Automatic Fire Extinguisher System with Safety Features for Vehicles

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Abstract. This project is aimed to prevent vehicles from fire explosions. In this project we used sensor, pipe valve, Fire extinguisher and Arduino. The sensor and pipe valve are placed in near the areas where there is a possible to catch on fire. The sensor and valve are connected to the Arduino and the valve is also connected to the fire extinguisher. Arduino is powered by separate battery. The working of the project is like whenever the fire is detected by the sensor, it transmits the signal to the Arduino and the Arduino transmit signal to the valve which is placed near to that fire. While doing this process, the Arduino unlock the central lock system of the vehicle and disconnect the battery to prevent the spreading of fire. For that we use separate battery for the Arduino. And also we use wi-fi module which send alert message to the fire station about the fire.

1 Introduction

In today’s world people are using transportation on their own instead of using the buses. The people are using the vehicles like bike, car, van, etc. Today each and every home have vehicle either bike or car or both. Vehicle transportation is increasing its field in all over the world. And the vehicle accident also increasing all over the world. For avoid vehicle accident many other features available all over the world but till accidents occurs continuously [1]. On the accident event lots of life are lost due to the fire spreading, vehicle exploding, etc. For controlling the fire accident, lot of devices are invented and used and it not efficiently work [2]. To reduce the fire accident and save the life of passenger or customer the automatic fire extinguishing system is used. The fire extinguishing system is used to reduce the fire or totally extinguish the fire in the fire accident. The loss of life while attempting to save another person's life is one of the most crucial elements of a fire disaster. Because of explosive materials, smoke, and high temperatures, it is occasionally impossible for firefighter personnel to access the scene of a fire. A prompt response to the fire can help avert several disastrous outcomes. [3] A fire outbreak is a risky conduct with numerous unfavourable consequences. A number of accidents can be avoided with the use of early fire detection and suppression. We have relied on human resources thus far. This frequently results in putting that person's life in danger. Security against fires becomes crucial in order to save lives [4]. This system has a created and suggested fire suppression system that locates the fire and extinguishes it by turning on sprinklers when a pump is activated. This project is aimed to prevent vehicles from fire explosions. In this project we used sensor, pipe valve, Fire extinguisher and Arduino. The sensor and pipe valve are placed in near the areas where there is a possible to catch on fire [5]. The sensor and valve are connected to the Arduino and the valve is also connected to the fire extinguisher. Arduino is powered by separate battery. The working of the project is like whenever the fire is detected by the sensor, it transmits the signal to the Arduino and the Arduino transmit signal to the valve which is placed near to that fire. While doing this process, the Arduino unlock the central lock system of the vehicle and disconnect the battery of the vehicle to prevent the spreading of fire [6]. For that we use separate battery for the Arduino.

2 RELATED WORKS

An intelligent and vision- grounded fire discovery system was created by Bu,F. and Gharajeh,M.S. It uses image processing to more instantly descry the onset of fires. Saeed,F., Paul,A., Rehman,A., Hong,W.H. and Seo,H. developed IOT grounded intelligent modelling of smart home terrain for free forestallment and safety estimate wireless detector network using multiple detectors to descry house fire beforehand [7]. Saeed,F., Paul,A., Karthigaikumar,P., and

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Nayyar, A. developed a convolutional neural network-grounded early fire discovery system that can honor fire using vids and images taken by security cameras [8]. They did this by utilising machine literacy and deep literacy styles. Kodur, V., Kumar, P., and Rafi, M.M. conducted study on fire safety and fire peril in structures with the thing of reviewing current fire protection strategies and demonstrating how they might be used to address current issues with fire accidents in structures [9]. Salhi, L., Silverston, T., Yamazaki, and T. Miyoshi created machine literacy to descry gas leaks and fires in smart homes using a data mining fashion.

3 PROBLEM IDENTIFICATION

The automobile related fires occur majorly due to the electrical system of the vehicle. The vehicle electrical system can maintain a limited amount of the electricity. If more amount of electricity is transmitted, the system will short circuit. This is majorly occur in e-vehicles [10]. The problems which cause fire accidents are explained and shown below.

3.1 Battery overcharge

Overcharging of battery is a one of the causes of fire accident. If battery is overcharging continuously, it may blow up. If it happens it might blow up and cause fire to the circuit in Fig. 1. If the circuit catches fire, then there is a possibility of vehicle caught fire too [11].

Fig. 1. Lithium Battery overcharge

3.2 Short circuit components

In vehicles, the electric components also cause fire accident in vehicle by damage in the circuit components. If any damage occurs in the components or in circuit, it creates sparks in the circuit which leads to fire accident in Fig. 2. The electric components must be checked and safely connected.

Fig. 2. Short circuit of components

3.3 Car Crash

Car crash also one of a cause of fire accident in vehicle in Fig. 3. During accident, 1. Leakage of fuel, 2. Damage of the electric circuit, 3. Damage of the battery may lead to major car fire accident.
3.4 Leakage of fuel

Some fire accident in vehicles due to fuel leakage. It is most common fire accident occurs because of the use of gasoline in vehicle [12]. Gasoline can easily catch fire under 45³ Fahrenheit in Fig.4.

4 FIRE EXTINGUISHING AGENTS

There are many types of gas are used in fire extinguisher to extinguish fire. They are called as fire extinguishing agents. These agents can be in the form of dry chemicals, foam, water types, CO₂ type of gas.

4.1 Dry Chemicals

Sodium bicarbonate is a type of dry chemical which is used in the fire extinguisher. During extinguishing of fire, it releases a carbon dioxide cloud which smothers the fire in Fig.5. Some other dry chemicals are potassium bicarbonate, potassium chloride, etc [13].
4.2 Foams

There are many types of foam agents are used in the fire extinguisher system. One of the foaming agents used in fire extinguisher is AFFF (Aqueous film forming foam) which forms a foam blanket on the surface of the fire to prevent oxygen to enter or mix with fire [14-15]. Because with the help of the oxygen only fire can create or spread. This foaming agent is majorly used in the airport in Fig.6. Other agents like alcohol resistant aqueous film forming foam, film forming fluoroprotein...etc.

4.3 Clean agents

These agents are used to extinguish fire by decrease the atmospheric oxygen which can be done by inert gas or CO₂. Halon, Halotron brx, CO₂ or Inert gas are some of the gases used to extinguish fire. Once these agents release fire will be discharge.

5 PROPOSED SYSTEM

The Fig.7 represents the automatic fire extinguishing system. In this diagram, one separate power supply is connected with the controller to perform the action. Then the three types of sensors which are used to detect flame or temperature
or smoke connected with the micro controller (Arduino). Fire extinguisher connected with the microcontroller. The electronic valve which is used to spray fire extinguishing agents on the fire is connected with both fire extinguisher and microcontroller. Wi-fi module which is used to send message by IOT technology connected with the controller. Central lock system of the vehicle is connected with microcontroller to unlock the vehicle door at the fire events. Buzzer also connected with the controller to notify the customer or passengers about the fire in Fig.7.

Fig. 7. Block diagram of Fire Extinguishing System

6 COMPONENTS USED

6.1 Arduino

Arduino is an open-source hardware which used in company, project for its easy control. It is a type of microcontroller which can operate the system with the help of programming or coding. With the help of Arduino software (IDE) we can able to feed programming to the Arduino in Fig.8.

Fig. 8. Arduino

6.2 Sensors

Sensors are used to sense or detect environmental conditions and send output signal to microcontroller or controller. There are many types of sensors are present based on their purpose. For example: To detect temperature of the environment, temperature sensor is used. In this project, there are three types of sensors are used in Fig.9. They are,
6.3 Wi-fi module

Wi-fi module is a type of controller which is used to send or receive data over wi-fi. Now a days, this type of modules mostly used in IOT technology to store data into cloud or database. Wi-fi modules are used in many technologies for its performance in modern technology. In Fig.10

![Wi-Fi Module](image)

7 WORKING OF FIRE EXTINGUISHING SYSTEM

- When fire present, the sensors which is placed nearest to the fire sense the fire. The temperature sensor detects temperature of the fire and the flame sensor detect fire and the smoke sensor detect smoke which occurs by the fire.
- Then the sensor transmit signal to the Arduino controller which identify the fire and send signal to the pump which connected with the fire extinguisher.
- Based on the fire occurs area the that area pump is turn on and the fire extinguishing gas or agent sprayed through the nozzle which placed near the sensors.
- When fire occurs, a buzzer also ON to notify the passenger about the fire and also, with the aid of IOT technology (Wi-fi module), a warning message is sent to the fire station and the passenger.
- During this process, the Arduino controller which also connected with the battery and the central lock system disconnect the battery to prevent the fire from spread and unlock the vehicle central lock system for passenger escape.
- For the battery disconnect and unlock door the Arduino has another separate battery connect to it. And after 10 to 15 seconds, the alarm off and the sensors again sense for the fire. If the fire occurs, the extinguishing of fire again done until the fire extinguish.

8 RESULT AND DISCUSSION

The result of the project is shown in below diagram. In the Fig.11 model shows the working model of the project which contains all the sensor and Arduino and buzzer. When the flame or smoke detect by the sensor, the buzzer will turn ON by the help of Arduino controller.
In Fig. 12, the LED which is attached to the Arduino shows the temperature, flame, and smoke sensor value or output before a fire event. The Arduino also disconnects the battery and central lock system of the vehicle.

In Fig. 13, the fire detection display is shown. It is displayed in the LED attached with the Arduino controller. Later, we attach the Arduino in the car monitor.

In Fig. 14, an alert message notification is shown when the vehicle catches fire. This is working fine with the help of Wi-fi module attached with the Arduino.
9 Conclusion

This project is developed for the passengers or the customer safe travel. In this project, as soon as the power is applied, it initially initializes itself, meaning that its sensors are initialized. Second, the system detects the environment (such as the temperature level) and locates the fireplace. Third, the system transmits the navigational data and begins to travel itself in the direction of the fireplace. Fourth, using motors and a submersible water pump, the robot eventually begins to put out the fire. Car door automatically open. And the battery of the vehicle gets disconnected by the controller of the system to prevent fire spreading. An alert message is send to the fire station or the passenger or customer relations about the fire accident. For this we use IOT hear to send alert message. By using this fire extinguishing system, we can able to reduce vehicle fire accident in future.

References