

NETWORK BASED INTELLIGENT FIRE ALARM

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Abstract— This system is mainly used in shopping malls and multi-level apartments to detect the fire and take necessary actions which were configured by the user. This product will detect fire within a short span of time (5 sec max) and the information will be triggered to authority via SMS and also in the main panel it will be acknowledged via LEDs, printing message on LCD and giving loud buzzer sound. The main advantage of selecting this product is to avoid so much wiring between main panel and slave zones. This reduction of wiring is achieved by using RS-485 networking concept, hence cost of the total system will be reduced by 50% of project cost. Another advantage is to configure the system settings of main panel will be done through LCD with keypad and also FIRE detected zone address will be displayed on LCD.

Index Terms— *Automatic fire detection, P89V51RD2 Microcontroller, GSM/GPRS, Rs-485, wireless network.*

I. INTRODUCTION

Fire, being an important process that affects ecological systems across the globe, still pose a serious challenge to the security of lives and properties. Even though it is been used by humans for various activities like cooking, signalling, propulsion purposes, it still remains as a serious threat to life & properties. In a developing nation, like India, Fire accident creates serious health and safety hazard, which also resulted into catastrophic situation. Associated with it is unnecessary injury or

complete loss of lives in one hand, partial or complete damage to expensive and valuable properties on the other hand. This huge loss is inestimably enormous; hence this project proposes an idea to develop a networked Fire Alarm system, assisted with GSM support. The project aims at developing a efficient, cost effective prototype which detects fire/smoke and alerts the public through various mechanisms such as Alarm, LEDs, LCD Displays. The system also employs a SMS mechanism to alert the concerned authority, even remotely. The prototype has been developed with such a vision that, it serves as an undeniable alternative security system for multi storied buildings and shopping malls.

In [1] an automatic fire alarm system based on wireless sensor networks is developed, which is designed for high-rise buildings. Using the surveillance centre is able to accurately locate the alarm source and it works at 433 MHz (433.30-MHz to 434.79MHz). In order to minimize wireless interferences the band is divided into 8 channels, and the channel spacing is 200 kHz. An automatic home security system is composed of the microcontroller based wireless sensor network centre node with GSM module, data collecting node, device control node and mobile phone.

Wireless Sensor Network (WSN) data collecting node module is connected with Pyroelectric Infrared Detector, Temperature Sensor, Smoke Detector and Gas Sensor separately shown in [3]. When the PIR finds that some people intrudes into the house or when the temperature sensor detects too high indoor temperature or when the gas sensor detects leakage

of gas, the data collecting node will send encoded alarm signal to the wireless sensor network center node through the wireless sensor network established in home. Once the Wireless sensor network center node receives alarm signal, it will send alarm short message to the users through the GSM module and GSM network immediately. Similarly the user can also control the various devices connected with device control unit through SMS. Whereas in [4] wireless sensor network based fire monitoring and extinguishing using Zigbee for an hospital building.

Fire monitoring system continuously monitors the surroundings and keeps a track of the temperature recorded and the intruders detected, performed by monitoring node.

In [5] reported that “Fire is a good servant, But a Master-Prevent Fire”. In the same way, electricity is a clean form of energy-use it efficiently. Otherwise, in electrical power distribution system, fire may occur due short circuit, overheating, overloading, unbalance loading, use of nonstandard appliances, improper way tapping of power, non standard electrical wiring, carelessness and loose connection etc. Such incidents can be minimized to a great extent if adequate fire precautions are observed. Electrical fires spread rapidly especially in buildings and cause loss of lives and property. It is, therefore, necessary to act fast. Raise an alarm for help. Switch off power supply to de-energise the equipment. Use dry sand, CO₂, dry powder or Halon extinguishers.

In this work, The GSM assisted fire alarm system aims at developing a prototype, which overcomes all these drawbacks, along with incorporating additional features. The system also stands unique, when it comes to wiring related issues in the main panel. The prototype avoids clumsy wirings, by the usage of RS485 for data exchange. It is also equipped with preventive measures, on fire detection.

II. NETWORK BASED INTELLIGENT FIRE ALARM

The Network based Intelligent Fire alarm system works as an un-deniable alternative for the conventional security systems. The Figure 1 represents the block diagram of the prototype.

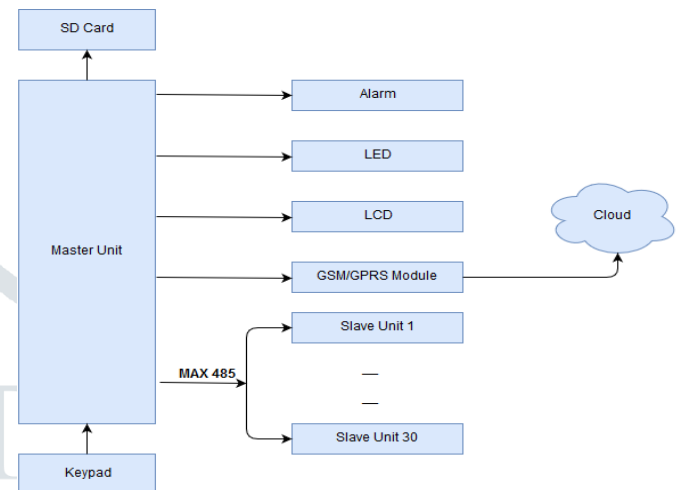


Fig 1. Block Diagram of Network Based Intelligent Fire Alarm

The Master unit comprises of a microcontroller. Micro controller controls the all the modules, which are attached to the master unit like LCD, LEDs, GSM module, SD Card and Keypad. The slave units and other peripherals communicate with the master unit and performs required actions.

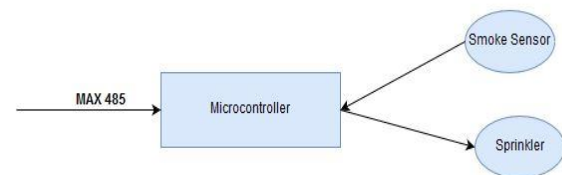


Fig 2. Slave Module

The slave unit comprises of a microcontroller & a smoke sensor. Figure 3. 2 represents the basic structure of the slave unit. The smoke sensor is used to detect any case of fire/smoke. The sensor senses the required parameter & transfers the reading as an input to the microcontroller. The output from the sensor will always be of analog nature. So the input of the controller is fed to the internal ADC & is converted into digital value, required for further processing.

The communication between the master unit & the slave is made possible through MAX485. This enables long distance communication between the master & the subsystem.

A. Fire Alarm Components

1) P89V51RD2 Microcontroller

P89V51RD2 is a very popular 8051 core microcontroller from NXP Semiconductors (formally Phillips). It can be programmed via serial port using NXP's utility or Flash Magic. It is a 80C51 microcontroller with 64kB Flash and 1024 bytes of data RAM.

A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI.



Fig. 3. Microcontroller P89V51RD2

2) Analog to Digital Converter (ADC0804)

ADC0804 is a very commonly used 8-bit analog to digital convertor. It is a single channel IC, i.e., it can take only one analog signal as input. The digital outputs vary from 0 to a maximum of 255. The step size can be adjusted by setting the reference voltage at pin9. When this pin is not connected, the default reference voltage is the operating voltage, i.e., Vcc. The step size at 5V is

19.53mV (5V/255), i.e., for every 19.53mV rise in the analog input, the output varies by 1 unit. To set a particular voltage level as the reference value, this pin is connected to half the voltage. For example, to set a reference of 4V (Vref), pin9 is connected to 2V (Vref/2), thereby reducing the step size to 15.62mV (4V/255).

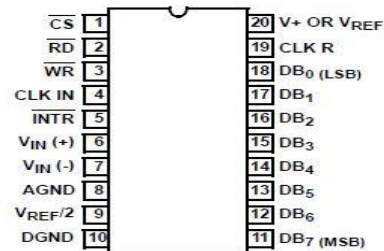


Fig. 4. Analog to Digital Converter ADC0804

3) Max 485

RS-485, is a standard defining the electrical characteristics of drivers and receivers for use in serial communications systems. RS485 is the most versatile communication standard in the standard series defined by the EIA. It has the versatile feature like Connect DTE's directly without the need of modems, Connect several DTE's in a network structure, Ability to communicate over longer distances, Ability to communicate at faster communication rates.

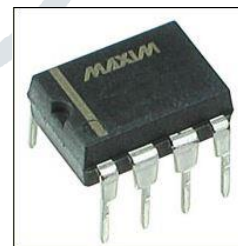


Fig. 5. Max 485

4) Smoke Sensor

A smoke detector is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as smoke

alarms, generally issue a local audible or visual alarm from the detector itself.



Fig. 6. Smoke Sensor



Fig. 8. GSM/GPRS Module.

5) GSM/GPRS Module

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer.

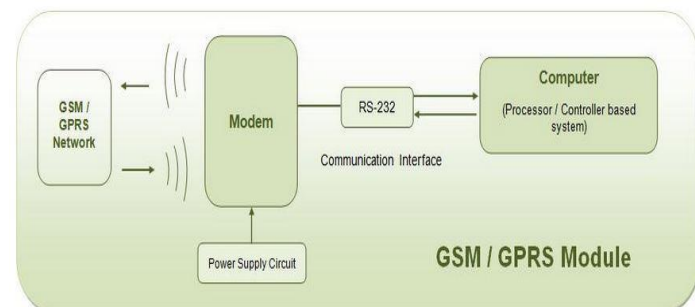


Fig. 7. GSM/GPRS Module.

6) Fire Sprinkler

Fire sprinkler or sprinkler head is the component of a fire sprinkler system that discharges water when the effects of a fire have been detected, such as when a predetermined temperature has been exceeded.

B. Modes of Operation of Fire Alarm

The system is been designed to have four basic modes of operation

- Normal Operation
- Test Mode
- Zone Isolation Mode
- Walk Mode

i. Normal Operation Mode :

In this mode the continuous monitoring of Smoke sensor is done. When the system is functioning well, there will be no fire alert or fault alert.

ii. Test Mode:

By selecting this option, user can test each zone's functionality whether it is working as per defined requirements, like when a FIRE occurred, how it should actually behave it.

iii. Zone Isolation:

If any problem detected at any zone, that particular zone we can made it as isolation mode by using keypad.

iv. Walk Mode

In this mode, the system acts as if in normal mode. The fire maintenance person will create a smoke near the sensor manually. So, the system will get activated for a short period of time.

III. OPERATION AND EXPERIMENTAL RESULTS

Micro controller controls the all the modules, whenever fire is detected by the zonal sensors, zonal microcontroller communicates with main distribution board through RS485 and displays the zonal number in the LCD, corresponding LED glows on the main distribution box as well as zonal box and buzzer sounds as well. Then corresponding zone information send to the main distribution box, from main distribution box, through GSM module the zonal information send to the authority people through SMS. By using 4x4 keypad, we can make particular zone into isolation mode. as well as we can do lamp test and walk mode. If any Fault detected at particular zone, the Zone information goes to the Main Distribution Box through RS 485 network Communication. The structural block diagram of the proposed system is shown in below figure. Which includes all the components with proper wiring and overall system implementation.

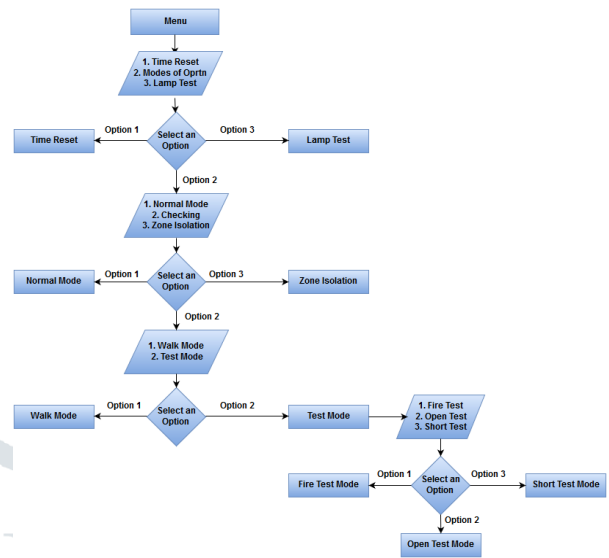


Fig. 10. Selection Mechanism.

The prototype design also comes with mobile app support. The mobile app make the system, easier to manage & maintain

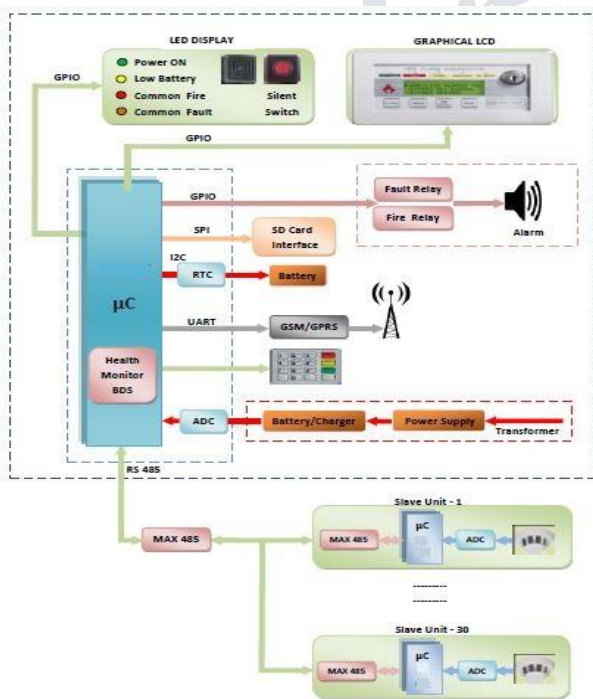


Fig. 9. Structural Block Diagram



Fig. 11. App Display.

IV. CONCLUSION

Network based Intelligent Fire Alarm system employs most advanced methods of data transfer and facilities high end surveillance, in case of fire. The system also uses various notifying mechanisms to alert the user like LSD displays, LEDs, Buzzers and even with SMS sending mechanisms. The network based intelligent fire alarm is also equipped with fire sprinklers attached to it, which starts working immediately, on detection of a fire. The system employs advanced testing mechanisms/modes for the prototype, so that

The below figure represents the basic flow of selection mechanisms employed in the prototype design.

the functionality of the system can be tested under regular intervals. The use of MAX 485 makes the system, cheaper & easy to network the zones down to a centralized main board.

The prototype can be made more advanced by facilitating a wireless data transfer mechanism between the master and slave units. The use of Zigbee technology for the purpose, will make the system more advanced in nature. Implementation of Zigbee technology with mesh network will make the system, a real icon among the technically advanced prototypes in the market. Remote debugging of the system can also be made possible. The implementation of remote debugging mechanism will make the system, stand unique among its competitors.

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