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Greenhouse Monitoring and Controlling System using ARM

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Abstract—The greenhouse monitoring and controlling can be done by using various technologies. The purpose of this project is to identify field conditions and offer field-related information. This includes an ARM7 processor, an LCD display, a GSM, and a few sensors. LCD will be used for field displays. A Subscriber Identity Module (SIM) that a user can communicate via this SIM-Number which is included in the GSM module. The corresponding sensor instantly activates in response to a specific command issued by the user, reads the current reading, sends the results to the user's mobile device, and displays the information on the field's LCD panel. If required, the appropriate action will be taken right away. Because of the automatic working of this project, it reduces the manpower.

Keywords—ARM7 LPC2148 Microcontroller, Sensors, GSM Modem, User Mobile phone

I. Introduction

The use of technology has led to significant changes in the agricultural industry, with farmers adopting advanced techniques to improve crop yield, quality, and efficiency. One of the most significant advancements in this area is greenhouse farming, which provides a controlled environment for optimal plant growth. By precisely managing factors such as pH levels, soil moisture, water levels, temperature, humidity, and light intensity, greenhouse cultivation can help increase productivity. In recent years, the integration of microcontroller-based systems with sensor technologies has made it possible to monitor and control greenhouse environments in real time.

This project uses an ARM 7 Microcontroller. The system integrates six essential sensors, including pH, soil moisture, water level, temperature and humidity, PIR, Light Dependent Resistor (LDR), and a GSM Modem along with SIM. The primary goal of the project is to develop a reliable, cost-effective, and scalable solution for greenhouse management that meets the increasing demand for sustainable agricultural practices. By utilizing the capabilities of the ARM 7 Microcontroller and sensor technology, the project aims to optimize resource utilization, enhance crop productivity, and reduce environmental impacts associated with traditional farming methods.

This system provides a solution for the optimization of water use, security of the greenhouse, determining the nature of soil and weather monitoring.

II. Block Diagram

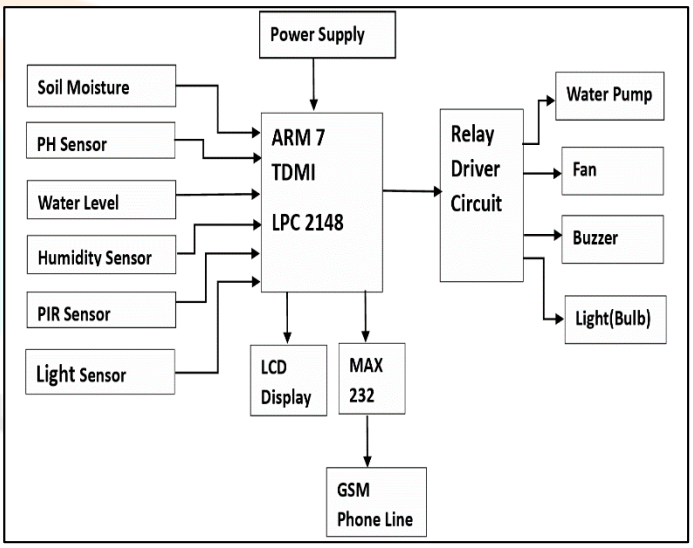


Fig. 1. Block diagram

III. Implementation of System

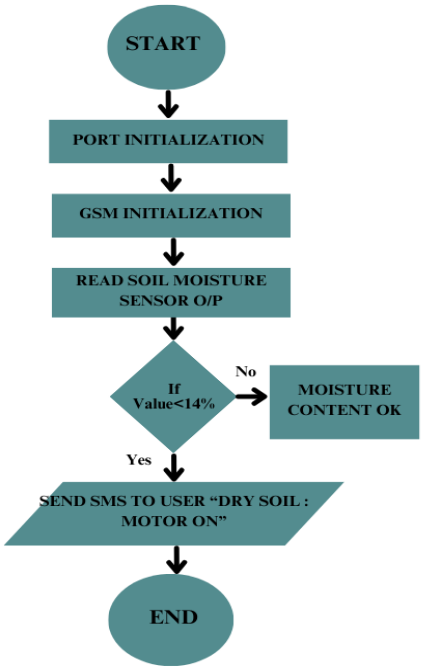
This system includes a microcontroller, sensors and a GSM phone line. If one of the parameters of the sensors exceeds the safety threshold that must be maintained to protect the crop. These sensors detect the change and the microcontroller reads it from the data on its input ports after

the microcontroller's ARM 7 ADC converts it to digital form. The microcontroller then takes the necessary actions using relays until the divergent parameter is reset to the optimal level. However, since the microcontroller is used as the heart of the system, it makes installation cheap and efficient. This system consists of various sensors, namely soil moisture, humidity, temperature, pH, PIR, water level and light sensors.

The whole system is divided into 4 sub-systems which are as follows:

A. Irrigation System

Software Design of Soil Moisture Sensor



This system uses water level and soil moisture sensors. A water level sensor is used to determine whether water is available in the tank or not. The soil moisture sensor checks the conductivity of the soil.

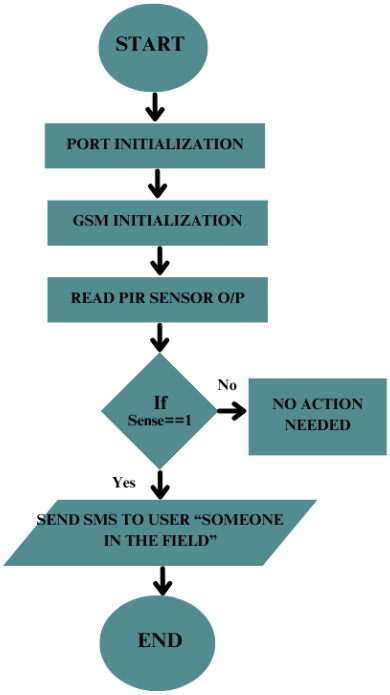
1) When the field is wet, the conductivity is higher and the resistance is lower.
2) When the field is dry, the conductivity is lower and the resistance is higher
   The moisture value will be sent to the user through GSM. and depending on this we can turn ON/OFF the water pump/motor.

B. Intruder Detection

Nowadays security in the agricultural field is very important. Intentional destruction or contamination of crops is a possibility that producers must guard against. A system has been designed to protect the crop in the field. The system is implemented which detects any intruder entering the field by using a PIR sensor. A PIR sensor can detect the motion.

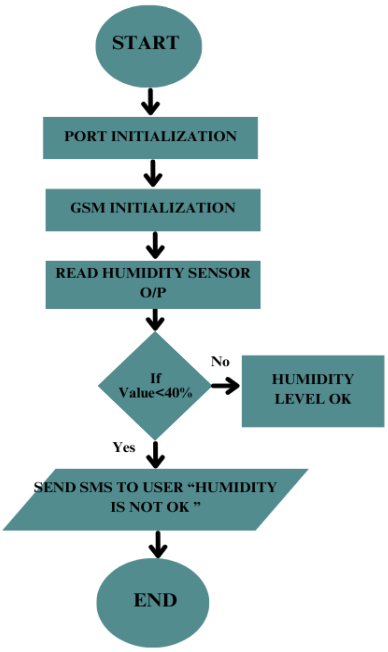
The PIR sensor is interfaced with the ARM7 microcontroller. Suppose if any intruder is detected then the buzzer will automatically turn on and the message "Intruder Detected" will be displayed on LCD and the message will be sent to the user through GSM.

Software Design of PIR Sensor



C. Weather Monitoring

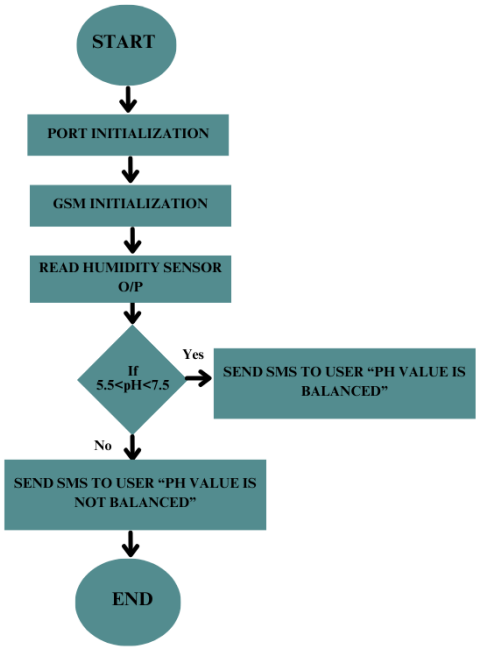
Software Design of Humidity Sensor



LDR, Temperature and humidity sensors are used to monitor weather conditions and depending on the input the fan and the light can be controlled. In the light detector, we use one LDR (light-dependent resistor). The resistance of LDR depends on the light intensity. When the light of the LDR changes, the resistance of the LDR also changes.

D. Determine the Soil nature

Software Design of pH Sensor



The system determines the soil's nature by determining the various pH levels in the soil. The pH level can be acidic, neutral or alkaline. Soil pH is a measure of the acidity and alkalinity in soils. pH levels range from 0 to 14, with 7 being neutral, below 7 acidic and above 7 alkaline. The optimal pH range for most plants is between 5.5 and 7.0. The pH sensor is used to measure the pH of soil the sensor is connected to the ARM7 through in-built ADC. The pH value and the soil nature are displayed on LCD. Thus, by knowing the pH level in the soil, the farmer can decide which fertilizer can be used on the crops. The pH value will be sent to the user through GSM.

IV. Result

1. Real-Time Monitoring: The implemented system successfully achieves real-time monitoring of greenhouse conditions, allowing users to access up-to-date information regarding temperature, humidity, soil moisture, and other relevant parameters.

2. Remote Accessibility: Leveraging GSM technology, the system enables remote access to greenhouse data via users' mobile phones. This functionality empowers users to monitor and control the greenhouse environment from anywhere with cellular network coverage.

3. User Interaction: Through the Subscriber Identity Module (SIM) integrated into the GSM modem, users can communicate with the system using their mobile phone numbers. This interaction mechanism facilitates seamless communication and command issuance to the greenhouse monitoring and control system.

4. Automated Response: Upon receiving user commands, the system autonomously activates specific sensors, retrieves current readings, and transmits the data to users' mobile devices. This automated response mechanism ensures prompt and accurate delivery of information, enhancing operational efficiency.

5. Data Visualization: The LCD display integrated into the system provides a visual interface for displaying field related information. Users can conveniently view sensor readings and other relevant data directly on the field's LCD panel, enabling quick assessment of greenhouse conditions.

6. Reduced Manpower: The automated functionality of the system significantly reduces the need for manual intervention in greenhouse operations. By automating monitoring and control tasks, the system minimizes manpower requirements and streamlines agricultural management processes.

7. Efficient Decision-Making: By providing timely and accurate field data, the system facilitates informed decision-making regarding greenhouse management. Users can promptly respond to changing environmental conditions and implement appropriate actions as needed, thereby optimizing crop cultivation outcomes.

V. Conclusion

The project is thus carried out using ARM7 TDMI core with the help of GSM technologies. This project is a prototype design that implements the solution for irrigation systems, monitoring plant growth, field security, and distant monitoring. The project that we have developed is just a prototype that acts as a preliminary version of a device and where we can extend the sensor for longer meters and a longer range. So, this can be developed in real-time application.

Future Scope

1. This project is a prototype design that implements the solution for irrigation systems, monitoring plant growth, field security, and distant monitoring.

2. The project that we have developed is just a prototype that acts as a preliminary version of a device and where we can extend the sensor for longer meters and a longer range. So, this can be developed in real-time application.

3. Therefore, in future a system can be built that maintains the field on its own with the help of IoT functionality and an embedded robotic System that works in association with a water quality measuring system, to automatically maintain the various parameters of the field without affecting the life or growth of crops. This consequently leads to reduce the demand for manpower and an increase in the growth rate.

4. Along with this, we can use an NPK sensor and datasheet and depending on the values of nitrogen, phosphorus and potassium we can predict which crop can be taken in agriculture.

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