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## Effective Fire Alarm System with Real Time Multi Sensor Data Fusion.

Muthukumar Santhanam<sup>\*</sup>, and Veeramuthu Venkatesh.

School of Computing, SASTRA University, Thanjavur, Tamil Nadu, India.

### ABSTRACT

Research in the area of early fire-detection demands inclusion of multiple sensors for accurate real-time decisions. This paper implements an effective fire detection alarm system based on Dempster-Shafer evidence theory principles. In reality, the phenomenon of the fire incident may have smoke, flame, and high temperature situations. However, these signals may happen simultaneously or sequentially. The proposed fire alarm system reduces uncertainty and extracts accurate results for more reliable decisions. In DST algorithm a belief function and plausibility function enhances the fusion algorithm and the simulation is done to compare with results obtained at different levels of fire. In proposed system SIM900 Global System for Mobile Communication (GSM) module and android app are used to send fire alerts to owners in real-time.

**Keywords:** GSM, multi-sensor, algorithm, android app.

*\*Corresponding author*



## INTRODUCTION

In designing practice, the framework structures, control questions and working conditions in diverse frameworks are mutative, there are numerous vulnerabilities. We trust that fire detection [1-3] framework can adapt to instability issues and has capacities of versatile and learning toward one self. Multi-sensor data fusions [4-6], neural network, image processing technology and fuzzy logic decision have been utilized for flame caution framework. Flame caution framework is an imperative method for flame anticipation, its capacity is to test the sign from flame scene handle and figure out if the fire happened. At present, the principle research ranges are keen flame caution framework taking into account multi-sensor. The capacity to focus a flame when it happens is discriminating, however there will be need to tell the inhabitants or manager of a building when a fire happens. A large portion of the current flame detection frameworks consequently incite a discernable alarm through a siren or a strobe light on the recognition of flame. Others however oblige manual incitation of the fire caution utilizing a catch or a break glass station. Remote monitoring [7, 8] and alerts have been carried out customarily utilizing the Public Switched Telephone Network (PSTN). In any case, GSM has been embraced because of its protected and dependable nature. Numerous frameworks likewise give an administration interface to dealing with these gadgets. Oxygen, high temperature and fuel are essential components that cause fire. The extent of each of these components decides the way of the flame. Uncontrolled fires have driven to major fire flare-ups driving to monstrous loss of lives and property. The fundamental purpose behind this is because of the absence of an early identification and notice framework. With progression in innovation, diverse methodologies have been produced to explain the flame threat. Up to this point, fire identification has been constrained to sensing just smoke. With advances in innovation it has gotten to be more obvious that the utilization of various sensors in flame identifiers fundamentally lessens false alerts and expands the effectiveness of the discovery framework. The utilization of multi-sensor methodology acquaints the need with total and translate information from the different sensors. This has prompted the reception of probabilistic systems and a few counterfeit consciousness methods in creating blaze discovery calculations. The initial few minutes of a flame episode are extremely key. The capacity to quench a little fire and keep it from spreading and bringing on catastrophe is significantly improved by ahead of schedule identification and notice. Fire episodes can incredibly be kept away from with the utilization of keen early cautioning and notices framework. As of late some blaze identification frameworks have consolidated remote notice ability which permits fire cautions to be sent remotely to concerned gatherings. In GSM-based framework, utilizing preset edge values for smoke and gas sensors to trigger cautions when these edges qualities are surpassed. All the current frameworks explored concentrated on multi-sensor fire recognition and notice, they however vary in their methodologies in usage. While remote warning of flame episodes may not be the center of some of these frameworks, a far reaching remote notice framework is vital. An online notice framework is proposed in view of the need to make the remote warning interface open regardless of the client's stage. These subsystems interface to give ongoing alarms of flame episodes to the fire and salvage group and any concerned gathering. The proposed framework likewise diminishes the dormancy accordingly time by giving a SMS alarm and android application notice to the fire and salvage group to effectively spot the scene of a fire episode. In this paper, the outline and execution of a GSM with an android application for a multi-sensor fire location and warning framework will be plot. The equipment configuration of the flame recognition gadget has been executed utilizing Dempster-Shafer [9, 10] proof hypothesis (DST) on a LPC2148 [11, 12] microcontroller stage is portrayed in this paper. The flame identification gadget equipment forms information from four separate sensors (Fire, Humidity, Temperature, Gas) utilizing a DST calculation and sends cautions through GSM when a blaze is recognized. The android application built flame notice stage with respect to the next hand permits remote observing of flame recognition from a main issue.

### System Design

The framework configuration takes after the iterative and incremental methodology. By receiving this methodology in framework outline and improvement, the obliged subsystem changes were made accessible right on time in the configuration prepare hence keeping the requirement for immoderate changes later in the advancement process. This methodology likewise helped in enhancing the framework outline. The equipment segment of the fire recognition framework is associated with the android application based fire notice framework by means of GSM system utilizing SMS. The framework is comprised of two fundamental subsystems. They are: (1) The blaze identification subsystem and (2) GSM and android based warning subsystem.

The gadget comprises of a fire sensor suite, a microcontroller (LPC2148) and a GSM module. These two subsystems are interconnected utilizing the GSM framework through SMS. Information from the sensors is transformed by the microcontroller utilizing the Dempster-Shafer proof hypothesis calculation. On identifying a fire, a SMS ready is sent from the GSM module to the android application. Correspondence between these subsystems is encouraged by the SMS peculiarity of the GSM innovation. Blaze cautions sent from the gadget through SMS on the identification of flame is directed to the android application through the SMS entryway. An essential piece of a flame identification framework is its capacity to advise individuals when a fire is distinguished. The warning subsystem performs this capacity by handing-off fire cautions to the fire and salvage administration and the holder of the structure ablaze progressively.

**System Requirements and Specifications**

The necessity social affair procedure included leading meetings with potential clients and specialists. Some of the utilitarian necessities created are: (i) the microcontroller subsystem must consistently screen the state of every sensor, (ii) it must send SMS alarms on recognizing a blaze and (iii) the GSM module must be exchanged on to send a message after a flame has been distinguished. Then again a portion of the non-utilitarian necessities produced are: (i) alarms from the gadget ought to be sent inside five seconds on recognizing a flame and (ii) the framework ought to have regulatory interface for overseeing data of every last one of gadgets. The Fire Notification System will be an android based application utilized for remote checking and administration of the fire identification gadgets. To increment the reaction time of the fire and salvage group and holders of structures on fire, continuous conveyance of blaze cautions was done utilizing SMS. To guarantee productive conveyance of cautions, warnings are executed utilizing visual alarms. For every fire scene, the framework likewise gives data on closest fire hydrants. With constant utilize, a great deal of information gets produced which is crucial in impacting choice making ablaze issues. The framework consequently has a peculiarity to create reports in light of the produced information. Thermistor, a temperature touchy resistor is utilized to quantify the temperature. A negative temperature co-productive is utilized as a part of which the safety quality is diminished when the temperature is expanded. At that point the last voltage is given to ADC for changing over the simple sign to advanced sign. At that point the comparing advanced sign is taken to process in microcontroller. The ADC quality will increment if the temperature increments.

A LPG GAS sensor, a sort of transducer which creates the voltage sign relies on upon the gas level serves to gauge the LPG GAS (propane) level in the air. At that point the voltage sign is given to non-upsetting data terminal of an operational enhancer (LM 741). The balance voltage is given to transforming data terminal. The last ADC changed over voltage is shown on LCD. A comparative usefulness will be with moistness sensor to quantify the dampness level in the air. The fire sensor is utilized to distinguish the fire event. At the point when the sensor identifies the blaze then it got to be short out. At the point when there is no fire the sensor get to be open circuit.

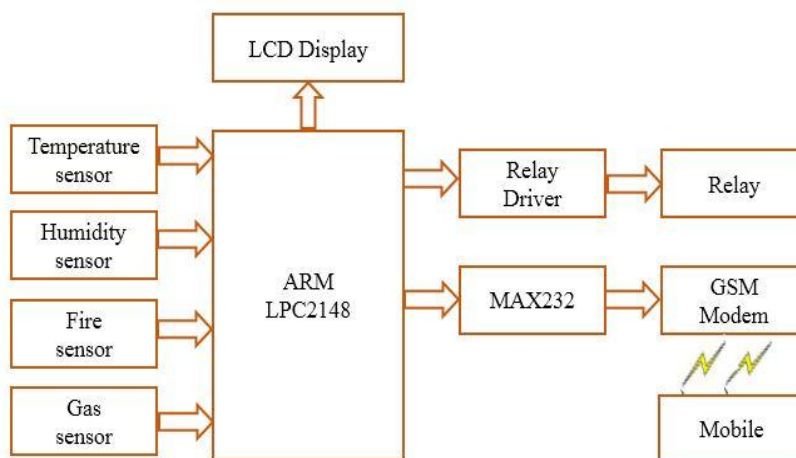


Figure 1: working model of fire detection system

Fig. 1 demonstrates the piece chart for flame caution framework utilizing ongoing Multi-sensor information combination. A LPC 2148 microcontroller improvement board was utilized for the gadget due to its relative simplicity of programming and its suitability for fast prototyping. The location programming for the gadget was modified utilizing Keil  $\mu$ vision4. To guarantee particularity, the framework was partitioned into discovery module (DST calculation) and correspondence module which collaborates with the GSM module locally available. The identification module calls the GSM module when it has effectively recognized the flame. Despite the accessibility of a few suitable means remotely transmitting data, SMS was utilized in view of the broad scope gave by telecom suppliers.

The correspondence module which deals with the conveyance of flame alarms was modified utilizing AT charges as a part of Keil  $\mu$ vision4. The unwavering quality of a flame recognition framework significantly relies on upon the sensors utilized and the capacity of the framework to enact a caution when a fire is identified. The following venture in the wake of identifying a flame is setting off a blaze caution. While the framework was intended to perform this type of flame notice, there is the need to remotely send fire cautions to whoever will be concerned. To demonstrate these alarms, an android based flame notice framework was planned and created.

### System Implementation

Usage includes a LPC2148 microcontroller which encourages multi-sensor interface for embodiment of constant qualities from nature where the blaze location subsystem is sent. The sensors interfaced are fire, temperature, mugginess and gas/smoke and these sensors structure the essential parts of subsystem, through which sensed qualities are bolstered to processor for further transforming. The current framework can't oblige more number of sensors to be interfaced with the framework and not fit to personal client about the causality of flame which helps him to take activities in earlier. The proposed technique in this paper beats the disadvantages by pleasing more number of sensors to take exact choices about the likelihood of flame and its causes, so that the client will be hinted constantly about the circumstance of observing range through GSM system based SMS cautions and android application based visual checking. The GSM system was utilized to encourage handing-off of alarms progressively. On the flare-up of flame, an alert is sent from the gadget to the fire warning framework which is intended to be available at the fire station.

An algorithmic methodology i.e., DST calculation separates from the existed methodologies for right on time fire identification. The fundamental activities of DST calculation are the accompanying:

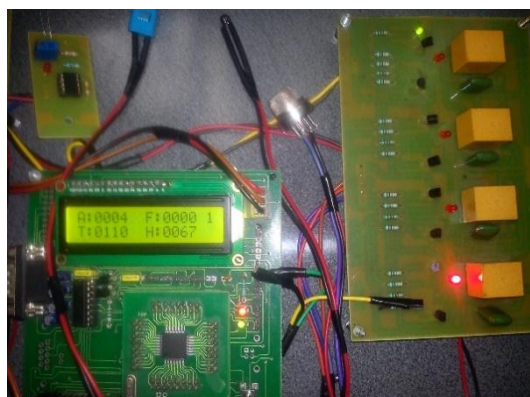
- It collects the sensor values in the directing region.
- It surveys the sensors readings through a combination procedure in light of progress identification and choice calculations.
- It decreases the vulnerability of sensor information combined from particular sensors
- It gives notices on crisis circumstances to the client or to neighboring clients
- It gives obvious or acoustic cautions in the occasion of crisis circumstances (e.g., a siren, a light or SMS)

A DST algorithm includes set of rules that makes accurate decisions to alert the user. The rules include normal condition of fire, initial stage of fire, chance of spread of fire and fire occurred. Only if any of these four conditions were met a notification will be sent to user. In initial stage a notification is sent to user through as an SMS indicating that condition is normal, and in addition it saves the power by notifying whenever it is needed respective actions that have to be taken are shown as prototype model by fixing relays, to which motor can be fixed to sprinkle water, a fire extinguisher to put off fire and anti-flame gas to counter the fire spread.

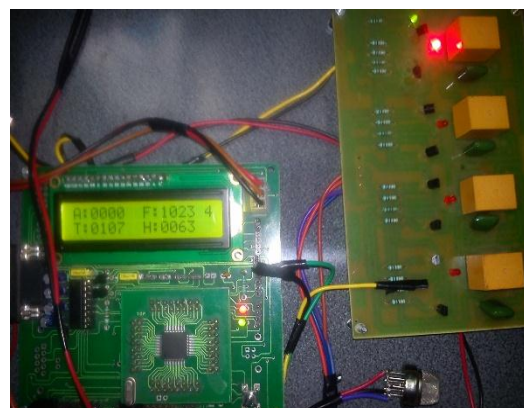
### RESULTS AND DISCUSSION

The figures 2(a) and 2(b) shows normal mode and fire detection mode, 3(a) and (b) are respective android app screen shots. Fig 2(a) demonstrates normal condition where LCD screen shows sensor values i.e., initial state, displayed with a glowing red led connected to respective relay. Fig 2(b) demonstrates Fire detection mode where LCD screen shows varied sensor values according to the state of fire occurred i.e., fire

detection mode. Fig 3(a) is visualization through an android app where it shows a startup screen asking Device number to enter to get message alerts. Fig 3(b) visualizes the received messages for varied conditions with respective sensor values stating the seriousness of Fire occurrence.

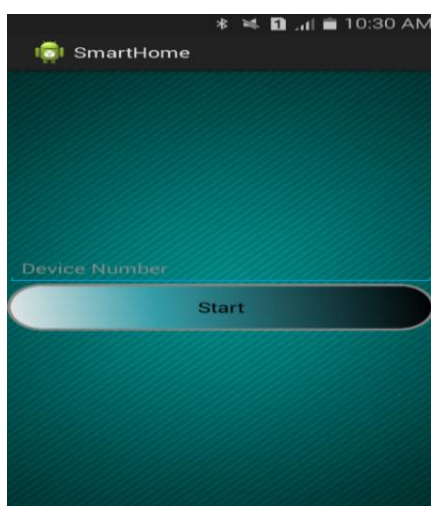


(a) Normal mode

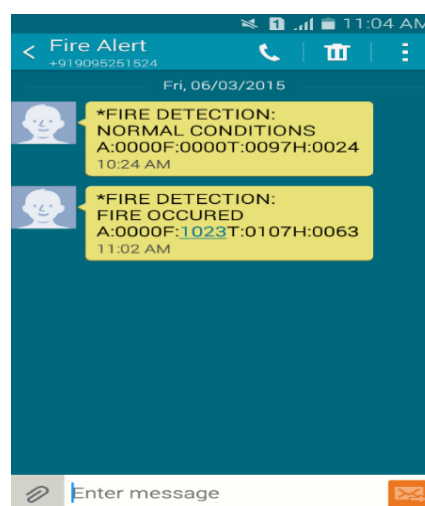


(b) Fire Occurred

Figure 2: Hardware setup of fire detection system



(a) Android app start up



(b) Message

Figure 3: Android app visualization

### CONCLUSION

Deployment of the communication module for multi-sensor fire detection and notification system targets at addressing the frequent fire outbreaks and their attendant emergency response issues. The designed fire alarm system detects fire outbreaks automatically and reports to the fire rescue service and also notifies the owner through SMS. It also supports rescue team and owner with an advanced visualization through an android application. The DST algorithm thus overcomes the drawbacks by decreasing uncertainty by considering belief function. Further modification can be done by implementing a map based GUI which makes rescue team to reach the accident point within no time.

### ACKNOWLEDGEMENT

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