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Review of Greenhouse Management Using Embedded System

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Abstract- ***Monitoring and control of greenhouse environment play an significant role in greenhouse production and management. To monitor the greenhouse environment parameters effectively, it is necessary to design a control system. There we can control the activities through PC and send to controller back which is in greenhouse environment. There it will activates the actuator according to our wish. The main objective is to design a simple, easy to install, microcontroller-based circuit to monitor and record the values of temperature, humidity, and sunlight of the natural environment that are continuously modified and controlled in order optimize them to achieve maximum plant growth and yield. PIC 16F877A controller is used. It communicates with the a variety of sensor modules in order to control the light, aeration and drainage process efficiently inside a greenhouse by actuating a cooler, fogger, dripper and lights respectively according to the necessary condition of the crops***

Keywords: LCD, CO_2, WIRELESS SENSOR NETWORK, Environmental monitoring and controlling.

1. Introduction

The rising demands for crop production and quality have significantly increased the utilization of high quality and productivity of green house. The system which we proposed helps us to closely monitor and control the microclimatic parameters of a greenhouse environment. The system comprises of sensors, microcontroller with inbuilt ADC and actuators (motors, led). When any of the 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 controller then performs the required actions by employing relays until the strayed-out parameter has been brought back to its most advantageous level. Agriculture is the primitive industry that mankind started first after born on earth and has the longest history among several industries and is very closely connected to the human development. In the past, agriculture was labor-intensive but the next generation farmers and associated organizations trying to apply new agricultural knowledge, new agricultural technology and agriculture IT convergence technology are increasing sharply in today's agriculture [1].

They are to realize value creation such as increased productivity and quality improvement by combining several IT technologies with agriculture. As the application range using a sensor is expanding in recent years, research has been actively carried out through combination with various sectors [2]. As a case applying the IT convergence technology, the productivity and quality of crops are improved by collecting environmental information inside the facilities such as greenhouse or plant factory by using WSN and creating optimal environment conditions for crops accordingly. HE 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 [1].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 [10]. 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. the concern with a lot of consumer needs and demand for the agriculture products has stimuli ted awareness among the farmer that increases their products in the market by implementing advance technologies in this industry. The products that are important that may come to the farmers' interest that controls the use of natural sources and natural environment which controls agriculture with various aspects. Therefore, this problem makes farmers' interest to implement agro

2. System Architecture

The system model consists of sensors, microcontroller, interface such as relay and actuators. Actuators such as ventilation fan, sprayer, heater, water pump, artificial lights are used. Our proposed system aim is to design a microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture level and sunlight of the natural environment that are continuously modified and it is get controlled in order optimize them to achieve maximum plant growth and yield**.** Controlling process takes place effectively by both automatically and manually**.** Depending upon the application, we will set particular threshold level for each climatic parameter. when

any of parameters level cross a safety threshold then microcontroller will perform the needed action by employing relay(motor driver) until the strayed-out parameter has been brought back to its optimum level. Manual controlling process is done by zigbee wireless network whenever necessary. Whose receiver side of zigbee is connected to PC in control room .VISUAL BASIC software is used here, which helps us to transmit the data back through zigbee wireless network to controller to perform, needed control action. Automatic controlling process takes place in the greenhouse environment itself as per designing microcontroller based circuit to monitor and control various parameters.

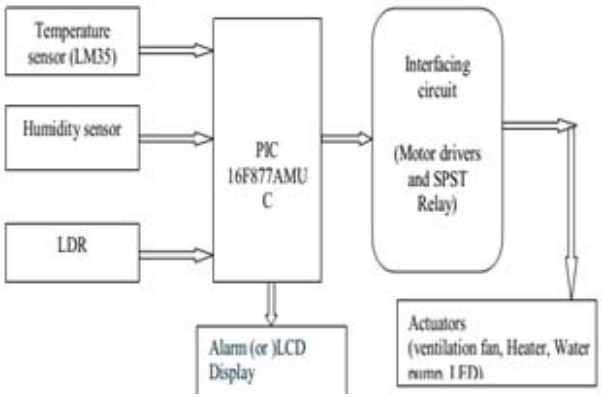

Figure 2.1: Basic system model of automatic controlling purpose

3. Experimental Setup in a Greenhouse

A. The Greenhouse Environment

A modern greenhouse [4-6] can consist of plentiful parts which contain their own local climate variable settings. As a result, a number of measurement points are also needed. This class of environment is challenging both for the sensor node electronics and for the short-range IEEE 802.15.4 wireless network, in which communication range is greatly longer in open environments.

B. 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. Communication amid sensor and node can be carried out by IIC interface. Luminosity can be measured by light sensor, which converts light intensity to voltage. Unstable output signal is handled by low-pass filter to get correct luminosity values. CO2 measuring [7] takes longer time than other measurements and CO2 sensor voltage supply have to be within few volts. The carbon dioxide value can be read from the ensuing output voltage. Operational amplifier raises the voltage level of otherwise frail signal from the sensor.

C. Greenhouses

A greenhouse is a configuration covering ground frequently used for growth and progress of plants that will return the owner's risk time and capital. This display is mounted with the purpose of protecting crop and of allowing a better environment to its progress. This shield is enough to promise a superior quality in production in some cases. However, when the major purpose is to achieve a better control on the horticulture development, it is necessary to test and control the variables that influence the development of a culture. The chief function of a greenhouse is to provide a more sympathetic environment than outside. Unlike what happens in traditional agriculture, where crop conditions and yield depend on nature resources such as climate, soil and others, a greenhouse ought to guarantee production independently of climatic factors. It is noteworthy to observe that even though a greenhouse protects crop from exterior factors such as winds, water excess and warmth it may cause plentiful problems such as fungus and excessive humidity. Therefore, mechanisms to scrutinize and control a greenhouse environment are incredibly vital to achieve better productivity. To get superior productivity and quality, better control system is necessary and as a result the production costs also get reduced. The chief elements involved in a greenhouse control system are: temperature, humidity, CO2 concentration, radiation, water and nutrients.

D. 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.

E. 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. On the other hand, squat humidity level environments might cause dehydration.

F. Radiation

Radiation is a fundamental element in greenhouse production and sunlight is the key source of radiation. It is an important component for photosynthesis and carbon fixing. The significant radiation features are intensity and duration. The radiation intensity is linked to plant growth and the duration is openly associated with its metabolism.

G. CO2 Concentration

CO2 is an essential nutrient for plant development, allowing the assimilation of carbon. The carbon retaining procedure occurs through the photosynthesis when plants take away CO2 from the atmosphere. During the photosynthesis, the plant uses carbon and radiation to produce carbohydrate, whose function is to permit the plant development. Therefore, an enriched air environment should contribute to plant growth, but it is also vital to note that an extreme carbon level may turn the environment poisonous.

H. Actuation System

An actuator is an piece of equipment which will produce an movement when signal is given. Actuators are used in the computer control of an environment, industrial automation and in robotics or, more generally, actuators are the machines used for output in control applications. For the situation in a computer controlled greenhouse, the actuators receive their control signal from the microcontroller to control the inside climate variables of the greenhouse.

4. System Model

4.1 Basic Model of the System

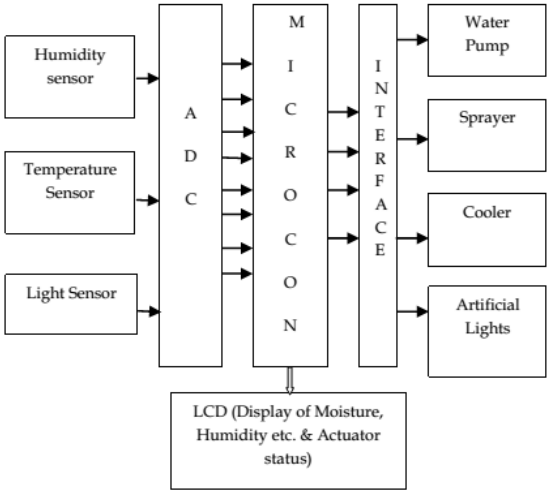

Figure 4: Block Diagram of the System

4.2 Steps Followed In Designing the System

Three general steps can be followed to appropriately select the control system:

Step # 1: Identify measurable variables important to production. It is very important to correctly identify the parameters that are going to be measured by the controller's data acquisition interface, and how they are to be measured.

Step # 2: Investigate the control strategies. An important element in considering a control system is the control strategy that is to be followed. The simplest strategy is to use threshold sensors that directly affect actuation of devices.

Step # 3: Identify the software and the hardware to be used. Hardware must always follow the selection of software, with the hardware required being supported by the software selected. In addition to functional capabilities, the selection of the control hardware should include factors such as reliability, support, previous experiences with the equipment (successes and failures), and cost [**2]**

5. Hardware Description

5.1 Transducers

A transducer is a device which measures a physical quantity and converts it into a signal which can be read by an observer [9] .It can also be read by an instrument [3]. The sensors used in this system are:

1. Light Sensor (LDR (Light Dependent Resistor))
2. Humidity Sensor
3. Temperature Sensor

5.2 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 [7].

5.3 Microcontroller (At89s51)

The microcontroller is the heart of the proposed embedded system [4]. It constantly monitors the digitized parameters of the various sensors and verifies them with the predefined threshold values [5]. It checks if any corrective action is to be taken for the condition at that instant of time. In case such a situation arises, it activates the actuators to perform a controlled operation [6].

5.4 Liquid Crystal Display

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector [4]. 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 [6].

5.5 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 input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

5.6 Power Supply Connection

The power supply section consists of step down transformers of 230V primary to 9V and 12V secondary voltages for the +5V and +12V power supplies respectively.

6. Conclusion

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. Further improvements will be made as less expensive and more reliable sensors are developed for use in agricultural production. The activities through PC and send to controller back which is in greenhouse environment. There it will activate the actuator according to our wish. The main objective is to design a simple, easy to install, microcontroller-based circuit to

monitor and record the values of temperature, humidity, and sunlight of the natural environment that are continuously modified and controlled in order optimize them to achieve maximum plant growth and yield.

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