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Monitoring and Controlling of Environmental Parameters of Polyhouse Based On Lab VIEW

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ABSTRACT: This paper discusses the design of a Farmer Friendly Software Setup based on LabVIEW. In this paper, design of hardware as well as software has been presented. Crop management depends on having the right information to make necessary decisions. Real-time monitoring of the polyhouse environment with sensors and advanced software can greatly improve yields and economic performance by optimizing plant growth. In this paper, we propose a system that can collect the information related to polyhouse environment and crop status and control the polyhouse automatically based on the collected information to predict and act on situations for perfectly controlled climatic conditions. By densely monitoring climatic conditions, this research has the purpose of establishing correlation between sensors signals and reference measurements, development of crops and the environmental variables to which they are exposed, to develop an automated computerized monitoring system for an intensive polyhouse facility that provides adequate control regardless of plant type or specie, and using this information to help farmers to increase yield, improve quality and timeliness of crops. Computer control software of LabVIEW will provide data acquisition and control, real-time graphical and stores it for current or later use.

KEYWORDS: LabVIEW , Polyhouse, Farmer Friendly software Setup, Virtual Instrumentation, Automatic parameter controller.

I. INTRODUCTION

By using polythene sheets Polyhouses are constructed to provide secured and controlled environment for the proper growth of the plant [1]. As the plants grow in a controlled environment inside a Polyhouse gives the advantage of high yield diseases. The required environment for plants growth and increased productivity can be met by adopting polyhouse cultivation method [2]. Polyhouse farming is a new technique in agriculture gaining foothold in rural India and can be successfully employed for niche areas of agriculture. Polyhouse cultivation as well as other modes of controlled environment cultivation has been evolved to create favorable micro-climates, which favors the crop production, could be possible all through the year or part of the year as required. The primary environmental parameter traditionally controlled is temperature, usually providing heat to overcome extreme cold conditions [3]. However, environmental control can also include cooling to mitigate excessive temperatures, light control either shading or adding supplemental light, carbon dioxide levels, relative humidity, water, plant nutrients and pest control.

II. POLYHOUSE AUTOMATION

Today, computerized control systems are the standard for modern polyhouses, with continued improvements as the technology advances. Environmental parameters can be maintained by these computerized control systems, where the system can be operated manually and/or automatically. The main components of any control system are measurement controller, data processing, data acquisition data presentation and recording. In the environment control system, each parameter must be maintained continuously within a certain range [5]. However, no such models yet exist for commercial polyhouse horticulture. In the agricultural sector, especially developing countries, the application of the

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 4, Issue 9, September 2015

environment control technology is still limited, mainly because of its high cost. Therefore, a sustainable development of environmental monitoring and control system for intensive polyhouse production is inevitable.

III. METHODS:- DESIGN OF HARDWARE FOR MONITORING AND CONTROLLING OF PARAMETERS OF POLYHOUSE

The temperature, humidity and light signals from polyhouse to be monitored and controlled, by interfaced to the computer using transducers and data acquisition (DAQ) card.

A. Data Acquisition

In the Polyhouse monitoring system developed, the DAQ card used is NI PCI 6251 from National Instruments. The main features of this DAQ card includes a sampling rate 1.25 MS/s, 16 analog inputs having 16 bit resolution, 2 analog outputs, 24 digital input outputs channels, Maximum analog input voltage range $\pm 10V$, On board memory 4095 samples, Input impedance $>10\text{ G}\Omega$ in parallel with 100 pF etc.

B. Temperature Sensor

PT 100 is the type of Resistance thermometers, also called resistance temperature detectors (RTD), is a sensor used to measure soil and air temperature in polyhouse monitoring and controlling system.

C. Humidity Sensor

In resistive humidity sensors, the change in electrical resistance of a material due to humidity is measured. The humidity sensor coupled to water circulating pump to control the relative humidity of air. Here we maintain the relative humidity of air. This is one type of watering system in this humidity sensor is use to find out humidity of air and if it is less then motor pump start and water is giving to the plant.

D. Light Intensity Control

In certain areas where natural illumination is absent or very low, illumination for plants may be provided by artificial sources. Incandescent bulbs generate excessive heat and are unsatisfactory in most instances. Fluorescent tubes are useful as the sole source of light. LDR is used by us for monitoring of light intensity in polyhouse.

E. Solid State Relay

To control the physical devices like pump, fan and heater, a thyristor based solid state relay is used. One of the digital outputs of DAQ card is used to trigger the solid state relay and thus control the energizing coil of the contactor. The solid state relay, used, has 330V ac, 10A rating on the output side and has a triggering voltage rating of 3 to 32V dc .Fig. 1 shows the complete circuit diagram of monitoring and controlling of environmental parameters of polyhouse

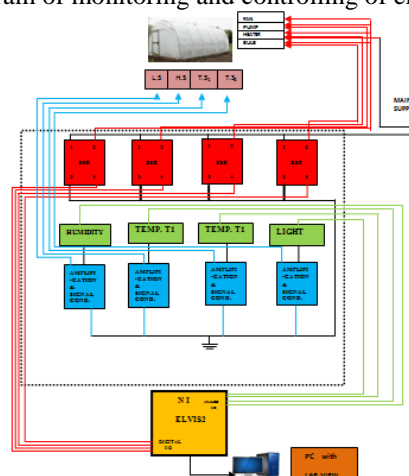


Fig.1 complete circuit diagram of monitoring and controlling of environmental parameters of polyhouse

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

The main function of this section is to convert the data from polyhouse section to a form which is acceptable to DAQ card. The outputs from different sensors are in millivolt, which is not sufficient for DAQ card. It is required to step up, amplification and regulation of voltage in this section. Fig.2 shows complete Setup for Monitoring and Controlling of Parameters for Polyhouse.

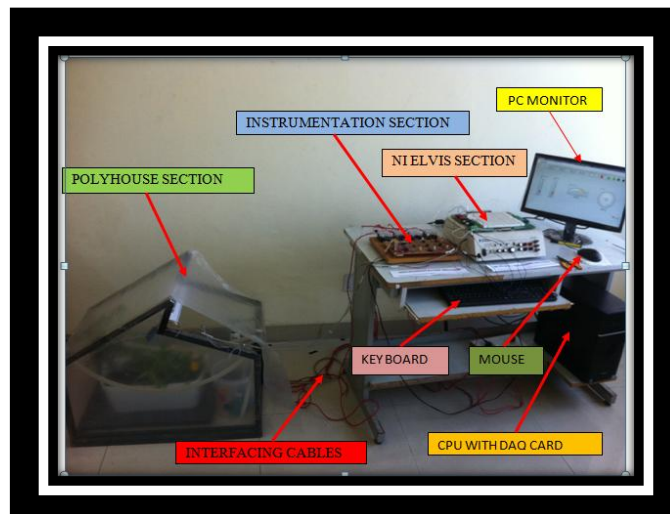


Fig.2 Complete Setup for Monitoring and Controlling of Parameters for Polyhouse

Monitoring and controlling of physical variables of polyhouse based on LabVIEW will be highly helpful for farmers. All the sensors assembled in polyhouse section have been employed for measurement of various environmental parameters of plants.

IV LABVIEW BASED SOFTWARE AND ITS EVALUATION FOR POLYHOUSE PARAMETER CONTROL

Being deemed as a standard data acquisition and instrument control software, LabVIEW is not only an innovative software product, but also is an integrated environment concerning graphical software development which is most widely used, develops faster and has the strongest functions [5]. The LabVIEW environment contains pre-installed drivers for a variety of measurement devices. The configuration of devices is in most cases done without user help [6]. We developed a VI for monitoring and analysis of different parameters of polyhouse using LabVIEW software. Graphical User Interface (GUI) and block diagram has been designed using G programming in LabVIEW. It is also capable of saving data in MS Excel file for records and further analysis. It has the following features:

- Measurement of air temperature of plant inside the polyhouse
- Measurement of soil temperature of plant in polyhouse
- Measurement of humidity of air flow inside the polyhouse
- Measurement of light intensity for plant growth
- Real time continuous monitoring of all the environmental parameters
- Varying all these parameters by controlling the ON/OFF of pump, bulb, fan and heater.
- Software design by us is of farmer friendly
- Saving the real time data like temperature, humidity, light etc for particular crops and plant in computer memory for future reference and analysis.

A. Real Time Temperature Measurement

The soil and air temperature signals are fed to the DAQ card through PT100 sensor.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

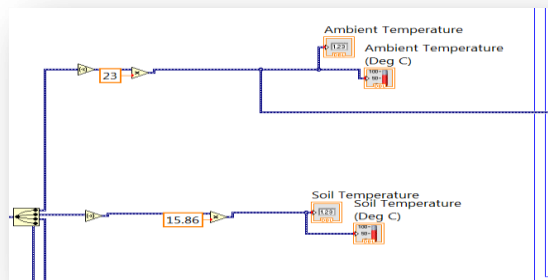


Fig. 3 Block Diagram for Soil and Air Temperature Measurement

The DAQ card makes it suitable for processing the data through computer. This data is imported in the LabVIEW software for further processing. Fig. 3 shows the part of block diagram which imports the real time data from DAQ card.

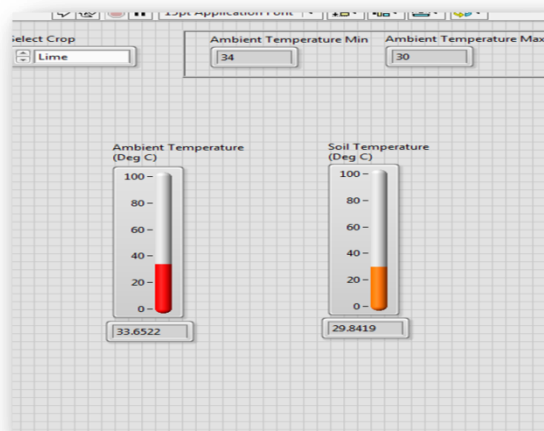


Fig. 4 Front Panel of Soil Temperature and Air Temperature Measurement

Fig. 4 shows the front panel GUI developed for measurement of soil and air temperature. Two different indicating meters as shown in fig.4 the actual value of soil and air temperature of inside polyhouse farming.

B. Real Time Humidity Measurement

Real time humidity value from the humidity sensor is fed to the computer through DAQ card. Fig. 5 shows the front panel of humidity measurement, the gauge meter indicates the real time humidity value which is displayed in %. Relative humidity min and max shows the respective humidity range of particular fruit/vegetable/crop. Different indicators are provided on front panel for indication of humidity, temperature, light etc. Block diagram used for humidity measurement is shown in fig.6.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

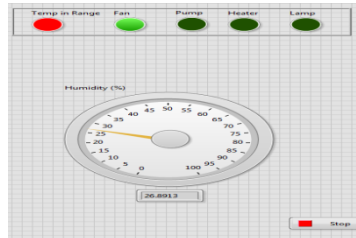


Fig. 5 Front Panel for Humidity Measurement

C. Light Intensity Measurement

Light is one of the momentous factor in a polyhouse as it helps photosynthesis, which affects the growth of plants. Photosynthesis is the process whereby plants turn the energy of light into their own building materials.

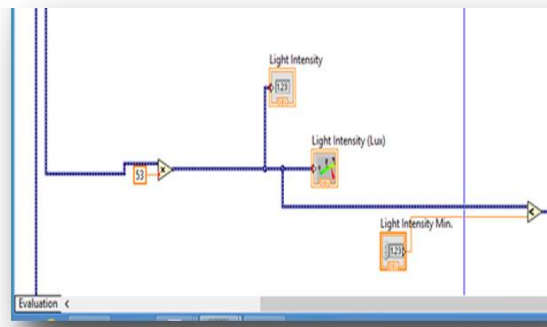


Fig. 6 Block Diagram for Humidity Measurement

LDR is used here for light intensity measurement, if light goes down from the defined value. LDR sends signal to the instrumentation block in voltage form, where it amplifies and then fed to DAQ card through ELVIS II. If light intensity goes down from limit, LED bulb will be ON. Fig.7 shows the block diagram and Fig.8 shows the front panel for light intensity measurement. Light is the energy source in promoting photosynthesis process for growth of plants. During winter time, the light level in India is not adequate for optimal crop production, to overcome this problem, LED bulbs are used by the us for lighting the plants inside polyhouse.

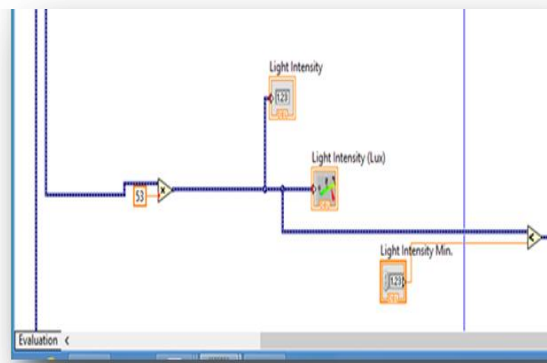


Fig. 7 Block Diagram for Light Intensity Measurement

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

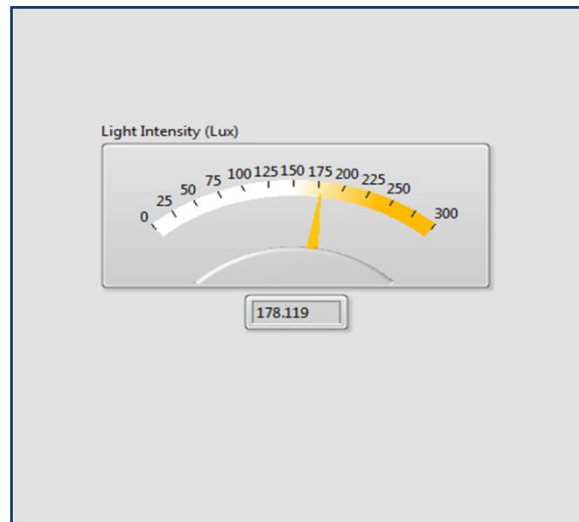


Fig.8 Front Panel for Light Intensity Meter

D. Farmer Friendly Graphical User Interface

Agriculture is the backbone of India’s economic activity and during the last 50 years there is a strong correlation between agricultural growth and economic prosperity. But our farmer is not that much technical savvy as of the rest of the world. For that purpose, we designed a Farmer Friendly Software. Farmers just have to select the particular crop using selector switch and all the environmental parameters will be set for that particular crop.

Fig.9 shows the front panel for Farmer Friendly User Interface, For example if we select “Jack” as a vegetable from selector switch, all the parameter sets accordingly. Temperature range set from 30-35 °C, humidity range set 20-35% light intensity as 175 lux. If these values measured from the polyhouse section are not in range, then it can be achieved by controlling of ON/OFF of devices like pump, bulb, heater and fan.

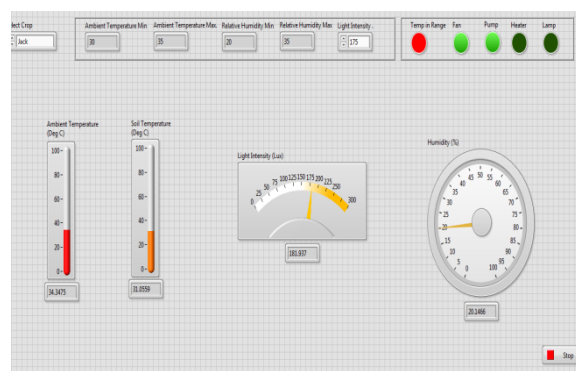


Fig. 9 Front Panel for Farmer Friendly User Interface

Selector switch is used to select different crops as per the requirement of farmer, all the parameters changed accordingly. Fig.9 shows the front panel and fig.10 shows the block diagram for farmer friendly user interface. The authors had visited different polyhouse and met farmers in Haryana and enquired the minimum and maximum ranges of ambient temperature, relative humidity and light intensity, for different vegetables and fruits commonly

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

grown in this area these value have been shown in the Table.1. While developing the Farmer Friendly User Interface, these values have been stored in the software, if farmer select a particular fruit like ‘banana’ from selector switch.

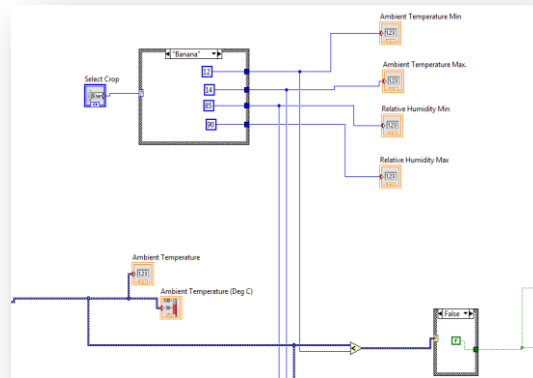


Fig. 10 Block Diagram of Farmer Friendly User Interface

All the parameters are set accordingly likewise soil temperature is 12°C, air temperature 14°C, humidity range from 85-90% etc. If the any of parameter is not in the range of banana plant, to achieve that value different appliances like fan or pump or heater are triggered ON/OFF. For example, if air temperature is 25°C, but for ‘banana’ it should be 14°C, fan will be triggered ON with the help of solid state relay. Similarly if temperature is 7°C to achieve 14°C heater will be triggered ON.

Table 1 Table for Vegetable Data Used In Farmer Friendly Setup

S.No.	VEGETABLE	TEMP. in (°C) RANGE	HUMIDITY in (%) RANGE
1	Capsicum	15 -30	50-80
2	Carrot	18-21	75-99
3	Bottle Gourd	20-28	30-35
4	Cucumbers	15-25	65-85
5	Bitter Guard	16-24	50-75
6	Lime	18-35	55-40

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 9, September 2015

Table 2 Table for Fruits Data Used In Farmer Friendly Setup

S.No.	FRUITS	TEMP. (°C) RANGE	HUMIDITY in (%) RANGE
1.	Banana	12-23	85-90
2.	Beal Fruit	9-23	65-80
3.	Guavas	18-30	65-90
4.	Jack Fruit	25-33	20-35
5.	Cheery	7-14	45-70
6.	Musk Melon	25-33	85-90
7.	Kiwi	2-10	45-60
8.	Strawberry	4-5	55-70
9.	Mango	18-35	65-90
10.	Pine Apple	8-10	75-90
11.	Pitch	16-35	45-67
12.	Baby Orange	10-25	85-90

V. CONCLUSION

In this paper the authors has discussed the step by step procedure adopted to design the hardware and software of an Automatic Polyhouse system. The author has implemented hardware for acquisition of real time temperature, humidity and light signals. Relevant software has also been developed using LabVIEW for real time monitoring and controlling of environmental parameters of polyhouse farming. The results of measured and analyzed parameters are displayed on the front panel GUI developed using user friendly indicators like meters, graphs, gauges, sliders etc. A farmer friendly graphical user interface has been developed using LabVIEW.

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