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Microcontroller Based Monitoring and Control of Greenhouse Environment

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ABSTRACT: Monitoring and control of greenhouse environment play an important role in greenhouse production and management.To monitor the greenhouse environment parameters effectively, it is necessary to deisgn a measurement and control system. The objective of this project is to design a simple, easy to install microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture and light of the natural environment that are continuously modified and controlled in order to optimize them to acheive maximum plant growth and yield. The controller used will be a low power, cost efficient chip manufactured by ATMEL having 16K bytes of on-chip flash memory. It will communicate with the various sensor modules in real-time in order to control the light, aeration and drainage process efficiently inside a greenhouse. An integrated Liquid Crystal Display(LCD) will also be used for real time display of data acquired from the various sensors and the status of yhe various devices. Also, the use of easily available components reduces the manufacturing and maintenance costs. The design will be quite flexible as the software can be changed at any time. It can thus be tailor made to the specific requirements of the user. 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: Wireless sensor network, LCD, Digital agriculture, Environment monitoring, Greenhouse monitoring, Environment parameter.

I.INTRODUCTION

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, the entire set-up becomes user friendly. Thus, this system eliminates the drawbacks of the existing set-ups and is designed as an easy to maintain, flexible and low cost solution.

II.LITERATURE SURVEY

Jia song: He proposed a system on Greenhouse monitoring and control system based on Zigbee wireless sensor network using 8051 microcontroller. Ai wei chan cita. They have discussed Greenhouse environment monitor technology. Implementation based on android mobile platform which uses android mobile phone as the monitoring terminal. In this paper parameters in the Green house are monitored on the LCD with microcontroller and controlling is shown through bulb and pump. Ayo H. Primicanta Mohd Yunus Nayan and Mohammad Awan. They proposed a method on Zigbee-GSM based Automatic meter reading system.

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III.SYSTEM MODEL AND ASSUMPTIONS

BASIC MODEL OF THE SYSTEM

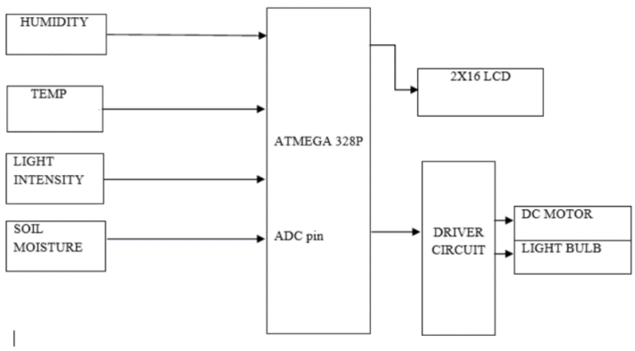

Fig. Block diagram of the proposed system

Parts of the System

- Sensors
  (i) Humidity and temperature sensor
  (ii) Light sensor(LDR)
  (iii) Soil Moisture sensor
- Analog to Digital Converter
- Microcontroller(ATMEGA 328P)
- Liquid Crystal Display
- Actuators-Relays
- Devices Controlled

IV.HARDWARE DESCRIPTION

Transducers

A transducer is a device which measures a physical quantity and converts it into a signal which can be read by an observer. It can also be read by an instrument. The sensors used in the system are;
1. Light sensor (LDR (Light Dependent Resistor))
2. Humidity and temperature sensor (DHT 11)
3. Soil Moisture sensor

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. We will be using ADC for data acquisition.

IMPLEMENTATION BLOCK DIAGRAM

Analog world	Transducer	Signal Conditioning	ADC	Micro-controller

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Microcontroller (ATMEGA 328P)

The microcontroller is the heart of the proposed embedded system. It will constantly monitor the digitized parameters of the various sensors and will verify them with the predefined threshold values. It will check if any corrective action is to be taken for the condition at that instant of time. In case such a situation arises, it will activate the actuators to perform a controlled operation.

Liquid Crystal Display

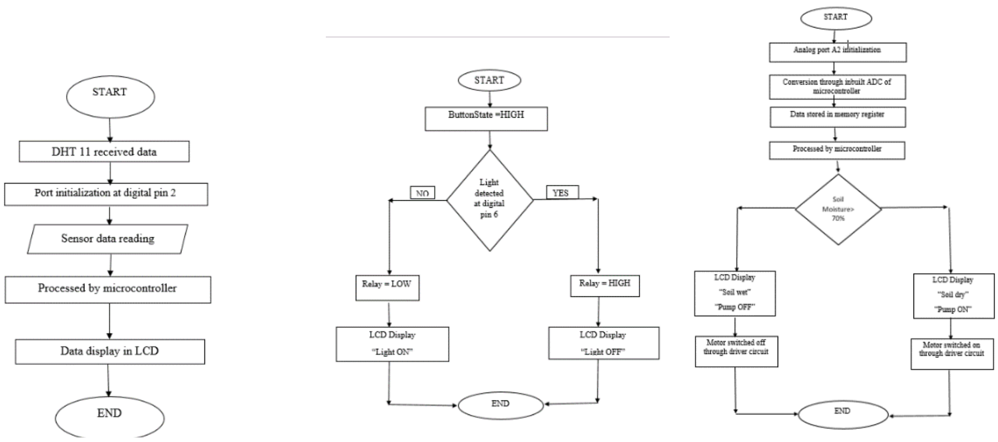
A liquid crystal display (LCD) is a thin, flat display device made up of monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. We are using a 2X16 LCD display in our system.

Relays

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. Because a relay is able to control an output circuit of higher power than the output circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

V.PROCESS FLOWCHART

Flowchart representing the working of the system for DHT 11(temperature and humidity sensor), LDR (light sensor) and soil moisture sensor respectively are shown below.



VI.EXPERIMENTAL SETUP IN A GREENHOUSE

The Greenhouse Environment

A modern greenhouse can consist of plentiful parts which contain their own local climate variable settings.

Sensors

Hasty response time, low power consumption and tolerance against moisture climate, relative humidity and temperature sensor forms a perfect preference and solution for the greenhouse environment.

Temperature

Temperature is one of the most key factors to be monitored because it is unswervingly related to the growth and progress of the plants. For all plants, there is a temperature range considered best and to most plants this range is relatively varying between 10ºC and 30ºC. Among these parameters of temperature: extreme temperatures, maximum temperature, minimum temperature, day temperature and night temperature, difference between day and night temperatures are to be vigilantly considered

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Water and Humidity

Another momentous factor in greenhouses is water. The absorption of water by plants is linked to the radiation. The lack or low level of water affects growth and photosynthesis. Besides air, the ground humidity also adjusts the development of plants. The air humidity is interrelated to the transpiration while the ground humidity is connected to water absorption and photosynthesis. An atmosphere with extreme humidity decreases plants transpiration, reducing growth and may promote the proliferation of fungus.

VII.RESULTS

The physical realization of this work was carried out to achieve the conceived idea. Here the work will be seen not just on paper but also as a finished hardware. After carrying out all the paper design and analysis, the hardware was implemented and tested to ensure it’s working ability and was finally constructed to meet desired specification.

SOIL MOISTURE

Tolerance = ± 0.2 V at 27^{0}C

TABLE 1. SOIL MOISTURE SENSOR READINGS

Soil condition	Transducer range
Soil is dry	0V
Optimum level of soil	1.9-3.5V
Moisture Slurry soil	>3.5V

LIGHT SENSOR

Tolerance = ±0.1V

TABLE 2. LIGHT SENSOR READINGS

Illumination status	Transducer range
Optimum illumination	0V-0.69V
Dim light	0.7V-2.5V
Dark	2.5V- 3V
Night	3V-3.47V

HUMIDITY AND TEMPERATURE SENSOR

Tolerance = ±0.1V

TABLE 3. HUMIDITY SENSOR READINGS

Percentage RH(RELATIVE HUMIDITY)	Transducer Optimum Range
0%	0-0.8V
0% to 9.81%	0.8-1.1V
12.9% to 20.1%	1.2-1.45V
22.7% to 30.06%	1.5-1.725V
30.8% to 40.5%	1.75-2.05V
41.3% to 50.3%	2.075-2.35V
51% to 60.02%	2.375-2.65V
61.6% to 70.5%	2.7-2.975V
71% to 80.2%	3-3.275V
81.1% to 90%	3.3-3.6V
91% to 100%	3.6-3.9V

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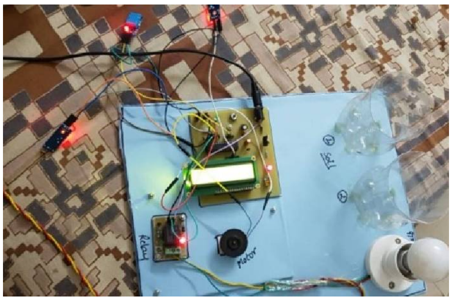
TABLE 4. TEMPERATURE READINGS

Temperature range in degree Celsius	Temperature sensor output(Vcc)
10^0C	0.5V
10^0 to 20^0C	0.5-1.0V
20^0 to 30^0C	1.0-1.5V
30^0 to 40^0C	1.5-2.0V
400 to 50^0C	2.0-2.5V
50^0 to 60^0C	2.5-3.0V
60^0 to 70^0C	3.0-3.5V
70^0 to 80^0C	3.5-4.0V
80^0 to 90^0C	4.0-4.5V
90^0 to 100^0C	4. 5-5.0V

Final prototype



VIII.CONCLUSION

During the implementation, number of conclusions has been encountered, based on 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.
The work has shown that the system performance is quite reliable and accurate.
The system has 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 in reliable control systems that will address several aspects of quality and quantity of production.

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