A Review of Greenhouse Climate Control Application for Cultivation of Agriculture products

Nikita Jain[1,] S.R.Bhakar[2], Rahul Singhal[3]

[1] *Ph.D Scholar, Department of Soil and Water Engineering, CTAE, Udaipur,Maharana Pratap University of Agriculture and Technology, 313001, Udaipur, India*

[2] *Peofessor,Department of Soil and Water Engineering, CTAE, Udaipur,Maharana Pratap University of Agriculture and Technology, 313001, Udaipur, India*

[3]*Dept. of Electrical Engineering, Malaviya National Institute of Technology, Jaipur - 302017,Jaipur, India.*

Abstract

Monitoring and control of greenhouse environment play an key role in greenhouse production and management. To monitor the greenhouse environment parameters effectively, it is demand 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 activate the actuator according to our wish and set threshold valves. The main objective is to design a simple, easy to install, microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture and solar radiation of the natural environment that are continuously modified and controlled in order optimize them to achieve maximum plant growth at different stages and yield. There are different microcontroller are available which can communicate with variety of sensors process efficiently inside a greenhouse by actuating a cooler, fogger, dripper and lights respectively according to the necessary condition of the crops.

Keywords

Microcontroller, Environment monitoring and controlling, Actuators.

1. INTRODUCTION

The increasing world population has changed food production scenario over the last decades. Developing countries, mostly in tropical and sub-tropical region, contribute and are expected to continue contributing as high as about 90% of the world population increase (Soni and Salokhe, 2004)[1].

A greenhouse is defined as a covered structure that provides plants with optimally controlled environment for adjustment of climate growth conditions, to reduce cost of production and increase crop yields (Badgery-Parker, 1999)[2]. The covering material of greenhouse structure can vary from simple covers to selective transmission medium for different spectral frequencies which traps energy inside the greenhouse and heats both plants zone and its surroundings. The cost of growing inside a greenhouse is generally greater than growing in the field; therefore monitoring and automation control of important environmental parameters such as air temperature, relative humidity (RH) are necessary to achieve high yield at low expense and to keep the environment competitive.

Greenhouse automation is all about an efficient, accurate and modern intensive-agriculture, which judicially utilizes all available natural resources, recycles the information within the system, and claims higher productivity, higher returns, better quality while remain environment friendly. Environmental control of greenhouses includes control and modification of day and night temperatures, relative humidity, solar radiation and soil moisture levels for optimum plant growth. Controlled environment plant production systems offer the possibility to provide large numbers of high quality crops with greater predictability. The goal of all environmental control systems is to enhance the growth of the plant, and provide a mature crop in timely fashion, with desirable quality as demanded by the market of the producer.

2. System for controlling Climate inside the greenhouse

The system model consists of sensors, microcontroller, interface such as relay and actuators. Actuators such as ventilation fan, Misting system, heater, Irrigation System, LED lights are used. Greenhouse Automation aim is to design a microcontroller-based circuit to monitor and record the values of temperature, humidity, soil moisture level and solar radiation of the natural environment that are continuously controlled in order optimize level to achieve maximum plant growth and yield**.** Controlling process can taken place by both automatically and manually depending upon the availability of sources such as electricity and human

power **.** Depending upon the type of crop and crop stages, we will set particular threshold level for each climatic parameter**.**

3. Experimental Setup in a Greenhouse

3.1. The Greenhouse Environment

A greenhouse contains their own climate variable settings. As result, a number of measurement points are also needed for maintain the optimum climate inside the greenhouse. This class of environment is challenging both for the sensor node electronics and for the short-range wireless network, in which communication range is great longer in open environments and the power consumption is less.

3.2 Sensors

A sensor is a device that detects and responds to some type of input from the physical environment. Sensors respond time is less, low power consumption and tolerance level is high against moisture in climate, relative humidity and temperature sensor forms a perfect preference and solution for controlling the greenhouse environment. Communication sensor and relay or actuators respond according to the threshold valves for taking the desire action for maintain the optimum climate inside the greenhouse.

3.2.1Temperature

Temperature is one of the most key factors to be monitored because it is directly related to the growth of the plants. For all plants, there is a temperature range considered best and to most plants this range is relatively varying between threshold valves because the requirement of each crop is different according to their growing seasons and growing stages. Among these parameters of temperature, maximum temperature, minimum temperature, day temperature and night temperature, difference between day and night temperatures are to be considered seriously.

3.2.2. Soil Moisture

Form the transplanting to harvesting stage the water requirement of plant varies according to growth of the plant. For that the soil moisture should be in the optimum range so the water requirement of

the crop should be fulfill without any stress on the growth of plant. So that, soil moisture sensor should be at different depth according to depth of the root zone of each plant. Water Available for plant is directly related to the transpisration system the plant.

3.3.3. Humidity

Humidity also effect the development of plants. The air humidity is interrelated to the transpiration. An atmosphere with extreme humidity decreases plants transpiration, reducing growth and may promote the growth of fungus. On the otherside, decrease humidity level environments might cause dehydration and effect the plant growth adversely.

3.2.3. Radiation

Radiation is a another fundamental element in greenhouse production and solar radiation is source of radiation. It is an important component for photosynthesis. If the plant get proper intensity and duration of light, the growth and reproductive system of plant will improve automatically.

.

3.3Circuit Description

3.3.1 Transducer

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 growth stages. 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 etc. Since all these parameters are interlinked, a closed loop control system is implemented for monitoring it.

3.3.2Analog to Digital Converter

In physical world parameters such as temperature, pressure, humidity, and velocity are present in analog signals, than 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.
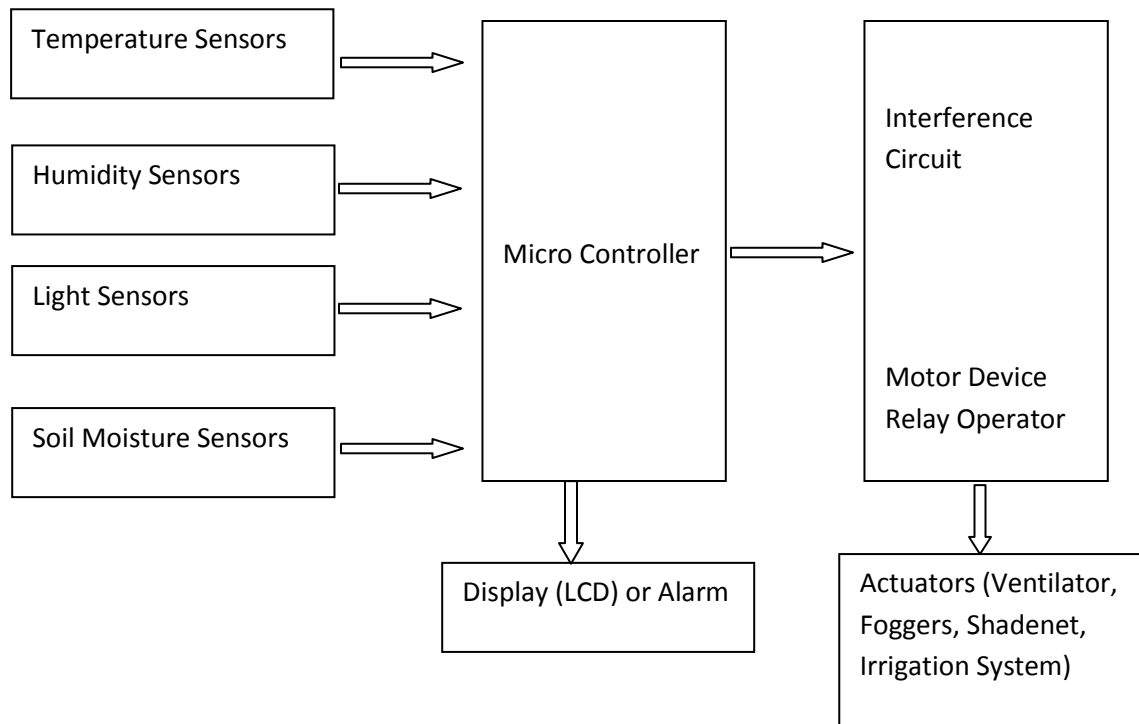
Fig:1 Block Diagram of Greenhouse Management

3.3.3 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. 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.

3.3.4 Relays

A relay is an electrical switch that opens and closes under the control of another electrical circuit. Relays are operator of actuators.

3.4. 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, actuators are the machines used for control applications for motor, fanpad, foggers, irrigation system, LED light, ventilation etc. For the situation in a computer controlled greenhouse, the actuators receive their control signal from the microcontroller and sent to the actuators to control climate inside the greenhouse

CONCLUSIONS:

A step-by-step approach in designing the microcontroller based system for measurement and control of the four essential parameters which directly effect   plant growth, i.e. temperature,

humidity, soil moisture, and light intensity, has been followed. 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, will result in reliable control systems that will address several aspects of quality and quantity of production which have potential in our agriculture. This system also reduces the dependency on the human power, so that it can be easily adaptable.

REFERENCES

[1] Soni P. and Salokhe V. M. 2004. Greenhouse automation and its viability under tropical conditions, AFITA / WCCA Joint Congress on IT in Agriculture, Bangkok, Thailand,pp: 109 - 116.

[2] Badgery-Parker, J. 1999.The greenhouse.Agnote DPI/249. New South Wales.

[3] Prasad R. K. , Madkar S. R. 2013. Design & Implementation of Wireless Transceiver for Data Acquisition in Wireless Sensor Network . *International Journal of Advanced Research in Computer Science and Software Engineering.* **3**(7) :2277 128.

[4] K.Radha Manohar 'Green House Management' (B S Publication) pp[1-54] .

[5] Ruiz-Garcia, L., Lunadei, L., Barreiro, P., Robla, I., 2009. A review of wireless sensor technologies and applications in agriculture and food industry: state of the art and current trends. Sensors **9** (6): 4728–4750.

[6] S. Prasad 'Greenhouse Technology and Management' (Agro Bios Publication)

[7] Wakloye Uday K 2012. Greenhouse Automation System. International Conference on Recent Trends in Engineering & Technology, *International Journal of electronics,* *Communication & Soft Computing Science & Engineering,* ISSN: 2277-9477,161-166.

[7] Zhang, S., Zhang, H., 2012. A review of wireless sensor networks and its applications. In: Proceeding of the IEEE International Conference on Automation and Logistics, Zhengzhou, China.