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Reducing Human Intervention on Greenhouse Monitoring and Controlling Based on Embedded System

K. Jagadeesh Kumar[1], N.Keerthi[2] ,B.Nagendra[3]
[1]Assistant Professor, Dept.of ECE, CREC, Tirupathi, A.P, India
[2] Assistant Professor, Dept.of ECE, CREC, Tirupathi, A.P, India
[3]Assistant Professor, Dept.of ECE, CREC, Tirupathi, A.P, India
[1]jagadish.kasula@gmail.com, [2]keerthi499@gmail.com,[3]nagendra.1019@gmail.com

Abstract
The goal of this paper is to develop a system, which uses Mobile technology that keeps control of the greenhouse effects by using different sensors. From the sensors, temperature, illumination, humidity quantities and water level are measured and the information is sent to the controller. Microcontroller will process this information and it will compare with the predefined data. If the values read from the sensors exceeds the predefined values then microcontroller will make the alert through buzzer and turns ON corresponding devices (like bulb, fans, motor etc) automatically and at the same time a SMS is send to the corresponding persons mobile that particular device is made ON. All the devices takes power from solar panels and simultaneously batteries also gets charged in the day time and in the night time the devices takes from power from batteries.
Keywords— Environment parameters monitoring, Microcontroller, Environment parameters controller, Power saving network, GSM.

I. INTRODUCTION

A greenhouse allows the growers to produce plants in places where the climate would otherwise be unfeasible to grow them. It makes plant cultivation independent of the geographic location or the time of the year. It also provides shelter for the plants, protects them from harsh weather conditions, insects and diseases. It allows plants to grow under an optimum condition, which maximizes the growth potential of the plants. Various environmental factors influence the quality and productivity of plant growth. Continuous monitoring of these environmental parameters gives valuable information to the grower to better understand how each factor affects the quality and the rate of plant growth, and how to maximize crop yield. Several research teams are engaged in greenhouse monitoring using wireless sensor networks.

A greenhouse provides shelter and protects plants from harsh environment and external interferences. It allows plants to grow under an optimum condition which maximizes the growth potential of the plants. The existing systems only allow for the monitoring of climate variables such as temperature or humidity and often overlook many other important factors such as CO2, light, soil moisture, soil temperature etc. Neglecting these climate factors leads to inaccurate observation of the overall greenhouse climate condition. To make up for this weakness, the prototype designed for this particular paper will allow better monitoring of the climate condition in a

greenhouse by integrating several sensor elements such as CO2, temperature, humidity, light, soil moisture and soil temperature into the system.

II. ENVIRONMENT PARAMETERS MONITORING

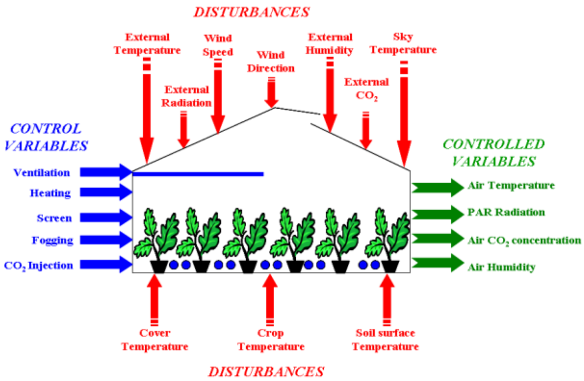

Fig. 1: Greenhouse parameters monitoring

Sensor technologies have made an enormous impact on the modern day industries. There are thousands of sensors available on the market ready to be attached to a wireless sensing platform. In this particular section of the paper we look at some of the sensor technologies that are available and can be used for monitoring the parameters of a greenhouse.

2.1 Humidity and Temperature Monitoring

SHT75 humidity and temperature sensors are Sensation's family of relative humidity and temperature sensors. These sensors integrate sensor elements together with signal-processing in a compact format and provide a fully calibrated digital output. They have humidity operating range from 0 – 100% and temperature operating range from -40 – 125°C. SHT75 sensors have low power consumption and fast response time.

2.2 CO_2 Monitoring

TGS4161 CO2 sensors are solid electrolyte CO2 sensors which exhibit a linear relationship between the changes in voltage output and the CO2 gas concentration on a logarithmic scale. They have low power consumption, good long term stability and excellent durability against humidity, making them ideal for indoor air control applications such as this project

2.3 Soil moisture Monitoring

VG400 soil moisture sensors are low frequency soil moisture sensors with low power consumption. Their output voltage is proportional to the moisture content in the soil. The VG400 sensors are insensitive to salinity, small in size and are water proof, making them ideal for both indoor and outdoor applications.

2.3 Soil Temperature Monitoring

THERM200 soil sensors have temperature span from -40 to 85°C. The output voltage is linearly proportional to the change in the temperature of the soil.

2.5 Light Monitoring

NORP12 light dependent resistance sensor has a spectral response similar to the human eye. Its internal resistance increases or decreases depending on the level of light intensity impinging on the surface of the sensor.

III. ENVIRONMENT PARAMETERS CONTROLLER

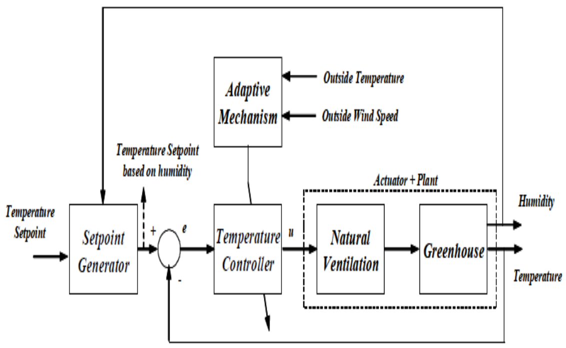

Fig. 2: Controlling of parameters

The above figure.2 shows controlling of greenhouse parameters. The controller consists of set point generator, adaptive mechanism, temperature controller and actuator. The controller keep on monitoring the parameters, when the monitoring parameter exceeds the predefined value, the actuator activates the particular devices. Adaptive mechanism gives the outside conditions to the controller.

Actual conditions of the green house are given back to the set point generator. The set point generator generates reference input based on actual greenhouse conditions. The summing point compares the reference input from the set point generator with actual condition of the green house and generates the error signal to the controller. Controller actuates the particular device to turn ON.

IV. MICROCONTROLLER

The ARM7TDMI core is a member of the ARM family of general-purpose 32-bit microprocessors. The ARM family offers high performance for very low power consumption, and small size. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles. The RISC instruction set and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

The ARM7TDMI core uses a pipeline to increase the speed of the flow of instructions to the processor. This enables several operations to take place simultaneously, and the processing and memory systems to operate continuously. The ARM7TDMI core has a Von Neumann architecture, with a single 32-bit data bus carrying both instructions and data. Only load, store, and swap instructions can access data from memory.

The ARM7TDMI processor memory interface has been designed to allow performance potential to be realized, while minimizing the use of memory. Speed-critical control signals are pipelined to enable system control functions to be implemented in standard low-power logic. These control signals facilitate the exploitation of the fast-burst access modes supported by many on-chip and off-chip memory technologies.

The ARM7TDMI processor has two instruction sets:

- The 32-bit ARM instruction set
- The 16-bit Thumb instruction set.

V. POWER SAVING NETWORK

The block representation of the power saving network is shown in figure 3 consists of solar panels, battery pack, controlling network and motor. When in the day time power required to the greenhouse supplied from the solar panels. When in the night time power required to the greenhouse supplied from the battery pack. Controlling network is automatically connects the solar panels power to the greenhouse devices and simultaneously charges the batteries in the day time. In the night time controlling network connects the batteries power to the greenhouse in the night time.

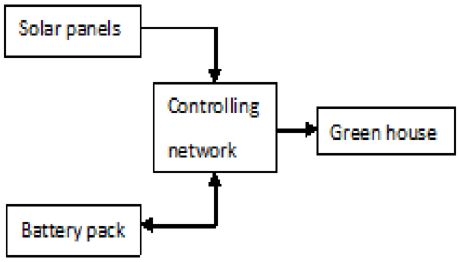

Fig. 3: Block representation of power saving network

VI. GSM MODULE

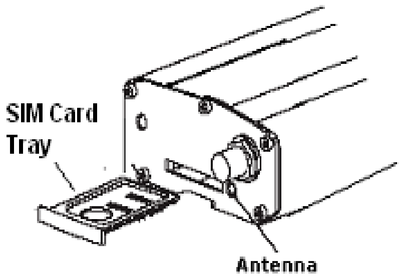

Fig.4: GSM modem

A GSM modem can be an external modem device, such as the Waveform FASTRACK Modem. Insert a GSM SIM card into this modem, and connect the modem to an available serial port on your computer. A GSM modem can be a PC Card installed in a notebook computer, such as the Nokia Card Phone.

A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port on your computer. Phones such as the Nokia 7110 with a DLR-3 cable, or various Ericsson phones, are often used for this purpose.

A dedicated GSM modem (external or PC Card) is usually preferable to a GSM mobile phone. This is because of some compatibility issues that can exist with mobile phones. For example, if you wish to be able to receive inbound MMS messages with your gateway, and you are using a mobile phone as your modem, you must utilize a mobile phone that does not support WAP push or MMS.

When you install your GSM modem, or connect your GSM mobile phone to the computer, be sure to install the appropriate Windows modem driver from the device manufacturer. To simplify configuration, the Now SMS/MMS Gateway will communicate with the device via this driver. An additional benefit of utilizing this driver is that you can use Windows diagnostics to ensure that the modem is communicating properly with the computer

VII. BLOCK DIAGRAM

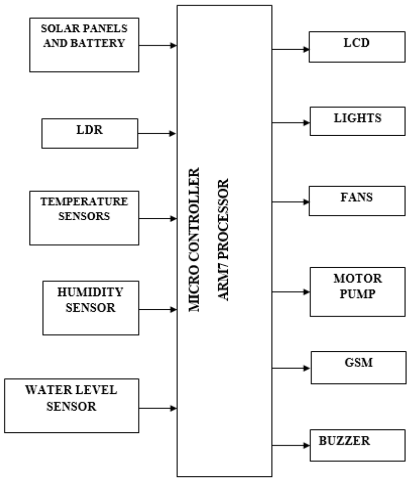

Fig. 5: Block diagram representation

In this paper is we required operating voltage for ARM controller board is 12V. Hence the 12V D.C. power supply is needed for the ARM board. This regulated 12V is generated by stepping down the voltage from 230V to 18V now the step downed a.c voltage is being rectified by the Bridge Rectifier using 1N4007 diodes. The rectified a.c voltage is now filtered using a 'C' filter. Now the rectified, filtered D.C. voltage is fed to the Voltage Regulator. This voltage regulator provides/allows us to have a Regulated constant Voltage which is of +12V. The rectified; filtered and regulat. ed voltage is again filtered for ripples using an electrolytic capacitor 100μF. Now the output from this section is fed to microcontroller board to supply operating voltage.

The goal of the paper is to develop a system, which uses Mobile technology that keeps control of the greenhouse effects by using different sensors. From the sensors, temperature, LDR, humidity quantities, water level are measured and the information is sent to the controller. Microcontroller will process this information and it will compare with the predefined data. If the values read from the sensors exceeds the predefined values then microcontroller will make the alert through buzzer and turns ON corresponding devices (like bulb, fans, motor etc) automatically and at the same time a SMS is send to the corresponding persons mobile that particular device is made ON. If there is any power cut then the controller will automatically switch to the secondary supply i.e. battery and the processes will run. And this information is sent to the user's mobile as an SMS.

VIII. EXPERIMENTAL RESULTS

A. Experimental Setup

Experiments were carried out to test the accuracy of each sensor used in the sensor station. THERM200 and VG400 sensors were tested in a garden. The area for testing was a 1m x 1m patch of soil. Two sensors of each type were placed next to each other and were tested at 30 different locations within the testing area. The reason for placing the sensors close to each other is to minimise any unexpected variances. SHT75, NORP12 and TGS4161 were all tested in an electronics lab. Two sensors of each type were placed close to each other and measurement samples were taken for an hour at intervals of 5 minutes. The results obtained from the experiments are presented in the next sub-section (figures 6 to 7)

B. Results

This sub-section presents the results obtained from the experiments done with each sensor.

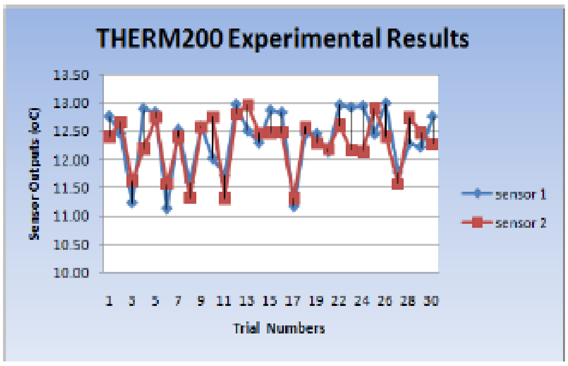

Fig.6: THERM200 experimental results (Soil Temperature)

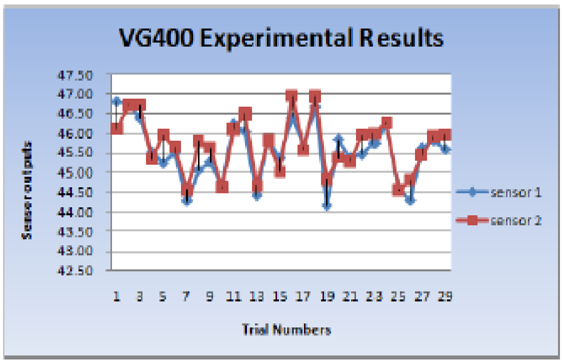

Fig.7: VG400 experimental results (Soil Moisture)

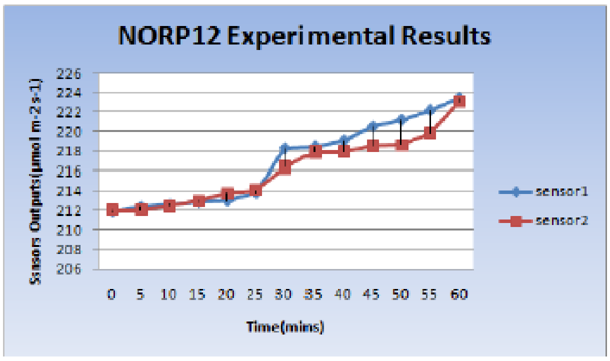

Fig. 8: NORP12 experimental results (Light Intensity)

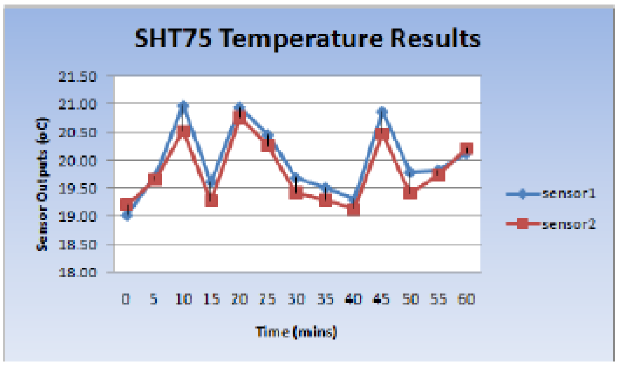

Fig.9: SHT75 experimental results (Ambient Temperature)

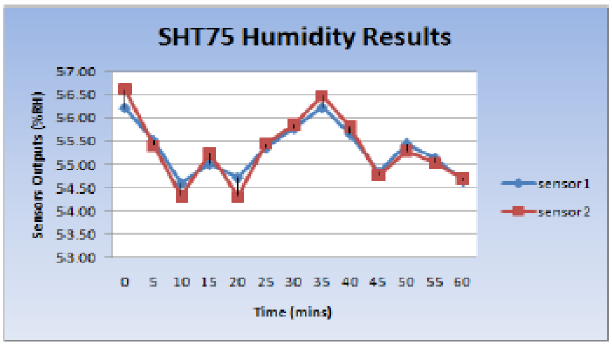

Fig.10: SHT75 experimental results (Relative Humidity)

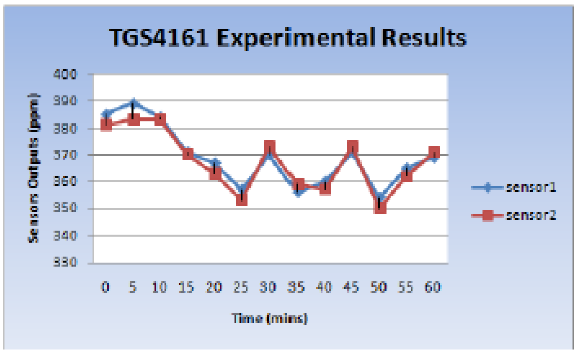

Fig.11: TGS4161 experimental results (C02)

The results obtained from the experiments show small variations between the readings of the two sensors. Future experiments will entail comparing data collected from these sensors with pre-calibrated standard devices to obtain more accurate results.

IX. CONCLUSION

The paper "Greenhouse monitoring and controlling of System Based on Embedded System" has been successfully designed and tested. Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the paper has been successfully implemented.

By the use of solar panels and battery pack, uninterrupted power supplied to green house and also saved power.

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