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IOT BASED GREENHOUSE MONITORING AND CONTROL SYSTEM

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ABSTRACT: With industrialization and continuously evolving climatic conditions, the urge to practice agriculture with the fusion of technology has become a necessity. In the era of Internet of Things where all eyes are witnessing the evolution of machine-to-machine interaction, there is also a lack of clarity in considering the type of protocol to be used in building a particular system like Green House. A green house is a regulated environment for agriculture where critical parameters like temperature, light, humidity, ph level of soil can be monitored with the help of sensor systems using Internet of Things protocols. Message Queue Telemetry Transfer protocol was chosen over Constrained Application Protocol and Extensible Messaging and Presence Protocol in the experiment conducted in terms of its light weight transmission, resource consumption and effectively providing the different quality of services to detect the temperature and humidity as well as the gas leaks encountered in a greenhouse environment.

Keywords: Greenhouse, Internet of Things, Message Queue Telemetry

1. INTRODUCTION

The agriculture is the backbone of India's economic activity. More than 50% of India's population relies on agriculture and it contributes about 14% to the overall GDP. A Greenhouse can be defined as a close structure which is used to protect the plants from external factors such as climatic conditions, pollution, etc. The crop agriculture in greenhouse is highly affected by the surrounding conditions. Basic factors affecting plant growth are sunlight, water content in soil, temperature, humidity etc. In IOT - based smart greenhouse farming, a system is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automating the irrigation system.
(A)Temperature Control: Temperature influences most plant development process including photosynthesis, transpiration, absorption, respiration and flowering. In general, growth is promoted when the temperature rises and inhibited when temperature falls. Each species of plant has a different temperature range in which they can grow. Below this range, processes necessary for life stops, ice forms within the tissue, tying up water necessary for life processes. Above this range, enzymes become inactive and again process essential for life stops.
(B) Humidity Control: Humidity is important to plants because it partly controls the moisture loss from the plant. The leaves of plants have tiny pores, CO2 enters the plants through these pores, and oxygen and water leave through them. Transpiration rates decrease proportionally to the amount of humidity in the air. This is because water diffuses from areas of higher concentration to areas of lower concentration.
(C) Moisture Control: Plants take water from the root system and lose water through transpiring leaves. Large amount of water is lost through transpiration process. The rate of water lost depends on the condition of soil, air flow, relative humidity in air and the temperature of the environment. Hence soil moisture level is needed to be considered.

2. LITERATURE SURVEY

[1] **Smart Design of Microcontroller Based Monitoring System for Agriculture –**
They have used microcontroller-based monitoring system which was developed and which monitors different environmental parameters like soil moisture, relative humidity and atmospheric temperature. Values of those parameter were transmitted wirelessly using radio frequency wireless module to central unit via microcontroller. Different experiments were performed by them to examine sensors as well as wireless module. It was found that there was little variation in moisture sensor's reading when it was exposed to different temperature. Wireless module worked effectively when introduce to various obstacles. Actual implementation of their system on large scale was challenging task for them.

[2] **Micro Controller Based Automatic Plant Irrigation System –**
They proposed an automatic irrigation system which helps in saving money and water. The entire system is controlled using 8051 microcontroller which is programmed as giving the interrupt signal to the sprinkler. Temperature sensor and humidity sensor are connected to internal ports of micro controller via comparator. Whenever there is a change in temperature and humidity of the surroundings these sensors senses the change in temperature and humidity and gives an interrupt signal to the micro-controller and thus the sprinkler is activated.

[3] **A wireless sensors network for monitoring environmental variable in a greenhouse –**
They proposed a research work in a tomato greenhouse in the South of Italy. They are using sensor devices for the air temperature, pH of water and CO2 level measurements with wireless sensor network. They have also developed a Web-based plant monitoring application. Greenhouse grower can read the measurements over the internet.

3. METHODOLOGY

Hardware used: Microprocessor- ESP32, LCD- 20*4, 2-channel 5V Relay module, 1-channel 12V relay module, Voltage regulator- 7805, Heat sink, Temperature and Humidity sensor- DHT11, LDR module, Soil moisture sensor, Bulb, Fan, Water-pump, Jumper wires.
Hardware.

Components	Purposes
Perspex	The main structure for the greenhouse.
DAQ Card (PCI-6024E)	The interface device between the hardware and software
Light Dependent Resistor (LDR)	The sensor to measure light intensity.
Precision Centigrade Temperature Sensor (LM35CZ)	The sensor to measure the temperature.
Power Resistor (5W)	The heating element for the greenhouse.
Light bulb (9V 5W)	The main source of lighting for the greenhouse. Also act as the control element for the light.

Light Emitter Diode (LED)	The indicator for the greenhouse. Also provide indication for alarm.
Fan	The control elements to regulate the greenhouse's temperature
DC Power Supply	The main supply for the greenhouse.

Table 1: Hardware

Software used: Arduino IDE, Blynk IoT Application

Components	Purposes
National Instrument's LabVIEW 6i	The main programming software for the system.
Microsoft Office 2010	The software to complete the documentations

Table 2: Software

System Architecture:

The proposed system consists of the sensing part, controlling part, monitoring part and a message sending and receiving part. In the monitoring part the sensors included are temperature sensor, humidity sensor, soil moisture sensor and Light detection sensor. These sensors will sense the various parameters of the environment. And the values will be displayed on an LCD display. These sensors are connected to the microcontroller ESP32 which is the controlling part. The actuators (Fan, Pump, Bulb) are switched ON based on the instruction passed to the microcontroller. An LCD is employed to show the condition inside the greenhouse. The system works in such a way that when the environmental parameters cross a safety threshold, the sensors detect a change and the microcontroller reads the data from its input ports and performs the suitable action in order to bring the parameter back to its required level. The microprocessor will continuously display climatic conditions on LCD and will send this data over internet and the user using Blynk IoT application will get the climatic report.

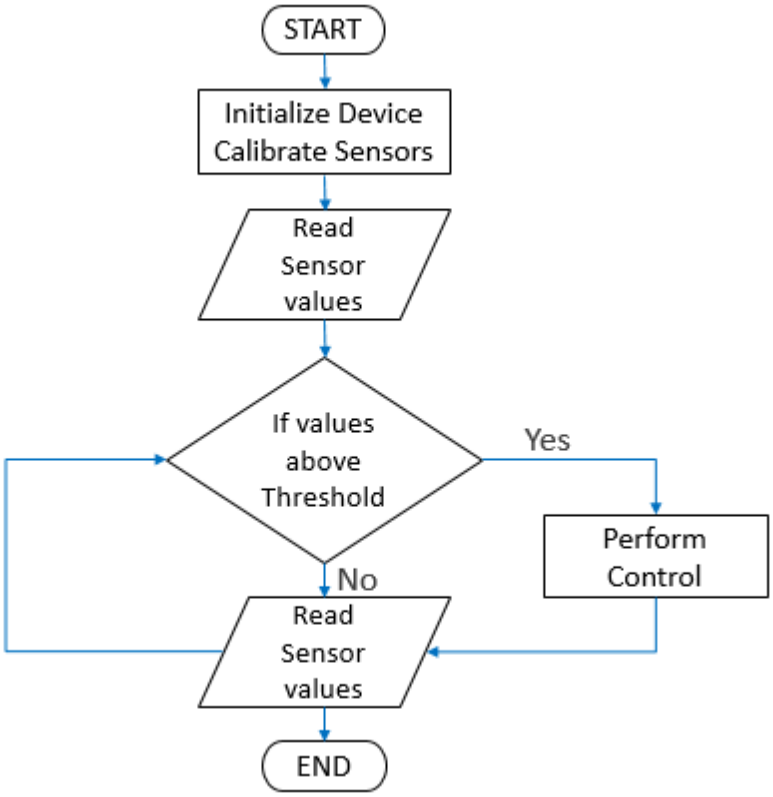

Figure: Flow chart

4. THE PROPOSED GREENHOUSE SYSTEM

Recently, the developments in the field of the IoT technology have led to renewed interest in developing the greenhouse technology. The pleasant was complaints from several things such as keep track the irrigation process and having to do it manually. Also, the plants may suffer from bad circumstances like temperature and light. The major objective of this paper is to develop practical smart greenhouse with three intelligent control systems in order to obtain suitable circumstances. The proposed system has the ability to monitor and control the greenhouse from any place in the world. Fig. 1 depicts the block diagram of the entire system.

The overall designed system could be divided into three important parts; hardware, software, and IoT structure.

A. Hardware Design:

The system compromises numerous tools that are utilized to obtain the desired system. The tools are explained in two sections (Sensing and Actuators):

a) Sensing:

In order to apply the automation process on a given system, sensors are required. The adopted intelligent control system is fed by sensor information. Several types of sensors are used including:

1) Temperature and Humidity sensor (Htd11): is new advanced temperature moistness sensor that has many favorable circumstances, for example, small size, basic interface, quick reaction, and inexpensiveness.

2) *The Soil humidity Sensor uses capacitance*: measure the water in a soil by computing the dielectric tolerance of the soil, which is a component of the water .

3) *A Light Dependent Resistor (LDR) or a photograph resistor:* is a gadget whose resistivity is a component of the occurrence electromagnetic radiation. Subsequently, they are light sensitivity gadgets.

b) Actuators:

The actuators could be defined as system that receive control signal that categorized as low power signal usually generated by the microcontroller to operate the devices that require high Energy that may be voltage or currents

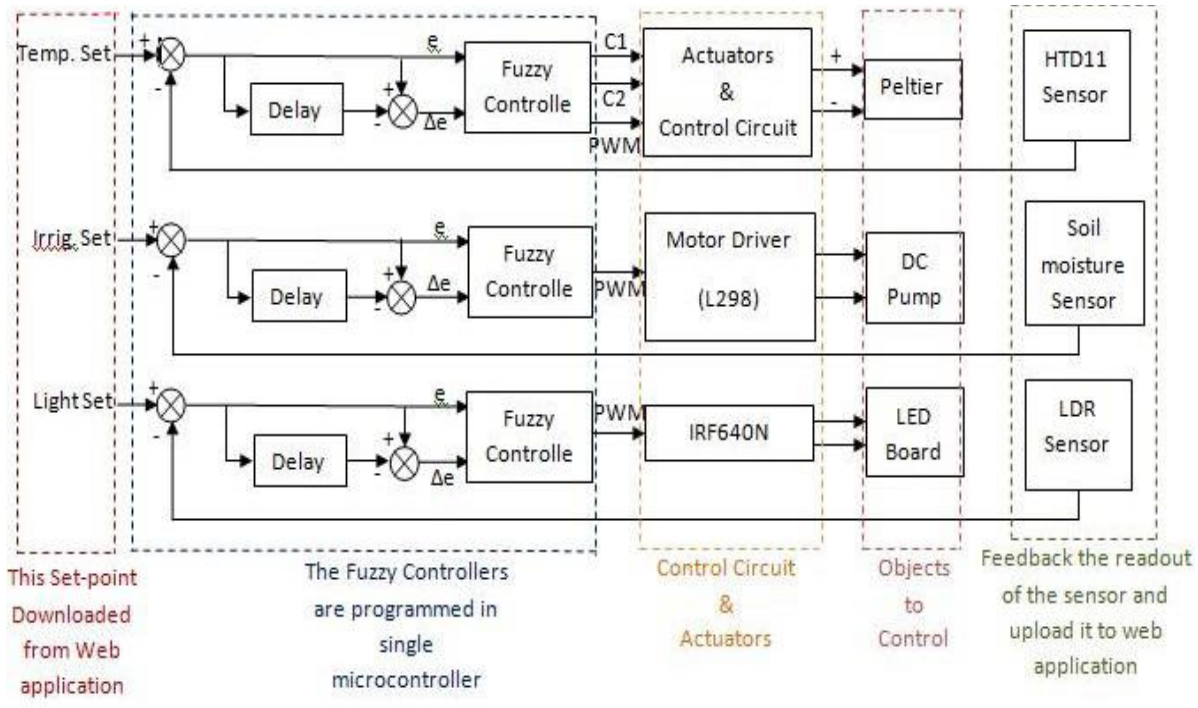

Figure: Block Diagram

5. RESULTS AND DISCUSSION

This control unit collects all the details regarding the plant growth, consisting of moisture, temperature and light sensor with a mini water tank attached for supplying sufficient amount of water to plants. The whole controlling system is having a power supply of 5V. LED is present in the controlling unit for providing enough light for the plants and a mini fan for controlling the temperature. Display console shows the measured values of moisture and temperature. We have created a cloud for storing all the details about the growth of plants. And have developed an android application for monitoring the greenhouse and controlling the environment inside the greenhouse.

6. CONCLUSION

A smart greenhouse monitoring system has been implemented successfully using the concept of IoT which can prove to be a boon for agriculture sector. The traditional system for greenhouse monitoring is labour-intensive and time consuming. The proposed system saves time, money and human effort. It provides a controlled environment for the plants and thus increase the overall yield. The smart greenhouse automatically optimizes the various parameters for the plant growth. It sends the real time data of parameters to the mobile app for continuous and effective monitoring.

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