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Design and Analysis of Automatic Fire Extinguisher for Vehicles

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Abstract: ***These days there is a rapid increase in automobile utilization in urban and rural areas, along with this there is an increase in the number of accidents related to automobiles. Apart from user/ driver related accidents a large number of other reasons cause fires in automobiles.***
Three components are needed to make a fire, Oxygen, Fuel and a source of ignition. Car fires are usually caused due to issues associated with fuel, electrical systems, the exhaust system and petroleum based fluids. By far though, the biggest causes of vehicle fires are fuel (gasoline) related.
The source of fire can be external or within the vehicle itself. Vehicle fires used to be quite common. Back in 1980's there were 456,000 car fires. In 1978 a big issue occurred with Pintos catching on fire.
This led the manufacturers to look at what design changes in vehicles will limit the three elements of the fire triangle from coming together.
Our project aims to design a device which automatically detect fire in vehicles and suppress them to prevent further damage to the vehicle.
The device which contains sensors and an extinguisher and a microprocessor can be placed under the hood of vehicles near the engine compartment and works when the engine (or any other part) catches fire. This application minimizes the possibility of death or injury and loss of property due to fire accidents in vehicles.
Keywords: Prevention of fire damage, smoke sensors, fire extinguisher, Arduino board, temperature sensors

I. INTRODUCTION

A huge fire broke out and spread across a parking lot at Yelahanka Air force station which at the time was hosting an Aero India Show, the fire burnt down around 300 parked cars. In another instance a Bangalore – Chennai Airavata KSRTC Volvo bus caught fire in 2013. We decided to build a solution to overcome this; a device must be designed to extinguish fire automatically. The widespread deployment of smoke alarms in our daily living environments and the pervasive use of technology present tremendous opportunities for smoke alarm deployment. Presently, the vast bulk of traditional smoke alarm systems are made up of sensor modules, transmission lines, and a regulating module, which are all linked to a sensor module. It connects detectors and alarms through the use of copper wires, insulated wires, or cables. Development of Automatic fire extinguishers includes the following components and the description for the components are discussed below.

II. COMPONENTS

A. Sensors

A sensor is a device used to detect changes in its environment and send the information to an electronic device like a computer processor. Sensors are always used with other electronics. Sensors are used widely around us in applications from touch sensitive screens on our phones to the O2 sensors used in automobiles.

The use of sensors have increased rapidly with the advancements in technology in micro machinery, said applications include manufacturing and machinery of robotics, medicine, airplanes and aerospace and the automobile industry. In our application, we are required to detect fire, changes in the environment caused due to fire are, rise in temperature, production of light and also the evolution of smoke. It is possible to detect a fire by sensing the change in temperature, light and smoke conditions. We achieve this by employing a combination of a light sensor, a temperature sensor and a smoke detector all connected to a microprocessor. There are a wide range of sensors available in the market and for our prototype design we have chosen DHT 22 type temperature and humidity sensor, LDR sensor and MQ-7 type Smoke detector.

1) *DHT 22 Humidity & Temperature Sensor:* The DHT22 Temperature and Humidity Sensor combine a temperature and humidity sensor with a digital signal output. It ensures high reliability through the use of digital signal acquirement and temperature and humidity sensor module. This sensor consists of a humidity sensor and an NTC (negative temperature coefficient) temperature measurement element; it provides an interface with a microcontroller and gives great quality, rapid response, and cost effectiveness.

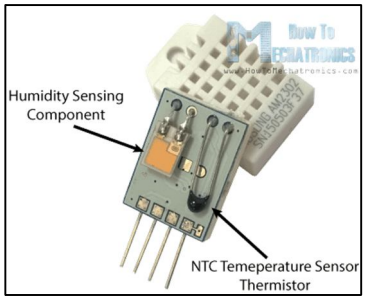

Fig. 1 DHT-22 Temperature and humidity sensor

2) *Carbon Monoxide Sensor/ Smoke detector (MQ-7):* The MQ-7 gas sensor makes use of SnO2as a substrate, which has a variable conductivity. It detects CO when low temperature (heated by 1.5V). The sensor's conductivity increases as the concentration of CO increases. A simple electro circuits used to convert and change the conductivity to correspond output signal of gas concentration. The MQ7 sensor is highly sensitive to CO. This sensor can be used to detect different gases containing CO; it is with low cost and suitable for various applications.

Fig. 2 MQ7 CO smoke detector

3) *LDR sensor:* The LDR Light Sensor or the light dependent resistor, generates an output as per the intensity of light it measures.The energy that exists within a very narrow range of frequencies broadly termed "light", and which ranges in frequency from "Infra-red" to "Visible" up to "Ultraviolet" light spectrum.

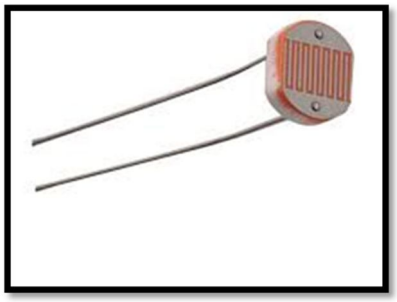

Fig. 3 LDR Sensor

4) *Microcontroller:* We have made use of an Arduino board for our design. Arduino is an open-source platform used for all electronics related projects. Arduino has a physical programmable microcontroller and also comes with software that can run on your computer, where the user needs to write the code and then upload the code to the physical board to execute. Arduino UNO is a microcontroller board which works on the ATmega32. It has a total of 14 digital input output pins in which has a PWM pin count of 6. For analog inputs there are another 6 analog pins.

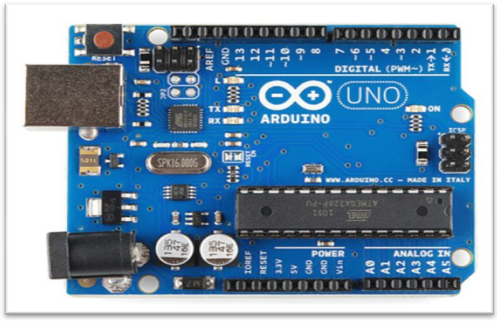

Fig. 4 Arduino Microcontroller

5) *Fire extinguishers:* A fire extinguisher is a fire suppression device used to extinguish or put out small fires, often in emergency situations. A fire extinguisher is not used on out-of-control fires, ones that puts the user at risk or otherwise requires a fire brigade. Typically, it is a hand-held unit containing an extinguishing agent which can be deployed to extinguish a fire.
6) *Arduino GSM Shield:* The primary use of the Arduino GSM shield is to help connect the Arduino to the GPRS wireless network by the means of simple data packets. For the GPRS shield to work only need to plug the GPRS module onto the board, on inserting a SIM card from any mobile operator with the GPRS coverage in that area. Then simply follow the instructions which help in connecting the internet.

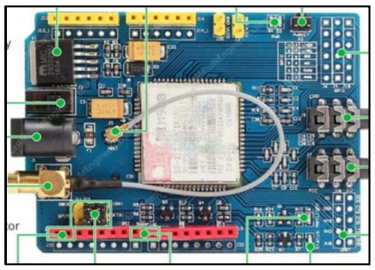

Fig. 5 Arduino GSM Shield

III.METHODOLOGY

Our paper presents the results of different studies concerning vehicle fire accident occurrence. Based on our analysis the most common damage patterns resulting in fires were identified. An automatic fire extinguishing strategy provides real time monitoring for vehicle, the setup is fully and controlled by Arduino, a programmed fire alarm and exploration are coded to a small microcontroller (Arduino). It sends a distress signal in the case of fire and helps to reduce the fire damage. The setup includes a temperature sensor and smoke detector whose outputs are connected to the controller. The setup takes into account the density or amount (PPM) of smoke and temperature in the engine bay, also monitors the amount of light in the engine bay. The system only deploys the extinguisher when there is an excess amount of heat and smoke in the engine bay corresponded with the increase in light energy, all of which a fire could cause , thus the probability of false alarms can be avoided. Arduino board considered here works based on the requirements as well as increase system reliability. The proposed system consists of the MQ7 smoke detector, Microcontroller Development Board (Arduino UNO), DHT-22 Temperature and Humidity Sensor, an LDR light sensor, apart from these components we also make use of a GPS and GSM module which enables a magnitude of possibilities like alarming and alerting the owner of the vehicle in case of a fire. We can also now get real time geo coordinates of the vehicle which can help the first responders if the owner requests to do so.

Different phases of work have been used to accomplish the project until the implementation of the system in real environment. It starts with the development of a sensor system for sensing the carbon monoxide gas concentration and followed by controlling and integrating the sensor with an Arduino UNO microcontroller.

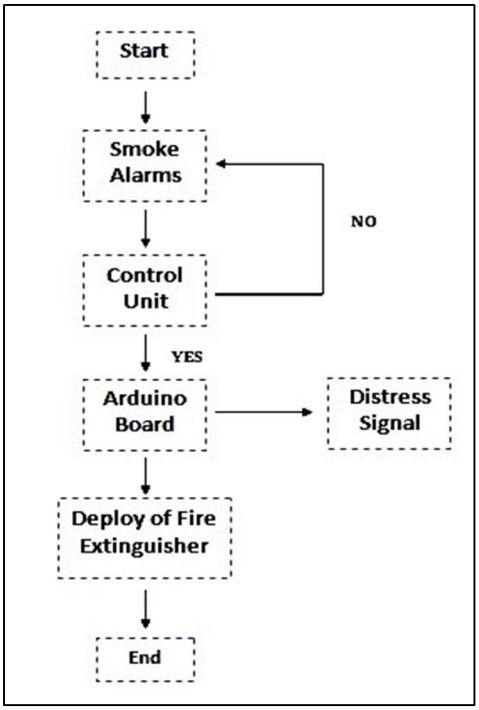

Fig. 7 Flow Chart

IV. FUTURE SCOPE

In the future we plan on building a system that can integrate the ECU of the vehicle, and expand the feature list of our product to a whole new level.On integrating we can now build a system that can monitor the health of the vehicle, remind the user for periodic maintenance, in case of any failure that the system can predict on understanding different data that we can pull up from the ECU, we can send an SMS alert right away reducing the risk of breakdown.We can further go ahead and build an app the can communicate with the vehicle using the OBD II port and once again it can unleash a whole lot of possibilities with regard to increasing the feature list of the device. We can implement parental controls this can help any older vehicle be as connected as one of the newer model.

V. CONCLUSIONS

A fire extinguishing system based on the simultaneous detection of CO and the rise in temperature and light generated by fire. The designed system which consists of smoke detectors which detect the smoke and temperature sensors that gives a trigger to control unit, as soon as signal received control system deploys the extinguisher automatically and discharges and smothers the fire. This system is applicable to different vehicles. The simple design of it allows minimum maintenance. There is a greatly reduced of malfunction, as there are no moving parts the risk of false alarm is also reduced. The overall performance of microcontroller based fire extinguishing system is determined by following factor: MCU speed MCU timing granularity MCU I/O features Accuracy and stability of the fire sensor used. Despite of having a narrow range of difficulty the popularity of microcontroller based system design is increasing day by day; besides improved and advanced technologies are replacing the older versions which is keep enhancing the system efficiency.

VI. ACKNOWLEDGMENT

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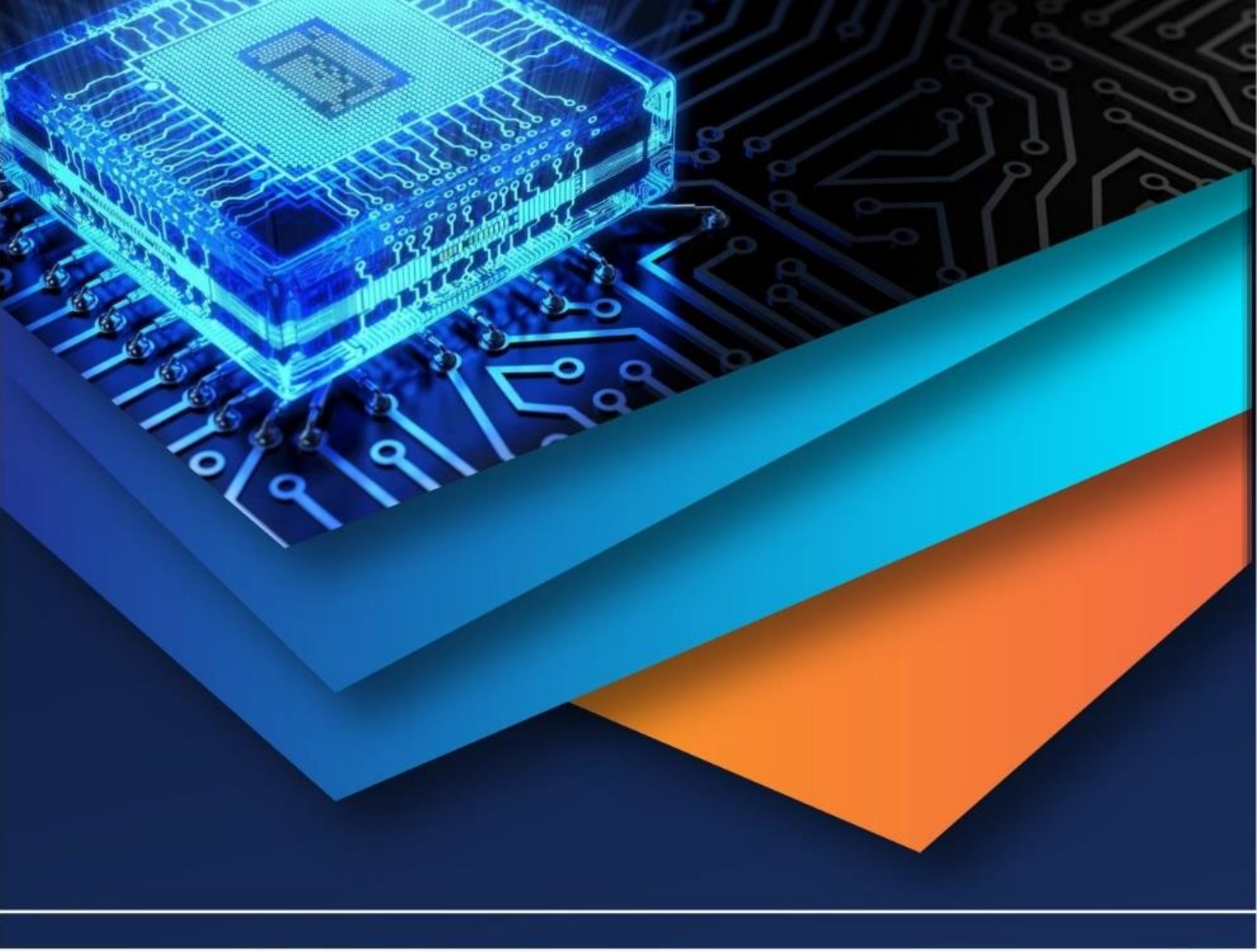

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