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Autonomous Fire Extinguisher System with Self-Preservation and Emergency Alert in Transportation

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Abstract - Fire accidents in transportation systems can cause serious damage and loss of human life, making early detection and quick response very important. This project presents an Autonomous Fire Extinguisher System that can automatically detect and control fire. The system uses flame and gas sensors to monitor the environment, and an Arduino Mega microcontroller to process the signals. When fire is detected, the system stops the vehicle, activates a water pump to extinguish the fire, and alerts passengers through a buzzer and LCD display. It also uses GPS and GSM modules to send emergency messages with location details, along with an IP camera for real-time monitoring. The proposed system reduces human dependency, minimizes damage, and improves safety by providing a fast and effective response during fire emergencies.

Key Words: Autonomous Fire Extinguisher System, Fire Detection, Arduino Mega, Flame Sensor, Gas Sensor, GSM, GPS, IP Camera, Vehicle Safety.

1.INTRODUCTION

Fire accidents in transportation systems are becoming a serious safety challenge, often leading to heavy damage and loss of human life within a very short time. In many cases, the major cause of this damage is the delay in detecting fire and taking immediate action. Conventional fire safety systems mainly provide alerts, but they depend on human response, which may not be fast enough in critical situations. With the advancement of embedded systems, there is a need for intelligent solutions that can not only detect fire but also respond instantly without human intervention. This paper presents an Autonomous Fire Extinguisher System that integrates fire detection, automatic fire suppression, and emergency communication into a single platform. The system uses flame and gas sensors for early detection, an Arduino Mega for processing, and automatically performs actions such as stopping the vehicle, extinguishing fire, and sending alerts with location details.

By combining sensing, control, and communication, the proposed system ensures a fast and reliable response during emergencies. This makes it a practical and cost-effective solution for improving fire safety in modern transportation systems.

2. LITERATURE SURVEY

Several researchers have worked on autonomous fire detection and extinguishing systems to improve safety and reduce human risk. In [1], an autonomous rover for wildfire extinguishing is designed to detect and control fire in outdoor environments. Similarly, [2] presents a remote-controlled fire fighting machine aimed at protecting human life by handling fire in hazardous areas. Autonomous fire-fighting robots have also been widely studied. In [3] and [4], the design and implementation of fire-fighting robots are discussed, where the system can detect fire and move toward the source to extinguish it. These systems reduce human involvement but are mainly focused on robotic navigation. Some works, such as [5], [6], and [7], focus on rover-based systems for exploration and hazardous environments. These designs highlight the importance of mobility and autonomous operation, which can be adapted for fire safety applications. Additionally, [8] and [9] discuss modular mechatronic systems for autonomous robots, emphasizing flexibility and system integration.

In [10], an intelligent fire extinguisher system is proposed, which detects fire and activates extinguishing mechanisms automatically. Similarly, [11] presents an autonomous fire extinguishing system that integrates detection and suppression techniques. In [12], an

Arduino-based dual-mode fire extinguishing robot is developed, combining sensor-based detection with automatic fire control. From these studies, it is observed that most systems focus on either fire detection, robotic fire extinguishing, or alert mechanisms. However, limited work has been done on integrating fire detection, automatic suppression, vehicle control, and real-time communication into a single system. Therefore, the proposed project aims to develop an integrated Autonomous Fire Extinguisher System that combines detection, control, and communication for improved safety in transportation environments.

3. EXISTING METHODOLOGY

In existing systems, fire detection is mainly implemented using sensors such as flame sensors, smoke sensors, and gas sensors. These systems are used to monitor the environment and detect fire hazards at an early stage. When fire is detected, the system activates alarms or buzzers to alert people. Some systems also use GSM modules to send alert messages to users. However, most existing systems only focus on detection and alerting, and do not take further action to control the fire. Some advanced systems include autonomous fire-fighting robots that can detect and extinguish fire, but they are mainly designed for specific environments and may not be suitable for transportation systems .In addition, many systems do not provide real-time monitoring or integrated communication features such as live video streaming and exact location tracking.

Limitations: Only fire detection and alerting are provided, automatic fire suppression is not included, dependency on human response, lack of real-time monitoring, and no integrated communication with exact location tracking.

4. PROPOSED METHODOLOGY

The proposed system integrates fire detection, automatic fire suppression, and emergency communication into a single system for improving safety in transportation environments. The system uses Arduino Mega as the main processing unit for controlling all components. Flame sensors and a gas sensor are used to continuously monitor the surroundings and detect fire or gas leakage conditions. When a fire is detected, the Arduino processes the sensor signals and immediately triggers multiple safety actions. The motor driver module is used to stop the vehicle, preventing further damage. A relay module is activated to turn ON the DC water pump, which sprays water to extinguish the fire at an early stage. A buzzer and LCD display provide instant alerts to passengers. The system also includes an IP camera for real-time monitoring of the situation. In addition, GSM module is used to send emergency alert messages, and GPS module provides the exact location of the vehicle. The alert message along with location details is sent to predefined contacts for quick response.

Overall, the proposed system works automatically without human intervention and ensures fast detection, immediate action, and effective communication. This integrated approach reduces damage, improves safety, and provides a reliable solution for fire protection in transportation systems.

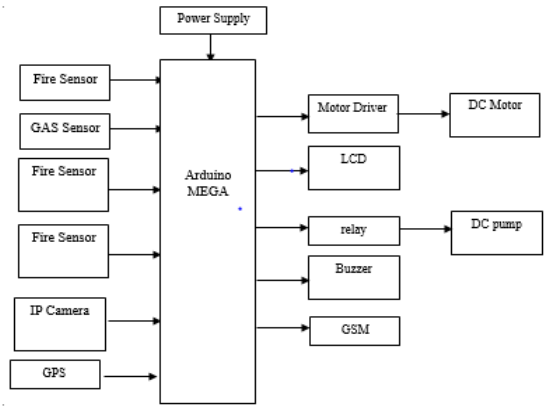

Figure 1: Block Diagram of Proposed System

5. WORKING PRINCIPLE

The system starts by initializing the Arduino Mega microcontroller, flame sensors, gas sensor, motor driver module, relay module, water pump, buzzer, LCD display, and communication modules. The flame and gas sensors continuously monitor the environment for any fire or gas leakage conditions. When a fire or gas is detected, the sensors send signals to the Arduino Mega for processing. The Arduino analyzes the inputs and confirms the presence of fire. Once confirmed, the system immediately performs multiple safety actions. The motor driver module stops the vehicle to prevent further damage. At the same time, the relay module is activated to turn ON the DC water pump, which sprays water to extinguish the fire at an early stage. The system also activates a buzzer to alert passengers and displays warning messages on the LCD screen. For emergency communication, the GPS module provides the exact location of the vehicle, and the GSM module sends an

alert message along with location details to predefined contacts. An IP camera is used to provide real-time monitoring of the situation. The system continuously monitors the fire condition, and once the fire is controlled, it stops the water pump and enters a safe mode. Thus, the system ensures automatic detection, quick response, and improved safety during fire emergencies.

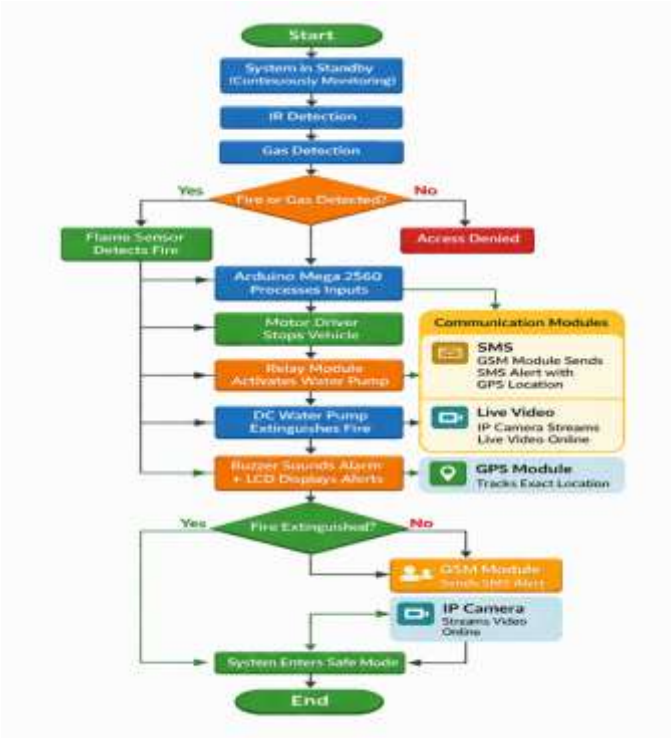

Figure 2: Flow Diagram of Proposed System

6. RESULTS AND DISCUSSION

The system successfully detected fire and gas conditions in real time using flame and gas sensors. The Arduino Mega effectively controlled all components, including stopping the vehicle, activating the water pump, and generating alerts. The LCD displayed system status, and the GSM module successfully sent emergency messages with location details. The IP camera provided real-time monitoring of the situation. Overall, the system improved safety by providing quick response, reducing damage, and minimizing human intervention during fire emergencies

Figure 3: Hardware Display

Figure 4: LCD Display when fire Detected

Figure 5: Message Alert Sent to mobile

7. CONCLUSIONS

The Autonomous Fire Extinguisher System was successfully designed and implemented to improve safety in transportation systems. The system effectively detects fire and gas conditions using sensors and automatically takes necessary actions such as stopping the vehicle, activating a water pump, and generating alerts. It also sends emergency messages with location details using GSM and GPS modules, and provides real-time monitoring through an IP camera. This system helps in reducing fire damage and protecting human lives by providing a quick and automatic response during emergencies. The system can be further improved by adding advanced fire suppression methods, improved sensors, and mobile application support for better monitoring. This project can be widely used in buses, cars, and other transportation systems to enhance safety and prevent major fire accidents.

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REFERENCES

[1] Choudhury, S., Sawant, S., Bidwalkar, L., Marathe, M. and Das, S., 2020, November. Design and implementation of autonomous rover for wildfire extinguishing. In 2020 IEEE International Conference for Innovation in Technology (INOCON) (pp. 1–6). IEEE.

[2] Raghavendran PS, Suresh M, Ranjith Kumar R, Ashok Kumar R, Mahendran K, Swathi S, Kamesh L, Sanjay R. An Intelligent Remote Controlled Fire Fighting Machine for Autonomous Protection of Human being. Int. J. Adv. Res. Sci. Eng. Technol. 2018 Dec;5:7620–6. Autonomous Fire Extinguisher Rover with Self-Preservation 613 [3] Reddy, M.S., 2021. Design And Implementation Of Autonomous Fire Fighting Robot. Turkish Journal of Computer and Mathematics Educa tion (TURCOMAT), 12(12), pp. 2437–2441.

[4] Reddy, Mohith S. "Design And Implementation Of Autonomous Fire Fighting Robot." Turkish Journal of Computer and Mathematics Educa tion (TURCOMAT) 12, no. 12 (2021): 2437–2441. [5] Uday, T.I.R., Ahmad, N., Ghosh, A., Jahin, J., Rahman, M., Iqbal, I., Islam, T., Farzana, F., Rahman, M., Rahman, G.E.U. and Tithi, F.S., 2018, December. Design and implementation of the next generation mars rover. In 2018 21st International Conference of Computer and Information Technology (ICCIT) (pp. 1–6). IEEE.

[6] Azim, M., Hossain, M.Q.R., Khan, M.N.R., Chowdhury, T. and Abdur Razzak, M., 2021. Six-wheeled wireless bomb defusal rover. In Advances in Automation, Signal Processing, Instrumentation, and Con trol: Select Proceedings of i-CASIC 2020 (pp. 1021–1033). Springer Singapore.

[7] Siegwart, R., Lauria, M., M¨ ausli, P.A. and Van Winnendael, M., 1998. Design and implementation of an innovative micro-rover. In Robotics 98 (pp. 181–187).

[8] Fonseca Prince, Andre. "Designing and implementing a modular mecha tronics infrastructure for autonomous robotic planetary exploration." PhD diss., Politecnico di Torino, 2020.

[9] Fonseca Prince, Andre. "Designing and implementing a modular mecha tronics infrastructure for autonomous robotic planetary exploration." PhD diss., Politecnico di Torino, 2020.

[10] Sonsale, P., Gawas, R., Pise, S. and Kaldate, A., 2014. Intelligent fire extinguisher system. IOSR Journal of Computer Engineering (IOSR JCE), 16(1), pp. 59–61.

[11] Rehman,A.,Masood,N.,Arif,S.,Shahbaz,U.,Sarwar, F., Maqsood, K., Imran, M. and Pasha, M., 2012, October. Autonomous fire extinguishing system. In 2012 International Conference of Robotics and Artificial Intelligence (pp. 218–222). IEEE.

[12] Raju, Joyal, S. Sheik Mohammed, Johaan Varkey Paul, Georgy Abel John, and Dinanath S. Nair. "Development and implementation of arduino microcontroller based dual mode fire extinguishing robot." In 2017 IEEE International Conference on Intelligent Techniques in Control, Optimization and Signal Processing (INCOS), pp. 1–4. IEEE, 2017.