

Design & Development of Smart Fire Safety System For e-Vehicles Using IOT

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ABSTRACT

The project concept of An autonomous fire safety mechanism for EVs is an inventive way of considering a less cost-effective design and a more convenient application for e-vehicle safety. Day by day, the number of fatalities in electric vehicles increases. In this project, our main aim is to reduce the number of accidents with electric vehicles by making a smart fire safety system for electric vehicles. With the rapid adoption of electric vehicles (EVs), ensuring their safety, particularly concerning fire hazards, has become paramount. This abstract presents a conceptual framework for a sophisticated fire safety system tailored specifically for EVs. The proposed system integrates advanced technologies such as battery monitoring systems (BMS), temperature and smoke sensors, machine learning algorithms, active fire suppression mechanisms, emergency shutdown features, remote monitoring capabilities, user alerts, and compliance with safety standards. By combining these elements into a cohesive system, EV manufacturers can significantly mitigate the risks associated with fires in electric vehicles, enhancing overall safety for drivers, passengers, and emergency responders. With this technique, the fire extinguisher automatically puts out the fire when it detects flames or smoke coming from the vehicle's fire zones. Numerous factors can cause an electric vehicle to catch fire. The lithium-ion battery is the primary cause of flames in electric vehicles used within them. Installing an autonomous fire extinguishing system with Internet of Things (IoT) technology can reduce potential financial loss from a fire while also raising vehicle and human safety standards. Additionally, as soon as an accident is discovered, the nearby authorities or emergency services are notified, allowing them to get to you sooner.

KEYWORDS:- Accident prevention, emergency alert, controller, fire incident, IOT technology, etc.

1. INTRODUCTION

The number of vehicle fire accidents is rising in tandem with the rise in e-vehicles. We don't have the contemporary technologies necessary to address this issue as a developing nation. Occasionally, the army and police arrive to assist them at the location. However, that is insufficient. The system's goal is to create a controllable car that can be installed in a car and warn the operator in the event of a fire. When things get out of hand, sensors kick in and start spraying water to put out the fire. The user can engage with the produced vehicle to efficiently put out the fire by controlling its movement remotely from a mobile device's screen. The guided vehicle's IOT (Internet of Things) integration enables it to arrange, evaluate, and process data, enabling the user to make the best choices made instantly. This reduces the possibility of fire damage occurring before the extinguishing unit arrives and lowers the risk

associated with the extinguishing team's participation. An automated door-opening system can lower the likelihood of casualties or fatalities in a typical auto-fire accident. On the other hand, firemen are individuals who commit their lives to putting out fires. Thus, the goal of this research is to reduce human intervention to avoid fire accidents.

2. LITERATURE SURVEY

Anij Joseph John,[01] has conducted an experimental study on "Robotic Vehicles with Automatic Fire Extinguishing." This automation is characterized as a mechanical construct that can carry out human functions or behave in a human-like way. Robotics is a skilled craft that involves intricate programming. It involves constructing systems and connecting cables, motors, and sensors, among other crucial parts. A robot that has a tiny fire extinguisher attached to it is called a firefighter robot. By attaching a

miniature fire extinguisher to it, the robot's automation used human control to put out the flames. It is an unavoidable aspect of being a firefighter to put out fires and rescue victims in hazardous situations.

Choton Kanti Das [02] has conducted research on the "Automatic Fire Extinguishing System Based on Fault Secure" design and implementation. Designing and implementing an "Automatic Fire Extinguishing System Based on Fault Secure" involves integrating various components to detect fires reliably, activate extinguishing mechanisms, and ensure system integrity even in the presence of faults. Here's a broad outline of how such a system could be designed and implemented. Employ reliable fire detection sensors such as smoke detectors, heat detectors, or flame detectors. These sensors should be strategically placed in areas prone to fires, such as kitchens, electrical rooms, or near potential ignition sources.

Andrzej Lebkowski [03] has conducted research on the "Electric Vehicle Fire Extinguishing System" through experiments. The fire extinguishing system on display For example, an electric car can notify its driver of a potential fire and take rapid preventive action based on information from its impact, flame, and temperature sensors. Unlike other methods that can only disconnect the battery, the fire system can actively attempt to put out the current fire to react further. An electric car's fire extinguishing system can communicate with various monitoring and diagnostic systems, such as remote electric vehicle diagnostics and emergency services notification.

Rafat Shams [04] An "automated fire extinguishing system with GSM alarm" concept was created. The requirements in this article are standards, problems with the design, and fixes for a project involving a fire suppression system that complies. Fighting fires is a risky and vital job. Quick extinguishment of a fire by a firefighter can limit losses and avoid damage. With the help of several useful technologies, firefighting and machines may now work together. The purpose of this thesis was to develop an efficient system that can identify and put out a fire as quickly as possible using a few key components. To increase the safety of the home, laboratory, office, factory, and other buildings crucial to human life in this situation, the system's goal is to put out the fire before it spreads.

Swetha Sampath [05] carried out a hardware-based "Automatic Fire Extinguisher Robot" investigation. utilizing a thermocouple to measure an oven's temperature of about 300°C. IC 71 was employed as an amplifier and comparator. A DC-AC transformer transforms the increased direct voltage into an alternating current. This method produces alternating voltage, which powers the water pump. Generally speaking, you can put out a fire with water or alternative materials like carbon dioxide and foam. Depending on the strength of the fire, barriers were

avoided and motion sensors were utilized to travel in all directions. To resist extremely high temperatures, calcium silicate plates protect the robot.

3. PROBLEM DEFINITION

The causes of e-vehicle fires generally fall into following categories.

- ❖ Electrical Short Circuit
- ❖ Friction At The Wheel Level
- ❖ Over Charging
- ❖ Thermal Expansion/Explosion Of Battery
- ❖ Engine Component Failures
- ❖ Other Factors

Many of these incidents could have been prevented with an improved maintenance and inspection program. The list of selective EV fire accidents occurred is given below (According to Wikipedia / google).

Location	Date	Cause Analysis	vehicle
Shangai, China	April 2019	A short circuit in the battery resulted from a faulty battery.	Tesla Electric car
Shaowu, China	May 2020	Short circuit	A VM electric Car
Bengaluru (India)	1 Octo 2023	Short circuit	Mahinda E20
Chattisgah (India)	30 Jan 2024	Unknown	Volvo C40

Table.1: EV fire mishaps



Fig.1. Situation with an electric vehicle in flame

4. OBJECTIVES

Intelligent fire safety system utilizing Internet of Things for electric cars (EVs) can be summarized as follows:

- ❖ By proactively identifying and reducing fire dangers, the main goal is to increase the safety of electric vehicles. The system's ability to integrate sensors and IoT technologies allows it to monitor vital data in real time and react quickly to possible fire issues.
- ❖ The central controller, which is linked to all the sensors, triggers the water sprinklers and sirens whenever it detects fire.
- ❖ To identify fire incidents and notify the closest law enforcement, who will get to you more quickly.
- ❖ In the prototype, Department Things speech cloud is used. The system has an IOT module installed, which enables data to be transferred to the cloud and reachable by all authorities.
- ❖ To find an experimental base result.

5. DESIGN AND SPECIFICATION

It is a simple and easy design this model looked like a rectangular box contained two part one part carrying controller and circuits in other side present nozzle, pipe and sensors (in this side we will be perform experiment). Dimension of model: Length \times width = 60cm \times 60cm. Height = 40cm.

6. FIRE SUPPRESSION NOZZLE PLACEMENT

The next stage is to figure out how many discharge nozzles are required and where to put them to get the best coverage once the fire hazards and places that need to be protected have been identified.

- ❖ Control Board where all the electric connection is attached.
- ❖ Top of the Battery Cell.
- ❖ Charging Port of EV Vehicle.

7. COMPONENTS

- ❖ Energy source
- ❖ Power Source (Battery)
- ❖ Battery
- ❖ LCD Display
- ❖ Buzzer
- ❖ Smoke detector
- ❖ Photoelectric detector
- ❖ Arduino Uno Controller
- ❖ DC Pump
- ❖ Nozzle
- ❖ Water storage
- ❖ Board of Development
- ❖ Switchboard Relay
- ❖ IoT (Internet of Things) Device
- ❖ Some other

Arduino Uno Controller: The Arduino Uno is one of the most popular microcontroller boards in the Arduino line-

up. It's widely used by hobbyists, educators, and professionals for a variety of projects due to its simplicity, versatility, and ease of use. The Arduino Uno is based on the ATmega328P microcontroller. This microcontroller is responsible for executing the program uploaded to the Arduino board. Six analog inputs, a 16 MHz quartz crystal, a USB port, a power jack, an ICSP header, a reset button, and 14 digital input/output pins—six of which can be used as PWM outputs—are all on the Uno. It's compatible with a wide range of sensors, actuators, shields (additional boards that can be plugged on top of the Uno to extend its functionality), and other electronic components.

Smoke sensor: Using a smoke sensor with an Arduino Uno can be a crucial component in various projects, especially those related to fire detection and safety systems. There are different types of smoke sensors available, including MQ series sensors like MQ-3, MQ-2, MQ-7, and MQ-135. These sensors detect various gases and smoke particles in the air. For smoke detection, you'd typically use sensors like the MQ-2 or MQ-135, which are sensitive to smoke particles.

Photoelectric sensor: Photoelectric sensors are devices that measure an object's distance from a source of light or determine if an object is present or absent. Numerous applications, including automation, robotics, security systems, and industrial processes, make extensive use of these sensors.

IoT Module: Integrating an Internet of Things (IoT) module with an Arduino Uno can enable your projects to connect to the Internet, allowing you to remotely monitor and control them from anywhere in the world. One popular IoT module for Arduino projects is the ESP8266 or ESP32 series, which provide Wi-Fi connectivity and are compatible with the Arduino IDE.

Liquid Crystal Display: Integrating a Liquid Crystal Display (LCD) with an Arduino Uno is a common and useful project. LCDs allow you to display text, numbers, and even simple graphics, which can be handy for various applications like temperature monitoring, time display, data logging, and user interfaces.

Relay: Using a relay with an Arduino Uno can be a fundamental aspect of many projects, especially those involving high-powered apparatus Like lights, motors, or heaters. Relays act as electrically operated switches that allow you to control a high-power circuit with a low-power signal from the Arduino.

DC Pump: Integrating a DC pump with an Arduino Uno can enable you to control the flow of liquids in various projects, such as automated watering systems, aquarium pumps, or hydroponic setups.

Buzzer: A buzzer is a device that produces a buzzing or buzzing sound, typically to signal something. It's commonly used in various applications, such as alarm systems.

8. WORKING PRINCIPLE

The model's sensors identify a fire when it begins. The fire detector finds the real fire by measuring the outside (Atmospheric) temperature and its operational range. The smoke sensor and photo sensor identify fire smoke. The Arduino CPU receives a signal from the sensors after that, which reads and processes the data that the sensors have transmitted. The microprocessor receives information from the sensors and uses it to control different actuators through the use of software. The CPU only has control over the LCD panel, IOT module, and buzzer when the data is obtained from the smoke detector. Additionally, the CPU manages the buzzer, LCD panel, Internet of Things module, and DC pump after the sensor's data is gathered. Water is drawn from the storage water tank device by the DC pump as soon as it starts. And the water spray lands in the vehicle's firing zone.

9. CONCLUSIONS

- ❖ The smart fire safety system for EVs using IoT represents a vital component of ensuring the safety, reliability, and sustainability of electric mobility, contributing to safer roads, reduced environmental impact, and improved public confidence in the future of electric transportation.
- ❖ The Automatic Fire Extinguishing System is a useful invention that is easily accessible to anyone. If a significant amount of time is devoted to its ongoing study and development, it may turn out to be a very useful product for the fire safety division.
- ❖ With its great regulating capability, this system can be used with fire extinguishers of various sizes.
- ❖ Both the driver and the passengers won't experience any disruption or unease following the installation of this device.
- ❖ Minimum maintenance is required because to its straightforward design.

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