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Fire Monitoring and Control System

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Abstract - *Fire outbreak has almost become a daily occurrence in our day to day lives. It often results in loss of lives and properties that are worth in millions. Therefore early reporting of fire is a key factor in successful handling of fire incidents. However the main challenge for the firefighters is successfully locating the place under fire. So with the advancement in technology, it is now possible to receive alert of fire outbreak along with its location using GSM and GPS technology. This paper proposed makes use of various sensors like flame, smoke, etc. along with GSM/GPS system in reporting of fire occurrence, with its location in a real time mode. This proposed system also makes use of water sprinklers for on-site control of fire. The proposed system is also cost effective and thus can be used at various Petrol stations, Forests (in case of forest fires), Industries, Malls, and Hospitals etc.*

Key Words: **GSM, GPS, flame sensor, smoke sensor, water sprinklers.**

1. INTRODUCTION

A Fire monitoring and control system is designed to detect the presence of fire by monitoring environmental changes associated with combustion with the help various sensors like flame sensor, smoke sensor etc. This system helps to notify people to evacuate the place under fire or any such emergency. It makes use of GSM system to send alert signal to the firefighting team to control the place under fire along with its location with the help of GPS system. In short this system will automatically notify the fire station concerning a fire occurrence in a particular place with the location of the site via Short Message Service (SMS) for quick response. This system uses a microcontroller as a processor, which monitors the conditions of flame, smoke and other sensors.

2. PROPOSED SYSTEM

The proposed system consists of various sensors like flame sensor, smoke sensor, LPG/CNG sensor, a LCD display, GSM module, GPS module, buzzer, and a water sprinkler. The proposed system is controlled by an ARM LPC2148 microcontroller. If the fire or smoke sensor detects fire or smoke then it (sensor) sends the control signal to the microcontroller interfaced to it. The microcontroller then takes the necessary action like ringing the emergency alarm (in this case a buzzer), sprinkling water for on-site control of fire, sending location information to the fire station using GSM and GPS. The fire station use location information by means of longitude and latitude and we can also find the shortest route to the location with the help of Google maps.

3. HARDWARE DESIGN

The hardware of the proposed system consists of various sensors(flame, smoke, CNG/LPG sensors), Microcontroller (LPC2148), GSM module, GPS module, a buzzer and water sprinkler.

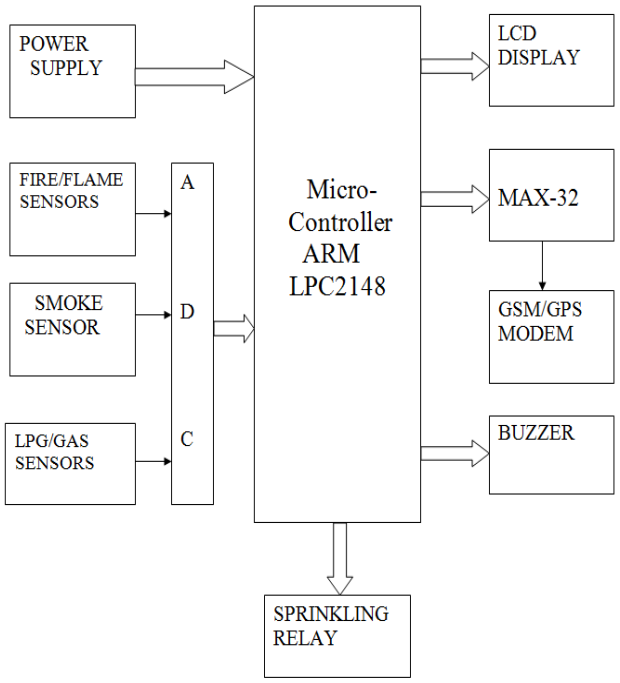

Fig-1: Proposed System

Fig-1 shows the block diagram of the proposed system, while Fig-2 shows how the alert signal is sent to fire stations on a smartphone and also that the alert signal contains latitude and longitude (can also include altitude) of location under fire.

Fig-2: Receiver (or received signal) at the fire station

3.1 SENSORS

The primary sensors that are used in this system are:

- Flame sensor: for detection of fire in the vicinity of the system,
- Smoke sensor: for detection of smoke.

The above sensors read the fire and smoke signals which are analog in nature. These analog fire and smoke signals obtained from their respective sensors are applied to an analog to digital converter (ADC), since microcontroller understands only digital signals. Other than flame and smoke sensors, CNG/LPG sensors are also used as secondary sensors for gas leakage detection.

3.2 Microcontroller LPC2148

The microcontroller is the heart of this system. The LPC2148 microcontroller is based on 16/32-bit ARM7TDMI-S. It has 32kB of on-chip static RAM and 512kB of on-chip flash program memory. In addition, the LPC2148 provides 8kB of on-chip RAM accessible to USB by DMA. It is having advanced RISC architecture. It consists of two 32-bit timers/counters with four capture and four compare channels each, PWM unit (six outputs) and watchdog. It also has two 10-bit A/D converters, single 10-bit D/A converter and two UART's.

3.3 GSM Module

Global system for mobile communication (GSM) is a digital mobile telephony system. GSM system uses Time Division Multiple Access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of data, each in its own particular time slot. The GSM module used in this system is SIM900A which is a complete dual-band GSM/GRPS module in a SMT type which is designed especially for dual-band Asian market. This GSM module delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data and Fax in a small form factor and with low power consumption. The GSM module communicates with the microcontroller through Universal asynchronous receiver and transmitter. To communicate over UART, we just need three basic signals which are namely, RXD (receive), TXD (transmit), GND (common ground). The TXD serial port of microcontroller is connected with the TXD of the GSM modem, while the RXD serial port of the microcontroller is connected to the RXD serial port of the GSM modem. AT commands is a set of commands or instructions which can be used to communicate with a GSM modem.

3.4 GPS Module

The Global Positioning System (GPS) is a satellite based navigation system consists of a network of 24 satellites located into orbit. This system provides important information to commercial users around the world and it is freely accessible to anyone with a GPS receiver. GPS receiver must be locked onto the signal of at least three satellites to calculate approximately 2D position i.e. latitude and longitude and track movement. With four or more satellites in sight, the receiver can establish the user's 3D location i.e. latitude, longitude and altitude.

4. SOFTWARE DESIGN

The programming of the microcontroller in the proposed system is done in embedded 'C' language using the Keil uVision5 software and the code is dumped into the microcontroller using Flash Magic software. A software named 'Protel' is used for PCB layout designing. In the initial development of the system 'Proteus 8 Professional' software is used for the simulation of the entire system

5. ALGORITHM AND FLOWCHART

ALGORITHM:

Step1: Initialize system i.e. LCD, relays, ADC

Step 2: Collect data from various sensors i.e. flame, smoke, etc.

Step 3: Take output from various sensors in ADC

Step4: Check the status of flame and smoke sensor (if it is ON or not)

Step 5: If fire sensor is ON then make buzzer and sprinkler ON

Step 6: Collect GPS location information

Step7: Turn on GSM modem

Step 8: Send SMS to fire station

FLOWCHART:

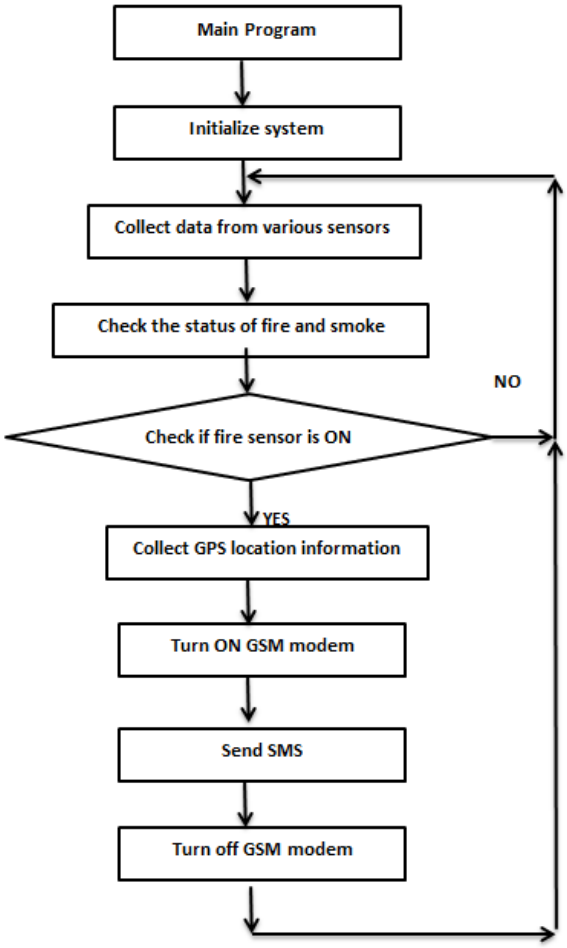

Fig-3: Flowchart of the proposed system

6. CONCLUSION

The design proposed in this paper is based on continuously monitoring the place prone to fire outbreaks and reporting of such fire incidents through GSM and GPS systems. This system uses the GSM for sending SMS to fire stations, while the GPS is used for getting actual location where the fire outbreak had taken place. The idea behind making use of sensors is because of quick response time, easy deployment and to equally save time and cost. Finally the objective of the project was successfully achieved with the proper and desired results. Therefore this system provides a better and reliable way of monitoring, controlling, locating and reporting of a place under fire breakout.

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