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Intelligent Data Acquisition for Green House Environment

S. Priya[1], S. Suresh[2], L. Valliammal[3] and V. Karthiga[4]

ABSTRACT

In the last few years data acquisition and control systems are PC based for industrial and laboratory applications. In this paper, we present a data acquisition process to monitor the greenhouse environment. The simulation process consists of Real Time setup using Proteus software. The changes in the sensor variables such as temperature, soil moisture and humidity are monitored and are interfaced to the Visual Studio to collect the data from the Real Time environmental setup. The interfacing is done with the help of virtual serial port driver to send the data from real time environment to the data acquisition side. The data are continuously monitored and increase in threshold values performs the necessary action to reduce them to their control values. Thus it provides an automatic control over the environment precisely.

Keywords: Greenhouse environment, sensor variable, Real time, Data acquisition, control values.

1. INTRODUCTION

The Control System for the Greenhouse Environment form an important part of the agriculture sectors in our country in order to grow plants under controlled climatic conditions for an optimum produce. Appropriate environmental conditions are taken into account for improved crop yields, optimum plant growth, and efficient use of water and other resources. Automation is done by process control of industrial machines and their processes, thereby replacing human operators. The environment temperature, soil moisture conditions and various climatic parameters govern plant growth. Automating the data acquisition process provides this information (temperature, soil moisture and various climate parameters) to be collected at high frequency with less labor requirements.Using these collected greenhouse environmental data, indoor environments can be monitored and can be effectively controlled, that can contribute to prevent crops from damages and to improve productivity and to prevent crops from damages.

Arduino is a platform for electronics prototyping that is an open source which is flexible, easy-to-use hardware and software. It is intended in creating interactive objects or environments for designers, artists, hobbyists. Arduino can sense the surroundings with the input signal from a variety of sensors and can affect its environment via controlling Water pump, heater, and other actuators. An automatic control system based on WSN which prevents dew condensation in the greenhouse environments. It consists of sensor nodes which collects data, base nodes which processes collected data, inside a greenhouse and an environment server for processing and storage of collected data. The system processes variables like Temperature, Humidity that are sensed and their continuous reading is sent to a remote PC through wireless. The parameter range are controlled by the programmer controller. An artificial plant growth controlenvironment platform, that focuses on the virtual instrument technology that measuresplant growth and controls the system, with the software platform Lab VIEW using virtual instrument. A setup that can control the polyhouse and

[1] HOD, Dept. of EEE, S.A. Engineering College, *Email: priyasakthi@gmail.com*

[2] Assistant Professor, Dept. of EEE, S.A. Engineering College, *Email: sivanthisuresh@gmail.com*

[3] Assistant Professor, Dept. of EEE, S.A. Engineering College, *Email: valliammal@saec.ac.in*

[4] Post Graduate, Dept. of EEE, S.A. Engineering College, *Email: for.karthi@yahoo.in*

collect the information of the polyhouse environment, crop statusautomatically with the collected information to predict and act to the situations for perfectly controlled climatic conditions .

A simulated environment for crop growth (a growth cabinet). The growth cabinet used the light-emitting diode light source for the crop growth and simulated environment that are artificially based on the necessary requirement of crop growth and development. A microcontroller circuit is used to monitor and record the values of temperature, humidity, sunlight of the natural environment and soil moisture that are continuously controlled and modified to cumulate them to produce maximum plant growth and yield. A network controlled embedded greenhouse monitoring based on simple 1-wire protocol and embedded web servers for connecting sensors and actuators. Hardware and software architecture of embedded web servers are described and their experimental results on monitoring and control of laboratory greenhouse model are presented. A system based on microcontroller to oversee and record the values of temperature, humidity, and sunlight of the natural environment to achieve maximum yield and plant growth. It communicates with a variety of sensor modules in order to control the light and aeration process according to the necessary condition of the crops.

A wireless system for monitoring the greenhouse based on Zigbee which is used to solve the problems such as necessitous real time data acquisition, more man power necessities and also to overcome the lack of the wired system such as complicated wiring. A monitoring and management centre that controls the humidity and temperature of the greenhouse, measures the carbon dioxide content, and also collect the information about intensity of illumination. A self-managing energy supply system in which the nodes are deployed with time synchronisation and are analysed. The system solves the problem of complex cabling with low power consumption, low cost, extended flexibility.

The existing system has PC or SMS based system for providing the greenhouse environment conditions continuously, but are bulky, unaffordable, difficult to maintain and less accepted by the technologically unskilled workers. Green house environment data are collected. Using Labview data are acquired and monitored from the remote place. Wireless sensor Network helps in data transmission through and the data are collected in the Labview simulation panel.

2. LITERATURE REVIEW

In this paper [1], authordeveloped a complete system designed to monitor and control the humidity inside a green house. Android mobile phone is used for this system, connected using Wifi to a central server which connects via serial communication to a humidity sensor and microcontroller. This embedded system for monitoring and controlling the green house is based on measuring the humidity and temperature by sensor that located at different places. The microcontroller will read the sensor periodically and updates the value of sensor to android. The monitoring and controlling is conducted through Android Smartphone. The result shows that the condition specified in sensor's datasheet and system in reality is appropriate and the result achievedby the test concludes that the system is working properly.In this paper [2], author developed a WSN (Wireless Sensor Network) based monitoring system that is automatic and prevents dew condensation in a greenhouse environment. Dew condensation of greenhouse crops on the leaf surface can promote diseases caused by bacteria and fungus, that affects the growth of the crops. The system is composed of sensor nodes for collecting data, base nodes for processing collected data, for driving devices and for adjusting the environment inside greenhouse relay nodes are used and an environment server for data storage and processing. Using the Bahrenburg formula for calculating the dew point on the leaves, to prevent dew condensation phenomena this system is realized on the crop's surface which acts as an important thing for prevention of diseases infections. They also constructed a physical model that resembles the typical greenhouse in order to verify the performance of the system with considerations to dew condensation control.

In this paper [3], authordeveloped an artificial plant growth control environment platform that focuses on the virtual instrument technology that measures plant growth and controls the system, with the software platform Lab VIEW using virtual instrument. For urban land resources are increasingly strained reality, the use of LED lights that areartificial controllable and VI (virtual instrument) technology, simulation of plant growth in natural environment as possible. A combination of hardware data acquisition card NI-PCI, serial communication technology (VISA), data acquisition (DAQ) technology, digital I/O port technology to build software control platform, upload sensor data in real time to the host computer via the data acquisition, the host are displayed in real-time graphical interface to design and to control the plant growth system that can achieve a controlled environment plant growth platform. The system is based on PCI data acquisition cards and LabVIEW software platform that developed for plant growth cabinet and control system, including data acquisition, serial communication, data storage and other functions, to achieve dynamic monitoring of environmental parameters inside the plant growth environment.In this paper [4], authordeveloped asetup that can collect the information of polyhouse environment and control the polyhouse and crop status automatically with the collected information to predict and act to the situations for perfectly controlled climatic conditions. Based on LabVIEW the design is a Farmer Friendly Software. In this paper, design of hardware as well as software has been presented. Right information and necessary decisionsshould be made for Crop management. Real-time monitoring withadvanced software in the polyhouse environment with sensors can greatly improve yields and economic performance by optimizing plant growth.

By monitoring the climatic conditions densely, this research has the purpose of establishing correlation between reference measurements and sensors signals, development of crops and the environmental variables to which they are exposed, for an intensive polyhouse facility an automated computerized monitoring system is developed that provides adequate control disregarding plant type or specie, and help farmers by using this information to increase yield, improve quality and timeliness of crops. LabVIEW's computer control software will provide data acquisition and control, real-time graphical and stores it for prevailing or later use. A setup collects the information related to crop status and polyhouse environment and controls the polyhouse automatically with the collected information to predict and act to the situations for perfectly controlled climatic conditions.In this paper [5], author developed a simulated environment for crop growth (a growth cabinet). The growth cabinet used the light-emitting diode light source for the crop growth and simulated ecological environment artificially based on the necessary requirement of crop growth and development. The process variables like Temperature, Humidity are perceived and their readings are continuous transferred to a remote PC via wireless. The project was initially monitored and computed on LabVIEW software and then its hardware circuit is prepared. Minimum response time for ON and OFF the control relay is in micro seconds. The programmer controller controls the parameter range. A greenhouse environment system that monitors the parameters based on wireless communication technology has been developed, that realizes the measurement, control of temperature, humidity and summary, and the other parameters. In this paper [6], author developed a microcontroller circuit is used to monitor and record the values of temperature, humidity, sunlight of the natural environment and soil moisture that are continuously controlled and modified to cumulate them to produce maximum plant growth and yield. Monitoring and control of greenhouse environment play a vital role in greenhouse management and production. To monitor the greenhouse environment parameters effectively, it is fundamental to design a measurement and control system. The values of temperature, humidity, soil moisture and sunlight of the ordinary environment that are continuously modified and controlled in order optimize them to attain maximal plant growth and yield. The controller used is a low power, cost efficient chip manufactured by ATMEL. It communicates with the various sensor modules in real-time in order to control the aeration, light and drainage process dexterously inside a greenhouse by activating a cooler, fogger, dripper and lights respectively bestow to the necessary status of the crops. An Liquid crystal display (LCD) is used for the real time display of the data acquired from several sensors and the status of the various devices. Also, the need of conveniently available

components deduces the manufacturing and maintenance costs. It can thus be tailor-made to the specific requirements of the user. This makes the system to be portable, an economical and a low maintenance solution for greenhouse applications, especially in rural areas and for small scale agriculturists.

In this paper [7], author developed anetwork controlled embedded greenhouse monitoring based on simple 1-wire protocol and embedded web servers for connecting sensors and actuators. Hardware and software architecture of embedded web servers are described and their experimental results on monitoring and control of laboratory greenhouse model are presented. The approach of Plant factory could realize the multiple targets of high yield, high quality, high efficiency and security. According to the research on the key technologies of plant factory, a small simulated environment for crop growth was designed. The growth cabinet used the light-emitting diode (LED) light source as growth light for crops and simulated environment artificially dependent on the need of crop growth and development. The crop can obtain stable environmental conditions for growth and development in contrast season and unstable environmental conditions with the help of sensors and embedded system. The outcome of experiments showed that the crop growth systems structure design was reasonable and had the advantages such as low-carbon, intelligence, reliable performance and security.

In this paper [8], author developed a system based on microcontroller to oversee and record the values of temperature, humidity, and sunlight of the natural environment to achieve maximum yield and plant growth. It communicates with a variety of sensor modules in order to control the light and aeration process according to the necessary condition of the crops. Embedded networked greenhouse monitoring and control based on simple embedded web servers and 1-wire protocol for connecting actuators and sensors is described. Software and hardware architecture of embedded web servers are described and the results of experiment monitoring and control of laboratory greenhouse model are presented.In this paper [9], author developed a wireless system for monitoring the greenhouse based on Zigbee which is used to solve the problems such as necessitous real time data acquisition, excessive man power requirements and also to overcome the lack of the wired system such as complicated wiring. Monitoring and control of greenhouse environment play an significant role in greenhouse management and production. To monitor the greenhouse environment parameters effectively, it is necessary to construct a control system. The controlling process takes place effectively by both manual and automatic manner. For manual controlling, zigbee wireless network is used, which will send status of greenhouse environment to control room. Here we can control the system via PC and send to controller back which is in greenhouse setup. There it will activate the actuator to our wish. The mainaim is to design a straight-forward, easy to install, circuit based on microcontroller to store and monitor the values of temperature, humidity, and sunlight of the natural environment that are regularly modified and controlled in order to optimize themand achieve maximum plant growth and yield. The controller being used is PIC 16F877A. It communicates with the a various sensor modules in order to control the aeration, light and drainage process dexterously inside a greenhouse by actuating a cooler, fogger, dripper and lights respectively according to the required condition of the crops.In this paper [10], authorpresents the current transformer (C.T) is used for measuring alternating electric currents. When the circuits current is too high to apply explicit to measuring instruments, a transformer produces a lesser amount of current accurately proportional to the current in the circuit, which can be effectively connected to measuring and recording instruments. The measuring instruments are isolated by the current from what may be very high voltage in the monitoring circuit.

3. PROPOSED SYSTEM

Data Acquisition is the intelligence gathering phase. Data acquisition is the process of examining signals that extracts the environment conditions of the real world and converts the resulting samples into digital numeric values that are manipulated by a computer. Data acquisition typically converts analog waveforms into digital values for further process to be dealt. The data acquisition system components include:

- Sensors which converts physical parameters to electrical signals.
- To convert sensor signals in the form of digital values signal conditioning circuitry is required.
- Analog-to-digital converters, conditions the sensor signals and converts it to digital values.

The real time environmental setup is designed in the Proteus software and it is interfaced to Visual Studio to acquire the data.GUI is used to design the output page in which data are monitored. Virtual Serial port driver software is used to transfer the data virtually from one to other. Data are transmitted and received automatically.

Arduino mega 2560 microcontroller is been used to control the sensors. The simulation output is the result of data that are from the real time environmental setup.

4. SYSTEM MODEL

In this block diagram we are using controller ATmega 2560. It has 54 digital input/output pins (15 used as PWM outputs), a 16 MHz crystal oscillator,4 UARTs (hardware serial ports), 16 analog inputs, an ICSP header, a USB connection, a reset button and a power jack. It connects to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The soil moisture, temperature, and humidity sensors are connected to the analog pins of the Arduino.

The DHT11 is a temperature and humidity sensor being used. It uses a capacitive humidity sensor and a thermistor that measures the surrounding air, and spits out a digital signal on the data pin. Soil moisture sensors measure the volume of water content in soil. Soil moisture sensors measure the volume of the water content indirectly by using the properties of the soil present in them. They are the electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

Humidity is the presence of water in air. Humidity measures the amount of water vapor present in a gas that can be a mixture, such as air, pure gas, such as argon or nitrogen. Humidity sensing is very important,

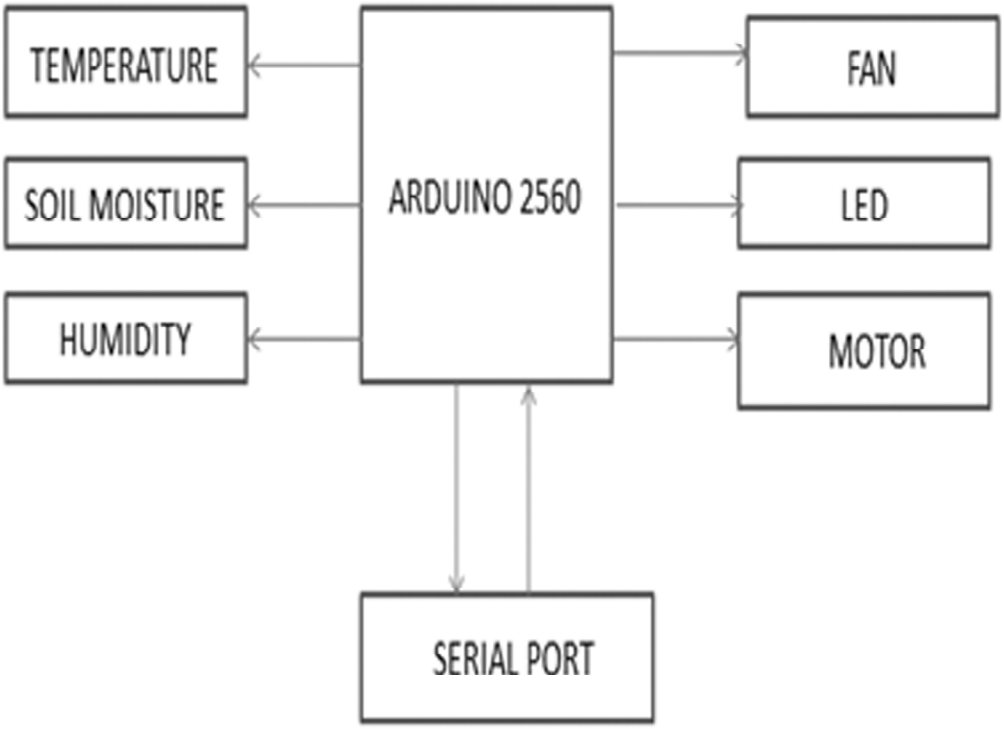


Figure 1: Environment Sensors

especially in the control systems for human comfort and industrial processes. Serial RS232 protocol has been used for serial transmission of data between the environmental set up to the output.

The Atmega controller 2560 is programmed with the help of arduino software and dumped in the proteusarduino schematic. Then interfacing is done with the help of serial ports. Virtual serial port driver drives the data from one to the other. Sensor are connected to the VCC = 5V and the other pin is grounded.

4.1. Data Logger

The GUI design page is the data logger part. The real time data changes are monitored on the GUI design page and if the temperature goes beyond the control value then the fan will be switched OFF automatically in order to stabilize the temperature to its threshold value and if it goes below the fan is switched ON automatically. Similarly if the moisture content is above its threshold then the motor is switched OFF and if the moisture level is below then the motor is switched ON.

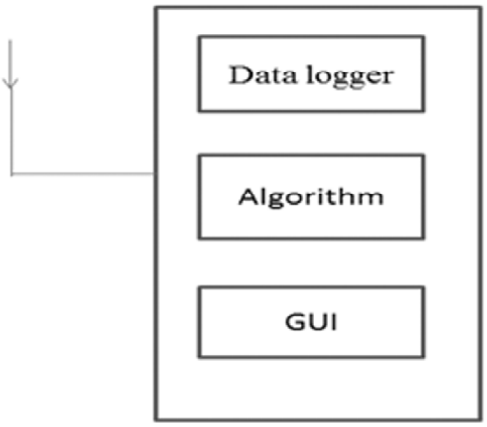
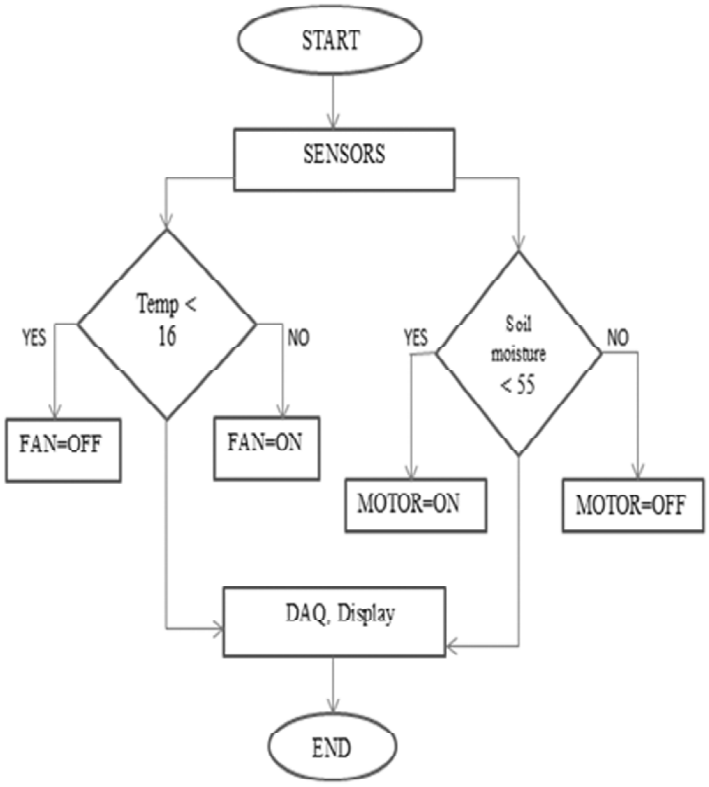


Figure 2: Acquisition Centre

4.2. Design Flow



5. RESULT AND DISCUSSION

The simulation environment of proteus is shown in the figure, sensors are connected to the Arduino analog pins, pin 0 and 1 are for transmission and reception for the Arduino and pin 2 and 3 for serial port transmission to be displayed in the output window.

The simulation environment of proteus is shown in the above figure, sensors are connected to the Arduino analog pins, pin 0 and 1 are for transmission and reception for the Arduino and pin 2 and 3 for serial port transmission to be displayed in the output window.

The above figure shows the output window being monitored if the temperature is less then the threshold value it will be indicated in red and if similarly for soil moisture if it goes below are above the threshold it is indicated in red and the water is OFF if it is above the threshold. LED is set in condition to be glownfor 10 hours a day so its indicated in green i.e., ON condition. If it is in OFF condition it is indicated in red.

The above figure is the simulation output for temperature, soil moisture and humidity are being correctly maintained at its threshold level.

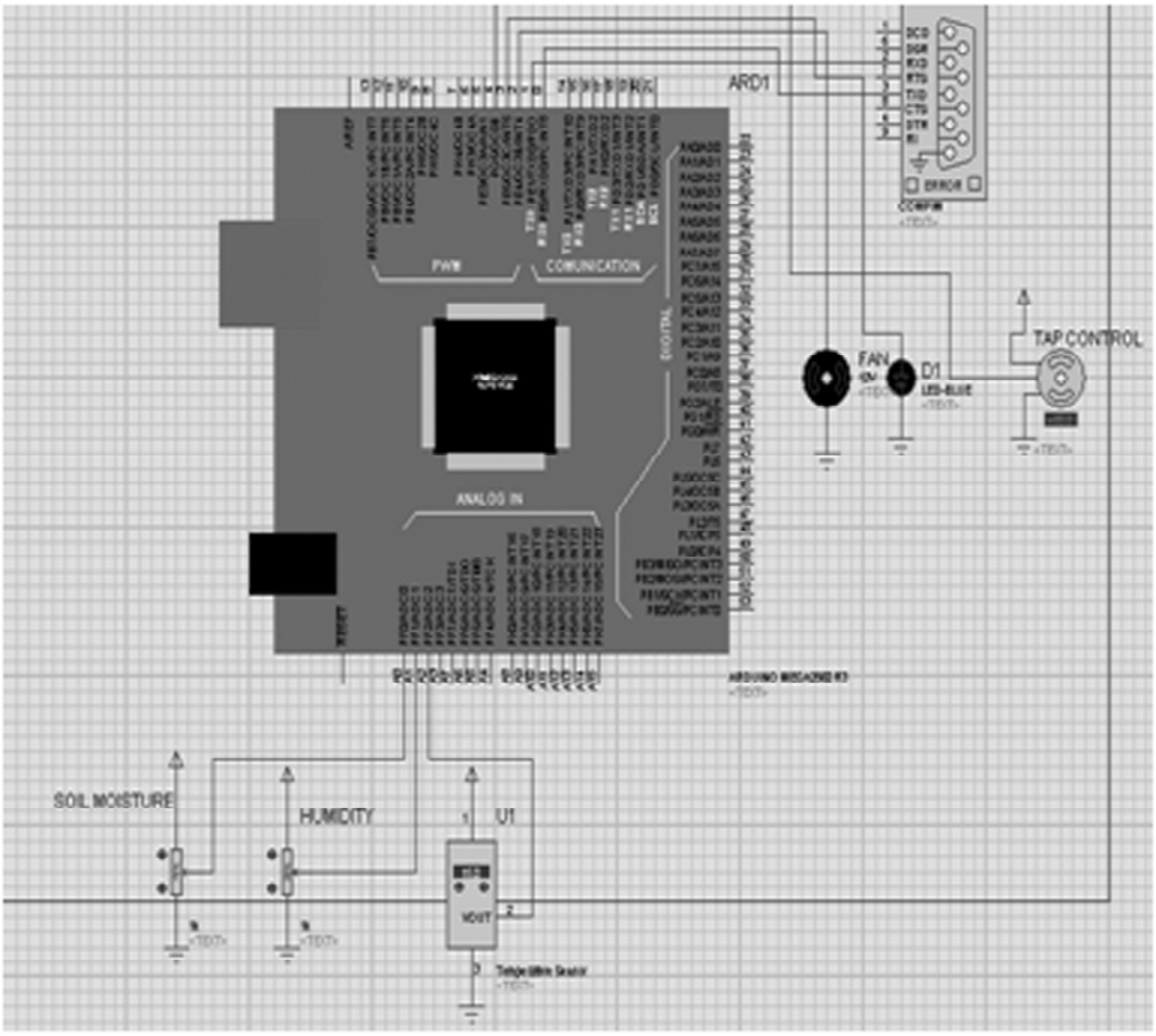


Figure 3: Proteus Simulation

Figure 4: Checks the temperature and soil moisture are above its threshold

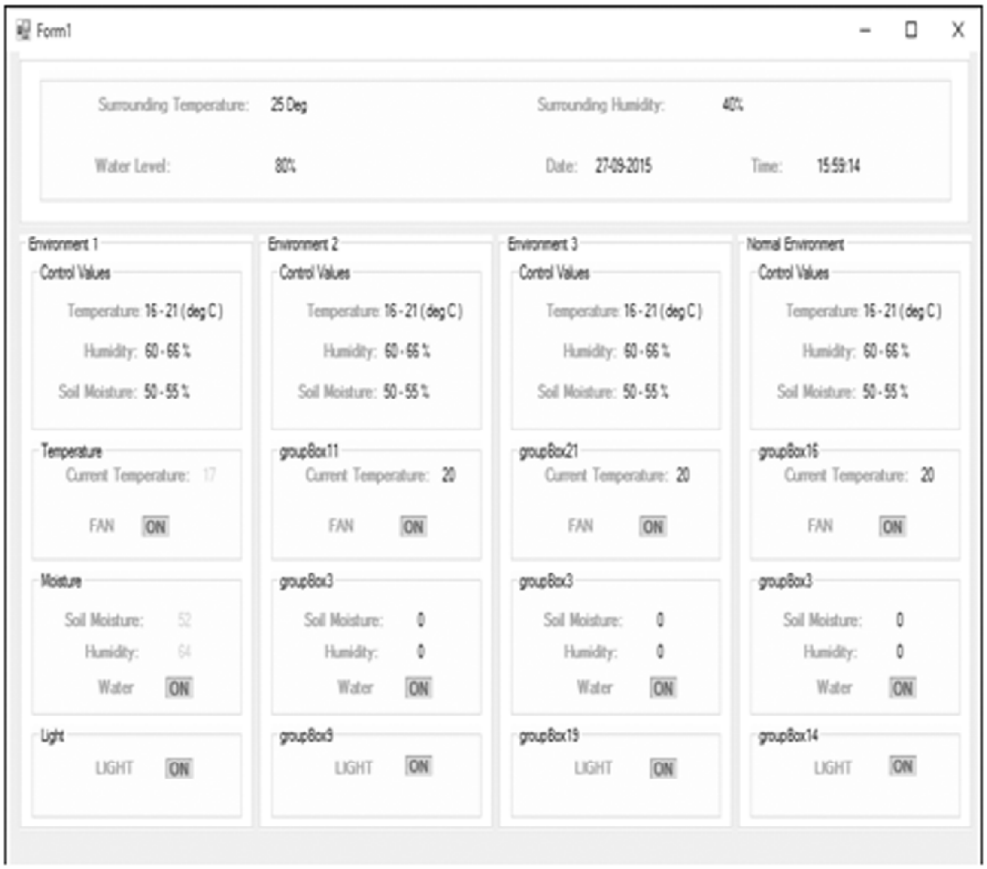


Figure 5:Checks the temperature and soil moisture lies on its threshold

6. CONCLUSION

This project presents the data acquisition of the environment necessary for plant growth. Real time environment is demonstrated with the help of proteus software. Real time environment data are interfaced to Visual Studio and data changes are monitored periodically. Data are collected in the database and are used for future reference.The above simulation is implemented in hardware and the data are acquired from the real time environment. Plant growth is stimulated using the overall setup. The data are been collected in time basis for the measure of plant growth as future work.

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