

Effective Greenhouse Environmental Control Systems

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ABSTRACT: Appropriate environmental conditions are necessary for optimum plant growth, improved crop yields, efficient use of water and other resources. Automating the data acquisition process of the soil conditions and various climatic parameters that govern plant growth allows information to be collected at high frequency with less labour requirements. The existing systems employ SMS-based systems for keeping the user continuously informed of the conditions inside the greenhouse; but are unaffordable, bulky, difficult to maintain and less accepted by the technologically unskilled workers. The objective of this paper is to design a simple, easy to install, microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture and sunlight of the natural environment that are continuously modified and controlled in order to optimize them to achieve maximum plant growth and yield. The controller used is a low power, cost efficient chip manufactured by PIC having 8K bytes of on-chip flash memory. It communicates with the various sensor modules in real-time in order to control the light, aeration and drainage process efficiently inside a greenhouse by actuating a cooler, dripper and lights respectively according to the necessary condition of the crops. This makes the proposed system to be an economical, portable and a low maintenance solution for greenhouse applications, especially in rural areas and for small scale agriculturists.

KEYWORDS: Include at least 4 keywords or phrases

I. INTRODUCTION

A green house is a building where plants are cultivated. A green house is built of glass or plastic; it heats up because the sun's incoming ultraviolet radiations warm plants, soil and other things inside the building. Air warmed by heat from hot interior surfaces is retained in the building by the roof and wall. The glass used for a green house works as a selective transmission medium for different spectral frequencies, and its effect is to trap energy within the green house, which heats both the plants and ground inside it.

Agriculture has been one of the primary occupations of man since early civilizations and even today manual interventions in farming are inevitable. Greenhouses form an important part of the agriculture and horticulture sectors in our country as they can be used to grow plants under controlled climatic conditions for optimum produce. Automatic greenhouse plants monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence their produce. Automation is process control of industrial machinery and processes, thereby replacing human operators

PROPOSED MODEL FOR AUTOMATION OF GREENHOUSE

The proposed system is an embedded system which will closely monitor and control the microclimatic parameters of a greenhouse on a regular basis round the clock for cultivation of crops or specific plant species which could maximize their production over the whole crop growth season and to eliminate the difficulties involved in the system by reducing human intervention to the best possible extent. The system comprises of sensors, Analog to Digital Converter, microcontroller and actuators.

When any of the above mentioned climatic parameters cross a safety threshold which has to be maintained to protect the crops, the sensors sense the change and the microcontroller reads this from the data at its input ports after being converted to a digital form by the ADC. The microcontroller then performs the needed actions by employing relays

until the strayed-out parameter has been brought back to its optimum level. Since a microcontroller is used as the heart of the system, it makes the set-up low-cost and effective nevertheless. As the system also employs an LCD display for continuously alerting the user about the condition inside the greenhouse.

MANUAL SET-UP

This set-up involves visual inspection of the plant growth, manual irrigation of plants, turning ON and OFF the temperature controllers, manual spraying of the fertilizers and pesticides. It is time consuming, vulnerable to human error and hence less accurate and unreliable.

PARTIALLY AUTOMATED SET-UP

This set-up is a combination of manual supervision and partial automation and is similar to manual set-up in most respects but it reduces the labor involved in terms of irrigating the set-up.

FULLY- AUTOMATED

This is a sophisticated set-up which is well equipped to react to most of the climatic changes occurring inside the greenhouse. It works on a feedback system which helps it to respond to the external stimuli efficiently.

II. SYSTEM MODEL

Fig 1 shows the block diagram of the automatic green house plant control system. When the system is switched on LDR (Light Dependent Sensor), water sensor, temperature sensor start monitoring the individual task.

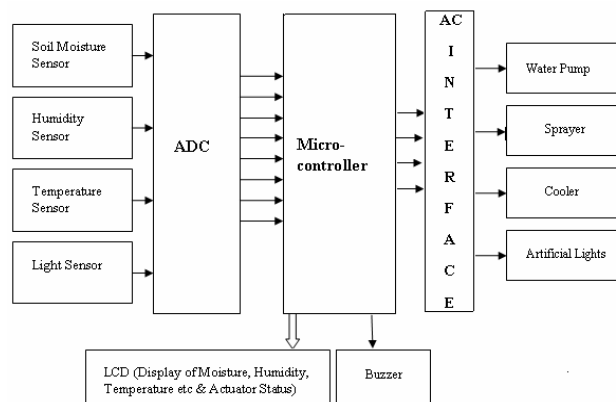


Fig 1 Basic Model of the system

Each sensor will take 20ms to complete the task. Output of the sensor is analog, this analog signal is converted into digital signal by using internal ADC(Analog to Digital Converter).The microcontroller store the data in temporary memory, if any fault is occur corresponding SMS will be send to the user through GSM model.

TRANSDUCERS

A transducer is a device which measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. Monitoring and controlling of a greenhouse environment involves sensing the changes occurring inside it which can influence the rate of growth in plants. The parameters which are of importance are the temperature inside the greenhouse which affect the photosynthetic and transpiration processes are humidity, moisture content in the soil, the illumination etc. Since all these parameters are interlinked, a closed loop (feedback) control system is employed in monitoring it.

SOIL MOISTURE SENSOR

Features of the Soil moisture sensor are;

1. The circuit designed uses a 5V supply, fixed resistance of 100Ω, variable resistance of 10KΩ, two copper leads as the sensor probes, 2N222N transistor.
2. It gives a voltage output corresponding to the conductivity of the soil.

3. The conductivity of soil depends upon the amount of moisture present in it. It increases with increase in the water content of the soil.

4. The voltage output is taken at the transmitter which is connected to a variable resistance.

The two copper leads act as the sensor probes. They are immersed into the specimen soil whose moisture content is under test. The soil is examined under three conditions:

Case#1: Dry condition-

The probes are placed in the soil under dry conditions and are inserted up to a fair depth of the soil. As there is no conduction path between the two copper leads the sensor circuit remains open. The voltage output of the emitter in this case ranges from 0 to 0.5V.

Case#2: Optimum condition-

When water is added to the soil, it percolates through the successive layers of it and spreads across the layers of soil due to capillary force. This water increases the moisture content of the soil. This leads to an increase in its conductivity which forms a conductive path between the two sensor probes leading to a close path for the current flowing from the supply to the transistor through the sensor probes. The voltage output of the circuit taken at the emitter of the transistor in the optimum case ranges from 1.9 to 3.4V approximately.

Case#3: Excess water condition-

With the increase in water content beyond the optimum level, the conductivity of the soil increases drastically and a steady conduction path is established between two sensor leads and the voltage output from the sensor increases no further beyond a certain limit. The maximum possible value for it is not more than 4.2V.

LIGHT SENSOR

Light Dependent Resistor (LDR) also known as photoconductor or photocell, is a device which has a resistance which varies according to the amount of light falling on its surface.

TEMPERATURE SENSOR

National Semiconductor's LM35 IC has been used for sensing the temperature. It is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). The sensor circuitry is sealed and not subject to oxidation, etc.

ANALOG TO DIGITAL CONVERTER

In physical world parameters such as temperature, pressure, humidity, and velocity are analog signals. A physical quantity is converted into electrical signals. We need an analog to digital converter (ADC), which is an electronic circuit that converts continuous signals into discrete form so that the microcontroller can read the data. Analog to digital converters are the most widely used devices for data acquisition.

MICROCONTROLLER CONFIGURATION USED IN THE SET-UP

The microcontroller is interfaced with the ADC in polling mode. INT0 is used for the LCD mode selection switch in order to switch between two modes of display:

- 1) Sensor output display
- 2) Actuator status display

Port details:

- Port 0: Interfaced with the LCD data lines.
- Port 1: Interfaced with the ADC data lines
- Port 2: Interfaced with the LCD Control lines and AC Interface control
- Port 3: Interfaced with the ADC control lines

GSM MODEL

GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

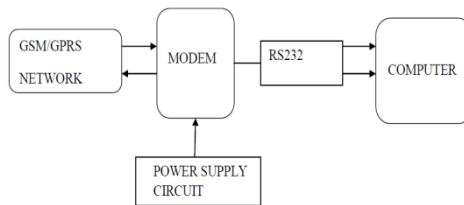
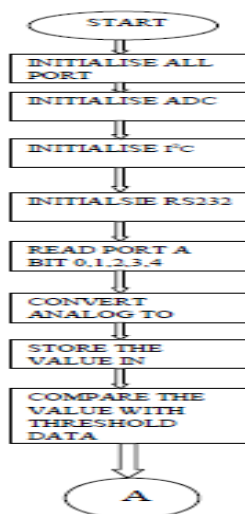


Fig. 2 GSM model

III.SOFTWARE DESCRIPTION

FLOWCHART

Start, initialize all the ports, initialise ADC ,initialize I2C,initialise RS232,read port A bit 0,1,2,3,4.values are in analog form convert that to digital in next stage. This digital value saved in temporary memory. Compare the temporary memory with threshold value. If the data is 1 then port B is 1 next send at command send SMS delay 30 refresh serial. If it is no scan down key if down key is 1 if it is yes then run up/down counter next save the value in E2 PROM refresh I2C.If no delay 1 second refresh RS232 then refresh ADC.



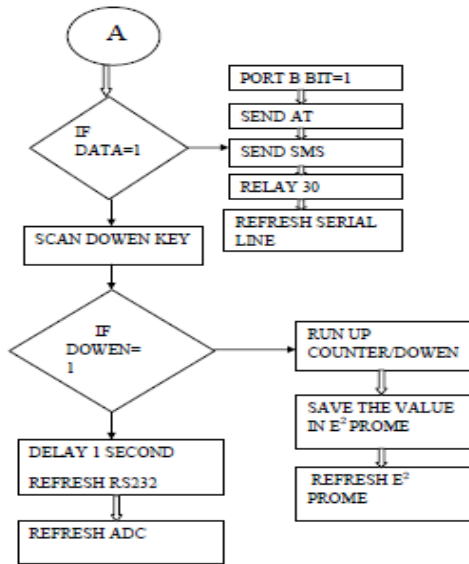


Fig 3 Flowchart

IV. RESULT

The results obtained from experimental set up of automatic greenhouse control system using GSM are given below, in this Paper wheat plants are used for experiment. For this plant initial condition is given below;

After giving initial condition it takes 2-3days to grow up. Finally it takes 4-5 months to get a crop. By using GSM user get SMS about the condition of the plant. If former adopted this techniques they get a good profit compare to the naturally growth plant.



Fig 4With Greenhouse System



Fig 5 without Greenhouse System

V. ADVANTAGES

1. Sensors used have high sensitivity and are easy to handle.
2. Low cost system, providing maximum automation.
3. Closed loop design prevents any chances of disturbing the greenhouse environment.
4. User is indicated for changes in actuator state thereby giving an option for manual override.
5. Low maintenance and low power consumption.
6. The system is more compact compared to the existing ones, hence is easily portable.
7. Can be used for different plant species by making minor changes in the ambient environmental parameters.
8. Can be easily modified for improving the setup and adding new features.
9. Provides a user-friendly interface hence will have a greater acceptance by the technologically unskilled workers.
- 10.

TEMPERATURE	30 °c
SOIL MOISTURE	70%
LIGHT INTENSITY	50%
HUMIDITY	20%

Table.1 Initial condition of plant

10. In response to the sensors, the system will adjust the heating, fans, lighting, irrigation immediately, hence protect greenhouse from damage.
11. Natural resource like water saved to a great extent.

VI. CONCLUSION

A step-by-step approach in designing the microcontroller based system for measurement and control of the four essential parameters for plant growth, i.e. temperature, humidity, soil moisture, and light intensity, has been followed. The results obtained from the measurement have shown that the system performance is quite reliable and accurate.

The system has successfully overcome quite a few shortcomings of the existing systems by reducing the power consumption, maintenance and complexity, at the same time providing a flexible and precise form of maintaining the environment.

The continuously decreasing costs of hardware and software, the wider acceptance of electronic systems in agriculture, and an emerging agricultural control system industry in several areas of agricultural production, will result

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in reliable control systems that will address several aspects of quality and quantity of production. Further improvements will be made as less expensive and more reliable sensors are developed for use in agricultural production.

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