from the raw data. For example, calculate the average soil moisture over a period.
   - Data Integration: Combine IoT sensor data with historical crop data and weather data to create a comprehensive dataset.

Step 3: Crop Recommendation Model
   - Select ML Algorithm: Choose a suitable machine learning algorithm for crop recommendation. Ensemble methods like Random Forest or Gradient Boosting often work well.
   - Training: Train the model using historical data, including crop yield, soil conditions, weather data, and other relevant features.
   - Validation: Evaluate the model's performance using validation data to ensure it provides accurate recommendations.

Step 4: Real-time Monitoring and Prediction
   - IoT Data Streaming: Continuously stream real-time IoT sensor data to the model.
   - Prediction: Use the trained model to make real-time crop recommendations based on current soil conditions and weather forecasts.
   - Alerts: Send alerts to farmers when specific conditions are met, such as low soil moisture or impending weather changes.

Step 5: User Interface
   - Dashboard: Create a user-friendly dashboard or mobile app for farmers to access recommendations and monitor field conditions.

Step 6: Evaluation and Improvement
   - Continuously evaluate the system's performance and gather feedback from users.
   - Make improvements to the recommendation model and user interface based on feedback and changing agricultural conditions.
Fig 1.0. Block Diagram 1
V. METHODOLOGY

1) **Arduino UNO:**
The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

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.
VI. CONCLUSION

The public's need for food is growing daily as a result of population growth, so farming practices are crucial to meeting this demand. India's traditional agricultural methods will not be sufficient to feed this vast population. To accomplish that, our farmers must implement new technologies. With the help of this project, we can move closer to improving Indian agriculture over its current state.

This work focuses on the features of textual news content. It's true that obtaining other social media-related features is challenging. For instance, it can be challenging to find users and post information on Facebook. Furthermore, the various datasets that have been made available in the style-based model only offer textual data.

It is evident from examining various methods for detecting fake news that supervised and unsupervised learning models using textual news content will receive most of the attention. It should be noted that machine learning models typically trade off recall for precision. This means that a model that excels at identifying fake news may also have a high false positive rate, whereas a model with a low false positive rate may struggle to identify them.

VII. Future Scope

A. The project's future potential is enormous. Large-scale implementation of this project is possible in the future. The project is very flexible in terms of expansion, so it can be upgraded in the near future as and when the need for it arises. Given the rapid population growth and the emergence of numerous new technologies over time, it is imperative that the agricultural sector progress in tandem with these developments.

B. This project's scope is restricted to crop prediction based on N, P, K, humidity, moisture content, pH, and temperature. To improve the precision and accuracy of the prediction, we can add even more attributes to this list.

C. For some input data, the Soil Health Card is utilized because it is an affordable option. However, we can also use pH, N, P, and K sensors to gather the same data from the field.

D. This project only focuses on crop prediction; however, it is possible to add additional functionality, such as recommendations for fertilizer, water management, pest control, crop protection from climate change, etc.

REFERENCES

[1] Enhancing precision agriculture by internet of thing and cyber physical systems. Authors: Roberto Fresco, Gianluigi Ferrari, Published in 2018
[7] Artificial Intelligence in Agriculture by Arka Bagchi Associate Consultant, Mindtree