IMPLEMENTATION OF MICROCONTROLLER BASED WIRELESS SCADA SYSTEM

Kandhare Pooja ,Jadhavar Santosh , Patil Pratish,

Guided By:- Dr. P.B.Mane

Abstract- **Supervisory control and data acquisition (SCADA) refer to the overall set of process control system systems that remotely monitor and measure remote sensors from a centralized location. Implementation of wireless SCADA system using microcontroller is the simple and basic way to monitor the atmospheric physical quantity like temperature and gas. To monitor the temperature and CO2 gas over different sites as real time application. A base station and distributed sensor nodes are suggested. A wireless technology like GPRS is used to connect the nodes & base station. Through wireless network various data collect by various sensors. At node side, sensor such as temperature and gas are send to base station collected data is displayed on GUI window. The advantage is real time monitoring and controlling, fast response and high sensitivity.**

Keyword: SCADA, GUI window, GPRS

I. INTRODUCTION

SCADA system which is able to monitor all the systems like temperature, Pressure, gas and Moisture, The SCADA master also performs data processing on the information's gather from the temperature, pressure and moisture sensor and sends the control commands in protocol format[14],

Manuscript received March 2014

Kandhare Pooja Ajay*, Department of Electronics and Telecommunication engineering/All India Shree Shivaji Memorial Institute of Information Technology, Pune*

Jadhavar Santosh Rajendra*, Department of Electronics and Telecommunication engineering,/All India Shree Shivaji Memorial Institute of Information Technology, Pune*

Patil Pratish Mukund, *Department of Electronics and Telecommunication engineering/All India Shree Shivaji Memorial Institute of Information Technology, Pune*

The proposed system is to achieve control over the Food storage firm through command sent by user. SCADA system consists of mainly the control room, field area and communication device. In the conventional SCADA systems the communication is achieved mainly through the radio waves and up to latest by message communication through GSM modem[2]&[5]

GSM is a wireless communication technology; most popular today for transmitting data anywhere in the world through SMS with the traditional ways of communication has their own pitfalls i.e. radio waves are susceptible to interference GSM message communication are quite slow and there is limitation for GSM messages. So we are proposing the new way of communication. [4]&[6]

In this project microcontroller of ATmega family is used, and the input to it is a GSM modem which receives the command from the user. General Packet Radio Service (GPRS) is chosen as the specific mobile communication to use as it provides an always on-line Inter connection without any time based charges. The status of temperature and gas are displayed on an LCD display interfaced to the microcontroller and the input to it is a GPRS modem which receives the command from the user and the output to microcontroller is given to a motor through a motor driver IC to controls the temperature and gas sensor displays the content of CO_2 gas on the field.

II. SYSTEM ARCHITECHURE

A. PROBLEM DEFINITION

SCADA system mainly face three main challenges, these are high cost at time the of installation, difficulty to achieving security and wired connection due to which it cannot use at remote place from server. So our proposed systems going to be develop using Wireless Networks with real time basis which having data transmission and reception capability

ISSN: 2278 – 7798

between pc and field area. The main objective of the implemented system is as follows

- Measurement & composition of gas using sensor at remote place.
- Collect the data from sensor nodes send it to base station by wireless channel.
- In base station we use the information on GUI window
- We also send the control signal from the base station to remote location to control the field temperature.

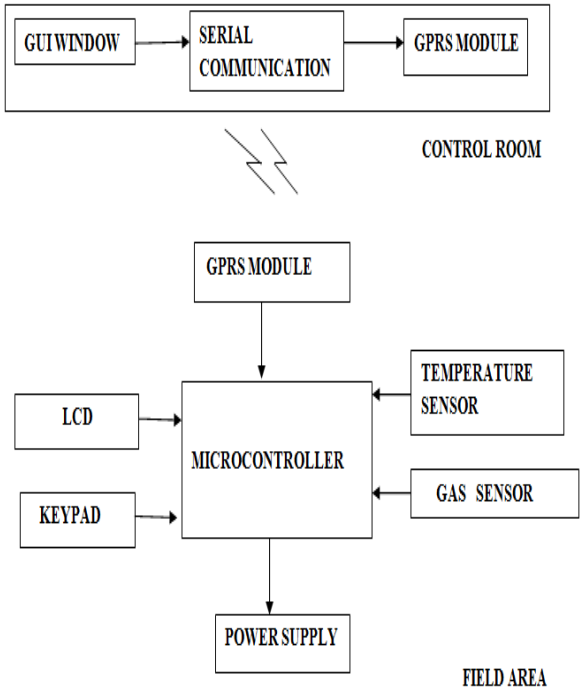

Figure.1. Block diagram of wireless SCADA system using microcontroller

B. PROPOSED SYSTEM

The system is used to monitor and control temperature and gas respectively .Gas sensor inside the system displays existing CO_2 gas and temperature sensor displays temperature of the atmosphere on the GUI window temperature can be controlled by, cooling fan provided on client side .

III. HARDWARE DESIGN

We discuss the detail of power supply, ATmega16 microcontroller, temperature sensor, gas sensor, LCD and GSM module in this part.

1. POWER SUPPLY

Starting with power supply design will make simple the project to implement because all electronic circuits require the DC voltage to work properly. To get proper DC voltage, we require the AC to DC convertor. This is done in power supply design.

This circuit require two DC voltages i.e. +5V and +12V.To get these voltages, we need a transformer to make the AC mains drop down to a safe value i.e.12- 15 volts and then use a rectifier to convert AC into DC. This circuit can give +5V output at about 150 mA current, but it can be increased to 1 A when good cooling is added to 7805 regulator chip. The circuit has overload and terminal protection. The capacitors must have enough high voltage rating to safely handle the input voltage feed to circuit.

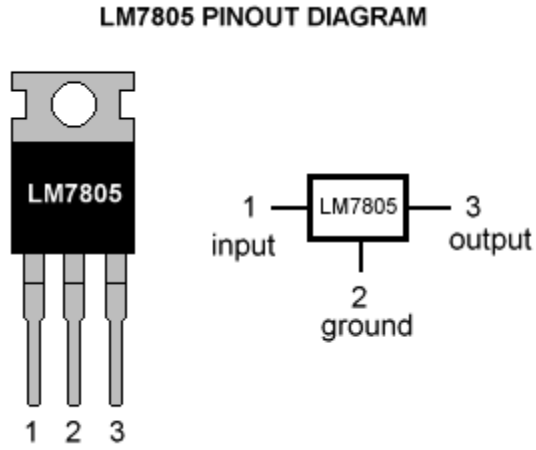

Figure 2 Pin out diagram of LM7805 [7]

2. ATMEGA 32MICROCONTROLLER

The Atmega32 is 8-bit microcontroller is responsible for all the operations with their low power consumption, various combination of 8-channel 10-bit ADC, four PWM Channels to reduce the program size, RISC architecture to store real time data and fast processing non-volatile memory is required so this microcontroller is particularly suitable for industrial control, access control. It also contains programmable serial UART for serial communication. By executing powerful instructions in single clock cycle, ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the

ISSN: 2278 – 7798

system designer to optimize power consumption versus processing speed.[10]

The idle mode stops the CPU while allowing the USART, two-wire interface, A/D convertor SRAM, Timer/counter, SP1 port and interrupts system to continue functioning. The power down mode saves the register content but freezes the oscillator, disabling all other chip function until the next interrupt or hardware reset. In power save mode, the asynchronous timer continues to run , allowing the user to maintain a timer base while the rest of device is sleeping. The ADC noise reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversion. In stand-by mode, the crystal oscillator is running while the rest of device is sleeping. This will allow very fast start up combined with low power consumption

3. GAS SENSOR

MQ-135 is an air quality sensor. It can use in air quality control equipments for buildings/offices. MQ-135 gas sensor has fast response and high sensitivity to detect the gas**.** It has features like simple driving circuit, stable long life, and wide detecting scope [8].

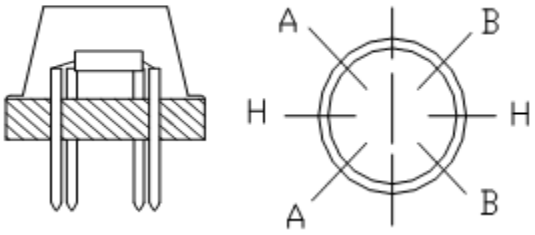

Figure.3 Structure and configuration of MQ-135

MQ-135 sensor mainly composed by micro AL_2O_3ceramic tube, Tin Dioxide (SnO_2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. It has 6 pins out of which 4 are used to fetch signals and remaining are used for providing heating current. Resistance of sensor is variable for various gases. It is suitable for detecting of NH_3, alcohol, Benzene, smoke, CO_2, etc. In this it use to detect CO_2 gas

4. TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the °Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in °Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature [9].

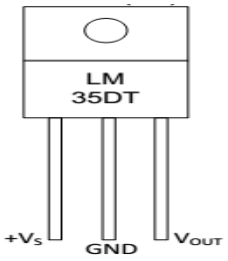

Figure.4 Structure of LM 35

5. LCD

The Liquid Crystal Display (LCD) is used to display the data. When we use 16 by 2 LCD that means that it can display the two lines containing 16 characters each. The pixel matrix is of 7 by 5 pixels that are each character can be displayed using 7 columns of the pixels and 5 rows of the pixels. To control the operation of LCD, three control signals are used which are EN (Enable), R/W (Read/Write), RS (Register Select).

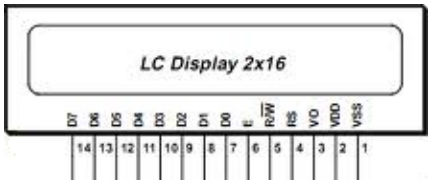

Figure.5 16×2 LCD

It is interfaced with ATmega16 microcontroller on the field area. The LCD is used to display the presence of gas such as CO_2 and present temperature in the atmosphere. The set point given by server is also display on LCD.

6. 4×4 keypad

A 4×4 keypad is interface with microcontroller on field side. To interface a 4×4 keypad to a microcontroller 8 lines are required out of which 4 lines are required to input pins and the other 4lines to the output pins of the microcontroller.

ISSN: 2278 – 7798

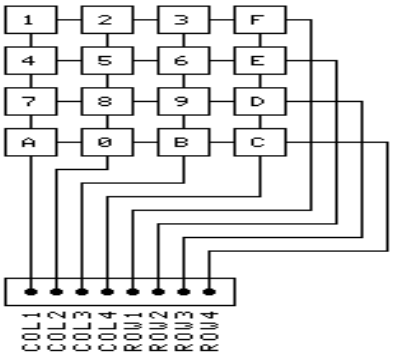

Figure 6.4x4 keypad

7. MOTOR DRIVER IC

L298 is high voltage, high current full bridged driver IC, having low saturation voltage and it has capability of over temperature control. [11]

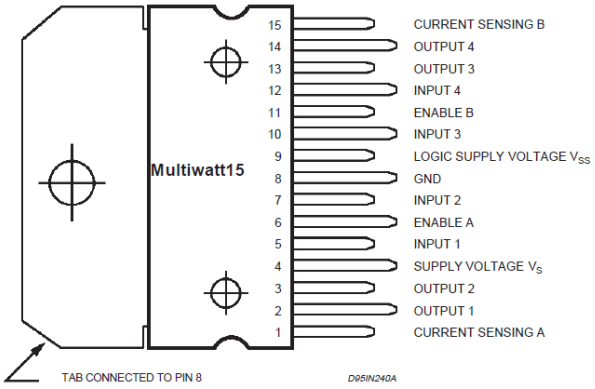

Figure 7.L298 motor driver structure

8. GSM MODULE

GSM (Global System for Mobile communication) is the most popular standard for mobile telephone system in the world.SIM900 GSM module used here is a quad-band (850/ 900/ 1800/ 1900 MHz) GSM module consists of a TTL interface and an RS232 interface. It has an embedded powerful TCP/IP protocol stack which is the main feature of module [12]. The GSM module always needs a computer or external processor/controller to receive "AT commands" form. GSM module itself does not provide any interface between the user and the network, but the computer to which module is connected is the interface between user and network

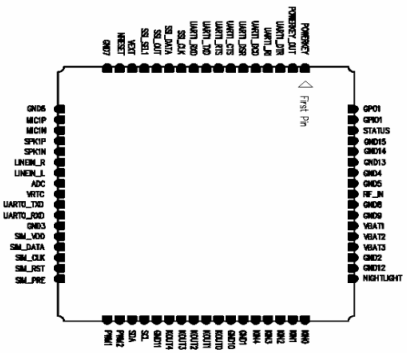

Figure.7 Pin assignment of SIM 900

IV.SOFTWARE DESIGN

Software design for SCADA system is based on two parts first is microcontroller programming and GUI window design. For wireless SCADA system GUI window at the server side is built using Microsoft visual studio 2010.Server side application run on windows operating system ,it requires the ".Net" version 4.0 being install on server side. At the field side microcontroller programming is done using AVR studio which is freely available on internet. The programming is build using embedded C language. Detailed flowchart for working of whole system as well as software design

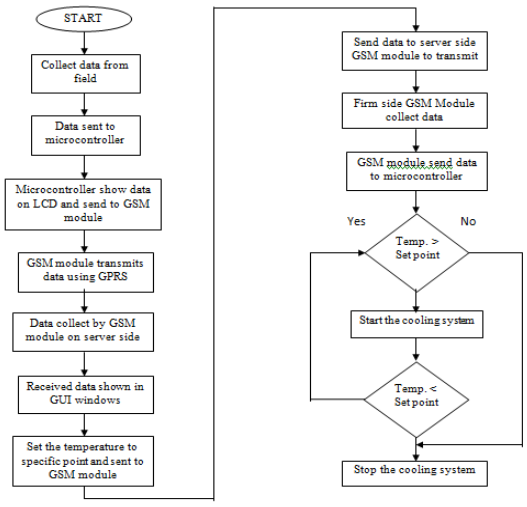

Figure8. Flow chart for general work flow of wireless SCADA system

V. ASSUMPTION

- The component of system should be always connected.
- There should be only one administrator
- Server must always run in windows operating system

ISSN: 2278 – 7798

- There should be internet connection available
- Proper hardware component should be available
- ".net " version 4.0 should be installed on pc
- Internet service provider should allow to connect each other

VII. EXPECTED RESULT AND DISCUSSION

The graphical user interface window using C# is shown in FIG.10. Through GSM module using GPRS type service communication is done within server and field. The server with GUI window shows the various data send by field side microcontroller. The snap shot of GUI window with results is shown in FIG.10.

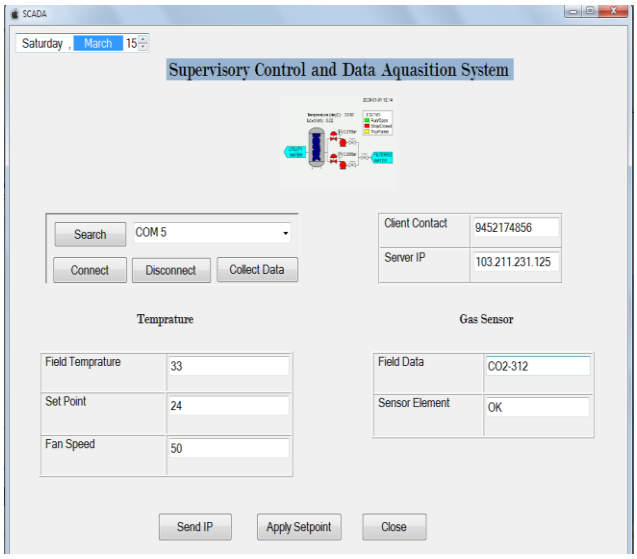

Figure10. Snapshot of GUI window

VIII.CONCLUSION

The proposed system continuously monitors CO_2 gas and controls temperature with the help of cooling fan provided at field side which is designed shows the quantity of gas and temperature in the atmosphere using Wireless service such as GPRS instead of wired connection. LCD displays data on field side and GUI window shows data on server side sent by microcontroller..We can set temperature from server and according to that cooling fan gets operate when temperature reaches to set point; the cooling system is stop automatically.

VI. REFERENCES

1. Andrew S. Tanenbaum, David J. Wetherall. "Computer networks" -- 5th ed, PEARSON pub.,ISBN-13: 978-0-13-212695-3, Page No.46-51.
2. Mr. Neeraj Khera,Sumit Balguvhar,"DESIGN OF MICROCONTROLLER BASED WIRELESS SCADA SYSTEM FOR REAL TIME DATA",UACEE International Journal of Advances in Electonics Engineering,Vol-2,PAGE NO:18-20,Issue 1 ISSN 2278 - 215X (Online).
3. David bailey,Edwin wright isbn ,"PRACTICAL SCADA FOR INDUSTRY"1st edition, Newnes publication,ISBN-07506658053.
4. Igor Nai Fovino, Alessio Coletta, Andrea Carcano, and Marcelo Masera," Critical State-Based Filtering System for Securing SCADA Network Protocols", IEEE transactions on industrial electronics, vol. 59, no. 10, october 2012, pp. 3943-3950.
5. B. Qiu and H. B. Gooi," Web-Based SCADA Display Systems (WSDS) ,for Access via Internet", IEEE TRANSACTIONS ON POWER SYSTEMS, VOL. 15, NO. 2, MAY 2000,PP.681-68..
6. Juha P. Lahti, Ahm Shamsuzzoha, Timo Kankaanpää" Web-based technologies in Power Plant Automation and SCADA Systems", 2011 IEEE International Conference on Control System, Computing and Engineering,pp.279-284.
7. LM78XX/LM78XXA datasheet, Fairchild semiconductors, October 2013, Rev. 1.2.
8. MQ-135 gas sensor datasheet, HANWEI ELCETRONICS, June 2010
9. LM35 temperature sensor datasheet, Texas Instruments, August 1999 –Rev. October 2013
10. ATmega 32 datasheet, Atmel Corporation, October 2002 – rev. February 2011
11. L298 datasheet, sparkfun electronics, January 2000
12. SIM900 datasheet, sim technology
13. Rajeev Kumar," Recent Advances in SCADA alarm System", International Journal of International Journal of Smart Home Smart Home Smart Home Vol.4, No.4, October, 2010 Vol.4, No.4, October, 2010.

ISSN: 2278 – 7798