

# Fire Accident Detection and Prevention monitoring System using Wireless Sensor Network enabled Android Application

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## Abstract

**Objective:** This paper gives an overview of existing fire-detector types which can be comprehended to one hundred percent completion combined with the progress connected with economical, portable, reliable microcontroller dependent programmed open flame alert system as slightly careful almost a little flames happenings in residence as well as professional areas. **Methods/Statistical Analysis:** The purpose of our developed system is alerting the far off property-proprietor accurately also rapidly through sending Short Message (SMS) by means of GSM network and transmitter values to the Central server using GPRS. **Findings:** Any linear integrated temperature sensor detects temperatures farther than the predetermined benchmark, although semiconductor sort sensor recognizes the existence of smoke or even gasoline coming from fireplace risks. On successful detection of fire, the device transmits the data to the central server with GPS co-ordinates which helps us out to locate the exact location using the maps application in android mobile, based on the link received through the SMS. **Application/Improvements:** The detectors are placed parallel to each other in required amounts. Indication read through every single detector from any kind of levels can be monitored and controlled using monitoring method.

**Keywords:** Arduino, Flame Sensor, GSM/GPRS, Smoke Sensor, Temperature Sensor

## 1. Introduction

With the advancements in the day to day life, fire-safety has become one of the primary problems. Fire hazards are fatally dangerous and denigrating regarding business and home security, furthermore devastating regarding human life. The obvious way to minimize the kind of loss is to respond to these emergency situations as quickly as possible. Thus, at present there is a huge demand and requirement for standalone autonomous flame detection techniques. These kinds of techniques render the operations involving quick recognition, burglar alert warning and sometimes inception involving flame quenching. These particular frameworks, outfitted with

smoke, temperature and pyro-electric detectors can easily identify the troublesome random predicaments, because it is equipped with the aid of a control mechanism which can instantly warn pertaining to venture thorough steps with ease. In these fatal predicaments, earlier detection effectively combined with quick warning system will probably produce lesser loss regarding property and life. We can observe some sort of flame or smoke alarm system in our neighbourhoods, especially inside the property or even remote places with a faraway spot depending on need. Remote alert framework offers the proprietor of the reason, the principle favourable position of checking faraway district along with catching quick reaction as soon as unexpected crisis message

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is gotten. Distant monitoring methods are made in multiple ways employing WSN, Ethernet, Internet and image processing along with digital communication technology<sup>1-3</sup>. In spite of the fact that the methods usually are dependable and still have many advantages, they are combined with concerns with regards to getting intricate, incompact, non-standalone, pricey and getting obsolete appurtenances. As a result, there is prerequisite to get a method which can possibly be dependable and reactive as well as straightforward, easy implementable and economical. Flame dangers lead to woebegone situations all through the world, particularly from the developing countries in which the flame-safety procedures usually are immature and infrequently substandard. Bangladesh, getting the cynosure connected with professional and household fire incident lately<sup>4,5</sup>, especially in Ready Made Garments area, is within extremely serious or urgent need of legitimate, dependable and very effectively reasonable flame security framework. Despite the fact that a number of superior devices are utilized throughout practical predicaments, a dependable, uncomplicated and implementable along with financially savvy robotic fire-alert program is not easily obtainable in developing countries. Consequently in particular task, overview of the current flame-detectors is conducted, after which, making use of those sensors along with brisk responsive flame/smoke detection equipped with alert system have been planned and applied. The developed system will be efficient in sending alert mail messages through GSM/GPRS<sup>6,7</sup> multilevel along with an alarming siren for the premises.

Fire monitoring systems primarily consists of two types of sensor nodes viz., mobile nodes and static nodes. For covering up the entire network area, the static nodes have to be in large numbers and as the mobility depends on the network and the nodes present, mobile numbers can be in moderate numbers. These mobile sensor nodes after the proper initialization will form Clusters and one of the nodes from each cluster is selected as Cluster Heads for information exchange, forming the backbone network<sup>8,9</sup>. The algorithm is deployed at the Cluster Heads and necessary routing and data aggregation takes place.

This data from Cluster Heads will be relayed to the base stations where the further processing takes place viz., temperature distribution graph to precisely locate the fire hazards. This base station relays the information to the operating personnel who takes necessary actions based on the information received.

We develop our system based on the location sensitivity information as the fire erupted in the forest<sup>10</sup> is strongly related to the location. The operating personnel need to set up the prerequisites for the distance parameter among the nodes that are deployed to monitor the area. Here, the data from sensors must be integrated and forwarded to the base station in such a way that, only the sensors that are nearby to each other should fuse their data with each other so that the location sensitivity holds. Both location and temperature should be integrated and sent to the base station. Here it should be taken into consideration that the far away nodes should not be integrated with each other as the criteria do not make any rationality.

We divide the entire area into smaller grids of square shapes. We set a threshold value of the temperature at the base station. Whenever the data from the Cluster Heads is received by the base station, it crosschecks the received temperatures with the threshold temperature values. If any of the grids goes beyond the threshold value, then the location is considered to be the location of the fire and the fire alarm warning is sent to the operating personnel in the form of SMS through GSM<sup>11</sup> service. Then the operating personnel over there decide the next course of appropriate action.

## 2. Hardware Design

The structure of the system has been shown in Figure 1.

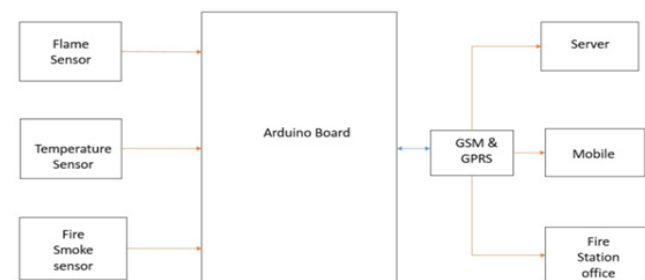


Figure 1. Block diagram of the project.

### 2.1 Arduino

Arduino is an open supply electronic device prototyping platform, dependent on variable electronics as well as applications. This Arduino is usually an easy yet advanced unit which is founded on At-mel's ATmega microcontrollers. The Arduino board software program is usually backed by Windows family of Microsoft, OSX family of Macintosh and also various Linux systems like

Red Hat, Kali etc, though almost all microcontrollers are restricted to Microsoft windows computer. Language programming depends on the high level programming language C and AVR can be appended through C ++ library sets. There exists a few types of microcontroller Arduino board<sup>12</sup> you can find, such as Arduino sets and Arduino guards. Arduino One will be one of the boards made with a microcontroller ATmega328 the Atmel microcontroller, “UNO” in Italian. One board will be the last with a progression of USB, which is the Arduino board to be your own reference model on the Arduino stage. The Arduino Uno has the resonator 16 MHz ceramic, a USB association, power connector, a huge ICSP header and the reset catch, 6 analog inputs and 14-pin digital input/output (of which six to eight can be utilized as PWM output). This benefits your own Atmega16U2 can be transformed and employed as a USB to serial converter rather than the traditional FTDI USB controller chip-to-arrangement in which we consider the greater part of the above tables. Our current board has a flash memory of 32 KB in which 0.5 KB will be taken via boot-loader, only 2 KB connected with SRAM, 1 KB of EEPROM and also 16 MHz clock speed. The Arduino board has been shown in Figure 2.

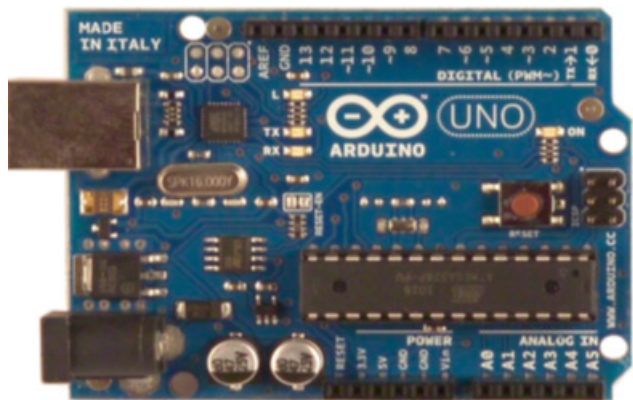


Figure 2. Arduino Board.

## 2.2 Temperature Sensor (LM35)

The LM35 string is a detailed IC temperature sensor, as their result voltage can be directly proportional temperature in Celsius (centigrade). The sensor was shown in Figure 3. Therefore leverage comes LM35 around direct temperature sensors aligned ° Kelvin, as the user seriously isn't needed to take away a continuous voltage through its result to get helpful Centigrade

scaling. The particular LM35, doesn't demand virtually any outer calibration or maybe cutting down on to produce common a precision of  $\pm \frac{1}{4}^{\circ}$  C to room temperature and  $\pm \frac{3}{4}^{\circ}$  C for an aggregate  $-55^{\circ}$  C to  $150^{\circ}$  C temperature range. Economic cost is normally guaranteed by clipping and adjustment in the measure of the wafer. This low output impedance LM35 linear output and exact adjustment without touching help to interface to peruse first as well as management hardware particularly simple. It can be utilized with individual strength products, as well as with negative supplies. Subsequent to just it called 60 mu of its offer, which has low self-warming, under 0.1 C in the stationary environments. The LM35 is appraised to work in a scope of  $-55$  to  $+150^{\circ}$  C temperature, while the LM35C is expected for  $-40$  to  $+110^{\circ}$  C range ( $-10^{\circ}$  with more prominent exactness). The LM35 arrangement is accessible bundled in water/air proof compartments transistor A-46, while the LM35C, LM35CA and LM35D are additionally accessible in the plastic TO-92 bundle transistor. The LM35D is likewise vain-power in a surface mount bundle 8-lead little blueprint plastic bundle and A-220.

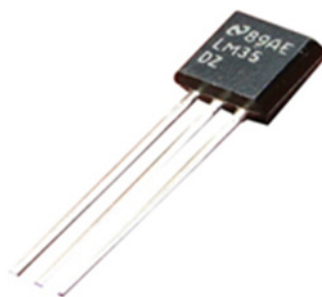


Figure 3. LM35 Temperature sensor.

## 2.3 Smoke Sensor

A smoke locator is a gadget that distinguishes smoke, normally as a possible signal associated with flames. Business oriented safety products emblems a sign to our flame security handle screen included in a new flames home security system, though household alarms, referred to as smoke alerts, typically identifies a local aesthetic security through the detector by itself.

## 2.4 GSM

GSM means Global System for Mobile Communications. This subscription and mobile equipment are by and large isolated in the GSM, as opposed to in simple systems

that point two or three being discharged. This record administration alongside keeping up another endorser smartcard might be SIM (Subscriber Identity Module) card, in spite of the fact that the air-called cellular equipment. In this manner, the mix of the SIM and cellular equipment is the mobile station. SMS is one of the inbuilt services of GSM, which gives a method for transmitting messages of restricted size and from the mobile stations. Dealing with the SMS is performed by the SMSC which is the task to be looked after by the employed GSM network for exchanging messages between the SMSC and the mobile stations.

### 3. Software Employed

To program ATMEGA328P at first we need to burn the boot loader of the new ATMEGA328P utilizing Arduino UNO R3 software programmer. To burn boot loader ATMEGA328P associate with new software programmer. The association is demonstrated as follows. Alert: Ensure developer is not associated with the outer power supply, as they sustain through the USB link associated with your PC and circuits required ATMEGA328P have managed +5 v supply. Then this framework is prepared to blaze the boot loader, to do this action simply open IDE on computer then upload configuration code which consists of two different codes named “optiLoader.h” and “optiLoader.pde”.

GPRS (General Packet Radio Service) is an information carrier administration bundle based remote correspondence benefit that is conveyed as an overlays system for GSM, CDMA and TDMA (ANSI-I36) systems. GPRS first radio packet applies to exchange client information bundles productively between versatile stations and GSM systems outer bundle information. Bundle exchanging is the place the information is partitioned into packets that are transmitted independently and afterward reassembled at the less than desirable end. GPRS underpins Internet pioneer packet based world.

### 4. Results and Discussion

To observe the particular effectiveness along with result on the program for us fire unfriendly circumstances, they completed 10 tests including re-enactment, individual having distinctive smoke gasoline, along with temperature ailments test result recommends that the framework

makes the wanted ready reactions under various states of dependable measure. The test setting tests are appeared in Figure 4. What's more, the reaction of the framework under various circumstances of flame or smog or gas or temperature is appeared in Figure 5 on usage of Android. Amid the checks, the time taken fire discovery mindful to message conveyed by means of the GPRS system by the procedure keeps on being alluded to all through. These point reactions are illustrated in Figure 6. The greatest time taken by the framework to convey the notice message was 10.5 seconds (Test No. 9) and the base time was 7 seconds (Confirmation 1 and 6) roughly. As seen, all things considered, the framework created takes 7 to 10 seconds to convey SMS caution to the fitting power, which is sufficiently quick to do the important measures to stay away from the danger of flame.

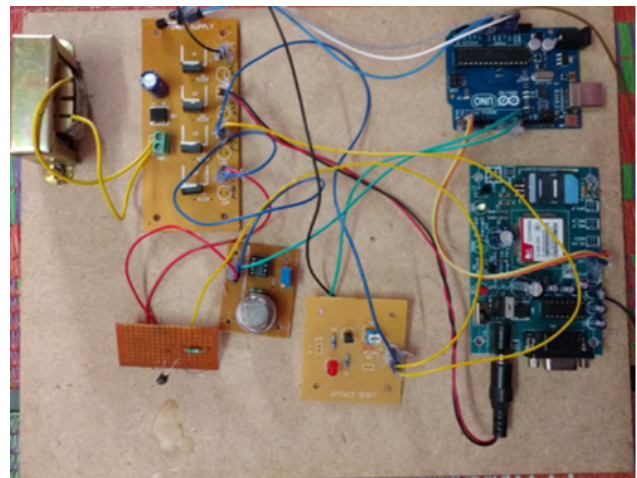


Figure 4. Hardware assembly.



Figure 5. Fire monitoring Android App.

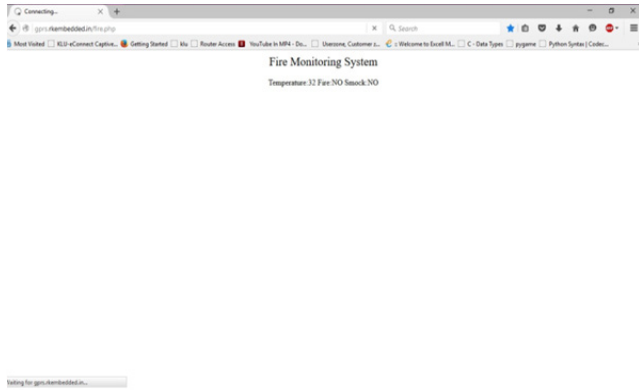


Figure 6. Data over Web Interface.

## 5. Conclusion

The developed fire alarm system is simple but it really offers vast division of App in residence and also manufacturing basic safety, specifically in creating nations around the world. Employing this method, fast and also reputable warnings can be performed for us to trigger preventative methods to avoid risk associated with flame dangers and also reduce losses associated with life and also property. This is the alert framework less expensive fires that performs dependably to guarantee fire wellbeing way and can be introduced in homes, businesses, rehearses, home articles and so forth effectively. This can be utilized to distinguish propane burnable as methane, LPG and so on. In the meantime frameworks planned with scope up to 100 square meters, just using so as to measure area a link of classification 6 cable connection seeing that facts brand. Huge commercial or maybe non-commercial region can be administered throughout the recommended system installing several modules, each of them for one floor or maybe for unit.

## 6. Acknowledgements

We are forever grateful to K. L. University for constant

guidance and support to this project. Inputs and suggestions by Embedded Systems and Sensor Networks ESSN of K. L. University are duly acknowledged.

## 7. References

1. Goswami A, Bezboruah T, Sarma KC. Design of an embedded system for monitoring and controlling temperature and light. *IJEER*. 2009; 1(1): 27–36.
2. YSI Incorporated. Water sampling and monitoring equipment for dissolved oxygen, PH, turbidity, temperature and level. N.p., n.d. Web; 2012 Jul. p. 1–35.
3. Arduino-Home Page. 2012. Available from: <https://www.google.co.in/#q=arduino+home+page>
4. Goswami A, Bezboruah T, Sarma KC. Design of an embedded system for monitoring and controlling temperature and light. *IJEER*. 2009; 1(1);27–36.
5. Martinez-de-dios J, Merino L, Caballero F, Ollero A, Viegas D. Experimental results of automatic fire detection and monitoring with UAVs. *Forest Ecology and Management*. 2006 Nov; 234:1–6.
6. Dhananjeyan S, Mohana Sundaram K, Kalaiyarasi A, Kuppusamy PG. Design and development of blind navigation system using GSM and RFID Technology. *Indian Journal of Science and Technology*. 2016 Jan; 9(2):1–5.
7. Dalip, Kumar V. Effect of environmental parameters on GSM and GPS. *Indian Journal of Science and Technology*. 2014 Aug; 7(8):1183–8.
8. Hao Q, Zhang ZJ. Two centralized energy-efficient deployment algorithms for mobile nodes in a mixed Wireless Sensor Network. *Journal of Computers*. 2014 Jan; 24(4):32–43.
9. Khaleghi B, Khamis A, Karray FO. Multisensor data fusion: A review of the state-of-the-art. *Information Fusion*. 2013 Jan; 14(1):28–44.
10. Jotheeswaran J, Koteeswaran S. Feature selection using random forest method for sentiment analysis. *Indian Journal of Science and Technology*. 2016 Jan; 9(3):1–7.
11. Ezema LS, Ani CI. Multi linear regression model for mobile location estimation in GSM Network. *Indian Journal of Science and Technology*. 2016 Feb; 9(6):1–6.
12. Arduino. 2016. Available from: <https://en.wikipedia.org/wiki/Arduino>