

Real Time Monitoring and Control of Multi Sensor Using GSM Techniques in Embedded System

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Abstract: This paper describes the design of a simple low cost microcontroller based real time monitoring and control of multi sensor using gsm techniques in embedded system. GSM modem using AT commands for sending and receiving message. The LM35 is an integrated circuit sensor that can be used to measure temperature with electrical output proportional to the temperature. The temperature sensor, Gas sensor and vibration sensor are connected to PIC 16F877A microcontroller. The sensors output are send message to concern person through serial communication and displayed in LCD. The GSM modem performs the operation of sending message to a particular SIM number. GSM technology provides users with high quality signal and giving them access to high quality digital communication at very affordable rates. GSM network operators can provide their customers with cheaper calling and text messaging options.

Keywords: PIC Micro Controller¹, Temperature sensor², Vibration sensor³, Gas sensor⁴, GSM modem⁵.

1. INTRODUCTION

The objective of this paper is to design and develop a wireless communication link to monitor and control equipments that are far away from the user and also develop a high security system to keep a check on them. In an industry during certain hazards it will be very difficult to monitor the parameter through wires and analog devices such as transducers. Embedded system plays a vital role in this paper. It is a user-friendly application system. GSM plays a key role for transmitting and receiving the data from the user. The main advantage of this concept is the real time direct measurement of the parameter through GSM technique. The stoppage and some accidents caused by increased temperature, gas leakage, and vibration can be avoided. The self designed GSM module is selected to finish the transmission and decoding of the data through "AT" command and coding of short PDU. Here, the temperature, gas leakage and vibration is monitored directly which is simultaneously displayed in the LCD and can be sent as a message by GSM technique.

2. METHODOLOGY

2.1 GSM

Global System for Mobile Communications or GSM (originally from Group Special Mobile), is the world's most popular standard for mobile telephone systems. The GSM Association estimate that 80% of the global mobile market uses the standard A GSM modem is a wireless modem that works with a GSM wireless network [1]. Global Positioning System is one of the widely used mobile standards. As the name specifies, it enables the mobile users to interact all over the world at any time [4].

It is a hardware component that allows the capability to send and receive SMS to and from the system. The communication with the system takes place via RS232 Serial port. Cell phone can be attached at the place of GSM hardware but it limits the hardware functionality such as sending or receiving of SMS [2]. GSM services include telephony, asynchronous and synchronous data services (2.4/4.8/9.6 Kbps); value added features (SMS, fax) and more. Speech is digitally encoded and transmitted as digital stream standards.

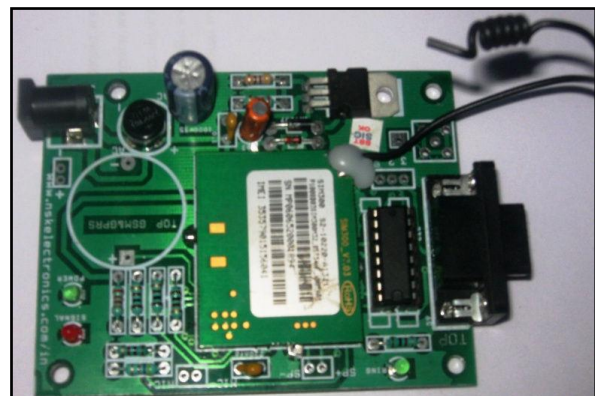


Fig 1. GSM Modem

GSM users can send and receive data, at rates up to 9,600 bps [3]. The dominant mobile phone network in the world today is GSM. It is a digital mobile communication network, which developed, rapidly in recent years. This network has coverage in most urban areas and offer support for the SMS [5].

2.2. SIM300

The SIM300 is a complete Tri-band GSM solution in a compact plug-in module [14] [15]. The GSM modem consist of SIM card named as a SIM 300 is fixed with the modem. The SIM300 offers GSM/GPRS for performing operations like voice, SMS, Data and also Fax. It is small in size to handle easily and perfectly in any device. AT commands also can be easily used because it has a TTL interface with microcontrollers, computers and also other device. AT commands are used to send and received SMS. SIM300 works with 3.4V to 5V.

2.3. AT comment [11]

- AT+CSMS - Select short message service
- AT+CMGF - Set short message service mode (1 for text mode, 0 for PDU mode)
- AT+CMGS - Sent short message
- AT+CSCA - Short message service number.

2.4. Microcontroller

The microcontroller used is PIC 16F877A. The program on the microcontroller, reads the value of the temperature and gas leakage, vibration detection. The micro controller programming is done using Embedded C, for control units. The PIC microcontroller PIC 16F877A has an operating speed Max 20 MHZ, voltage (2-5.5v). Memory consists of flash program RAM, EEPROM and Data Memory [7]. Displayed data of temperature, gas leakage, vibration detection are transferred to RS 232, it is interfaced with Microcontroller through MAX232 [6].

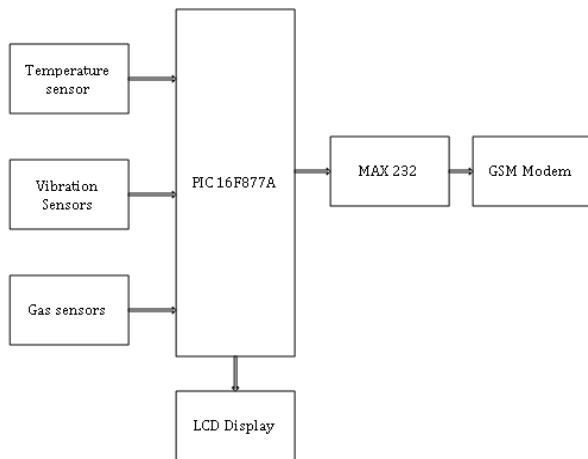


Fig - 2: Block Diagram

The program is written in Embedded C in MPLAB. MPLAB Integrated Development Environment is an integrated toolset for the development of embedded application employing Microchip’s PIC and PIC microcontroller [13]. The compile tool is CCS (Custom Computer Service) used to convert C Language to HEX File. The HEX file is dumped into the PIC microcontroller using super pro 580u. All the code is design for project we are used MPLAB IDE Tools V8.70. [12].

2.5. Principle

As GSM is the main objective, the temperature, gas,

vibration which is continuously monitored by using multisensory system. When exceeds three parameters the message is sent to mobile as an indication for avoiding damage or accidents. This operation is processed by PIC microcontroller in which the program written in Embedded C is dumped into it. It is thus referred as precaution for avoiding damage and alert given to persons by sending message to mobiles.

2.6. LCD: (liquid crystal display)

A 16x 2 LCD is used for display the message when the temperature, gas and vibration exceeds.

2.7. MAX 232

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V supply[17]. It is used to transfer the data from microcontroller to GSM modem.

3. RESULT AND DISCUSSION

The temperature, gas and vibration measured from the Multisensor system and are processed by a built-in microcontroller .Embedded C is used for programming the controller unit. The LM 35 is the temperature sensor connected to RA0 port of the PIC microcontroller device. The output voltage is obtained in milli volt and is amplified using IC 741. The amplified signal is displayed as volt. The gas sensor connected to RA1 port and vibration sensor connected to RA2 port of the PIC microcontroller device. The PIC device is connected with the GSM modem and LCD display device.

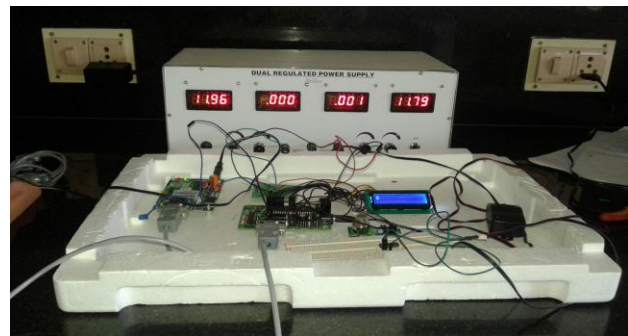


Fig – 3: Hardware Setup

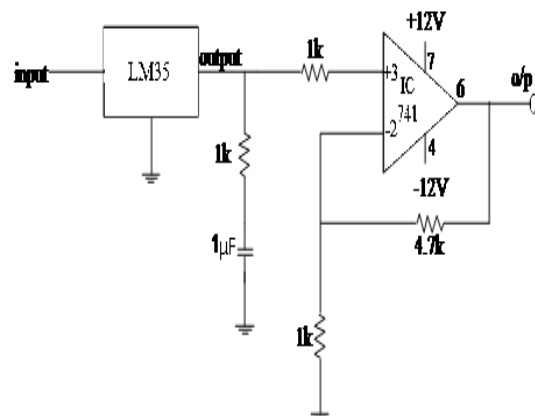


Fig: - 4.Circuit Diagram of LM35

The result is displayed in the LCD. The parameters like temperature, gas, vibration can be monitored directly which is simultaneously displayed in the LCD and also sends as a message by GSM technique.

LM35 produces 10mV per degree °C [9]. The microcontroller required the input volt for ADC port is 0V to 5V. The output voltage of temperature sensor is 100°C = 1V. In the circuit, we use op-amp (IC741) to amplifying 1V to 5V. We interface the temperature sensor to the PIC16F877A microcontroller using the ADC port on the microcontroller [10].

The LM35 series are precision integrate-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature [7]. 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 [8]. Temperature (°C) = Vout (100 °C/V) so if Vout is 1V, then, temperature = 100 °C. The output voltage varies linearly with temperature.

3.2 Temperature Sensor (LM35)

Temperature sensor is used to sense the temperature. The temperature received in the output of LM35 does not need any further calibration or any other functions and also it draws only 60 micro amps from its supply. The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature, i.e., its scale factor is 0.01V/degree C.

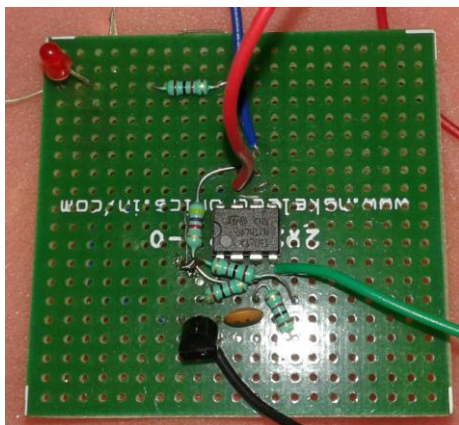


Fig – 5: Temperature sensor

3.3 Gas Sensor

They are used in gas leakage detecting equipments in industry and home. They are suitable for detecting of LPG, natural gas, town gas. The sensor has excellent sensitivity combined with a quick response time. When the target combustible gas exists, the sensor’s conductivity is higher along with the gas concentration rising [16]. When concentration of gas exceeds microcontroller automatically alert the consumer by sending SMS and activate the LED, Buzzer and display the message on LCD display [18].



Fig – 6: Gas Sensors

3.4. Vibration Sensor

A piezoelectric sensor is used as accident detection sensor. A piezoelectric transducer has very high DC output impedance and can be modeled as a proportional voltage source and filter network. The voltage V at the source is directly proportional to the applied force, pressure, or strain. The output signal is then related to this mechanical force as if it had passed through the equivalent circuit. [17].



Fig-7: Vibration Sensor

The Vibration Sensor Detector is designed for the security practice When Vibration Sensor Alarm recognizes movement or vibration, it sends a signal microcontroller and through the GSM modem. Vibration sensors are used for monitoring the vibration levels of various rotating equipment like fans, motors, pumps, etc.

4. PCB DESIGN

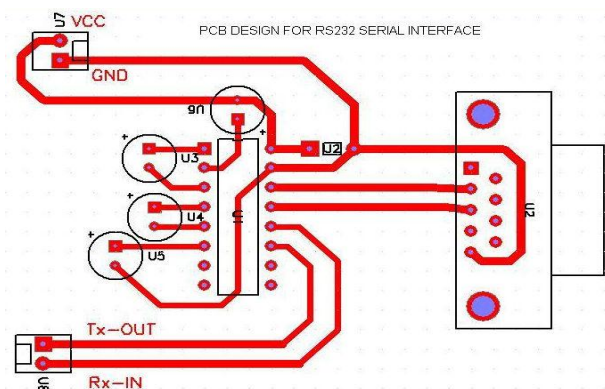


Fig – 8: PCB Design for RS232 Serial Interface

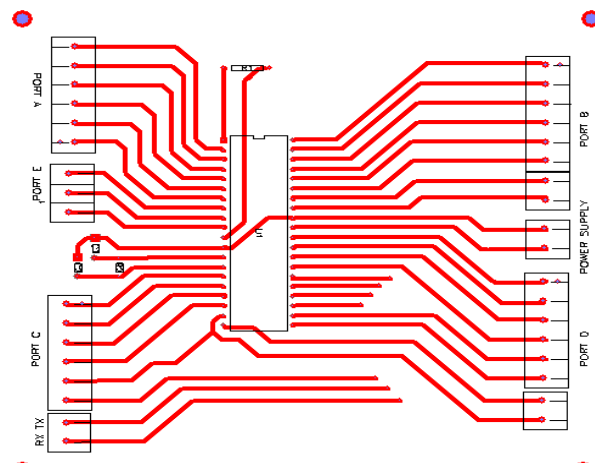


Fig - 9: PCB Design for PIC Microcontroller

5. CONCLUSION

The Multi sensors are connected to PIC microcontroller and varying temperature, Gas leakage and vibration detection is sent to GSM modem which is simultaneously displayed in LCD and also sends as message. Through this experiment and implementation we came to know that the temperature, Gas leakage and vibration detection can be monitored using multi sensor systems and can be send as SMS to mobile successfully.

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