

PREDICTIVE ANALYTICS FOR CROPS

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ABSTRACT

This paper presents the development of a crop prediction system leveraging Internet of Things (IoT) and Machine Learning (ML) to optimize agricultural productivity. Using real-time data collected from IoT sensors, the system evaluates critical environmental factors like soil moisture, pH, temperature, and humidity. It employs advanced machine learning algorithms to recommend the most suitable crops for specific environmental conditions. The solution aims to empower farmers by providing data-driven insights, improving crop yield, and promoting sustainable farming practices. This user-friendly system integrates cloud-based accessibility to ensure remote real-time monitoring and decision-making.

Keywords: Crop Prediction, Machine Learning, IoT, Sustainable Farming, Data Analytics

1. INTRODUCTION

Agriculture remains the backbone of the global economy, yet traditional practices face challenges such as climate change, resource depletion, and inefficient decision-making. IoT and ML technologies offer innovative solutions for overcoming these hurdles by introducing precision agriculture. IoT sensors provide real-time environmental data, which, when analyzed through ML algorithms, enables data-driven crop recommendations tailored to specific conditions. This paper focuses on the design and implementation of a scalable crop prediction system aimed at enhancing productivity and sustainability.

2. METHODOLOGY

This study integrates IoT and ML to collect, process, and analyze agricultural data for crop prediction. The methodology involves deploying IoT sensors to capture environmental parameters, processing the data using machine learning models, and providing real-time predictions through a mobile application.

2.1 Data Collection

IoT sensors, including soil moisture sensors, pH meters, temperature monitors, and humidity sensors, are deployed to collect environmental data. These sensors are integrated with an Arduino microcontroller and ESP8266 Wi-Fi module for real-time data transmission to a Firebase Realtime Database.

2.2 Data Processing and Prediction

The system uses Decision Tree Regression to analyze sensor data and predict suitable crops. The training dataset comprises historical agricultural data, including crop requirements and environmental conditions.

2.3 System Architecture

The proposed architecture incorporates:

1. Hardware: Sensors, Arduino, ESP8266
2. Software: Firebase, Python libraries (NumPy, Scikit-learn), and Flutter for the mobile interface
3. Cloud Integration: Ensures remote accessibility and real-time data analytic

2.4 User Interface

A mobile application developed using Flutter provides an intuitive interface for farmers. It displays real-time environmental conditions, crop predictions, and actionable recommendations.

3. MODELING AND ANALYSIS

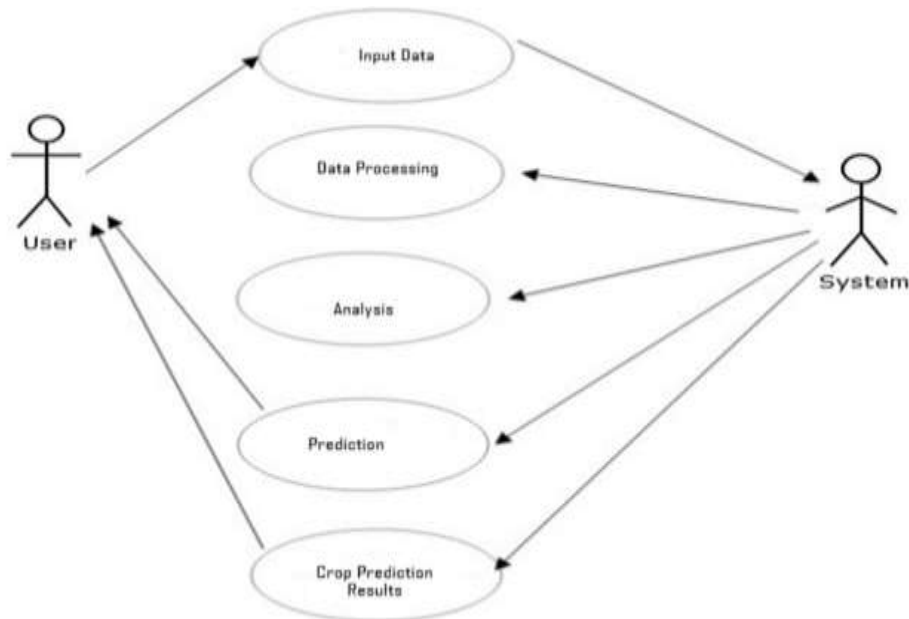


Figure 1: Procedure followed.

4. RESULTS AND DISCUSSION

The system was tested on a dataset comprising environmental parameters and crop yields. Key outcomes include:

- **Accuracy:** The Decision Tree Regression model achieved a prediction accuracy of 85%, with room for improvement through more extensive training datasets.
- **User Accessibility:** The mobile application facilitated seamless data visualization and decision-making.
- **Sustainability:** Optimized resource use and reduced crop failure risk were observed, promoting sustainable farming practices.



Figure 2: Page displaying types of crops to be cultivated.

5. CONCLUSION

This crop prediction system exemplifies the potential of IoT and ML in revolutionizing agriculture. By providing farmers with precise, data-driven insights, the system enhances productivity, minimizes resource waste, and fosters sustainable practices. Future work will focus on expanding the crop database and integrating market analytics to further optimize farming decisions.

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