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GSM based Remote Monitoring of Waste Gas with the Implementation of MODBUS Protocol and GPS

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Abstract

Industries release many toxic gases like CO_2 etc., above the specified limit. This is a matter of serious concern as it affects people's health. A design has been developed for measuring and monitoring the amount of gas (particularly CO_2) from any factory site. This will be of help in case when a factory or chimney releases harmful gases cross the permissible limit. An alarm will be sent to the operator's mobile when level of CO_2 exceeds the standard level. It also has the temperature of that particular location and can also measure the pressure of CO_2.GSM and GPS module comprising of elements like MSP 430 (controller), MG811 (gas sensor) and LM 335 (temperature sensor) are used to locate the plant. So far, researches have been done in this area with respect to the remote measurement of CO_2 and that the data was sent by GSM. Here we have also used the GPS to locate the exact position of the factory site. In the present study, we have also used serial communication protocol, MODBUS (which proved to be a good replacement of low speed wireless channels) and GUI. This assisted us by monitoring and providing the update on local monitoring station and also measuring the temperature. Also the controller used is capable of responding to 247 different devices, a good choice for future expansion of a system like this.

Keywords: *GPS, GSM, MG811, LM335, MSP430, MODBUS*

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INTRODUCTION

System Design

Architecture of the designed monitoring System is shown in the Figure 1 and 11. This system will be helpful [2] to measure the level of polluted gas and temperature of the plant. It also continuously gives data to local system using MODBUS protocol. Operator's mobile will have some sort of indication or alarm when value exceeds than some predefined level [9,10].

Sensors

LM335 Temperature Sensor

Working as a 2-terminal zener, the LM335 has a breakdown voltage specifically relative to absolute temperature at 10 mV/°K. With under 1–Ω dynamic impedance, the gadget works over a current range of 400 μA to 5 mA [4, 3]. On calibrating at 25°C, LM135 has an error less than 1°C over a 100°C temperature range [6]. The temperature sensor is shown through Figure 2.

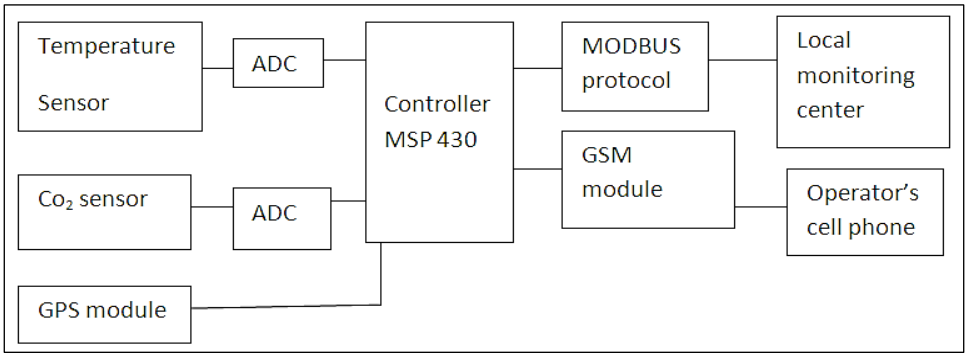

Fig. 1: *Gas Plant Monitoring System Architecture.*

$V_{out}=V_{out}T0\times(T/T0)$
Where,
T=Temperature, and
T0=Reference temperature.
Calibration of temperature: [(Temp–2138)×410)/4096]+27

CO_2 Gas Sensor

A carbon dioxide sensor or CO2 sensor is an instrument for the estimation of carbon dioxide gas. The most widely recognized standards for CO2 sensors are infrared gas sensors (NDIR) and synthetic gas sensors. Measuring carbon dioxide is critical in numerous modern procedures.

CO2 (CARBON DI-OXIDE) WORKING PRINCIPLE

When the sensor is exposed to CO2 the following electrodes reaction occurs:

Cathode Reaction

2Li++CO2+1/2O2+2e-=Li2CO3

Anodic Reaction

2Na++1/2O2+2e-=Na2O

Overall Chemical Reaction

Li2CO3+2Na+=Na2O+2Li++CO2

These sensors can be interfaced with 4-pin SIP headers (Figure 3), and are perfect with most microcontrollers. At the point when certain predefined level has been achieved, they are having alarm facility [5].

Control Software

This is illustrated through the algorithm in Figure 4.

Setting Up Hardware with HyperTerminal

This can be clearly understood from Figures 5, 6 and 10.

MODBUS protocol is a messaging structure developed by Modicon in 1979. It uses master slave or client server communication between devices. In master slave technique, only master can start the communication [1]. Slave (other communicating devices) responds to the master either by supplying the data or by taking the action told by the master (Figures 7 and 8).

- RTU mode; and
- ASCII mode.

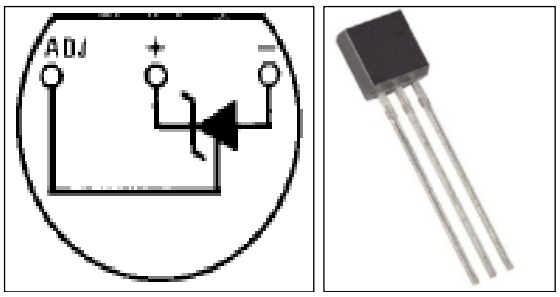

Fig. 2: *LM335TemperatureSensor.*

Fig. 3: *4-Pin SIP Headers.*

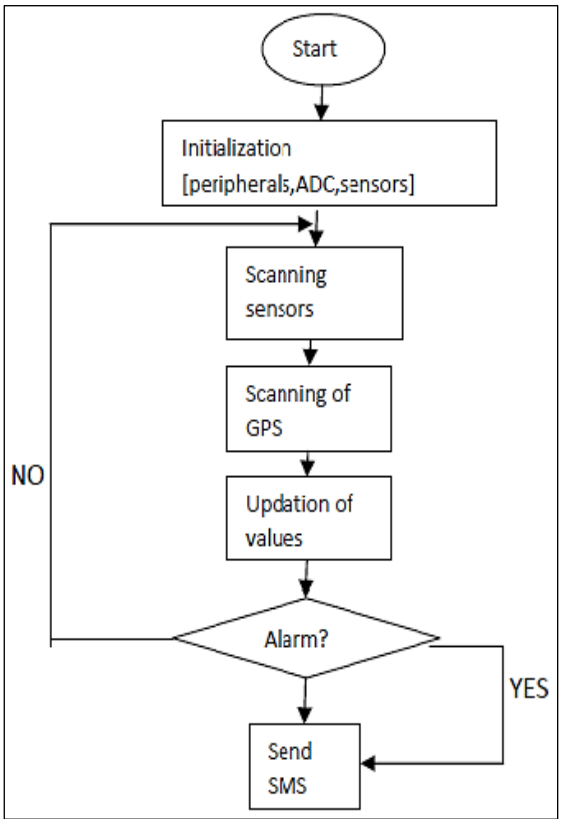

Fig. 4: *Algorithm for Control Software.*

This mode is chosen with serial correspondence in this particular case with baud rate (Figure 9); however it can be chosen with equivalence also. The frames, the message and data are different things. Information outline structure relies on upon transmission mode [7]. ASCII mode messages begin with a colon character ":" (ASCII 3AH) and end with a carriage return-line encourage combine of characters [8,11] (CRLF, ASCII 0DH and 0AH). The main suitable characters for every single other field are hexadecimal 0–9 and A–F [1].

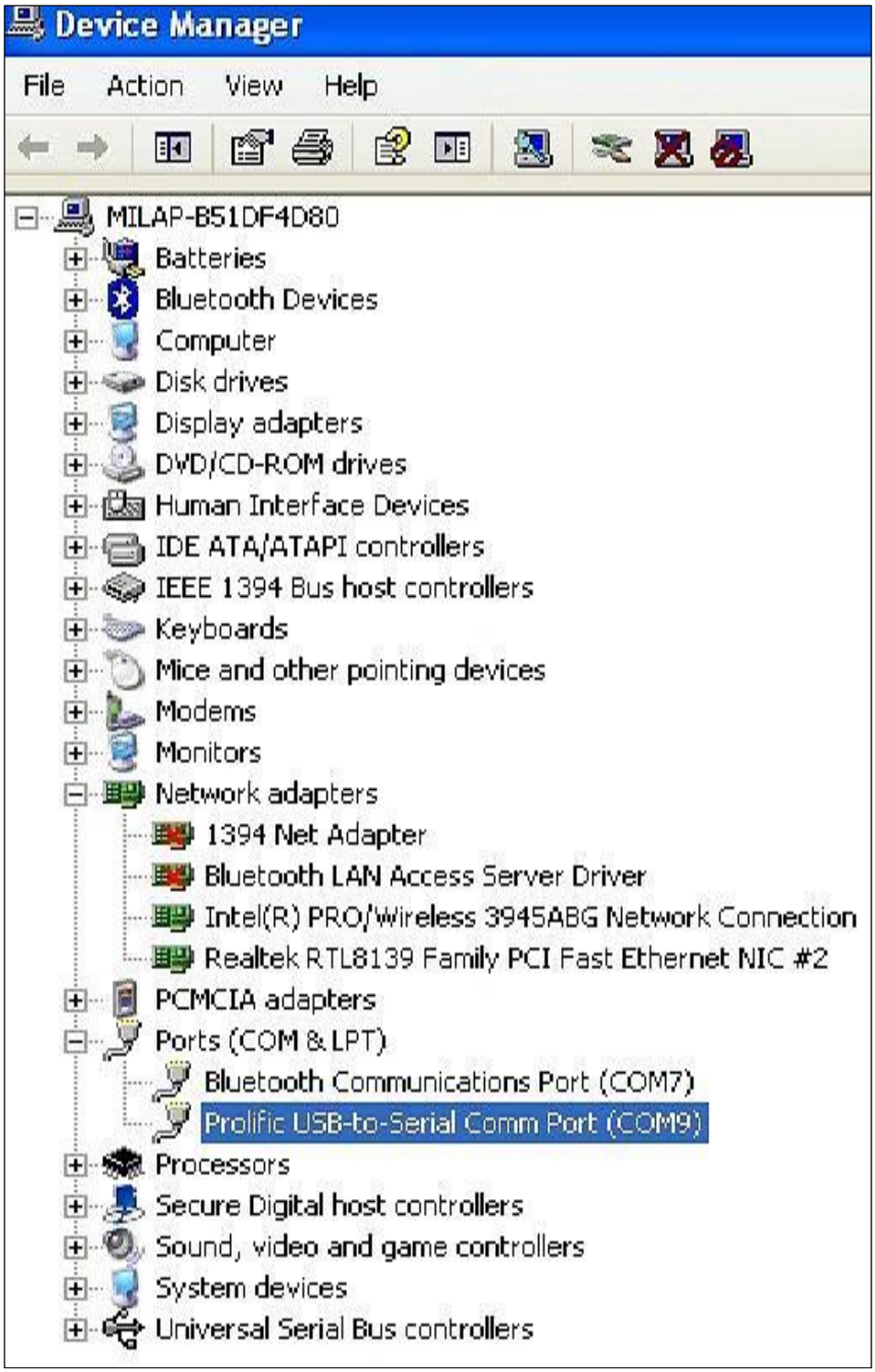

Fig. 5: *Finding Connecting Port by Device Manager.*

Fig. 6: *Connecting with the GSM Module.*

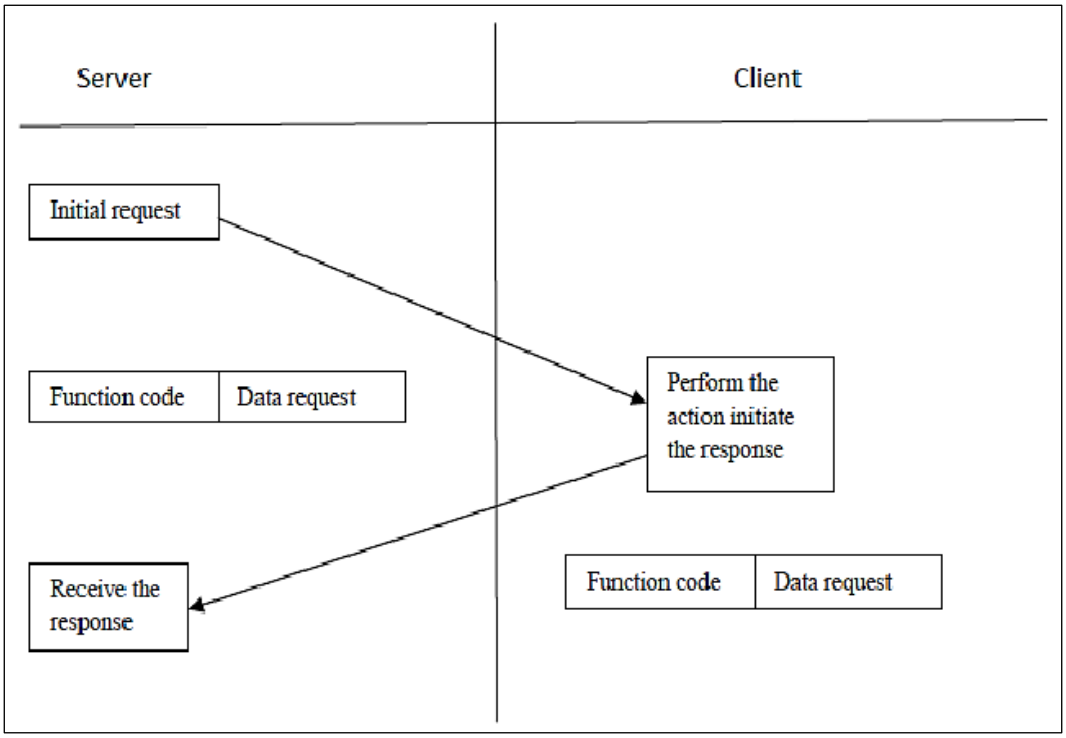

Fig. 7: *MODBUS Transaction (Error Free).*

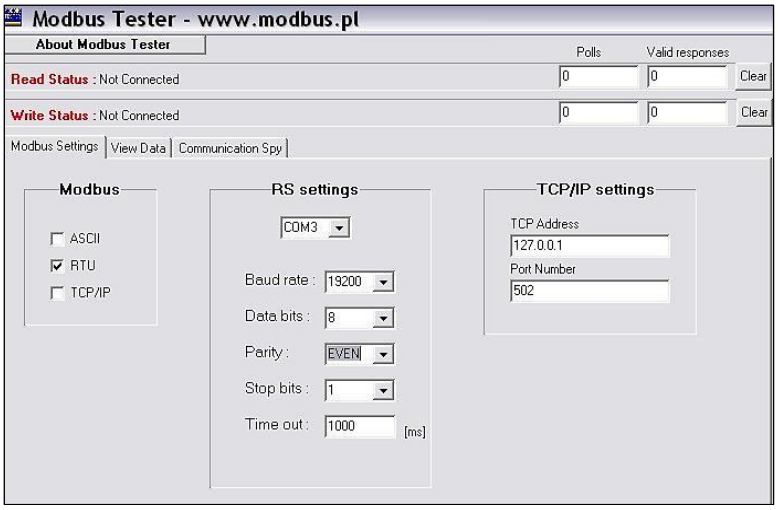

Fig. 8: *Modbus Settings.*

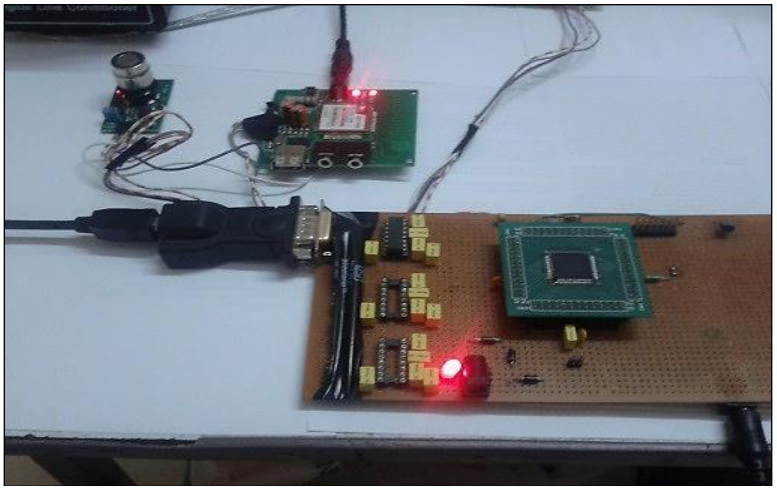

Fig. 9: *GSM Module Connected with Sensor.*

Fig. 10: *Setting up HyperTerminal.*

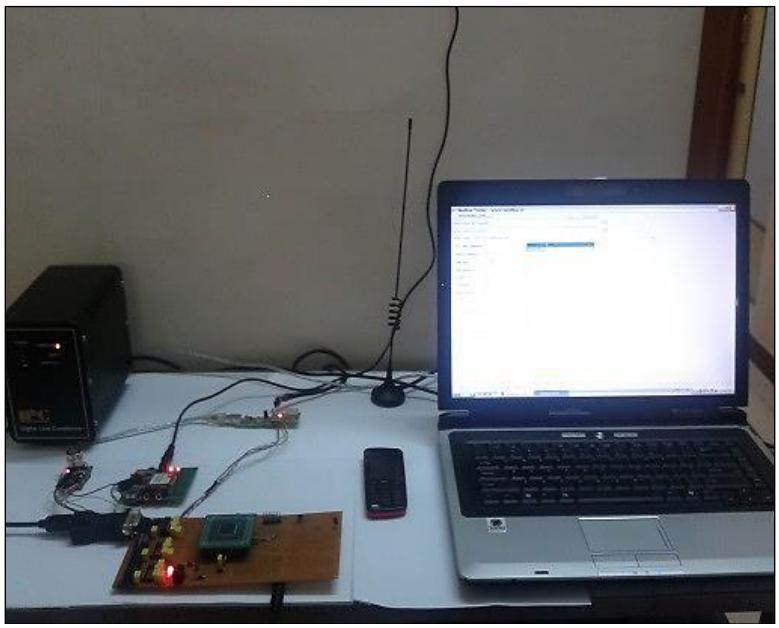

Fig. 11: *Setting up GPS.*

TEST RESULTS

TimeSlot (Min)	**Temp** (°C)	**CO_2 (gm)**	**Latitude** (N)	**Longitude** (E)
10:45 a.m.	29	175	22.3039	70.8022
11:00 a.m.	28	180	22.3039	70.8022
11:15 a.m.	31	200	22.3039	70.8022
11:30 a.m.	32	213	22.3039	70.8022
12:00 a.m.	34	160	22.3039	70.8022

CONCLUSION

The GSM and GPS based gas plant monitoring system is utilized to gauge temperature and CO_2 level. MODBUS is utilized to interface with GSM module. Small in size, real-time communication, reasonable in price and simple to keep up, make this a better option when compared to costly monitor systems being brought from abroad by the ecological supervision and administration divisions.

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