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Semi-Automated Polyhouse Cultivation Using LabVIEW

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ABSTRACT
The optimum solution for polyhouse maintenance with minimum hardware and human effort is developed. By using this proposed model the temperature inside the polyhouse can be measured and controlled. For measuring the temperature inside the polyhouse LM35 sensor is used. And for maintaining constant temperature inside the polyhouse cooling fan is used. By using national instruments ELVIS-II board these hardware components are interfaced. The overall implementation is done with the help of LabVIEW programming. The proposed model provides the cost effective solution and has the advantage of easy installation. This model operates on the given threshold value of temperature. Whenever the temperature increases beyond the programmed value the cooling fan will starts working to lower the temperature without any further manual instruction. By provision of this automatic cooling function the human effort can be reduced to a maximum extent and cultivation can be performed in a fruitful way by providing optimum conditions for the growth of the plants. For this proposed model the threshold value temperature is taken as 35^{o}C. The status of the environmental conditions inside polyhouse can be observed in the computer with the help of LabVIEW. The GUI provided by LabVIEW shows the value of temperature and its conditional parameters and status of cooling fan.

Keywords
DAQ, ELVIS II, LabVIEW, LM35, Polyhouse cultivation, Sensor.

1. INTRODUCTION
By using polythene sheets polyhouses are constructed to provide secured and controlled environment for the proper growth of the plant. As the plants grow in a controlled environment inside a polyhouse gives the advantage of high yield irrespective of environmental changes,climatic changes and also location. Also it provides suitable environment for the growth of the plant and protect the plants growing inside the polyhouse from abnormal weather conditions and from different plant diseases. The required environment for plants growth and increased productivity can be met by adopting polyhouse cultivation method. The automation of polyhouse is crucial for controlled the environment inside the polyhouse. For the proper growth of the plant and for high yield of production, the monitoring and controlling of different climatic parameters need to be maintained continuously. Few of the parameters that can be monitored and controlled are temperature, humidity,

soil moisture and light intensity inside the polyhouse. For good health conditions of the plant and increased crop yield the above mentioned parameters are to be monitored on fixed intervals.

Various papers are published based on the automation of polyhouse over the past few years with different mechanisms of controlling modules and monitoring stations by using various technologies. In the Table 1 the existing mechanisms are compared based on various controlling parameters. Purna Prakash Dondapati proposed an Automated Multi Sensor Green House Management system [1] which explains how to overcome the effects and disadvantages which are observed in the normal cultivation without human observation. It also explains the effective working of sensors which help the project to become automated to yield more useful results in cultivation.Greenhouse Automation System[2] proposed by Uday A. Waykole used WSN technology in which Zigbee is used for node to node communication. In this system [2], wireless sensor network has been used for collecting information from point to point and the environmental parameters inside the greenhouse are measured by sensors and the collected data is stored in a database and is furthertransferred to the receiving station. Finally the information so far receivedby the receiving station is displayed with the help of LCD display unit andfurther monitored.

The system [3] is an automated greenhouse management system proposed by Sumit A. Khandelwal used GSM for node to node communication. Compared to the previously stated systems [1] and [2] this system monitors more environmental parameters such as fire, absence of light and rain in addition to shade, light and controlling of motor pump in addition to the previously mentioned parameters. As it monitors more number of crucial parameters, it has the advantage of increasing the productivity of crop and also has the provision of remote access and control as it uses GSM. InduGautam has proposed a system [4] titled Innovative GSM Bluetooth based Remote Controlled Embedded System for Irrigation which has the advantage of using both GSM and Bluetooth based on the position of farmer or end user. When the user is within the distance of 10 meters from the controlling unit, using Bluetooth technology the information will be transmitted to the user through the Bluetooth module and whenever the user is not in thepremises of 10 meters the information will be transmitted to the user by using GSM module. This system provides the information about electricity consumption, temperature, humidity, water level and also about any fire accidents which can monitored with the help of smoke sensor MQ2. The main advantage of this system is monitoring more parameters and cost effective solution when communicating with the user/farmer.

K. Ranganand T. Vigneswaran proposed Embedded Systems Approach to Monitor Green House [5]. This system [5] monitors the parameters like Humidity, Water pH, Soil wetness, Light intensity and temperature with thehelp of respective sensor units which were placed in various locations and the data is collected by the main controlling unit, the acquired data is processed and analysed according to the program and sends the information to the receiving end using GSM modem. Kiran Sahu and Mrs. Susmita Ghosh Mazumdar proposed a Digital Greenhouse Monitoring and Controlling System based on Embedded System [6], which is a wired technique for monitoring parameters such as temperature, humidity, soil moisture and sunlight of the existing environmentinside the Greenhouse for achieving proper plant growth and high yield of the crop. Rajeev G Vishwakarma and Vijay Choudhary proposed a system called Wireless Solution for Irrigation in Agriculture [7] which helps the farmer to control up to eight devices from remote location using GSM with the specific commands for controlling water motors etc., thereby utilizing less man power and human effort. Vandana Pandya and Deepali Shukla proposed a system [8] of GSM Modem Based Data Acquisition System collects the information about temperature, rainfall, humidity etc. and the acquired data is processed by AT mega 644P and using GSM the collected information will be transmitted to the end user through SMS. G.K. Banerjee and Rahul Singhal proposed a Microcontroller based Polyhouse Automation Controller [9], which measures the information about temperature and humidity inside the polyhouse and uses LCD display for monitoring the same, the whole system is based on wired communication.

Table 1.Comparison of Existing Remote Monitoring and Control Systems [11]

References	Technology	Processor	Monitoring Station
[1]	Wired	AT89C52	LCD Display
[2]	Zigbee, WSN	PIC	LCD Display
[3]	GSM Modem	(-)	PC
[4]	GSM Modem, Bluetooth	PIC16F877A	Mobile
[5]	GSM Modem	PIC16F877A	Mobile, LCD
[6]	Wired	AT89C51	LCD Display
[7]	GSM	AT89C51	Mobile, LCD
[8]	GSM	ATmega 644P	Mobile, PC
[9]	Wired	PIC16F877A	LCD Display

Both the proposed systems [1] and [6] are based on the wired technology and uses LCD display in the monitoring stations for monitoring the parameters information, the controller inside these two systems is AT89C52 and AT89C51. As the PIC microcontrollers has the advantage of inbuilt ADC, the above mentioned system [9] used PIC 16F877A and also the same wired technology and LCD display for monitoring station like the systems proposed in [1] and [6] are used. Whereas the system [7] is implemented with wireless technologywhich uses GSM for communication, for processing and analysing AT89C51 microcontroller is used and for monitoring LCD is used. The models [4] and [5] used PIC16F877A controller which uses GSM for communication and mobile is the monitoring station. In contrast to [5], the system [4] used the Bluetooth technology for communicating the information to the end user, provided if the end user has the provision of Bluetooth option in the mobile device. The system [8] uses PC for monitoring and GSM for communication and main controlling module is AT mega Arduino.

The problems and complexities of the above mentioned techniques are overcome with the proposed system of polyhouse cultivation using LabVIEW. Here the external requirement of hardware is minimum. The hardware modules used in the proposed system are Temperature sensor for monitoring the temperature inside the polyhoue and a cooling system like FAN to maintain the required temperature. For monitoring the temperature one LM35 temperature sensor is used. And for maintaining constant temperature cooling fan is used. The overall monitoring of the proposed system can be done by using LabVIEW software. For this proposed model PC is the main central monitoring unit.

2. HARDWARE DESIGN OF PROPOSED POLYHOUSEAUTOMATION SYSTEM

2.1 Hardware architecture

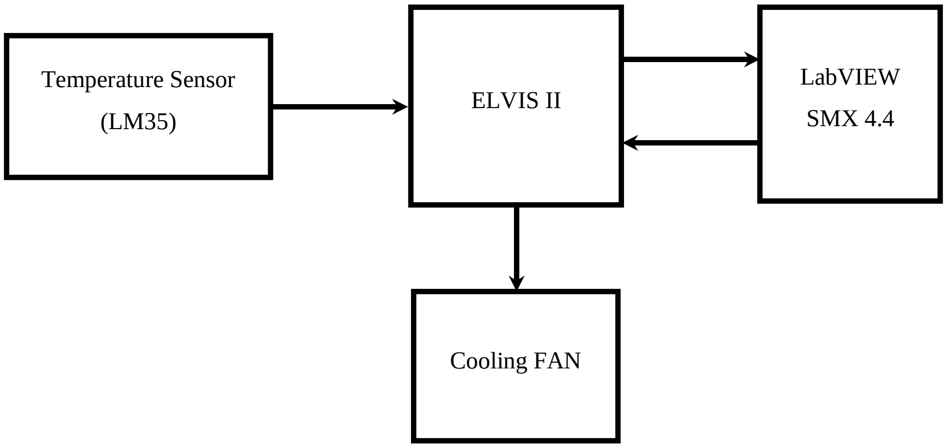

Figure 1. Block level representation of Proposed Model

LM 35 is used to read the ambient temperature in the target place that is inside the polyhouse. The output of LM35 is analog voltage with range 0-5V. Zero volts represent the 0^oC and increases by 10 mV for every 1^oCrise in temperature. The output of LM35 is interface to ELVIS-II board with input and output pins. Data acquisition system of LabVIEW is used to read the analog voltage from ELVIS-II board. After acquiring the required data from DAQ, it is compared with the preset temperature. So that if the ambient temperature is greater than preset temperature the DC motor will be ON which in turns ON the fan, here irrespective of the ambient temperature the fan will be ON state for three minutes.The proposed system is designed in such a way that after every three minutes the same process repeats.

2.2 ELVIS-II

It was developed by national instruments (NI). ELVIS-II series combines hardware and software into one complete laboratory suit. ELVIS-II series prototyping board connects to the work station. The prototyping board supports all the signal terminals of the NI ELVIS-II series for use through the distribution strips on either side of the bread board area. It has the availability of eight different AI channels. In the proposed system LM35 output is connected to AIO. As ELVIS-II has variable power supply, the power required for LM35 is also acquired from ELVIS-II only.

The NI ELVIS mx software includes SFP instruments, LabVIEW express VIs, and signal express blocks for programming the ELVIS-II hardware. To access the NI ELVIS mx express VIs, open LabVIEW block diagram and select measurement I/O. It has got 24 digital I/O pins. Out of these one is used for LED and the other for switching ON/OFF The temperature controlling element is FAN.

2.3 Temperature sensor

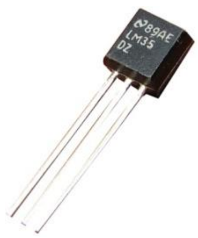

Figure2.LM35

LM35 is a temperature sensor with output range from 0^oC-100^oC. It has the sensitivity of 10 mV/^oC. It has very good linear characteristics and various advantages which are suitable for industrial applications. The output of this device is analog voltage with inbuilt signal conditioning. It requires +5V dc supply. For this proposed model, is operated in the range of 30^oC to 50^oC and it shows suitable linear characteristics as repeated for 10 times making less hysteresis. Among the availability of various temperature sensors LM35 is used for the implementation of the proposed system because of its different advantages like more accuracy than using Thermistor, as it is sealed provides no oxidation, produces high output voltages than thermocouples which leads to no further provision of amplification. And it does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°Cover a full of −55 °Cto +150°C temperature range. It has very low self-heating of less than 0.1°C in still air, as it draws only 60 µA from its supply. The LM35 is rated to operate over a −55°C to +150°C temperature range.

3. FLOW CHART

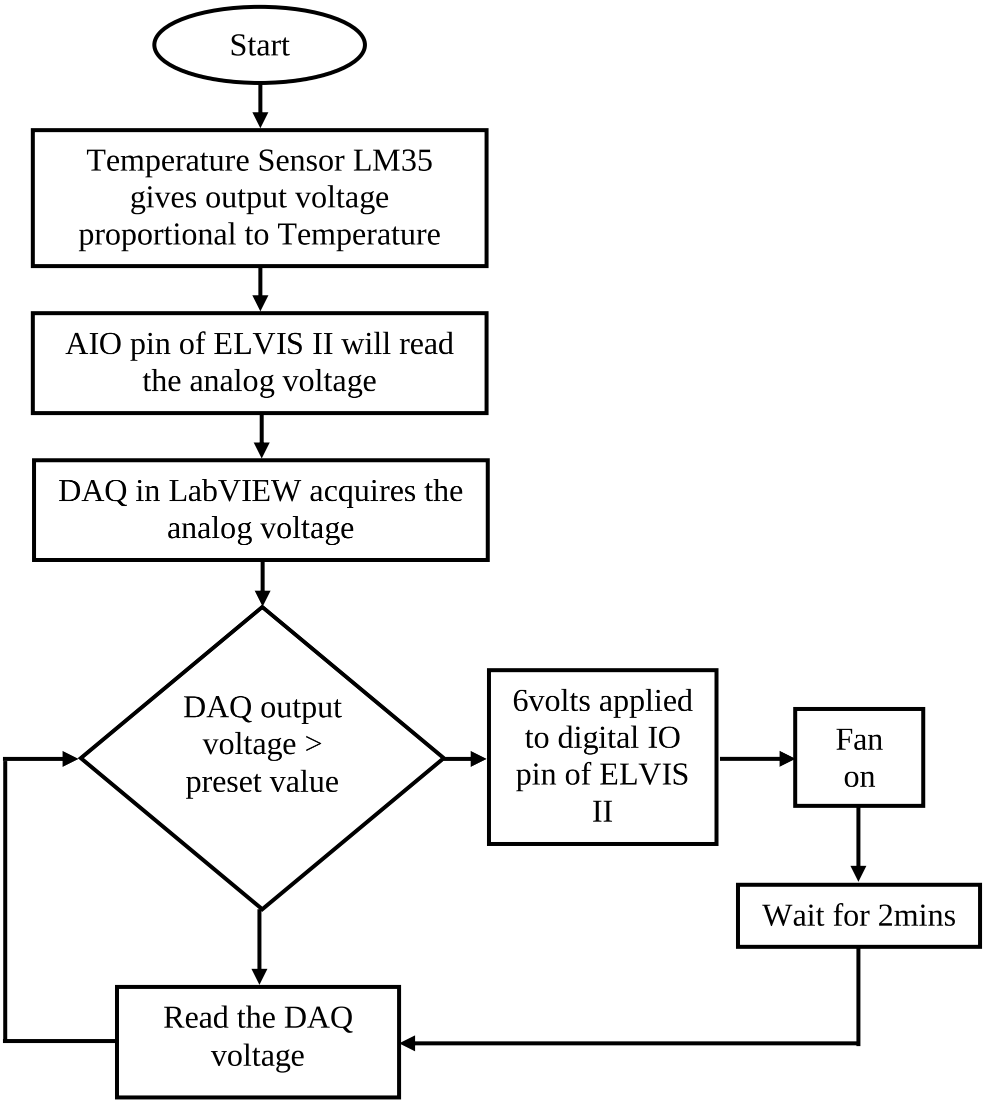

Figure 3. Flow chart for the proposed model

The operation of proposed system is shown above.LM35 is used to sense the ambient temperature and its internal signal conditioning circuits will condition the output voltage to 0-5 volts, which is proportional to the ambient temperature with sensitivity of 1mV/^{o}Ci.e., for every 0^{o}C rise in ambient temperature the output voltage of LM35 increases by 1mV.The analog output of LM35 is interfaced to ELVIS II workstation with AIO (analog input port 0). LabVIEW is used to acquire the data from ELVIS II board using DAQ assistance. DAQ is configured for analog input voltage through the pin AIO. So the output of DAQ is voltage which represents the ambient temperature. Another DAQ is configured for digital output. Now compare the analog voltage of DAQ with preset voltage of 3.5mV, so that if temperature is greater than 35^{o}C,6V digital output is written to the digital IO pin of ELVIS II and it is connected to cooling fan and the fan goes to ON state,otherwise it writes 0v to digital IO pins of ELVIS II so that cooling fan will be in OFF state. It was programmed in such a way that if cooling fan is powered once it will continue in the same state for 3 minutes to avoid frequent switching in between the fan ON/OFF states.

4. SOFTWARE DESCRIPTION

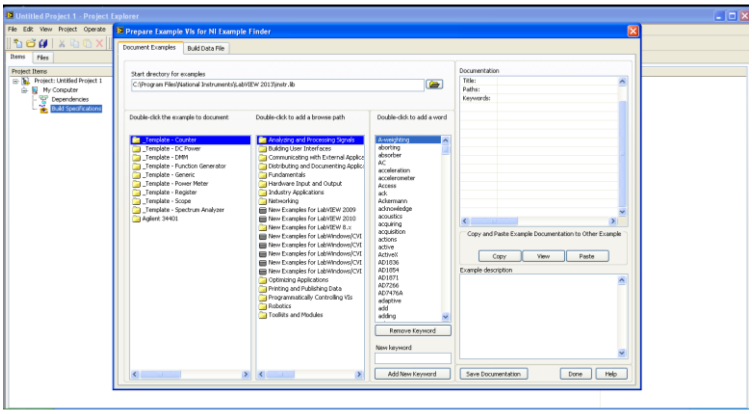

Figure 4. LabVIEW

It is a graphical programming environment developed by national instruments (NI). LabVIEW 2013 version is used for implementing the proposed model. It has two windows, one is front panel and the other is block diagram. Front panel shows the control elements and indicators. Block diagram is used to connect different blocks to realize the application. In this package, it is required to install ELVIS mxs. In block diagram go to function and select express VI then pick DAQ for acquiring data from ELVIS-II. And can easily configure the express VI according to the requirements of the application.

5. RESULTS

The Table 2 shows some of the readings of LM35 sensor and its actual computed value. When the reading of LM35 is observed as 0.30 mV the actual ambient temperature inside polyhouse is 30^{o}C. Similarly, whenever the temperature reading is 0.60 mV the corresponding temperature would be 60^{o}C.The status of the cooling fan is dependent on the value of temperature sensor output. For the case of 0.30 mV given by LM35 the cooling fan will be in OFF mode,as the programmed threshold value is 0.35 mV. And during the cases of 0.40, 0.50 and 0.60 the fan will be in ON state only.

Table 2. Tabular Wave Form about Temperature readings

S.No.	LM 35 Reading (mV)	Actual Value (^oC)
1.	0.30	30
2.	0.35	35
3.	0.40	40
4.	0.50	50
5.	0.60	60

The Figure 5 shows how ELVIS II board which is interfaced with the temperature sensor and cooling fan.

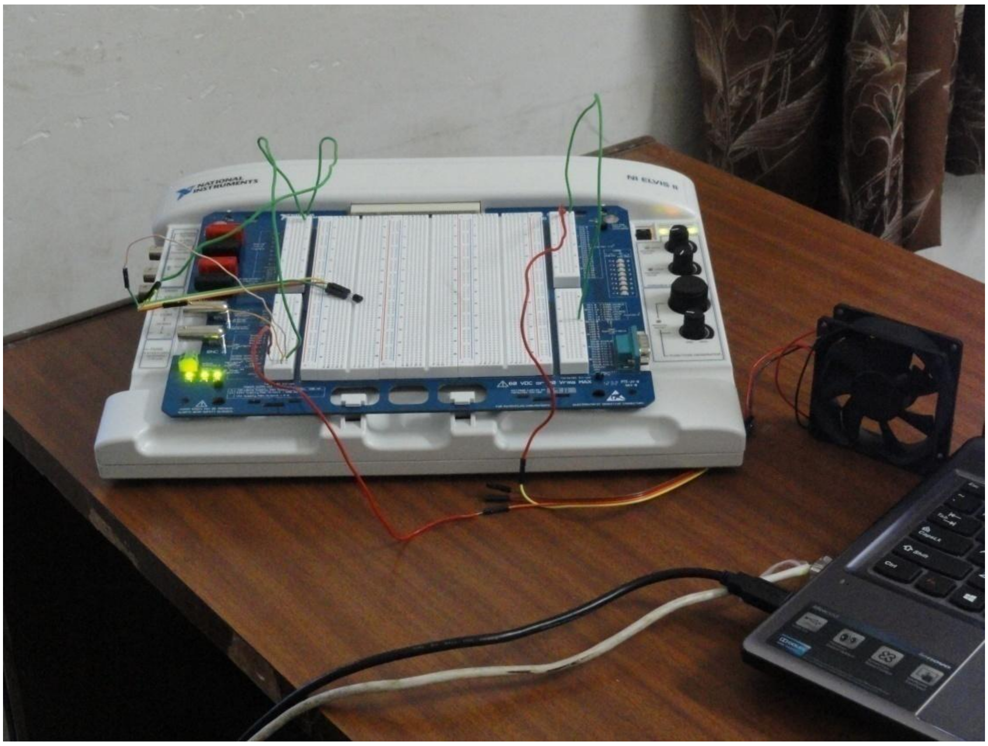

Figure 5. ELVIS II Board

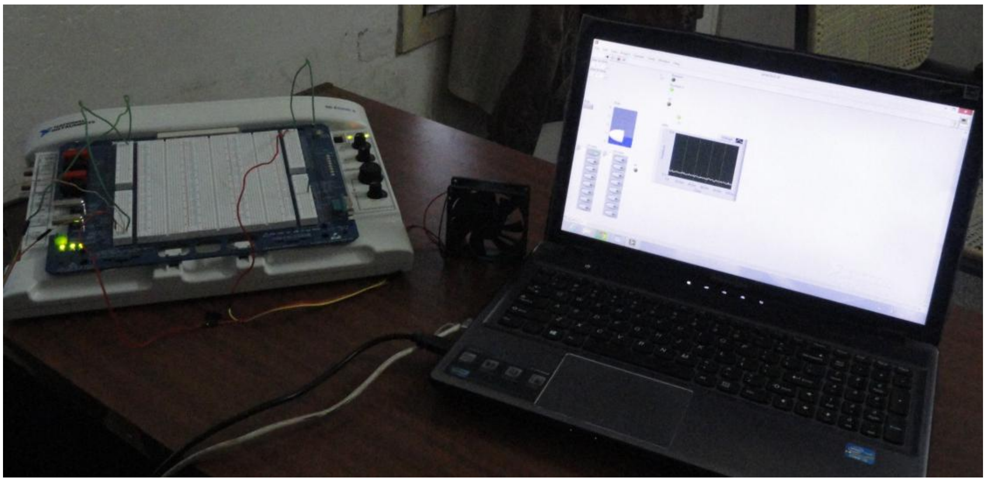

Figure 6. Simulation setup of the proposed model

The overall setup of the proposed model can be seen in the Figure 6.

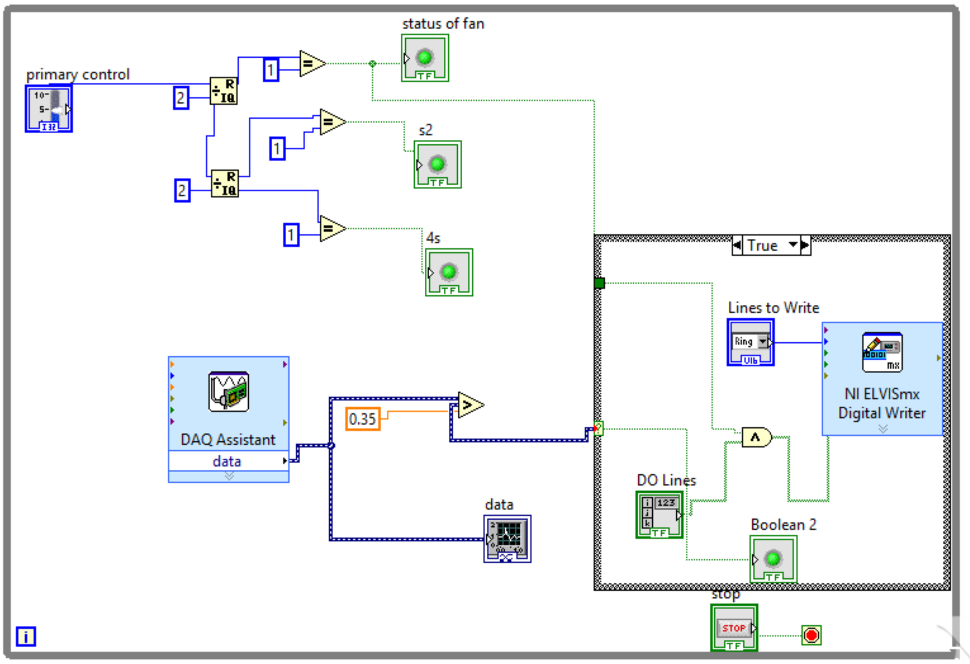

Figure 7. Block level implementation in LabVIEW

The overall software implementation of the proposed model can be observed from the Figure 7. It shows the blocks of logic level indicators and the functional loops based DAQ and ELVISmx.

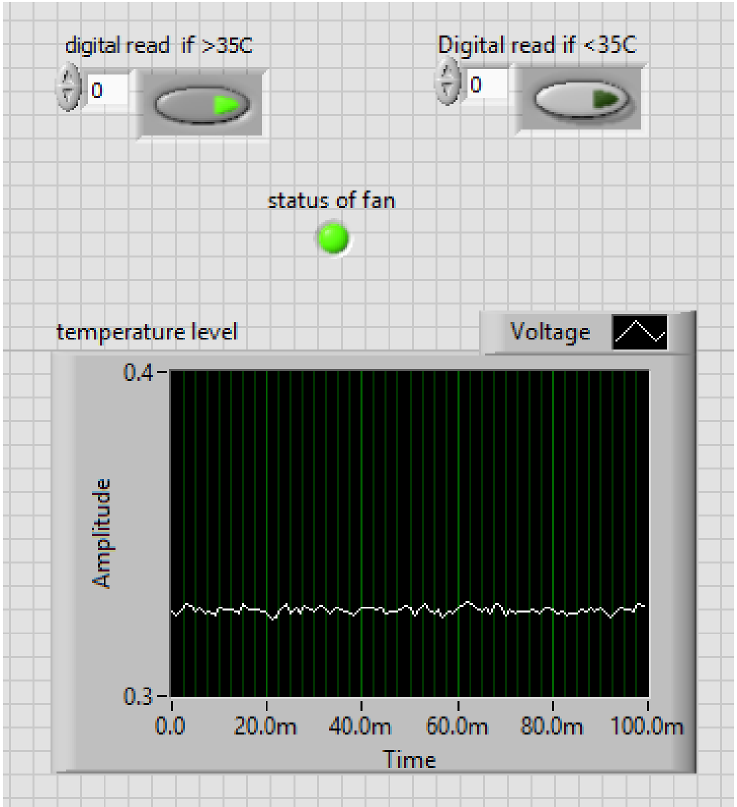

Figure 8. Variation of temperature readings of LM35 and position of fan when temperature is below 35°C

The variation of temperature curve when the temperature is below 35°C can be observed from the Figure 8. It is the final output screen which shows the temperature level, logical indicators and status of fan.

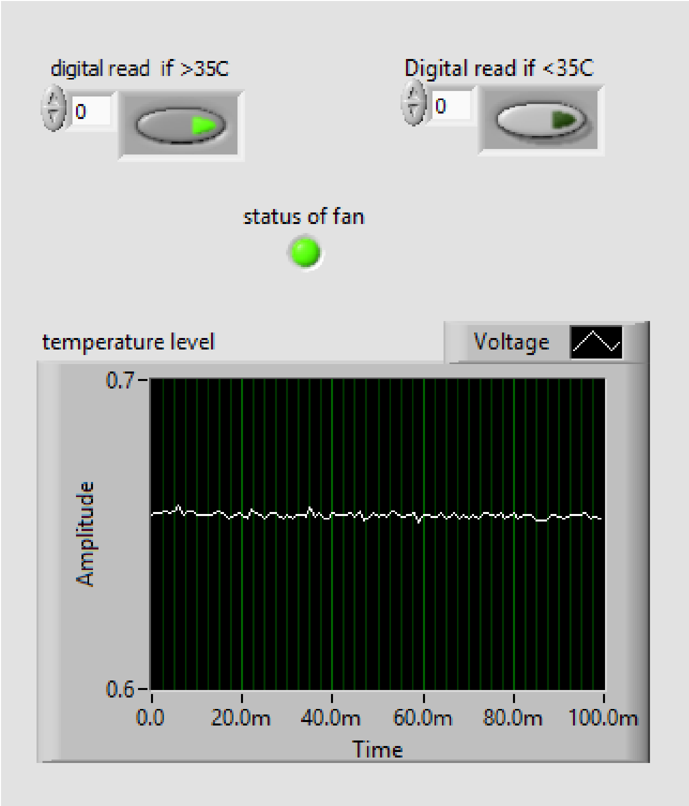

Figure 9. Variation of temperature readings of LM35 and position of fan when temperatureis greater than 35°C

When the temperature is greater than the threshold value of 0.35mV the position of the temperature curve appears as shown in Figure 9. Similarly across 0.35mV the waveforms of the temperature isshown in Figure 10.

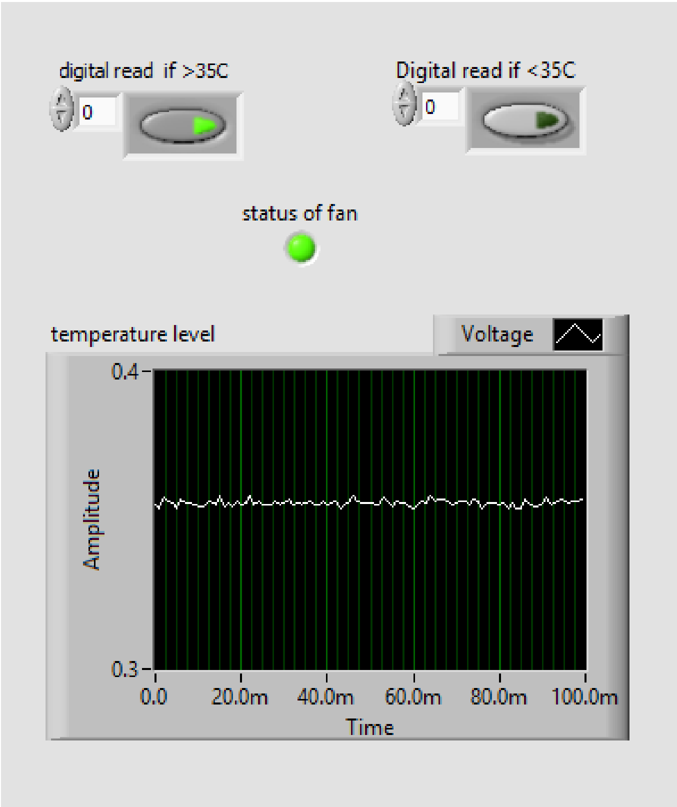

Figure 10. Variation of temperature readings of LM35 and position of fan when temperature is equal to 35 ^{o}C

6. CONCLUSIONS

The problem of providing constant temperature for the plant growth which in turn increases crop production can be achieved with the minimum hardware requirement and less utilization of human effort by using this proposed model.Other climatic parameters like humidity, soil moisture content, light intensity, carbon dioxide levels inside the polyhouse can be measure, monitored and required control action can be performed by interfacing the above said parameter monitoring sensors and processing the acquired data which in turns performs the required action results in the proper plant growth and increased crop yield. As the proposed system has the advantage of the cooling system the temperature inside the polyhouse is monitored and controlled at regular intervals. It is evident that the proposed system has reduced the human effort to its minimum. Also, it has the advantage of cost effectiveness. It needs only the monitoring sensor and cooling fan with the additional controlling module of national instruments ELVIS-II board. All these were controlled by using the LabVIEW software.

REFERENCES

[1] PurnaPrakashDondapati and K. GovindaRajulu. An Automated Multi Sensored Green House Management.*Journal of Technological Exploration and Learning (IJTEL),*Vol. 1, Issue 1,August 2012, 21-24.

[2] Waykole UA. Greenhouse Automation System.*In proceedings of the 1st International Conference on Recent Trends in Engineering & Technology, Special Issue of International Journal of electronics, Communication & Soft Computing Science & Engineering,* 2012, 161-166.

[3] Sumit A. Khandelwal. Automated Green House Management Using GSM Modem.*International Journal of Computer Science and Information Technologies*,Vol. 3(1), 2012, 3099–3102.

[4] InduGautam and S R N Reddy. Innovative GSM Bluetooth based Remote Controlled Embedded System for Irrigation. *International Journal of Computer Applications*,Vol. 47, No.13, June 2012, 1-7.

[5] K. Ranganandand T. Vigneswaran. An Embedded Systems Approach to Monitor Green House,*Recent Advances in Space Technology Services and Climate Change (RSTSCC),* 2010, 61-65.

[6] KiranSahu andSusmitaGhoshMazumdar. Digitally Greenhouse Monitoring and Controlling of System based on Embedded System. *International Journal of Scientific & Engineering Research*,Vol. 3, Issue 1, January 2012,1-4.

[7] Vishwakarma RG andChoudhary V. Wireless Solution for Irrigation in Agriculture.*In the Proceedings of International Conference on Signal Processing, Communication, Computing and Networking Technologies (ICSCCN),*July 2011, 61-63.

[8] VandanaPandya anddeepaliShukla. GSM Modem Based Data Acquisition System. *International Journal of Computational Engineering Research, IJCER,* Vol. 2, Issue 5, September 2012, 1662-1667.

[9] Banerjee GK andSinghal R. Microcontroller based Polyhouse Automation Controller. *International Symposium on Electronic System Design (ISED),*December 2010, 158-162.

[10] SenguntharGayatri R andEkataMehul. A Survey on Greenhouse Automation Systems.*International Journal of Engineering & Science Research, IJESR,* Vol. 3, Issue2, February 2013, 2321-2327.

[11] National Semiconductor,*Precision Centigrade Temperature Sensors, LM35,*data sheet,November 2000.

[12] J. Travis and J. Kring. *LabVIEW for Everyone: Graphical Programming Made Easy and Fun, 3rd edition.* Prentice Hall, 2006.