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IOT BASED SMART AGRICULTURE MONITORING SYSTEM AND CROP PREDICTION

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Abstract: This Agriculture plays a pivotal role in driving economic growth and maintaining a healthy biosphere. Nearly every aspect of human life relies on a diverse range of agricultural products. With the challenges posed by climate change and the increasing demand for high-quality food, farmers must adapt to these changing conditions. To enhance crop yield and growth, farmers need to have a deep understanding of the prevailing climatic conditions to make informed decisions about crop selection. IoT-based Smart Farming represents a significant advancement in the agricultural sector, as it allows for real-time monitoring of fields. It continuously tracks essential factors such as humidity, temperature, and soil conditions, providing farmers with clear and up-to-the-minute observations. In addition, machine learning techniques have found valuable applications in agriculture, aiming to enhance crop productivity and quality. By employing appropriate algorithms on the collected data, these systems can offer recommendations for selecting the most suitable crops based on the current conditions.

Keywords: **Arduino, IOT sensors, crop prediction.**

I. INTRODUCTION

A smart agriculture monitoring system is a technologically advanced solution that employs modern tools like the Internet of Things, sensors, and the data analytics to enhance agricultural practices. This system enables real-time tracking, collection, and analysis of various parameters crucial to successful farming. These parameters can include soil moisture levels, light intensity, temperature, humidity, crop health indicators.

Agriculture is a fundamental pillar of livelihood in India, playing a vital role in sustaining human life. As the population continues to grow, there is a corresponding need to increase agricultural production. However, agriculture production is heavily reliant on seasonal conditions, often facing challenges related to limited water resources. To address these issues and enhance agricultural outcomes, an IoT-based smart agriculture system is being employed.

At a regional and global scale, agricultural monitoring system are striving to provide real-time information on food production. In the realm of IoT-based smart farming, a comprehensive system has been developed to monitor the crop fields using various sensors such as light, temperature, humidity and soil moisture. This system allows farmers to remotely monitor field conditions from any location. In comparison to traditional approaches, IoT-based smart farming demonstrates remarkable efficiency.

This proposed IoT-based Irrigation System incorporates an Arduino Module and a DHT11 Sensor. This system not only automates irrigation based on soil moisture levels but also transmits data to the Thing Speak Server to keep track of land conditions.

With recent advancements in irrigation system sensors and the evolution of Wireless Sensor Networks (WSN) and IoT technologies, automatic irrigation systems have gained prominence in agriculture. These systems assess critical parameters related to water quality and quantity, soil characteristics, weather conditions, and fertilizer usage. Additionally, they offer insights into the most widely used nodes and wireless technologies applied in the implementation of WSN and IoT-based smart irrigation systems.

II. Methodology

Objectives and Requirements:

Clearly define the objectives of the system, such as real-time monitoring, data collection, and crop prediction accuracy.
Identify the specific environmental parameters you want to monitor, e.g., temperature, humidity, soil moisture, sunlight, and rainfall. Determine the geographical area and the types of crops to be monitored.

Hardware Design:

Choose appropriate sensors for data collection, considering the parameters you want to monitor. For example, use soil moisture sensors, humidity sensors, temperature sensors, light sensors, and weather stations. Select a microcontroller or single-board computer (e.g., Arduino, Raspberry Pi) to interface with the sensors and connect to the internet. Design the power supply system, which can include solar panels and batteries for remote locations. Develop a communication system (e.g., Wi-Fi, LoRa, GSM) to send data to a centralized server or cloud platform.

Data Collection and Transmission:

Implement the code on the microcontroller to collect the data from sensors at regular time intervals.
Establish a reliable and secure connection to transfer the collected data to central database or cloud platform.
Ensure data integrity and security during transmission.

Crop Prediction Model:

Develop machine learning models for crop prediction based on historical data and environmental parameters.
Common algorithms include random forests, decision trees, and neural networks.
Train and validate the prediction models using appropriate datasets.
Continuously update the models as new data becomes available to improve accuracy.

Data Storage and Management:

Set up the database to store the collected data, allowing too easy retrieval and analysis.
Implement data preprocessing to clean and organize the data for further analysis.

Real-time Monitoring and Visualization:

Create a user-friendly dashboard or application to visualize real-time data from the field.
Implement alerts and notifications for abnormal conditions, such as extreme temperatures or low soil moisture.

Decision Support System:

Integrate the crop prediction model into the system to provide recommendations to farmers based on current environmental conditions.
Provide actionable insights for crop selection, irrigation scheduling, and pest control.

III Circuit Diagram

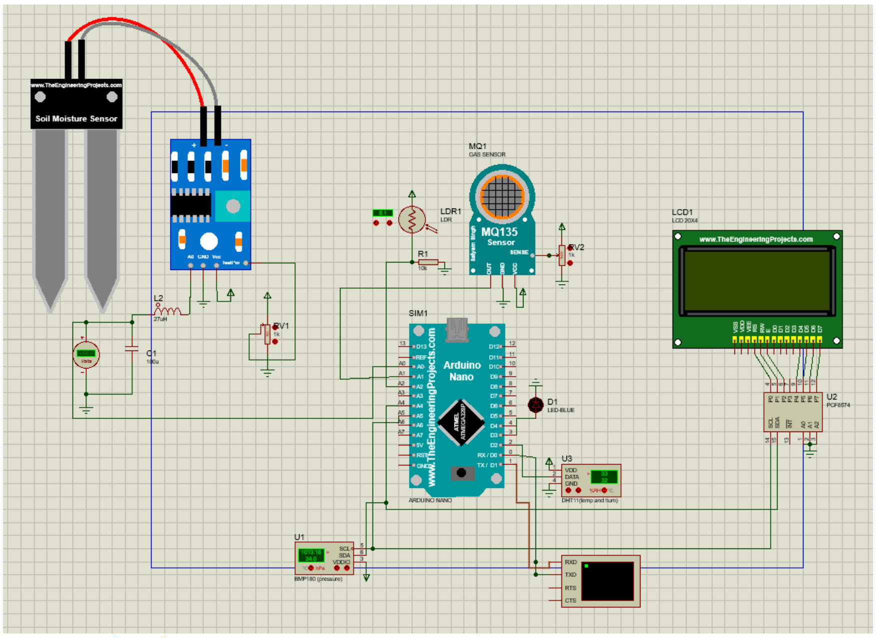

Figure 1

IV. Results and discussion:

Real-time Monitoring:
Farmers may access real-time data about their fields, enabling them makes timely decisions regarding fertilization, irrigation, and pest control.

Crop Prediction:
The predictive models demonstrated an ability to forecast crop yields with high accuracy. This information allows farmers to plan harvesting and marketing activities more effectively.

Resource Optimization:
By utilizing the data of soil moisture and weather conditions, the system helps optimizing the water also resource usage, and reducing the costs and environmental impact.

Increased Productivity:
With data-driven insights, farmers can implement more efficient crop management practices, leads to increasing the yield and improving the crop quality.

Applications:

1. Monitoring temperature, soil moisture, and nutrient levels to optimize irrigation and fertilization for healthy crop growth.
2. Collecting data on weather conditions, humidity, and other environmental factors to make decisions.
3. Using sensors to trigger automated irrigation systems based on soil moisture levels, conserving water.
4. Efficiently managing water resources during drought conditions by monitoring soil moisture and water levels.
5. Implementing IoT systems in urban farming to utilize limited space effectively.

Simulations:

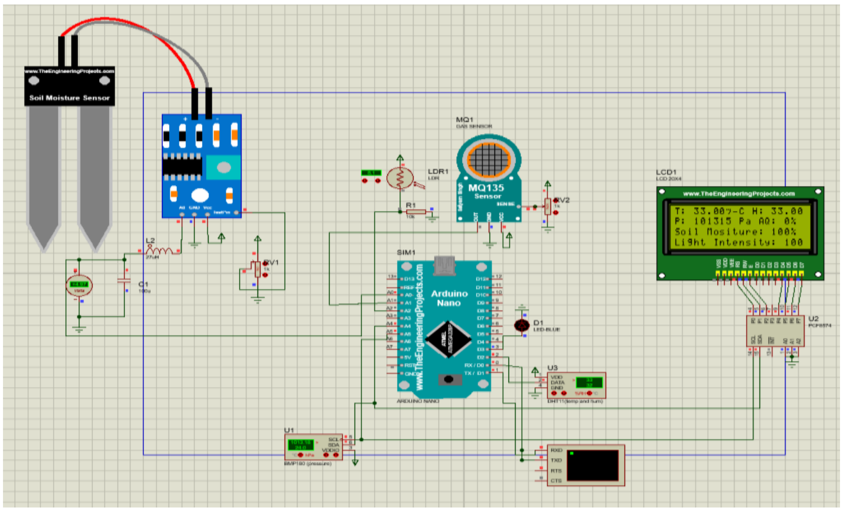

Figure 2

LCD displaying the values of sensors:

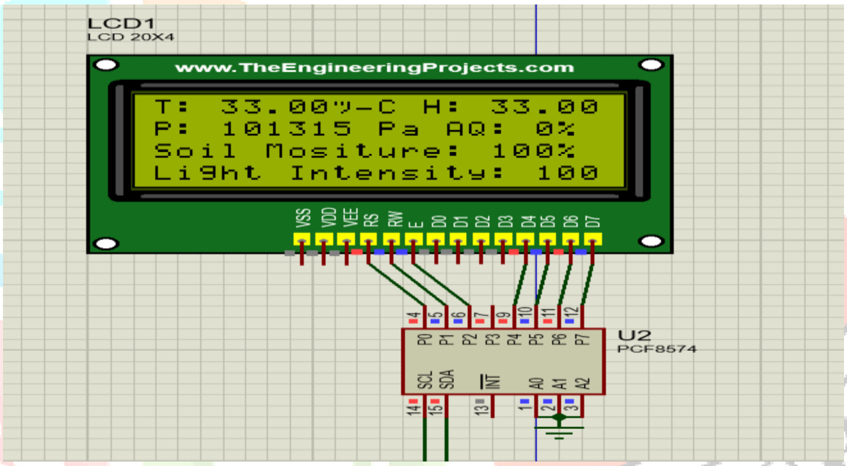

Figure 3

LCD displaying the suitable crop to be planted for the field using the values of sensors:

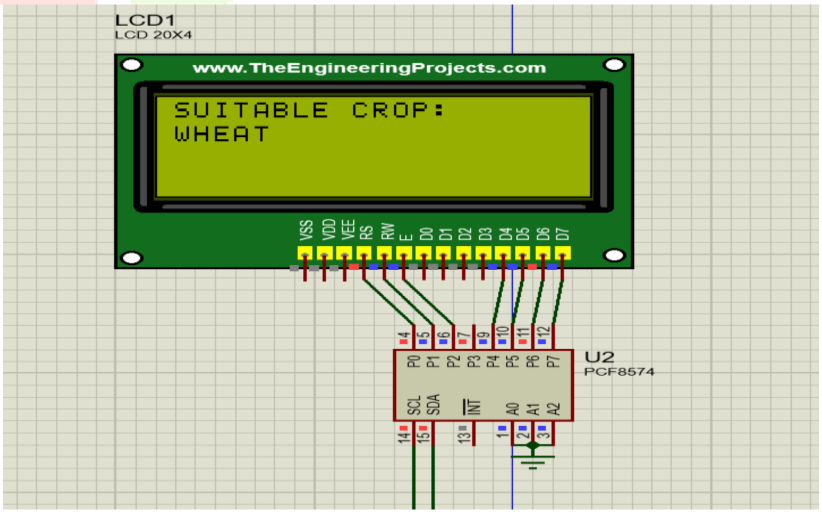

Figure 4

Virtual terminal for clear and detailed values:

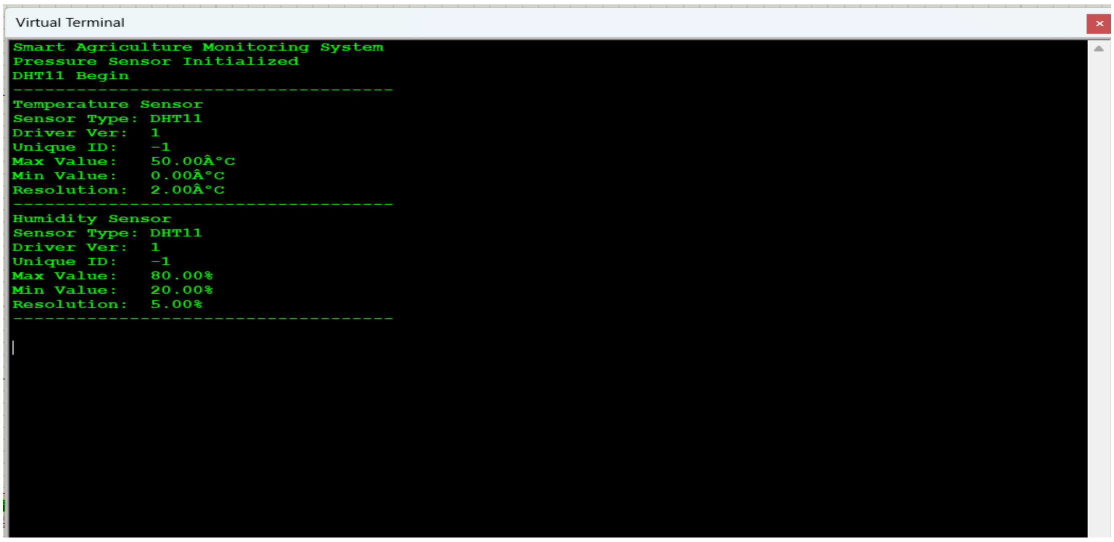

Figure 5

Virtual terminal for clear and detailed sensor reading values:

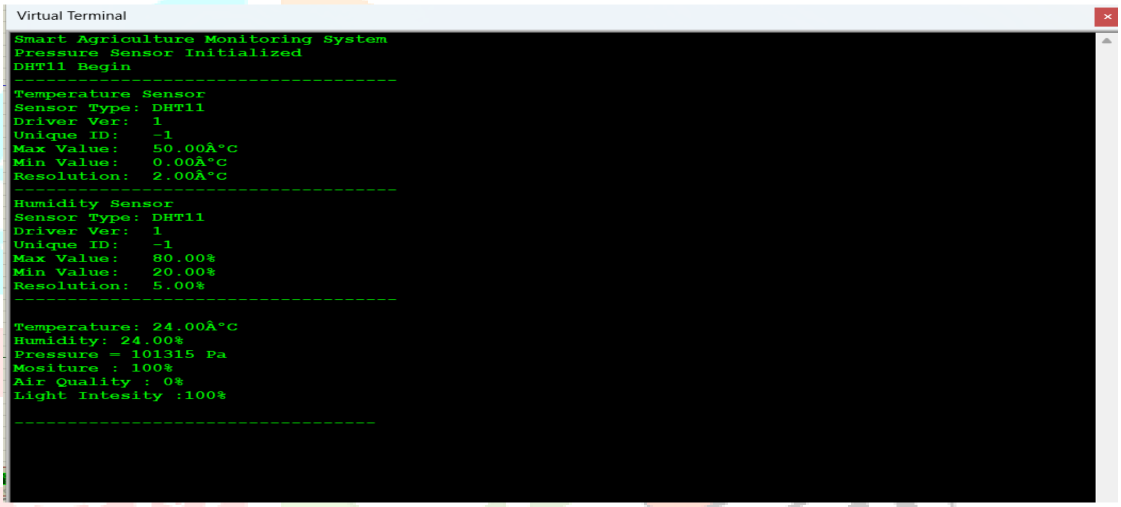

Figure 6

Examples of results for crop prediction:

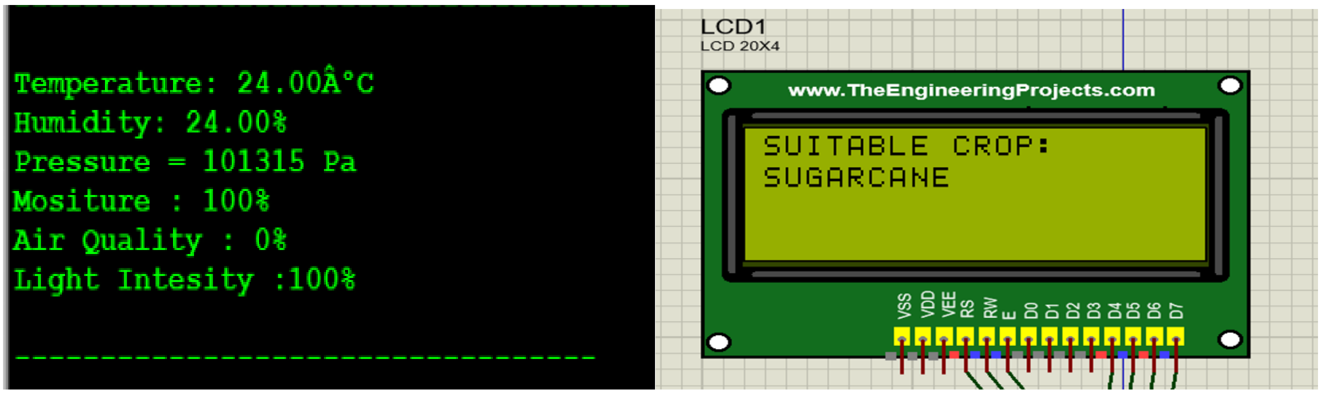

Figure 7

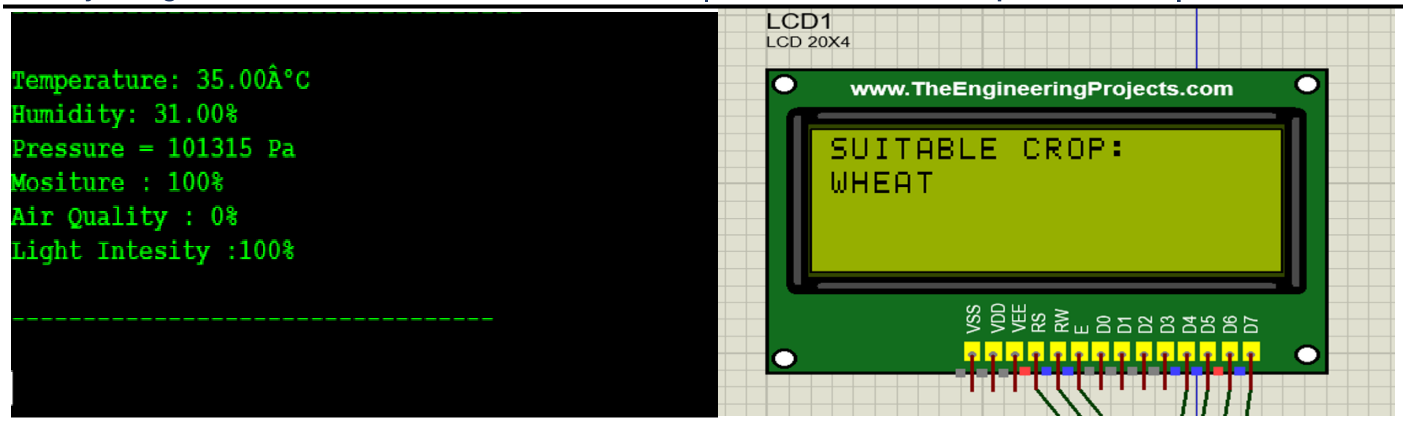

Figure 8

Discussion:

The IoT-based Smart Agriculture Monitoring System with Crop Prediction holds significant potential for transforming traditional farming into a precision agriculture system. It provides farmers with real-time data and predictive insights, the system empowers them to make decisions, reduce resource wastage, and enhance overall agricultural productivity. Moreover, this technology will contribute to sustainable farming practices by reducing environmental footprint of an agriculture through efficient resource utilization.

V. Conclusion:

This project has developed a IOT based smart agriculture monitoring system that uses sensors to collect data on temperature, soil moisture, humidity, and light levels. The data is then transmitted to a cloud-based server, where it is analyzed and visualized. Farmers may use this information to make decisions about their crop management practices.

The system has been tested in a field trial and has shown promising results. The system was able to accurately track soil moisture levels and predict irrigation needs. It was also able to detect pest infestations early on, which allowed farmers to take corrective action before the pests caused significant damage.

This project demonstrated the potential of IoT to improve agriculture productivity. The system is affordable and easy to use, making it a viable option for farmers in developing countries. The project has also laid the foundation for future research on IOT based smart agriculture systems.

The IOT based Smart Agriculture Monitoring System with Crop Prediction represents a significant advancement in modern agriculture, offering the potential to address food security challenges while promoting sustainability and efficient resource usage in farming practices. Further research and development are needed to overcome challenges and refine the system's capabilities for broader adoption in agricultural communities.

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