



Emergency Fire Response System using Embedded System in Internet of Things (IoT)

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ABSTRACT: This paper suggests IoT-based emergency fire response system that can send information intelligently according to the detection of flame and gas leakage to the owner or fire-service. It's also able to send the location with existing fire emergency response systems in times of fire and gas leakage. The aim here is to design an "IoT-based Emergency Fire Response System" using embedded system. A robot capable of fighting and sending information off fire and gas leakage for a certain room will be designed and built. It must be able to autonomously navigate through a modelled floor plan while actively scanning for a flame. The robot can even act as a path guider in normal case and as a fire extinguisher in emergency. Robots designed to find a fire and gas to send information, before it rages out of control, can one day work with fire-fighters greatly reducing the risk of injury to victims. The project will help generate interests as well as innovations in the fields of robotics while working towards a practical and obtainable solution to save lives and mitigate the risk of property damage.

KEYWORDS: IoT, GSM, Fire Response System, Arduino

I. INTRODUCTION

There are many possibilities that a fire can start in an industry or in any remote area. For example, in cotton mills, garments, fuel storages, etc. electric leakages can lead to huge damage. Also it's a worst-case scenario, causing heavy losses not only financially but also destroying areas surrounding it. Robotics is the emerging solution to protect human lives and their wealth and surroundings by faster information. A robot is an automatically guided machine, able to do tasks on its own. This project, which is our endeavor to IoT-based Emergency Fire Response System which is able to send information by GSM (global system for mobile communication), comprises of a machine which not only has the basic features of a robot, but also has the ability to detect fire and extinguish it. This robot processes information from its various sensors and key hardware elements through microcontroller. It uses flame sensor to detect the fire accident and gas sensor to detect the gas leakage and Ultrasonic sensor to avoid obstacle. A robot capable of extinguishing a simulated tunnel fire, industry fire and military applications are designed and built. Flame sensor will be used for initial detection of the flame. Once the flame is detected, the robot sounds the alarm with the help of buzzer provided to it, the robot actuates an electronic valve releasing motor off on the flame.

Also gas sensor will be used for detection of the gas leakage. When the gas leakage is detected, the robot sounds the alarm with the help of buzzer. The project helps to generate interests as well as innovations in the fields of robotics while working towards a practical and obtainable solution to save lives, asset and mitigate the risk of property damage. Fire fighters face risky situations when extinguishing fires and rescuing victims, it is an inevitable part of being a fire fighter. In contrast, a robot can function by itself or be controlled from a distance, which means that fire fighting and rescue activities could be executed without putting fire fighters at risk by using robotics technology instead. In other words, robot decreases the need for fire fighters to get into dangerous situations. This robot provides fire protection with quick sms/call to the owner and fire service when there is a fire in a tunnel or in an industry by using automatic control of

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robot by the use of microcontroller in order to reduced loss of lifeand property damage.This robot uses dc motors, castor wheel, microcontroller, sensors,fan and GSM.

Microcontroller is the heart of the project. Microcontrollercontrols all the partsof the robot by the use of programming. In this robot as the fire/gas sensor sensesthe fire/gas, it sends the signal to microcontroller; since the signal of the sensor isvery weak the amplifier is used so that it can amplify the signal and sends it to microcontroller. As soon as microcontroller receives the signal a buzzer sounds,the buzzersound is to intimate the occurrence of fire accident and also send the information tothe receivers. After the sounding of the buzzer micro controller actuates the drivercircuit and it drives the robot towards fire place to avoid any kinds of obstacle, as therobot reaches near the fire micro controller actuates the relay and fan switch is madeON and fan is running on the fire through the motor.

II.SYSTEM MODEL AND ASSUMPTIONS

IoT based designshave developed another innovative and public utility product formass communication. This is a Fire Fighting Robot which is used for prevent houses, offices and shops from fire. The basic idea behind this project is that robot moves in the suffocated fire area in houses, other offices etc, when users arenot present at home or office. It will find the existence of fire using flame sensor and whenthe fire is detected by robot ,it will try to fight with fire using fan/water and as wellas sent the message to you using SMS or GPRS Packets. Such Devices can be usedat different areas of the human being life. Such offices, houses, factories etc. Wirelescommunication has announced its arrival on big stage and the world is going mobile.We want to control everything and without moving an inch. This GSM Fire FightingRobot is possible through Embedded Systems. The use of "Embedded System inCommunication" has given rise to many interesting applications that ensures comfortand safety to human life.The main aim of the project will be to design a SMS electronicFire Fighting Robot toolkit which can replace the traditional Fire Fighting Robot. Therobot fighting on the fire and send SMS to owner of the house and the fire service, Thesystem is made efficient by SIMs so that the SMS can be received by number of devicesboards in a locality using techniques of time division multiple access.

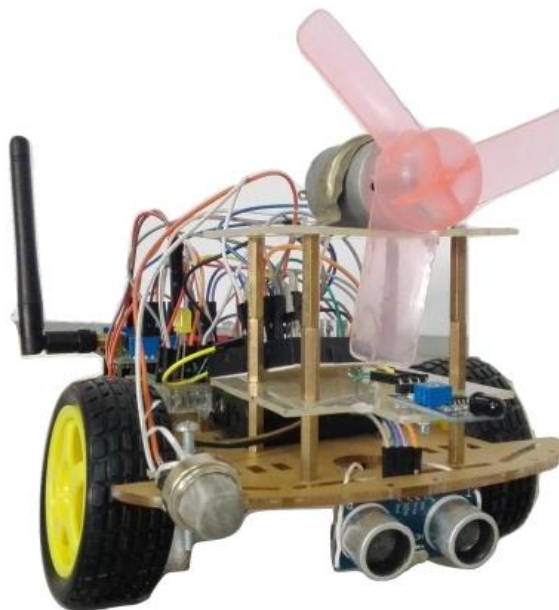


Fig .1 Fire Response System

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A. Components

Hardwares which have been assembled here are

1. GSM(SIM900)
2. Flame Sensor (sen-0018F)
3. Gas Sensor (MQ2)
4. Motor Driver (L293D)
5. Ultrasonic Sensor(HC-SR04)
6. IRF540 (NMOS)
7. Voltage Regulator (L7805)
8. Voltage Regulator (L7808)
9. Arduino Uno board
10. Microcontroller(ATmega328p)
11. DC Motor (+12V)
12. Water pump/Fan (+5V)
13. Buzzer
14. Rechargeable Battery (12V)
15. Chassis
16. Jumper Wire
17. Switch

In software, arduino compilers and proteus have been used.

III.WORKING PRINCIPLE

This is the circuit diagram of emergency fire response system.As a source we supply20V dc.We used 5V to gas flame and ultrasonic sensor by LM7805 Voltage regulatoralso supply 8V to arduino board by L7808 voltage regulator. In GSM there are two supplymodes with one internal supply and two external supply. We used internal supply mode and take power from arduinouno. We also used 12V to the pin no.8 and 5V to the pinno.16 of L293D motor driver. Arduino code is used to the Atmega-328p microcontroller.

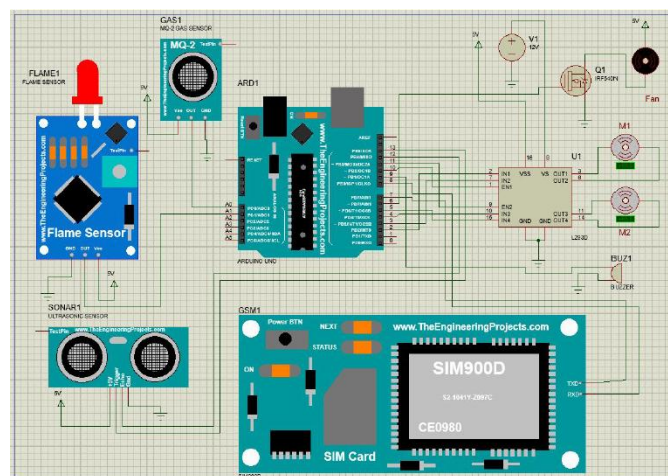


Fig 2: Circuit Diagram



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Gas sensor connected to A0 pin. flame sensor connected to A1 pin Ultrasonic connected to 12 and 13 pin of microcontroller. GSM Rx; Tx pin connected to microcontroller 7,8 pin for receiving and transmit data microcontroller 2,3 pin connected to motor driver 2,7 pin for drive left motor and left motor connected to 3,6 pin. Microcontroller 4,5 pin connected to 10,15 motor driving pin for drive right motor and right motor connected to 11,14 pin. microcontroller pin 10,11 connected to motor driver pin, driver 1 and 9 pin for speed control of left motor and right motor. Microcontroller pin 9 connected to Buzzer and pin 6 connected to NPN transistor for switching the fan. For gas sensor (MQ-2) below code used to find out the quantity of leakage gas. If the quantity of gas above 200ppm the gas sensor send a signal to the microcontroller for sending information to the owner and fire service via GSM. It also sends another signal by LED9 (microcontroller pin9) to the buzzer.

If the analog value of smoke or gas sensor is $\text{smoke} > 200$ value. then gas sensor send signal to microcontroller, when the microcontroller led9 pin is high. Buzzer will be ON. and led9 pin is low, Buzzer will be OFF.

The flame sensor is very sensitive to IR wavelength at 760 nm -1100nm light. It will be create the analog signal to get the fire. Analog value is 10 bit (210bit = 1024 value) for the flame sensor. If the analog value of flame sensor is $\text{flame} > 1000$ to $\text{flame} < 2000$ robot consider that the flame out of the range. If the value is $\text{flame} < 1000$ to $\text{flame} > 100$ then flame sensor send signal to microcontroller and go ahead to flame. At the same time Microcontroller give information to GSM for sending sms to the owner and fire service. If the value is $\text{flame} < 200$ to $\text{flame} > 0$ then flame sensor send signal to microcontroller. Stand certain distance from the flame and fan will be running. extinguish fire, after extinguishing robot go to stand by condition.

Again when the analog value of flame sensor is $\text{flame} > 1000$ to $\text{flame} < 2000$ robot consider that the flame out of the range. If the value is $\text{flame} < 1000$ to $\text{flame} > 100$ then flame sensor send signal to microcontroller. For Ultrasonic sensor (HC-SR04) below code used to find out the obstacle detects. A short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. This sensor only will be detect the obstacle and robot move in front of obstacle and go ahead to flame.

If the analog value of ultrasonic sensor is $\text{distance} < 20$ value. then robot will be move on the side of the obstacle and go ahead the fire.

A. Flow Chart

When robot is first booted, it initialized all the sensors and at the same time, it goes to standby mode where only gas-flame-ultrasonic sensors, Arduino and GSM module will be running. Once all the components start, the whole system checks for the gas. When buzzer alarms for the presence of gas, microcontroller transmits information to GSM module to send SMS to the owner or fire service team. And finally it goes back to standby mode.

But when it does not sense any gas, it looks for flame. If fire or flame is detected, then same working principle is followed by microcontroller to connect GSM module and the system automatically goes in front of the fire.

So what happens when it senses any obstacle while moving towards fire ? Ultrasonic sensor detects the obstacle and instructs the system to move to other available direction to reach towards fire. Then it positions itself at the certain distance from the fire and fan starts rotating. Finally fire extinguisher becomes active and after extinguishing, the system again goes to standby condition. And it is never ending process and keeps on working similarly.

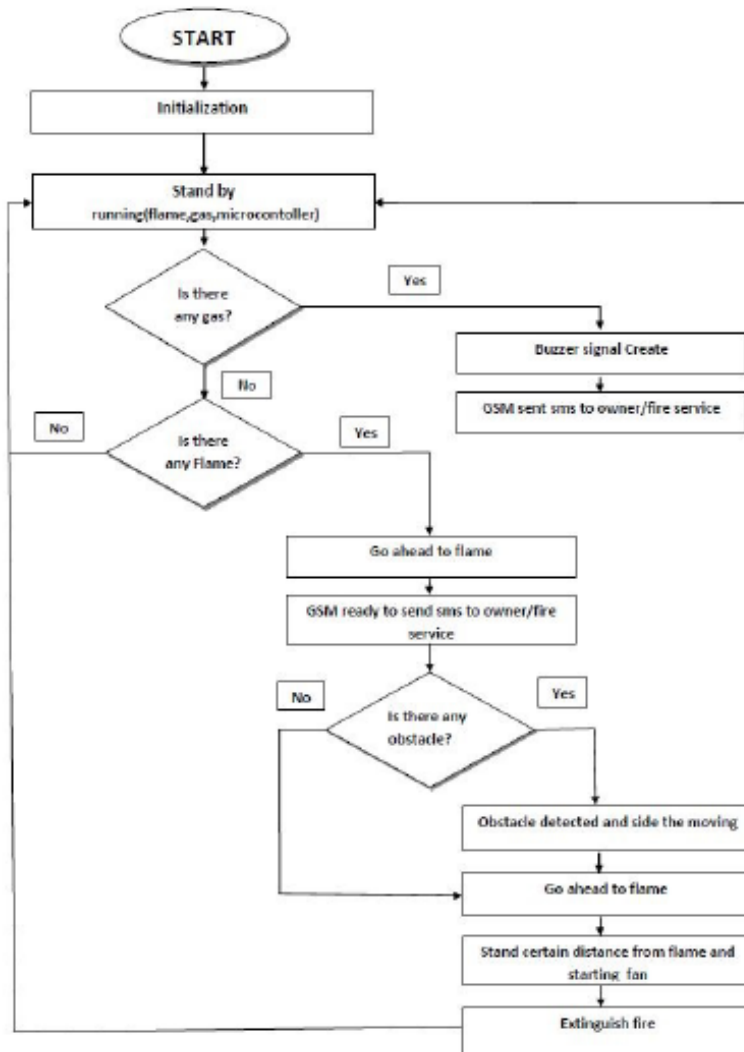


Fig 3 : Flow Chart

IV. FUTURE WORK

In this paper full emergency fire response systems are explained with the help of GSM module and various sensors. There is an ample requirement of implementation of automatic fire detecting system to protect lives and assets from fire hazards. Use of IoT technology which is real-time control via the Internet or wireless network will extend the monitoring and control of fire safety systems outside of the building as well as status of the fire safety system and other building systems can be monitored at any time and from anywhere. The fire safety systems located in many areas can also be controlled from one central facility office. This will increase the efficiency and reduce costs for building management operations, more efficiently classify between fire and non-fire threats and increase the time available for property and life protection. However, Internet based monitoring and control of building service systems will need security protection to prevent false fire information being provided to building owners and fire brigades.



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V. CONCLUSION

The designed fire alarm system presented a unique vision and it has wide area of application in household and industrial safety, especially in developing countries like Bangladesh where internet is a major issue. This is a cost effective fire alarm system which performs reliably to ensure safety from fire, and can be installed in houses, industries, offices, warehouses etc. very easily. This paper has presented a very simple concepts which are used in this particular field. It aims to achieve a reliable and efficient result with the technological innovation. The outcome shows that higher efficiency is indeed achieved using the re-modelled embedded system. With a common digital platform, it will enable the increased flexibility in control, operation, and expansion; allow for machine intelligence, and eventually benefit the clients with improved and prompt services, reliability and increased convenience. The day is not far when this technology will push its way into your house hold, making you more lethargic, but certainly for positive way. Since this initial work cannot address everything within the proposed framework and vision, more research and development efforts are needed to fully implement the proposed framework through a joint effort of various entities.

REFERENCES

- [1] J. San-Miguel-Ayanz and N. Ravail, "Active fire detection for fire emergency management: Potential and limitations for the operational use of remote sensing, Natural Hazards", vol. 35, no. 3, pp. 361-376, 2005.
- [2] Z. Liu and A. K. Kim, "Review of recent developments in fire detection technologies," Journal of Fire Protection Engineering, vol. 13, no. 2, pp. 129-151, 2003.
- [3] A. Somov, D. Spirjakin, M. Ivanov, I. Khromushin, R. Passerone, A. Baranov, and A. Savkin, "Combustible gases and early fire detection: an autonomous system for wireless sensor networks," in Proceedings of the 1st International Conference on Energy-Efficient Computing and Networking. ACM, 2010, pp. 85-93
- [4] C. Elmas, Ö. Ustun, and H. H. Sayan, "A neuro-fuzzy controller for speed control of a permanent magnet synchronous motor drive, Expert Systems with Applications", vol. 34, no. 1, pp. 657-664, 2008.
- [5] K. Devi, R. Singh, S. Gautam, and D. Nagaria, "Speed control of induction motor using fuzzy logic approach," 2015.
- [6] X. Le, "Fire Detection Robot using Type-2 Fuzzy Logic Sensor Fusion", 2015.
- [7] Arduino Uno SMD, <http://mohanrajkm.blogspot.com/2016/12/arduino-india-arduino-india-arduino-uno.html>
- [8] Arduino Uno R3 kjdElectronics, <https://kjdelectronics.com/ArduinoUnoR3>
- [9] ELECTRON+ICs, <https://www.facebook.com/Lankepillewar/posts/792009084275565>
- [10] Arduino - ArduinoBoardUno, <https://www.arduino.cc/en/Main/ArduinoBoardUno>
- [11] Arduino Uno | MouserIndia, <http://www.mouser.com/new/arduino/arduino-uno/>
- [12] Arduino - ArduinoBoardUnoSMD, <https://www.arduino.cc/en/Main/ArduinoBoardUnoSMD>
- [13] ATmega328 Datasheet-Gravitech, <http://site.gravitech.us/Arduino/NANO30/ATMEGA328datasheet.pdf>
- [14] SIM900 GPRS/GSM Shield - LinkSprite Playground, 8. [http://linksprite.com/wiki/index.php5?title=SIM900GPRS=](http://linksprite.com/wiki/index.php5?title=SIM900GPRS)
- [15] GSM - Architecture, Features Working - ElProCus, <https://www.elprocus.com/gsm-architecture-features-working/>
- [16] Simple Telecommunication: GSM Principles, <http://simcom07.blogspot.com/p/gsm-principles.html>
- [17] How the GSM system works?. - Electronic Circuits and ... - CircuitsToday, <http://www.circuitstoday.com/how-the-gsm-system-work>
- [18] Flame detection - Wikiwand, <http://www.wikiwand.com/en/Flamedetection>
- [19] Flame Sensor Module - Future Electronics Egypt, [http://www.futelectronics.com/wp-content/plugins/fedownloads=Uploads=Flame sensor arduino:pdf](http://www.futelectronics.com/wp-content/plugins/fedownloads=Uploads=Flame%20sensor%20module.pdf)