A Novel Remote Monitoring System for Environmental Parameters in Greenhouse

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ABSTRACT: The paper is presented for remote monitoring of greenhouse parameters with the help of sensors and GSM communication. It overcomes the disadvantages of wired and wireless constraints such as complicated wiring, difficult maintenance and distance, to monitor and control the applications. The application will have embedded system which consists of Arduino microcontroller, real time operating system, sensors, GSM modem and control devices to monitor the environmental parameters condition namely temperature, humidity, CO_2 concentration and light intensity in greenhouse.The threshold levels of the sensors will be set with the help of push button keys or remotely via GSM communication mode. By this, environmental parameters in greenhouse can be monitored manually as well as remotely.

IndexTerms:Sensor; Automation; SMS; GSM; Monitoring System

I. INTRODUCTION

In greenhouse more number of the parameters is to be control because, the varieties of the crops are large. They are increasing day by day because of the development in agriculture technology. The automation is possible with simple hardware by using microcontroller where only the controlling is possible but user (farmer) will not get information about the greenhouse. On progress towards the improvement to monitor and control, an attempt was made using wireless technology. There are many technologies can be used for wireless application. It was tried to adopt the wireless communication like Infared, Bluetooth, Zigbee and RT technology. But the attempt has failed because of technology constraints.

In this situation, the wireless sensor network with additional hardware and sofware is a solution for greenhouse control. If parameters still increase, then for WSN technology bandwidth may not be sufficient [1]. A Control System of Environment Parameters of Greenhouse based on CAN Bus is existing and requires wired system [2]. The Wireless Measurement and Control System for Environmental Parameters in Greenhouse [3], overcomes thee disadvantages of wired monitoring system, such as complicated wiring &difcult maintenance.

This project is designed to overcome the above mentioned disadvantages, using which the environmental parameters in every greenhouse can be measured and controlled by microcontroller remotely. The Parameters settings can be made in two modes i.e. by using push button keys or by GSM communication mode remotely. A user can know the greenhouse status or control the system at any time by sending the commands through the GSM technology. The user can use mobile phone to set the sensor parameters fom any place by sending a setting command message to the GSM modem. Also the monitoring device will send the environmental conditions to the user on request at any time field.

Shen Jin, Song Jingling, Han Qiuyan, Wang Shengde introduced a GSM-SMS remote measurement and control system for greenhouse [2] based on PC-based database system connected with base station. Base station is developed by using a microcontroller, GSM module, sensors and actuators. In practicaloperation, the central station receives and sends messages through GSM module. Criterion value of parameters to be measured in every base station is set by central station, and then in base stations parameters including the air temperature, the air humidity. Modularization is adopted in the design of the system hardware, and the software exploitation is realized by embedded operating system, all of which make the system easy to be extended maintained and transplanted.

[3] proposed an example of the enhancement of the photovoltaicpumping system efficiency depends on the optimization of the photovoltaic energy generation and the system consumption. This paper

presents an optimally designed and realized photovoltaicpumping system which can be used for irrigation, under the variation of climate conditions, in the remote area, far away from national electric grid, of Batna region in Algeria. The photovoltaic pumping system is built at the laboratory level and the first tests of the control parts have showed very promising results.

G. K. Banerjee and Rahul Singhalet. al. [4] proposed a method using microcontroller for the control of temperature and relative humidity inside a poly house. In the proposed method,the greenhouse controller senses the change in temperature and relative humidity with the help of input sensors and process the output to take appropriate control action. The proposed system is a low cost and user friendly system with high stability and reliability.

[5] proposed the automation of a free-standing greenhouse using supervisory control & data acquisition (SCADA) system. The end product is expected to give the farmer or end user a kiosk type approach. Entire greenhouse operation will be governed and monitored using this kiosk. This approach is fairly novel considering the unified system design and the SCADA platform,NI LabVIEW 7.1. Wi-Fi technology is also explained in [6].

II. PROPOSED FRAMEWORK

The hardware unit of the prototype of the system is represented by the block diagram bellow. It contains a Arduino ATMega328 microcontroller as the main processing unit and itgets inputs from the temperature sensor (LM35) and a LDR sensor (simulated using a variable resistor). From the data obtained from the sensors the program. It also uses a GSM module which sends information from of SMS to the user from which the data obtained from the sensors and the data obtained from the user.[2]

A. Arduino ATMega328

The Arduino Uno is a microcontroller board based on the ATmega328. It has a 16 MHz ceramic resonator, 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a USB connection, a power jack, an ICSP header, and a reset button. This board is very simple and can be easily used, everything you need to support the microcontroller is in this board, just plug it in a computer via USB cable and power using an AC-to-DC adapter or battery to get started.
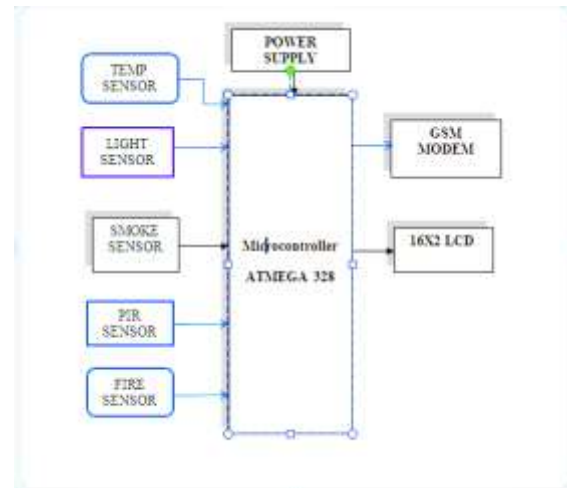

Fig.2 Block diagram of functional unit

B. GSM/GPRS (SIM 900)

SIM 900(General Packet Radio Service network modem for wireless transmission of data packets): GSM/GPRS TTL -Modem is built with SIMCOM Make SIM900 Quad-band GSM/GPRS engine, works on frequencies850 MHz, 900 MHz, 1800 MHz and 1900 MHz. It is very compact in size and easy to use as plug in GSM Modem. TheModem is designed with 3V3/5V TTL interfacing circuitry, which allows you to directly interface 3V3 Microcontrollers(ARM, ARM Cortex XX, Arduino etc) .The baud rate can be configurable from9600-115200 through AT command. InitiallyModem is in Auto baud mode. This GSM/GPRS TTL Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS a well as DATA transfer application in M2M interfacex).

The communication protocol includes AT commands.Some of the basic commands are mentioned below:
ATD9876543210 (To dial a number)
AT+CMGF (To send Text Message)
AT+CMGR (To read the received Text Message)
When GSM is interfaced with Arduino development

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board, an inbuilt header file "GSM.h" may be used with predefined functions. Example code to send an SMS is givenbelow

sms.beginSMS(9876543210);

sms.print(messageString);

sms.endSMS();

Serial.println("\nCOMPLETE!\n");

To use this GSM header file, a GSM shield is available. The transmitter of GSM module with +12V operating voltage isconnected to RX2 (receiving pin) of Arduino Due and the RXof the GSM is connected to TX2 (transmission pin) of Arduino.

C. Temperature Sensor (LM35)

The temperature sensor will give a variable output voltage with respect to the temperature variation. LM-35 is used as temperature sensor which is a precision integrated-circuit temperature sensor, Calibrated directly in ° Celsius(Centigrade), Linear + 10.0 mV/oC scale factor with accuracyO.soC (at +25°C) with rated for full -55° to +150°C range.Here we will set the minimum temperature value to 20° C and maximum temperature values to 30° C (for demo purpose, inreal time the settings will vary with respect to plantation in thegreenhouse).

D. Light Detecting sensor

Light detecting resistor is a photoconductive light sensor does not produce any electricity but simply changes its resistance when subjected to light energy. The commonly used photo resistor is called LightDependent Resistor or LDR. LDR will have a resistance that varies according to the amount of visible light. The lightfalling on the brown zigzag lines on the sensor causes the resistance of the device to fall. This is known as a negative coefficient. There are some LDRs that work in the opposite way i.e. their resistance increases with light (called positive coefficient) Now, in order to use this device in a simple circuit, all we need to do is put a voltage across it and measure the current flowing through it. However, measuring current can be a little tricky. So, we put another resistor in series, andmeasure the voltage across the LDR. This makes us a potential divider, and the voltage across the LDR is proportional to the current.

E. PIR Sensor

The PIR (Passive Infa-Red) sensor is a device that detects motion by measuring changes in the infared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single 110 pin. The PIR used is the 555- 28027 part number. This is about how the sensors and respective devices can be monitored and controlled with respect to the environmental conditions. The keypad is used to confgure the parameters.

F. Methane Gas Sensor(MQ-4):

The MQ Series are commonly used gas sensors with electrochemical sensing element incorporated with a small heater, which senses gas whose proportion is known and thus provide an analog output.Methane, a vital Greenhouse gas, can be sensed using MQ-4, TGS-2611 or methane detectors. Since MQ-4 gives output between 200ppm to 10000 ppm, it proved an apt sensor for use due to its other features [9] as mentioned below:

- The operating voltage and heating voltage is +5 volts.
- The Detecting Concentration Scope is 200ppm-10000ppm
- Low Cost
- Easy circuit

III. RESULTS AND DISCUSSIONS

These screen shots contains information in the user mobile.Which the SMS received from the GSM module number which gives alert information during automation and monitoring.
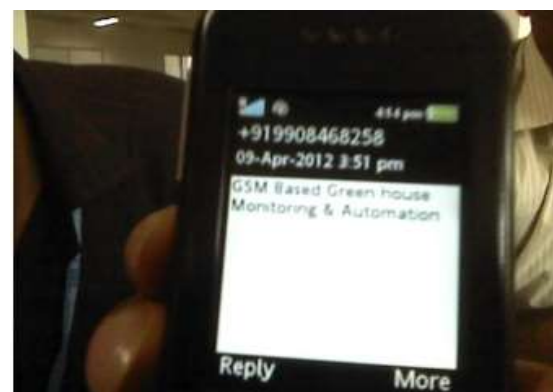

Fig. 6: This shows that system is ready for the process.

IV. CONCLUSION

The remote monitoring system for environment parameters in greenhouse based on global system for mobile communications technology is developed and initially experimented. The experimental results indicate that the system has some features as follows: 1) It can be used in agriculture vegetable greenhouse to monitor and control the environmental parameters to overcome the disadvantage of traditional measuring and controlling. 2) It can be kept long distance, real time monitoring for parameter of greenhouse and the information can be obtained of greenhouse at any time. 3) It has the advantages of GSM technology , not needing cables, low power consumption, low cost, good robustness, flexible extension, convenient installing over the traditional measurement and control system.

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