



(RESEARCH ARTICLE)



## A precise GSM and GPS integrated fire alarm system

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### Abstract

This paper presents the idea of a fire-alarm system that is based on Global System for Mobile Communication (GSM) and Global Positioning System (GPS). Keeping in view the importance of real-time notifications for safety related issues, we developed a fire-alarm system assisted by GSM and GPS technology. It is challenging to monitor homes at far off places. However, the availability of modern sensors and wireless technology have played an important role to deal with such issues efficiently. Moreover, recent improvements in the field of information technology have provided cost effective and efficient solutions. In this study, a low-cost smart fire alarm system is designed and implemented using Arduino microcontroller that continuously receives temperature and humidity signals from the sensors. In case of any emergency, the owner receives warning messages by GSM with the exact location of incident traced by GPS. To get accurate and improved results, a variable threshold alert algorithm is used for temperature compensation and accuracy.

**Keywords:** Fire Alarm System; Sensors; Arduino; GSM; GPS

### 1. Introduction

With the advancement in technology, the wireless networks and devices are becoming popular and are being deployed at large scale. These technologies are also gaining attention because of their low power consumption and pervasive monitoring. Mainly sensor networks collect data in a raw form and send them to the decision support systems for an action. Sensor networks have made strong roots in many application areas like military, object tracking, security, monitoring, disaster management and smart environments etc. [1].

Safety & security of living or operating-place is one of the foremost primary issues. The increasing risk of fireside accidents and their various natures have made it crucial to reinforce safety even after deployment of the recent technology. Today's complicated security systems are pricey and plenty of those may fail to trigger a real-time alarm in cases of intrusions or fire incidents. Therefore, a cheap and fast-reactive security system is required [2].

Normally, the remote viewing of a house requires a workstation or a PC that is moderately big in size and inconvenient to hold around throughout the day. The alternative use of smart portable devices also requires to convey them frequently and monitor manually. WSN (Wireless Sensor Network) and GSM innovation conjointly has the benefit of wide coverage that guarantees remote viewing and speedy systems [3-4]. To make a fire alarm system more intelligent, SMS through GSM module is adopted for alarming fire event remotely in which the client can get the notice alert at any moment [5]. Such system instigates the caution message from the security framework when the client is out of its premises. There are bit cheaper and secure systems with a stunning feature of control through android applications but eventually clients would need some training for using these systems and applications [3].

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In [6], the anticipated system structure comprises of numerous detecting component composed in an HDG204 Wireless LAN 802.11b/g. One of the hubs has HDG204 coordinator, and the others were end gadgets like DHT11 temperature and humidity sensor etc. Arduino Wi-Fi shield changes an Arduino circuit to append to the net by the WIFI remote applications. By using this system, the user becomes able to track their safety at the site of installed router that connects mobile phones and devices.

In [7], the developed system is claimed to be an intelligent and low-cost security system. It uses thermal heat and proximity sensors. User's mobile receives alert messages when Arduino triggers fire alarm. They used Sensor LM35 to trace a temperature change. To detect all types of intrusions, low-power passive infrared and proximity sensor are used. AI is used to generate house-map based patterns that can increase safety & security levels. In [8], the framework is made out of sensors, MSP430F149 as main control chip, and TC35I as GSM module. Their results claim that this design is reliable and convenient to use. Another system's equipment works with sensors, Atmega644p, sim548c (GSM module), Buzzer, and microcontroller [9]. The yields of the considerable number of sensors are associated with ADC. Temperature is ceaselessly checked, if it is high, an SMS is sent to the owner of house.

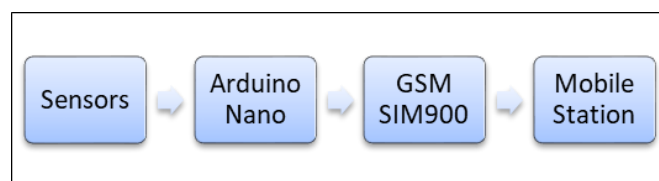
All these methods and systems use different sensors, micro-controllers, algorithms and protocols to make a smart surveillance system. There is some extra consideration that we take to intimate the exact location of emergency in a home or office. We try to improve fire alarm system in its efficiency, accuracy and reliability and make it capable of using GPS to locate the exact fire site. The planned framework has the feature of convenience and it tries to best utilize the available sensors and technology.

Section II of this paper provides an overview and description of the proposed system. Results are available in section III and finally, section IV concludes this paper.

## 2. Material and methods

### 2.1. Proposed Design of System

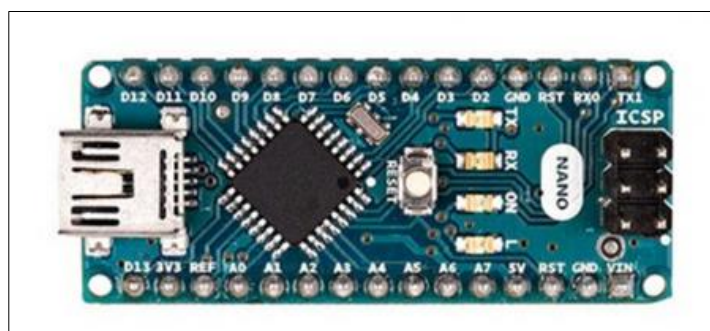
Fig. 1 provides abstract view of the system flow. Sensors are used to get data and further they are attached to micro-controller. Data is sent to MCU continuously. A GSM module is also attached with micro-controller. A threshold is set in the MCU, if the data sent reaches beyond the limit of threshold, GSM module sends a warning message to the owner.



**Figure 1** System Flow

#### 2.1.1. Arduino-nano

The micro-controller used is Arduino Nano that is a breadboard-friendly complete and small board (Fig. 2). It is based on ATmega328 that has almost same functionality as of Duemilanove. There is no DC power jack and it is able to work with a Mini-B USB cable [10].



**Figure 2** Arduino Nano

### 2.1.2. GSM module

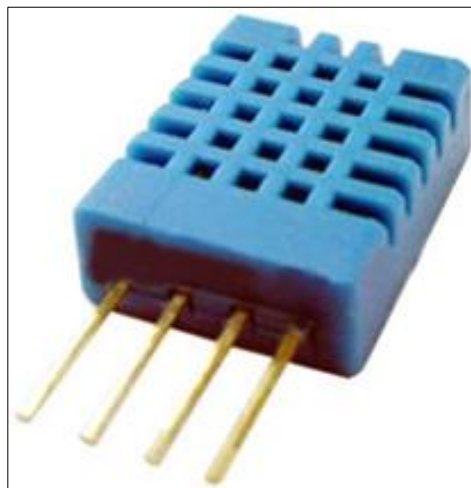
GSM serves as a worldwide standard for cell phones. With the help of Arduino GSM shield, the Arduino board can connect to internet. It can send/receive SMS and can make calls using GSM library [11]. SIM900 provides a complete solution of Quad-band GSM/GPRS packed in an SMT module. It can be embedded in customer applications.



**Figure 3** SIM900

### 2.1.3. DHT11

DHT11 as a temperature and humidity sensor has a dedicated NTC for measuring temperature [12]. To provide sensor values as output, it uses an 8-bit microcontroller. Its technology ensures the high responsibility and long stability. The sensor has quick response and possess anti-interference ability.



**Figure 4** DHT11

### 2.1.4. NEO-6M

The navigation system GPS (Global Positioning System) is active in all weather conditions and it works 24 hours, everywhere in the world without any cost charged. The module NEO-6M (Fig. 5) has an external antenna that has ability to track 22 satellites.



**Figure 5** NEO-6M

Arduino as a central system controller communicates with all alternative devices through a serial communication. It needs power that may be provided from a power supply through an adapter. After proceeding with connections between Arduino and GSM for transmission of messages to take place in best manner, DHT11 is plugged to find the amount of temperature and humidity within the encompassing space. Required libraries belonging to DHT-11 are loaded and code is designed to generate warning messages in case of temperature exceeding a limited value. NEO-6M GPS chip helps to track the exact location that is embedded with the message sent to the client. The system waits for the client to perform a responding action within 15 minutes after that the same procedure is completed incessantly till the required action has been taken.

### 3. Results and discussion

After the design of overall system, it is activated and tested for different scenarios. The temperature around the Fire Alarm System is raised beyond the threshold value and response time is noted in different experiments. Multiple instances of GPS system are tested around a house. The output received may be quickly tested by using simple Google location maps. After going through all setup of experiments, it is observed that the developed GSM based security framework gives sensible reaction to the detecting component and sends SMS once it distinguishes the temperature is getting over the expected level. The time taken by the framework to convey the SMS depends on the scope space or change of the required portable system. The SMS conveyed by the framework takes an average time in worst case as 25-30 seconds. The overall design is accurate, efficient and cheap. Moreover, it is economically favorable, as step by step the cost of SMS is diminishing. At the same time the system has also some disadvantages which still needs to be addressed. If we meet these demerits, we can make it more efficient.

- Everywhere throughout the globe, there may be areas without access of signals, hence no network of cell phones in that space. In this case, SMS can't be conveyed.
- More seasoned people still don't appear to know about the usage of portable and acknowledge it.

### 4. Conclusion

In this study, security measures of a home are considered and an intelligent fire alarm system is proposed. The system uses different programmable sensors with accuracy and reliability. It is a GSM based security system and tested with the help of mobile networks. In case of any fire incident, a message is sent to the user with the information of exact location of fire. The idea of making an efficient, reliable and convenient fire alarm system is presented that provides alerts with the location of fire incident through SMS.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

The authors declare no conflict of interest.

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