# CO2 Monitoring System from Remote Location using GSM, GPS and Concept of MODBUS

Seema B. Vora
RGTU
SSSIST
Sehore,Bhopal

Mukesh Tiwari
RGTU
SSSIST
Sehore,Bhopal

Jaikaran Singh
RGTU
SSSIST
Sehore,Bhopal

## ABSTRACT
The system developed here is useful for measurement of waste gas (like Co2) remotely. This will helpful particularly for the environment department because many chimneys releases polluted gases now- a –days, which is a serious issues for Global warming. If any factory emits gas beyond some predefined specified limit, this system will send an alarm to operator's mobile. For this, infrastructure of GSM has been used. Moreover we have implemented MODBUS-a serial communication protocol. And for local monitoring, a user friendly GUI has been developed so that required action can be taken immediately. Location of affected site is monitored by GPS module. Measured data can be sent to any mobile by just entering the mobile number in developed GUI. Controller MSP 430 is used for hardware development. As gas sensing element, MG811 is used. This system also monitors temperature of location and for that LM 335 is used.

## Keywords
GPS, GSM, MG811, LM335, MSP430.

## 1. INTRODUCTION
In 21st century, as the technology advances, high speed, compact and wireless systems are in demand. Wired communication cannot meet the requirements of speed and cannot be available everytime, everywhere.

It has been observed that many chimneys releases polluted gases like CO2 which affects people's health badly. [1] [9].

A challenge for web services is to find reliable and efficient methods to transfer large data between them. The development of a modular Server/Client library that uses SOAP as a control channel while the actual data transport is accomplished by various protocol implementations [5]

Real time remote data monitoring through GSM technology allows user to get the informative data whose measurement unit is located somewhere else.GSM is a wireless communication technology; most popular today for transmitting data anywhere in the world through SMS with the help of mobile phones.

SMS is a globally accepted wireless service that enables the transmission of alphanumeric messages between mobile subscribers and external systems [10].

In Short message service, the most attractive feature we can highlight is regular delivery of messages and moreover instant acknowledgement service.In addition to this, GPS concept will trace real time position of remotely situated RTU.

## 2. RELATED WORK
Remote measurement of CO2 has been done previously and that data was sent by GSM. GPS module was used to trace the position of chimney. We have used here MODBUS-the serial communication protocol. Moreover another parameter-temperature is also measured and updated. The precision and accuracy of recorded results of measured Co2 and position from GPS have been increased. The controller used here can give response to 247 different devices, which is good for future expansion of a system at low cost. A GUI (graphical user interface) is developed for convenience of operator and data can be sent to any mobile number by just entering the number in GUI.

### 2.1 System Hardware
Figure 1 shows the complete architecture of the GAS plant monitoring System. This system will continuously measure the pressure of the Carbon Dioxide and temperature of the plant and continuously update the values on the local SCADA (Supervisory Control and Data Acquisition) system using MODBUS protocol. Alarms will be sending to the operator's mobile using GSM technology. Position of the remote terminal unit is identified using GPS module, which is interfaced with this monitoring system.

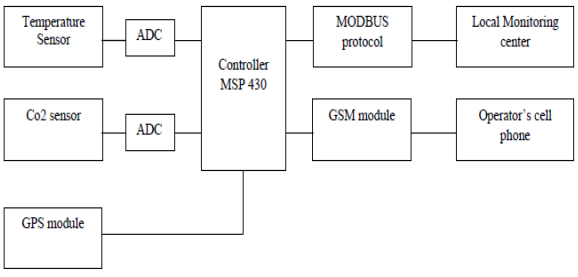



**Fig.1 Gas Plant Monitoring System Architecture**

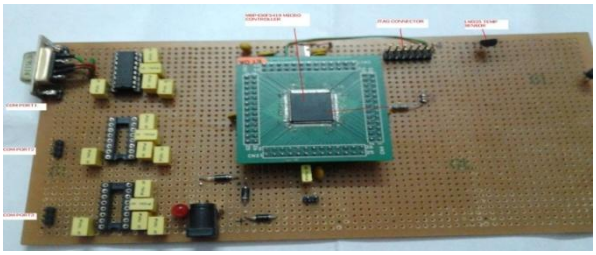


**Fig.2 microcontroller interfacing stage**

## 3. SENSORS

### A) LM335 Temperature Sensor

The LM335 series are highly precise temperature sensors. Moreover calibration is easy.

They are calibrated in °Kelvin. They can give range from µA to mA and they are not expensive

Calibration of temperature is as follow:

(((temp - 2138) * 410) / 4096)+27:

**Fig.3 LM335 Temperature Sensor**

### B) CO2 Gas Sensor

A carbon dioxide sensor or CO2 sensor is an instrument for the measurement of carbon dioxide gas. The most common principles for CO2 sensors are infrared gas sensors (NDIR) and chemical gas sensors. Measuring carbon dioxide is important in many industrial processes.

**Fig 4 Implementation of MG811**

**CO2 (CARBON DIOXIDE) WORKING PRINCIPLE**

When the sensor exposed to CO2 the following electrodes reaction occurs[4]

Overall reaction: Li2CO3 + 2Na + = Na2O + 2Li + + CO2

These sensors are compatible with most microcontrollers. They can be interfaced with 4 pin SIP headers. When certain predefined level has been reach, they are having alarm facility

## 4. CONTROL SOFTWARE

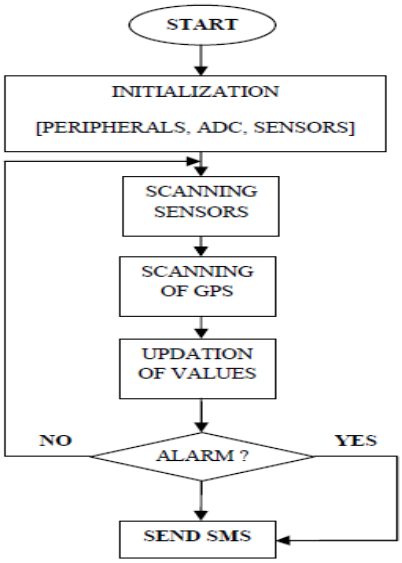



**Fig 5. Flow chart of control software**

## 5. SETTING UP HARDWARE WITH HYPERTERMINAL

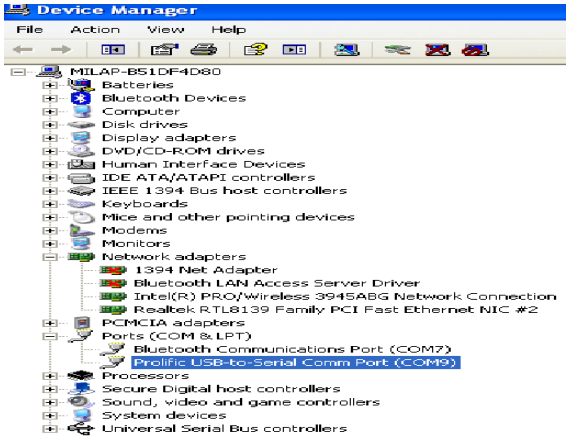



**Fig 6.Finding the connecting port of sensor by device manager**

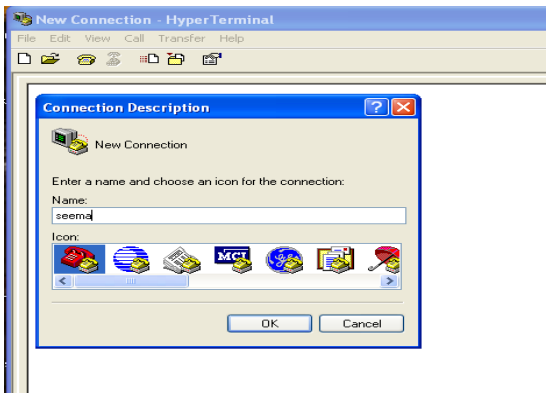



**Fig 7.Connecting with the GSM module**

## 6. MODBUS

MODBUS was developed by the MODICON Company and has become a standard communication protocol. [3]

A system for showing the results of measurements locally is consisting of many Remote terminal units (RTUs) and one master unit. Each RTU is located at the factory site from which we want to measure the quantities like Gas and temperature. All this information is sent through serial communication protocol MODBUS, which is good option over conventional low speed wireless channels.

Each RTU works as slave and MU as master. Master will send a query and slave has to give response. But all this communication must be done in a proper MODBUS frame format. Each data is saved in two byte register.

MODBUS can be connected in RS-232, RS-485 or Ethernet. However here it is connected as RS-232 for the sake of simplicity.

Standard MODBUS networks employ one of two types of transmission modes: [6]

- ASCII Mode
- RTU Mode.

MODBUS is used to communicate intelligent devices like sensors and instruments.MODBUS is also an ideal protocol application where wireless communication is required. For example a client can read the ON / OFF states of a group of discrete outputs or inputs or it can read/write the data contents of a group of registers. When the server responds to the client, it uses the function code field to indicate error-free response.

MODBUS Protocol Data Unit for serial line communication = 256 - Server address (1 byte) - CRC (2 bytes) = 253 bytes. [3]

Consequently:

RS232 / RS485 ADU = 253 bytes + Server address (1 byte) + CRC (2 bytes) = 256 bytes.

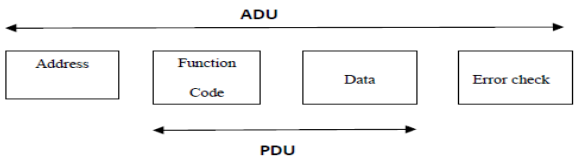



**Fig 8.General MODBUS frame**

When a message is sent from a Client to a Server device the function code field tells the server what kind of action to perform. Function code "0" is not valid. Sub-function codes are added to some function codes to define multiple actions. The data field of messages sent from a client to server devices contains additional information that the server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

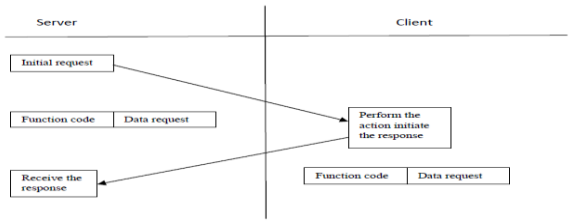



**Fig 9. MODBUS transaction (error free)**

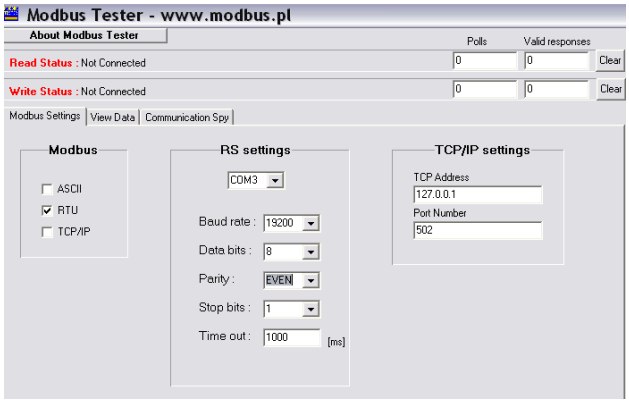



**Fig 10.MODBUS settings**

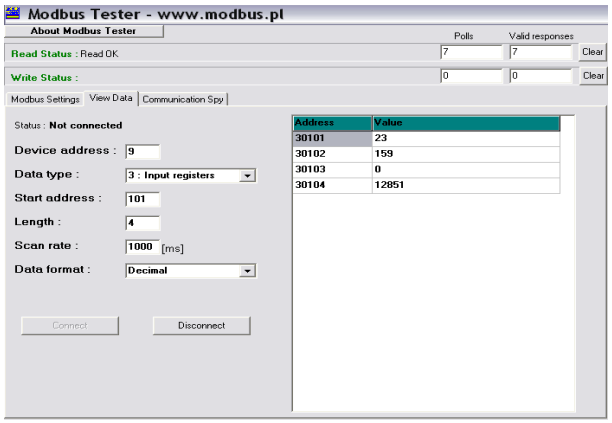



**Fig 14.Measurement of CO2 without alarm (0 in third row)**

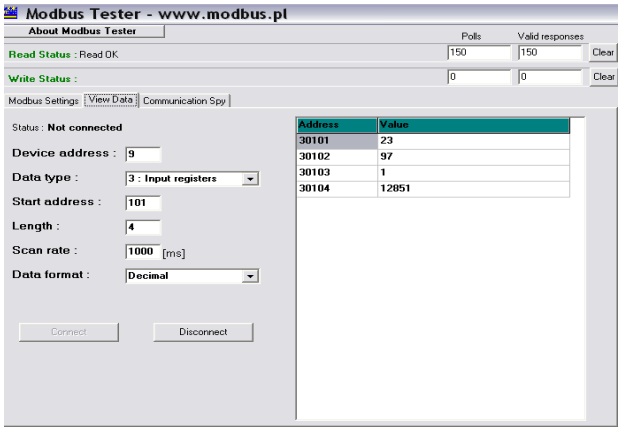



**Fig 15.Measurement of CO2 with alarm (1 in third row)**

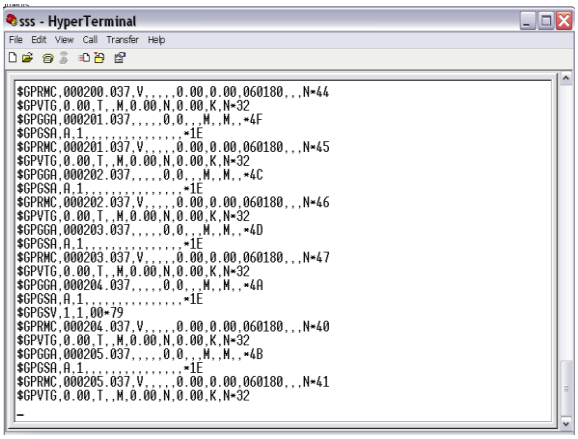
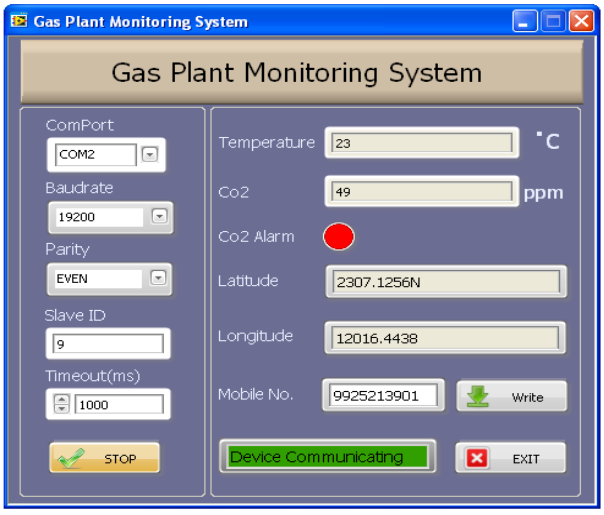
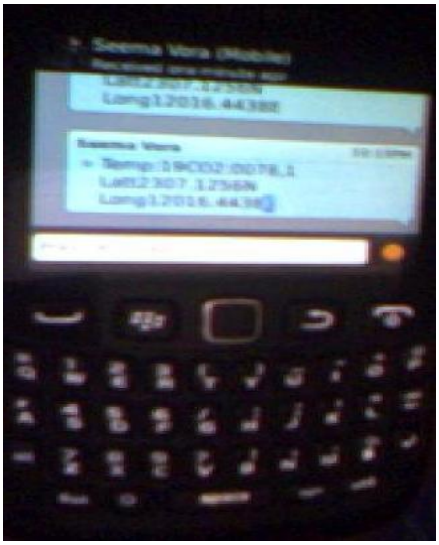



**Fig 16.Locating position of device by GPS**

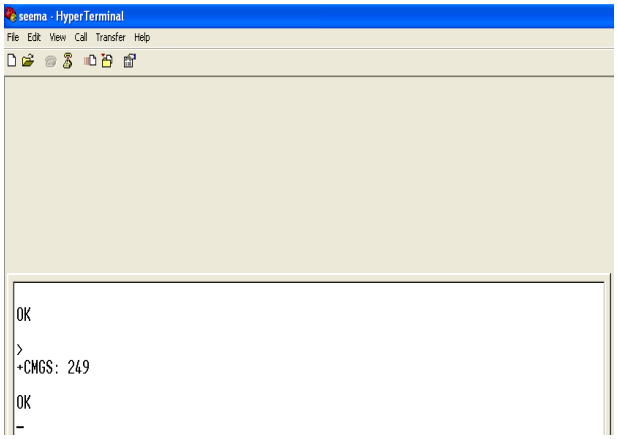
## 7. TEST RESULTS

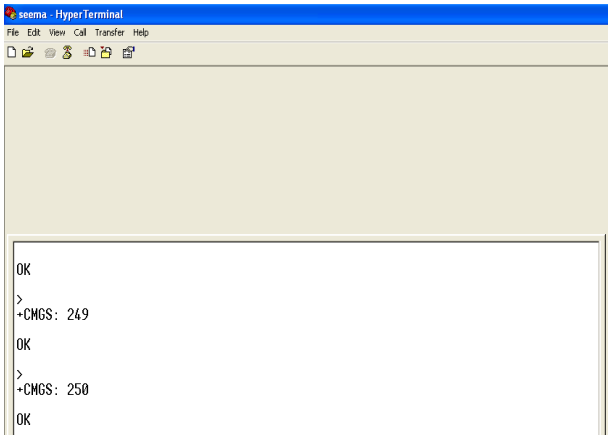



**GUI**



**Message received on mobile**




**Acknowledgment received**

## 8. REFERENCES

[1] B. Priya, S.Rajendran, R.Bala and Gobb R,Remote Wireless Health Monitoring Systems, 2 Conference on Innovative Technologies in Intelligent Systems and Industrial Applications

[2] F. H. Ramírez Leyva, J. P. Acevedo Cuellar, R.G.Maldonado Basilio, E. Espinosa Justo, Proceedings of the 14th Internationa Conference on Electronics, communications and Computers ,2004.

[3] MODBUS ORG, "MODBUS Application Protocol Specification V1.1", www.modbus.org, Access Date: Jan 2003.

[4] www.parallax.com CO2 Gas Sensor Module (#27929) v1.0 2/25/2010.

[5] Spiros Koulouzis, Edgar Meij M. Scott Marshall ,Adam Belloum Enabling Data Transport between Web Service through alternative protocols and Streaming, Fourth IEEE International Conference on eScience,2008.

[6] Chen Lin,Research on Voltage acquisition systembased on Modbus Industrial Bus and Single Chip School of compute an information Shanghai Second Polytechnic University Shanghai, China in 2009 International Conference on Signal Processing Systems.

[7] David Dolezilekand Brian McDermott Schweitzer Engineeri Laboratories, Inc., USA. REMOTE DATA MONITORING AND DATA ANALYSIS FOR SUBSTATIONS- CASE STUDY IN IMPLEMENTATION

[8] WANG Haikuan1,2, HOUWeiyan1,2 FEI Minrui1, 2 1. Shanghai Key Laboratory of Power Station Automation Technology, Shanghai 200072, P. R. China. Proceedings of the 29th Chinese Control Conference july 29-31, 2010, Beijing, China

[9] Zhao Xiaoqiang , Zhang Zuhou Xi'an. University of Posts and Telecommunications Xian, Shaanxi 710021, China "Development of Remote Waste Gas Monitor System" 2010 International Conference on Measuring Technology and Mechatronics Automation

[10] Chwan-Lu Tseng a, Joe-Air Jiang b,, Ren-Guey Lee c,Fu-Ming Lub, Cheng-Shiou Ouyangb, Yih-Shaing Chenb Chih-Hsiang Changb a National Taipei University of Technology, Taiwanb National Taiwan University, Taiwan c National Taipei University of Technology, Taiwan Feasibility study on application of GSM–SMS technology to field data acquisition Received 29 October 2005; received in revised form 28 March 2006; accepted 29 March 2006.