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GREENHOUSE MONITOR AND CONTROL WITH LABVIEW

S. K. Soni
Department of Instrumentation and Control Engineering,
School of Technology, Nirma University, Ahmedabad, India

ABSTRACT

Monitoring and controlling a greenhouse environment involves sensing the changes occurring inside it which can influence the rate of growth in plants. The System consists of various sensors, namely temperature and light. These sensors sense various parameters – temperature, humidity, and light intensity and are then sent to a computer Lab view application via a DAQ Assistant.

Key words: DAQ, LabVIEW, Greenhouse, DHT22, LDR sensor, NI USB-6009

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1. INTRODUCTION

Agriculture is the backbone of human civilization. Without it human would have starved to death long ago. Agricultural products are largely dependent on environmental conditions. [11] Different plants require different kind of environment to grow so growing plants in harsh climatic conditions has always been a challenge to the mankind.

Way back in 13th century the concept of modern day Green House or glass house was developed in Italy. Greenhouse concept helped human civilization in many ways. During world war people of USA and UK developed roof top garden or kitchen garden to supplement the nation's food reserve. [10] Today, Netherlands is world leader in developing high end Greenhouse system. Greenhouse is a technology where plant is grown in an artificial manner inside a controlled environment. [5] In some of the regions, where the climatic conditions are extremely adverse and no crops can be grown, greenhouse is used to grow fruits, vegetables, flowers. The primary advantage of greenhouse technology is that it is used to protect the plants from the adverse climatic conditions such as wind, cold, precipitation, excessive radiation, extreme temperature, insects and diseases. [6]

To create a controlled climate inside the Greenhouse, different physical parameters have to be monitored and controlled such as, temperature, humidity, gas levels, light intensity, air pressure, air velocity, soil moisture, pH of water, conductivity of the soil etc. [8] Real time data of above physical parameters has to be acquired in a continuous manner and if any kind

of abnormality found then subsequent control action has to be taken. This project develops a data acquisition and data logging system, which monitors several important parameter of the Greenhouse, i.e. temperature, humidity, light intensity, soil moisture. Data is acquired using different sensors and these parameters are captured using NI DAQ 6009 in real time. The parameters are logged in excel file for future analysis. In a large plant, data are acquired remotely using either remote Input-Output modules or using WI-FI modules and the data is sent to a central server for record keeping and necessary action. [7]

The objective of this project is to develop a prototype of an actual greenhouse and demonstrate the performance of the system subjected to parameter variations. To acquire parameters from the greenhouse system different transducers are mounted in the greenhouse system are interfaced with NI DAQ 6009 card. The DAQ card interfaced with computer via USB port. Graphical user interface (GUI) is designed is LabVIEW to monitor and control different greenhouse parameters.

The paper is divided in to five different sections. After introduction, the second section gives a brief about materials and experimental structure. Section three explains testing and analysis of the designed greenhouse system and different parameter acquisition its necessary control. Results are presented in section four. Section five concludes with project outcome.

2. MATERIALS & EXPERIMENTAL STRUCTURE

2.1 Material for Greenhouse Casing

Traditionally greenhouses are built with glass, but this comes with several disadvantages: Glass is heavy and because of this it requires a much better frame construction than cut plastic or acrylic sheeting., It is easily broken, an expensive risk. It is initially expensive to build, and requires deep foundations to carry the weight. [3]

Here for the prototype we have used acrylic sheet for greenhouse casing. In this we will see why we used acrylic instead of glass and we will also see factors which we have considered for selecting the casing material. [2]

We measure the size of casing.

Clear acrylic sheeting on the other hand has several advantages, it is as transparent as the finest optical glass. It is lightweight, in fact it there is a huge decrease in weight when you compare it to a glass panel. Acrylic is extremely strong with an impact resistance 6 - 17 times greater than glass. Acrylic sheeting is completely durable in all weathers and has excellent UV stability. A non yellowing material, you can expect your greenhouse to look spectacular for a good 15 - 20 years. It is chemical resistant. Acrylic sheets have a significant impact on the overall performance of a greenhouse, which means that because of acrylic sheet greenhouse there can be extensive plant growth. Acrylic sheets save you from artificial heating, misuse of electricity, time and cost. Furthermore, acrylic sheeting is easy to work with.[4] Thinner sheets can be cut with a knife or scriber, much the same as glass. For thicker sheets a Jigsaw may be used provided it is fitted with special acrylic blades.

The length of the casing is 19 inches, width of the casing is 12 inches and the height of the 12 inches.

Figure 1. Structure Design

Figure 2. Structure top view

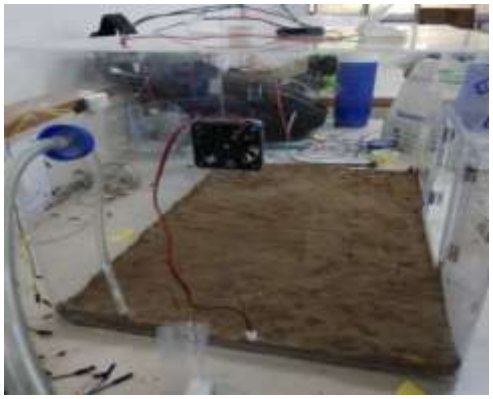

Figure 3. Structure Side View

Figure 4. Structure front view

2.2. Parameters and its Measurement

The purpose of the design is to monitor and control the desired environment, which is ideal for plants optimum growth. Plant requires sufficient amount air humidity, surrounding temperature, light intensity and air (nitrogen, carbon dioxide and oxygen) for their growth. [9] In this project air humidity, surrounding temperature, light intensity and soil moisture are monitored and controlled. In the greenhouse set up four soil moisture sensor (YL-69), humidity and temperature sensor (DHT22), 3 exhaust fans, LDR sensor, water pump, bulbs and sprinklers are mounted to monitor and control the environment. To interface physical system with computer NI USB-6009 (DAQ card) is used. [1]

Table 1 Monitoring and control of Greenhouse parameters

Parameters	Sensor	Control devise
Soil moisture	Soil moisture sensor (YL-69)	Water pump
Humidity and Temperature	Humidity and Temperature sensor (DHT22)	Exhaust fans and sprinklers
Light intensity	LDR sensor	Bulb

3. TESTING AND ANALYSIS

3.1. Moisture Control

Moisture sensors (YL69) are mounted at different places of the ground through which an average moisture reading is considered and accordingly water pump turned on or off to maintained desired level of moisture in the soil. [8] An Ultrasonic sensor (HCSR04) is also

mounted in the reservoir to avoid dry run of the pump. Accordingly indication regarding low water level is shown in LabVIEW based GUI.

3.2. Temperature Control

A temperature sensor (DHT22) is used to measure the temperature and humidity respectively. It is important to maintain these both parameter for the optimum growth of the plant. The range of temperature in green house system is around 25 -30°C for better growth of the plants.[6]

3.3. Humidity Control

Humidity is controlled by implementation of sprinklers. The range for humidity in green house model is approximate 40-60% as per the sensor.

3.4. Light Intensity Control

LDR sensor measures light intensity and accordingly Bulb intensity is varied by placing rheostat based circuitry for light intensity control.

3.5. GUI Designed in LabVIEW

After connecting all the component through DAQ-card or the greenhouse parameters are monitored and controlled in desired manner. If Arduino is used as a controller with the help VISA serial it can be interfaced with LabVIEW to develop GUI.

4. RESULTS AND DISCUSSION

The results of the experiment are attached in the section. The GUI developed in LabVIEW through which user can continuously monitor greenhouse parameters and responds as soon as the system is subjected to changes by doing appropriate action.

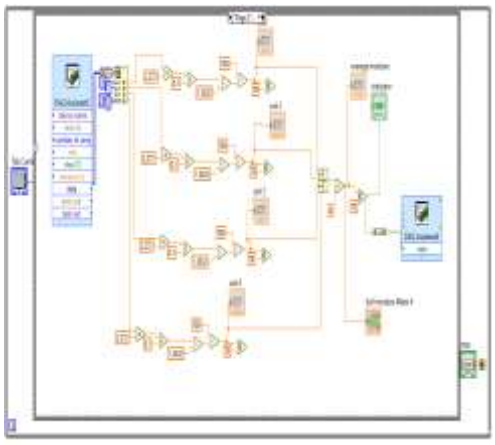

Figure 5. moisture sensing algorthim

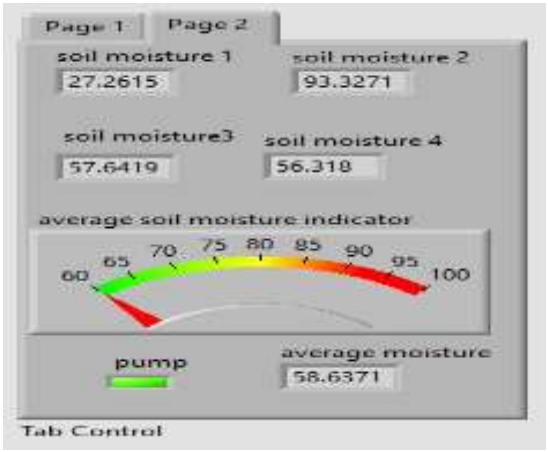

Figure 6. Moisture sensing GUI

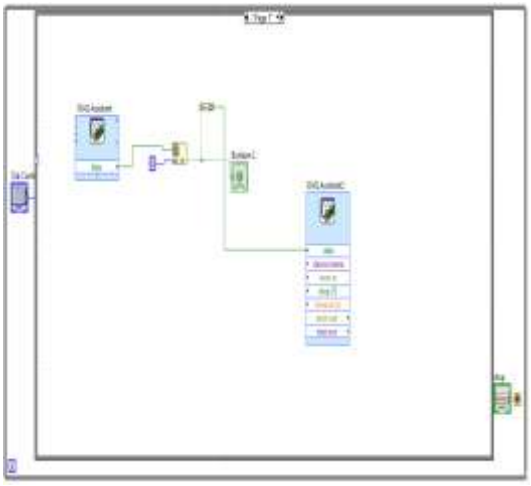

Figure 7. Light Intensity Module

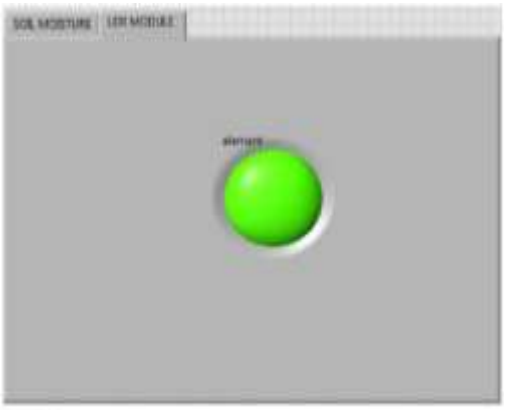

Figure 8. Switch on the buld for Low light

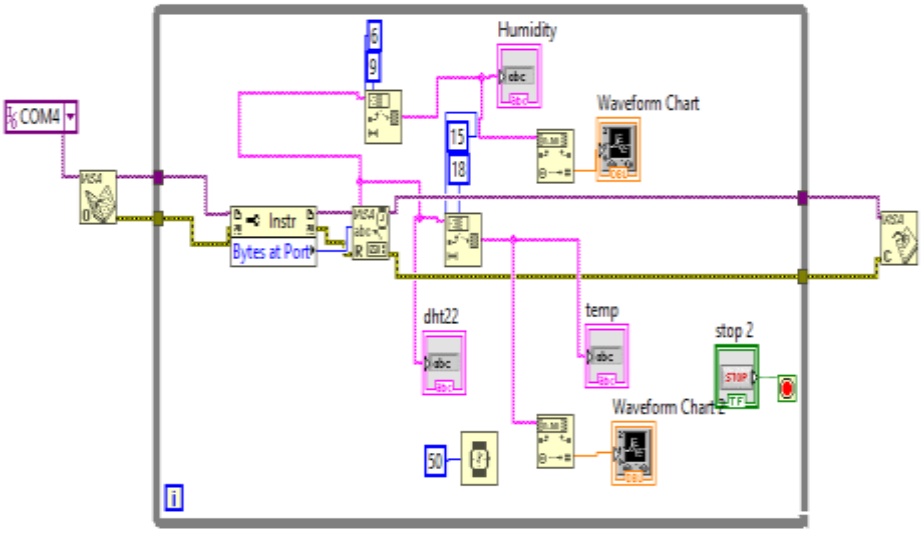

Figure 9 Humidity Contol Algorithm

It can be observed that the use of monitoring and control Systems with the help of GUI allows to monitor key parameter for plant growth such as temperature, relative humidity, Soil moisture, Light intensity etc. The software and hardware used allow to know the, etc. Which makes it possible to perform simple control strategies.

5. CONCLUSIONS

Thus in greenhouse we can control and maintain key parameters such as temperature, soil moisture , air humidity, light intensity in desired proportion for an optimum growth of the plant. The designed structure is a prototype of an actual greenhouse. To demonstrate the performance the system has been subjected to parameter variations. The system performance has been checked by testing control action performance. In further expansion additional parameter such as air (nitrogen, carbon dioxide and oxygen) composition for different gases be monitored and maintained gas proportion inside the greenhouse so that performance can be improved. The water PH can also be included for enhancing the performance. Moreover the study on a small setup can be extended to large size green house and parameter variation study for different crops.

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