RESEARCH ARTICLE

SAMRIDDHI Volume 15, Issue 1, 2023 Print ISSN: 2229-7111 Online ISSN: 2454-5767

Electronics Management System with Location-based Fire, Flood and Shock Alert on Mobile Device

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Abstract

When a fire takes place where it can't be easily noticed (e.g., underground parking, big industries, malls, warehouses, hospitals, etc.), it takes a lot of time to get the location detected because of which heavy damages occur due to this delay it becomes difficult to put-off the fire by the fire brigade team. The same is the case with damages due to flooding. Hence, if early action is taken, heavy damages can be controlled and human lives can be saved. Our device-electronics management system with fire, flood, and shock alert on the phone can detect fire, flood, and shock up to a certain level and send the alert of Google maps-based location (through SMS) to the concerned authorities so that they can quickly reach the spot without any delays. The device also protects people from getting electric shocks and fluctuations from the main supply. The ultimate objective is to reduce the response time taken by the concerned authorities, which will reduce the intensity of the damage.

Keywords: Fire, Flood, Delay, Location, Lives, Response time, Damages.

SAMRIDDHI : A Journal of Physical Sciences, Engineering and Technology (2023); DOI: 10.18090/samriddhi.v15i01.09

Introduction

The Electronics management system which we have developed is a safety system that can save a person from getting a shock from any electronics/electrical system which sometimes can be life-threatening as well. The next use of the system is to detect fire in an area and send its location to a nearby fire station automatically using GSM and GPS. Imagine it is nighttime and no one is there who can recognize a fire being lit up deep inside a mall, shopping complex, cinema theatre, factory, hospital, etc. There is a lot of delay which takes place in detecting the fire and its location, which in turn may cause a lot of damage to the property as well as if some people get trapped in it, this situation can be life-threatening. Our system can save lives as well as minimize damage by giving early detection alert to the concerned authority. There have been numerous cases wherein there has been a loss of lives and property because of a delay in detecting the fire. Our system will not let this happen. The third use of our system is of detecting flood situation in first floors of offices, malls, houses, hospitals, etc. the system will detect flood up to a certain height and send the information to the concerned authority via GPS and GSM. Take the example of the Chiplun floods in 2021, Chennai floods in 2017 and the Kedarnath flood disasters. Thousands of people lost their lives because of rising water level where they lived and no one knew about their location. If immediately the location of that place would have been known; many lives can be saved. The overall objective of the Electronics Management System is to control the damage and save precious lives.

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How to cite this article: Shahapurkar P, Hanchate P, Waghmare S, Bairagi VK. (2023). Electronics Management System with Location-based Fire, Flood and Shock Alert on Mobile Device. *SAMRIDDHI : A Journal of Physical Sciences, Engineering and Technology,* 15(1), 67-72.

Source of support: Nil

Conflict of interest: None

Methodology

This section discusses in detail the research methodology employed in this study. The employed methodology consists of five distinct steps. Each of these steps are further discussed in subsequent sections.

- Working principle of zero sequences current transformer to detect ground leakage current (Electric-shock detection):

The basic principle of zero-sequence current protection is based on Kirchhoff's current law: the algebraic sum of the complex current flowing into any node in the circuit is equal

to zero. When the lineand electrical equipment are normal, the vector sum of each phasecurrent is equal to zero.

Therefore, the secondary winding of the zero-sequence currenttransformer has no signal output. When the ground fault occurs, thevector sum of each phase current is not zero. The fault current causesmagnetic flux in the ring core of the zero-sequence current transformer and thus we get output.

Voltage Divider Rules to detect mains voltage level.

Voltage Division Rule Formula

The formula for voltage division rule for "n" number of series connected resistance is given below.

$V_{R1} = V [R_1 / (R_1 + R_2 + R_3 + \ldots\ldots + R_n)]$

$V_{R2} = V [R_2 / (R_1 + R_2 + R_3 + \ldots\ldots + R_n)]$

……

$V_{Rn} = V [R_n / (R_1 + R_2 + R_3 + \ldots\ldots + R_n)]$

Carefully observe the above formula. You will notice that, if wewant to find voltage across any one of the resistances (say R_1), the total voltage (V) is multiplied with the ratio of another resistance (R_1) & total resistance

($R_1 + R_2 + R_3 + \ldots\ldots + R_n$)

Fire Detection (Combination of Smoke and TemperatureSensor)

This sensor contains a sensing element, mainly aluminum-oxide-based ceramic, coated with Tin dioxide, enclosed in a stainless-steel mesh. The sensing element has six connecting legs attached to it.Two leads are responsible for heating the sensing element, the other four are used for output signals. Oxygen gets adsorbed on thesurface of the sensing material when it is heated in air at high temperatures. Then donor electrons present in tin oxide are attractedtoward this oxygen, thus preventing the current flow. Whenreducing gases are present, these oxygen atoms react with the reducing gases, thereby decreasing the surface density of the adsorbed oxygen. Now current can flow through the sensor, which generates analog voltage values. These voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high. A combination of Smoke sensors and Temperature sensors can prevent false Firedetection

Literature Survey

[1] Principal of Use of Zero Current Transformer: In the third phase of the four-wire circuit, the phasors of the three-phase currents areequal to zero. That is, when Ia + Ib + Ic = 0 is connected to the current transformer in three phases and four rows, the induced current is zero. When there is an electrical shock or leakage fault in the circuit, the leakage current flows into the loop, then to the current transformer phase of phase three and phase from zero, andthe value: Ia + Ib + Ic = I (current transformer) to the second coil.have a magnetic field, a component of the electronics circuitdetection component, and the device finally compares the pre-determined action values are greater than the current action, even if the critical transfer action operates on the actuator switch.Turned off. The mutual inductor attached here is called the zero-sequence current transformer. The current value of the three-phase range is not equal to zero, and the current output is zero in the current sequence.

[2] Interference GPS module with Arduino: To connect your GPSmodule to Arduino, use the +5V from the Arduino power side and any ground PIN. Any two pins will work for serial communication,but we will use 3 and 4:

1. Connect the Arduino pin 3 to the RX pin of the GPS Module.
2. Connect the Arduino pin 4 to the TX pin of the GPS Module.

Reading raw data on GPS is a very small matter: simply create a new serial connection using SoftwareSerial and align it with yourstandard baud module for GPS. For many, it should be 9600 bauds.

[3] MQ-2- smoke sensor: If the smoke level is above 1000 ppm, the circuit opens the audio can be adjusted as needed. This project uses the MQ-2 and Arduino sensors to detect and detect different smoke concentrations.

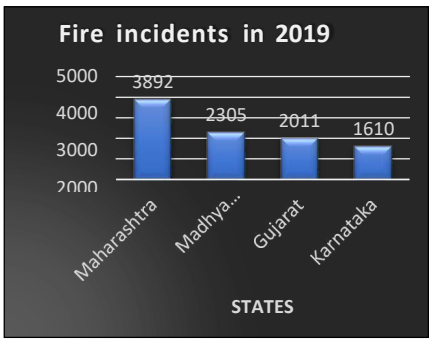
The sensor voltage varies equally with the measured smoke/gas in the atmosphere. Relation between voltage and gas:

1. When the gas is concentrated, the output voltage increases.
2. When the gas level is low, the output voltage decreases.

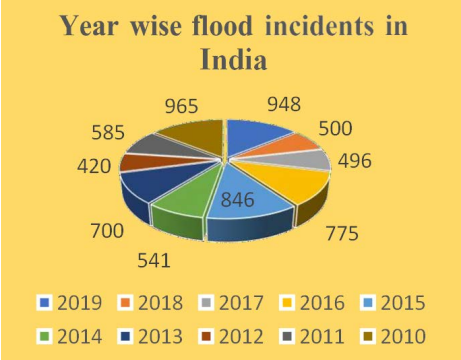
[4] The magnitude of the damage done and the lives lost can be reduced and kept under control if the response time delay for the situation is reduced. Our project does this work in the best possibleway. There is no other product in the industry that can deliver the area immediately in the event of a severe fire/flood. At least 11 coronavirus patients have died after a major fire broke out in the ICU ward of a public hospital in Ahmednagar, Maharashtra on Saturday, officials said.

Ahmednagar Regional Coordinator Rajendra Bhosale confirmed that 11 patients had died and that one patient was critically injuredafter a fire broke out in the ICU section of a public hospital whereCOVID-19 patients were being treated. Shankar Misal, chief of the fire department at Ahmednagar Municipal Corporation, said the blaze broke out around 11 am.

[5] A huge fire broke out on Monday afternoon in Palghar in



Graph 1: Fire incidents in 2019 and number of deaths



Graph 2: Flood incidents in India

Maharashtra at a toy factory and two engines and several firefighters were working, said a firefighter, adding that there were

no reports of injuries. until now. The blaze started around 3.30amand smoke from chemical fumes and flammable fibre was seen from a distance on Palghar-Manor Road, he added. [6] In June 2013, the Kedarnath region experienced one of the worst disasters in its history of widespread destruction. Coincidentally, the tragedy occurred during peak tourist and pilgrimage at Chota Char Dham Yatra. Therefore, increasing the number of victims has a negative impact on immediate rescue and relief efforts. The entire state region was hit by 'heavy' to 'very heavy' rains. Which leads to floods and landslides in a wide area.

[7] How the SIM card works: SIM card technology is one of the most popular technologies used in mobile phones to activate communication and c to connect to the server system and to be used in various electrical and electronic projects. Subscriber Identity Module containing the integrated circuit for International

Mobile Subscriber Identity or IMSI as well as the keys to identifyand verify subscribers to the system. The SIM is embedded in a smart card that can be transferred to different phones. SIM card provides security system for users. The first SIM card was made in1991 by Giesecke and the Deviant of Sagem communications in France.

Information stored on the SIM card includes a unique serial number called ICCID, International Mobile Subscriber Identity orIMSI, Security Verification information, network information, Personal Identity Number or PIN and personal code to open or PUK to open it. The SIM card contains its internal memory storage,personal and financial information, and GSM/CDMA identity. Modern SIM cards allow the storage of application data that is connected to the handset or server using the SIM application kit.

The SIM card saves network-specific information to verify who isregistered on the network. For most keys, the most important keysare ICCID, IMSI, verification key or Ki, Local Area Identificationor LAI, and the operator's emergency number. Micro sim is designed for the latest mobile phones. The SIM also contains otherdata such as Short Message Service or SMSC number, Service Provider Name or SPN, Service Dial

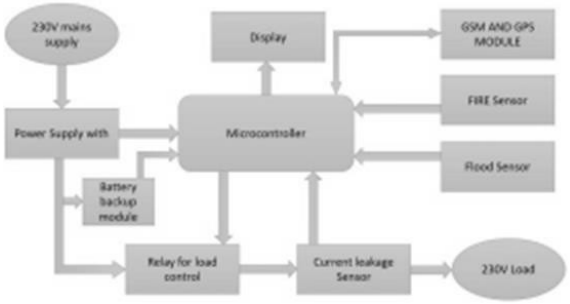


Figure 1: Block diagram

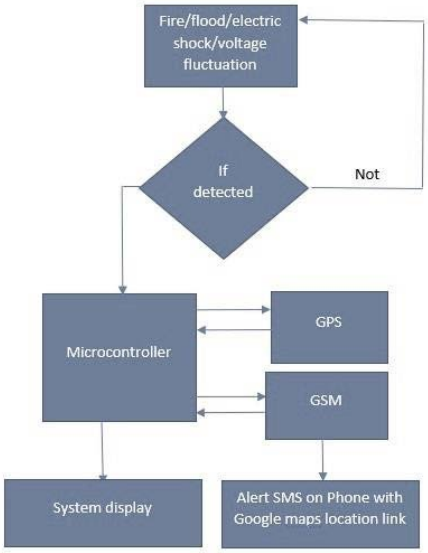


Figure 2: Process flow

Number or SDN, Extra ValueService or VAS, etc. The SIM comes with a variety of datacapabilities ranging from 32KB to 128K and can be limited to 250contacts.

[8] Safety equipment available in the market: The market size ofthe global fire safety equipment market is estimated at USD 43,487.6 million by 2020 and is expected to grow at a combined annual growth rate (CAGR) of 6.6% from 2021 to 2028. Increasing demand for fire safety equipment in industries, such as utilities, automotive, manufacturing, energy and energy, petrochemical, oiland gas exploration, mining, and construction is expected to further market growth. Several developed and developing regions such as Europe, North America, and Asia Pacific have enacted strict laws, which authorize the installation of fire safety equipment in residential, industrial, and commercial areas. These factors drive the need for fire safety equipment. The oil and gas sectors are particularly prone to fire hazards due to the involvementof flammable materials.

In addition, government regulations to protect workers from fire hazards further increase the need for fire protection equipment.

The residential unit is expected to register the highest CAGR at theforecasting time.

Based on the solution, the market is divided by fire

Table 1: Values of smoke readings in terms of ppm

Scenario	*1st trial*	*2nd trial*	*3rd trial*	*Average*	*ppm standard*
Normal surrounding	0.08	0.05	0.05	0.06	0-8
Smoke from flame	210.32	192.46	200.03	200.93	100-300

Table 2: values oftemperature reading in ℃

Scenario	*1st trial*	*2nd trial*	*3rd trial*	*Average*	*Temp. standard*
Ambient room temperature in degree Celsius	29.43	29.36	29.21	29.33	0-100
Temperature during fire in degree Celsius	52.41	64.87	76.29	64.52	0-100
Time in seconds	300	600	900	600	-

suppression and fire detection. Fire detection dominated the market and accounted for more than 60% of global revenue by 2020, resulting in rising government policies, regulations, and directives, as well as the use of advanced diagnostic technology.In addition, a growing number of fire hazards around the world have compelled the need for fire safety equipment.

Previous works

[1] Sensor-based smart fire detection and fire alarm system: This system can detect fire and send the alert with google maps location link in SMS on the phone. Two different sensors are used to detect the fire. first is the smoke sensor and second is the flame sensor. The system also triggers water sprays so that the fire will extinguish.

[2] Design of a home fire detection system using Arduino and SMS gateway: This is a fire safety as well as prevention system which can send alert on phones via SMS. The system first detects temperature and if the temperature is above 45°C, it then detects for any smoke coming out. It can also detect any LPG gas leakage and thusprevents fire.

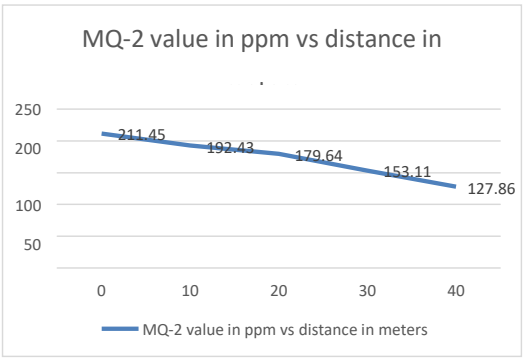
[3] Flood monitoring and alerting system using Arduino in IOT: Flood is a major natural disaster with takes place in almost every part of the world. Hence it is very important to mitigate this situation. This system detects the water level with a sensor and sends the data to a computer via NodeMCU which works on the principle of IOT.

[4] The design and implementation of a wireless flood monitoring system: This system can detect the flood level with the help of an ultrasonic sensor and sends the data to the Arduino microcontroller. This can tell whether the area is safe, cautious ordangerous based on the predefined levels. This can also give alerton phone via GSM or Bluetooth. The water level is shown by different LEDs incorporated within the system.

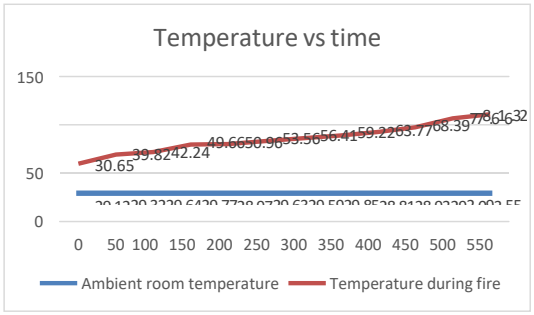
[5] IOT based water flood detection and early warning system: This system detects the water level with the help of a water level sensor, temperature sensor and humidity sensor. All these sensors are connected to the Arduino UNO and when the flood situation occurs and system displays the parameters

Table 3: Values of flood sensor

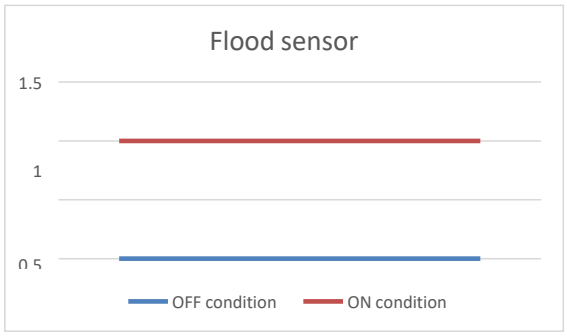
Scenario	*Sensor status*	*Water level height from surface in meters*
Normal condition	OFF	0
Flood condition	ON (activated)	5



Graph 3: MQ-2 value vs distance



Graph 4: Temperature vs time



Graph 5: Flood sensor output

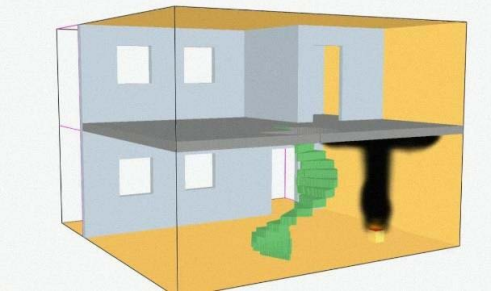


Figure 5: Fire simulation inside a room

Figure 6: Fire simulation inside a room

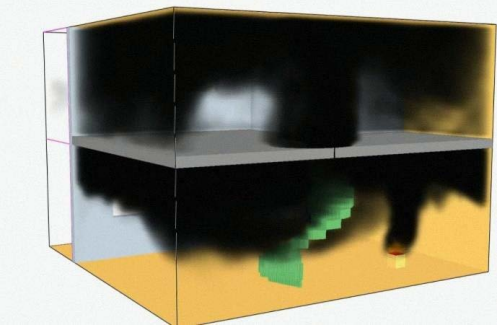


Figure 7: Fire simulation inside a room

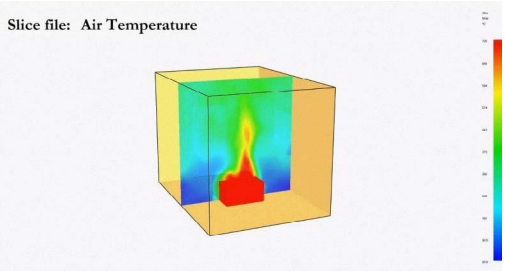


Figure 8: Air temperature during a fire

on a LCD display and simultaneously sends the data to all the people living near the floodsituation via SMS.

Results

Table 1 shows the values of smoke readings in terms of ppm (parts per million). Table 2 shows the values oftemperature reading in degree celsius. Table 3 shows the values of flood sensor. Simulations were performed on fire dynamic

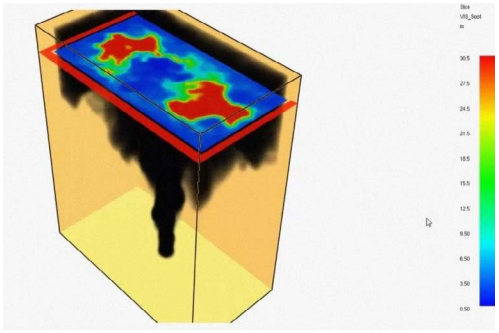


Figure 9: Fire smoke heat map with temperature

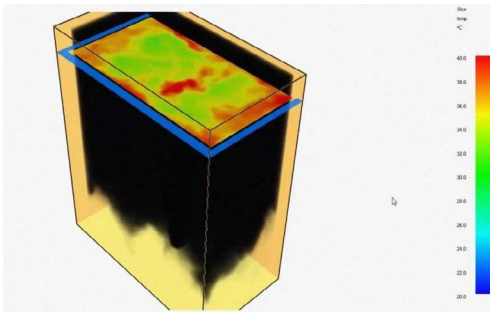


Figure 10: Fire smoke heat map with temperature

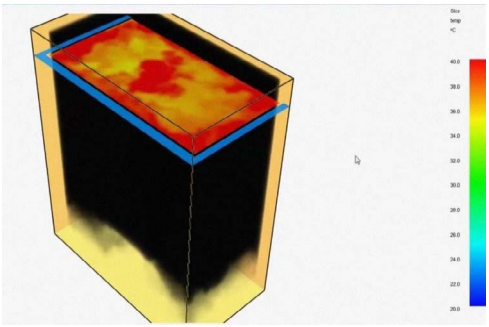
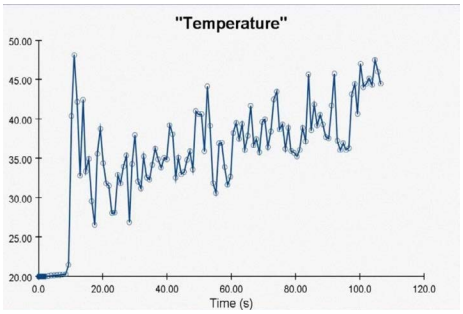


Figure 11: Fire smoke heat map with temperature

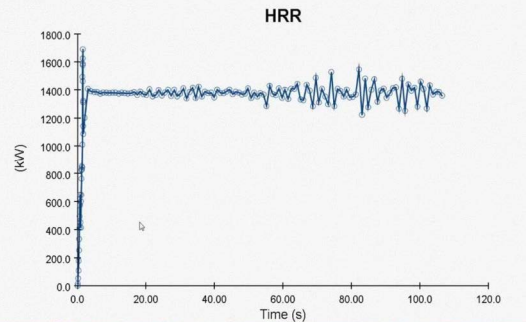


Graph 6: Temperature vs time graph based on the above simulations

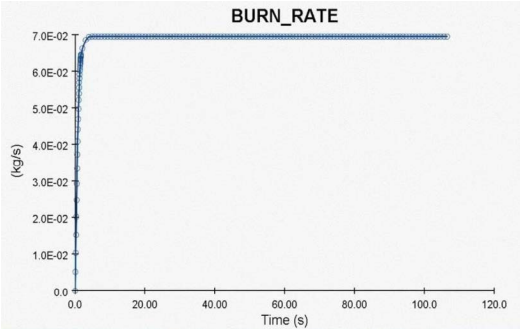
simulator The above simulation (Figures 3-9) shows the amount of smoke which will occur when a fire breaks out in a 2-floor building.

This simulation shows the flame temperature using a heat map.

The above graphs are based on the simulations performed



Graph 7: Heat release Rate (HRR) vs time graph based on the above simulation



Graph 8: Burn Rate vs time

on fire dynamics simulator and ansys analysis software. All the results obtained on the simulation are in sync with the practical values obtained during hardware testing.

Conclusion

- The electronics management system is designed keeping in mind the overall safety of people as well as goods which can get damaged due to fire or flood.
- The system works either on wall socket or battery in case of a power failure.
- It can even save a person from getting an electric shock.
- The simulations performed on Fire Dynamics Simulator matcheswith the results obtained on the real hardware based sensors.

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