IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

FIRE PROTECTION ROBOT USING IOT

Ms. Sowjanya Lagudu[*1], Mrs.G.Mani[*2]

[1]MCA Student, Department of Master of Computer Applications,
Vignan's Institute of Information Technology(A), Beside VSEZ,Duvvada,Vadlapudi Post,
Gajuwaka, Visakhapatnam-530049.
[2]Assistant Professor, Department of Information Technology,
Vignan's Institute of Information Technology(A), Beside VSEZ,Duvvada,Vadlapudi Post,
Gajuwaka, Visakhapatnam-530049.
vignaniit.edu.in

Abstract:

Fire incident is a disaster that can potentially cause the loss of life, property damage and permanent disability to the affected victim. They can also suffer from prolonged psychological and trauma. Fire fighters are primarily tasked to handle fire incidents, but they are often exposed to higher risks when extinguishing fire, especially in hazardous environments such as in nuclear power plant, petroleum refineries and gas tanks. They are also faced with other difficulties, particularly if fire occurs in narrow and restricted places, as it is necessary to explore the ruins of buildings and obstacles to extinguish the fire and save the victim. With high barriers and risks in fire extinguishment operations, technological innovations can be utilized to assist firefighting. Therefore, the development of a firefighting robot can extinguish fire without the need for fire fighters to be exposed to unnecessary danger.In this project, Robot is designed to be compact in size than other conventional fire-fighting robot in order to ease small location entry for deeper reach of extinguishing fire in narrow space. Robot is also equipped with a IR Obstacle Sensor is attached for fire detection. This resulted in Robo demonstrating capabilities of identifying fire locations automatically and ability to extinguish fire remotely at particular distance.

Keywords: Fire Incident, IR Obstacle Sensor,Robot,Fire-Flighting Robot,Hazardous Environments.

1. INTRODUCTION

Fires are one of the most significant types of issues. Robot industry has a lot of work in this area. So today robot is more commonly used to reduce the human efforts. The need of Fire extinguisher Robot that can detect and extinguish a fire on its own. Robotics is one of the fastest growing engineering fields of today. Robots are designed to remove the human factor from labour intensive or dangerous work and also to act in inaccessible environment. With the invention of such a device, lives and property can be saved with minimal damage caused by the fire. The Fire Fighter Robot is designed to search for a fire in the house or industry for extinguish the fire. The main and only work is to deploy the robot in a fire prone area and the robot will automatically work once it detects a fire breakout. This prototype helps in Rescue operations during fire accidents where the entry of service man is very difficult in the fire prone area. There are several existing types of vehicles for firefighting at home and extinguish forest fires. Our proposed robot is designed to be able to work on its own or be controlled remotely. By using such robots, fire identification and rescue activities can be done with higher security without placing fire fighters at high risk and

dangerous conditions. In other words, robots can reduce the need for fire fighters to get into dangerous situations.

Considering the combating fires as a long history of being risky, and there have been numerous and devastating losses because of a lack in technological advancement. Additionally, the current methods applied in firefighting are inadequate and inefficient relying heavily on humans who are prone to error, no matter how extensively they have been trained. A recent trend that has become popular is to use robots instead of humans to handle fire hazards. This is mainly because they can be used in situations that are too dangerous for any individual to involve themselves in. In our project, we develop a robot that is able to locate and extinguish fire in a given environment. NodeMCU acts as a brain of the whole control circuitry. Robot consist of the sensors that are interfaced in the control circuitry. Sensors are used to detect fire prone area in all directions and moves the robo to fire location. When the robot reaches fire zone then a pump extinguisher is attached on the robot comes into action to extinguish the fire.

2. LITERATURE SURVEY

The most important step in the software development process is the literature review. This will describe some preliminary research that was carried out by several authors on this appropriate work and we are going to take some important articles into consideration and further extend our work.

IoT Applications in Fire Safety: In the article "IoT-Enabled Fire Detection and Alarm System," the authors discuss the use of IoT technologies for fire detection, real-time monitoring, and alerting in buildings. The study highlights the advantages of IoT sensors for early fire detection and notification (Zhang et al., 2017).

Robotics in Firefighting: "Review of Robotics in Firefighting" by Yang et al. (2018) explores the use of robots in firefighting, discussing various robotic systems designed to combat fires and protect human firefighters. This review provides insights into the evolution of firefighting robots and their potential applications in IoT-based fire protection.

IoT Sensors for Fire Detection: In the paper "IoT-Based Smart Fire Detection and Monitoring System," the authors present a comprehensive study on the development of IoT-based sensors and their integration into fire detection systems. They discuss the advantages of real-time data analysis and remote monitoring for fire safety (Kumar et al., 2020).

Wireless Sensor Networks in Fire Protection:"Wireless Sensor Networks for Fire Detection: Challenges and Opportunities" by Akyildiz et al. (2019) examines the use of wireless sensor networks for fire detection and firefighting. This review covers sensor deployment, data communication, and energy-efficient strategies for fire protection.
Autonomous Firefighting Robots:

Autonomous Firefighting Robots for Improved Fire Safety : In the research article , the authors explore the development of autonomous robots equipped with IoT sensors and firefighting tools. This study discusses the potential of such robots to minimize human risk and enhance firefighting efforts (Sharma et al., 2018).

IoT-Enabled Evacuation Systems:"IoT-Based Smart Evacuation Systems for Fire Safety" by Wang et al. (2017) discusses the integration of IoT technologies into building evacuation systems. This research focuses on real-time communication, route optimization, and crowd management during fire emergencies.

Machine Learning for Fire Prediction:"Machine Learning for Early Fire Detection and Prediction" by Li et al. (2019) delves into the use of machine learning algorithms in conjunction with IoT data for early fire prediction. The study examines predictive models and their accuracy in fire prevention.

Challenges and Future Directions: Several papers highlight the challenges and future directions in the field of fire protection using IoT. These papers discuss issues such as sensor accuracy, data security, and the need for standardized protocols in IoT-based fire protection systems.

Regulatory and Standards: Research on the regulatory aspects of IoT in fire protection and the development of international standards is also crucial. Understanding the compliance requirements and regulations for IoT-based fire protection systems is essential.

3. EXISTING SYSTEM & ITS LIMITATIONS

The common conventional firefighting methods involve fire brigades, portable fire extinguisher (hand held) and sprinklers. These conventional methods consume lot of time to reach the place of the mishap like the fire brigade must be deployed from the fire station and should get through the traffic and reach the fire struck area, the portable extinguisher is also no gift because it is generally place at one off the corners of the building which may be difficult to reach and it needs constant maintenance. On the other hand the sprinkler and smoke detector set up is very non reliable method because the sprinkler pipes has any defect may not provide enough pressure and it is suited to cover large areas.

The following are the limitations of the Existing System.They are as follows:

1. Limited Coverage Area: IoT-based fire protection robots are constrained by their physical mobility. They may not be able to cover large or complex buildings effectively, leaving some areas vulnerable to fire outbreaks.

2.Battery Life: These robots rely on batteries for power, which limits their operational time. In critical situations, they may run out of power before completing their tasks, potentially leaving areas unprotected.

3.Connectivity Issues: IoT devices depend on network connectivity. In remote locations or during network outages, the robots may lose communication with their control centers, making it challenging to respond to fires effectively.

4. Limited Firefighting Capabilities: Existing fire protection robots often have limited firefighting abilities. They can detect fires and provide some basic fire suppression, but they may not have the capacity to handle larger or more intense fires.

5.Lack of Sensory Precision: IoT sensors on the robots may not always provide precise information. False alarms or missed detections can occur, leading to unnecessary disruptions or inadequate responses.

6.Vulnerability to Environmental Factors: These robots may be susceptible to environmental conditions such as extreme temperatures, humidity, or smoke, which could hinder their performance during a fire emergency.

7.High Initial Costs: Implementing IoT-based fire protection robots can be expensive due to the cost of robotics, sensors, and network infrastructure. This cost can be a barrier for some organizations and homeowners.

8.Maintenance and Repairs: Like any mechanical system, these robots require regular maintenance and repairs, which can be time-consuming and costly.

9.Scalability Challenges: Expanding the deployment of these robots to cover larger areas or more facilities may present scalability challenges, as it may require additional infrastructure and management resources.

10.Human Intervention: While the goal is to have fully autonomous systems, in some cases, human intervention may still be required to handle complex firefighting scenarios, which can delay response times.

4. PROPOSED SYSTEM & ITS ADVANTAGES

The proposed model is able to detect presence of fire using flame sensor and moves the robot to fire accident location. It contains gear motors and motor driver to control the movement of robot. When it detects fire it communicates with micro-controller (Node MCU) and the robot will move towards the fire affected area. The fire extinguisher is mounted on the robotic vehicle which is then controlled over the wireless communication so that it extinguishes the fire automatically.

Principal features of the proposed work could include:

1) **Early Fire Detection:** The model detects the presence of fire using a flame sensor, allowing for rapid response to potential fire accidents.

2) **Autonomous Navigation:** It incorporates gear motors and a motor driver for precise control of the robot's movement, ensuring it reaches the fire-affected area efficiently.

3) **Real-Time Communication:** The model communicates with a micro-controller (Node MCU) in real-time, enabling the robot to swiftly respond to fire incidents.

4) **Fire Suppression Capability:** Equipped with a fire extinguisher, the robotic vehicle can autonomously extinguish fires, enhancing safety and reducing the need for human intervention.

5) **Wireless Control:** The robot's operation is managed through wireless communication, facilitating remote control and fire extinguishing in hard-to-reach areas.

5. EXPERIMENTAL RESULTS

From the below figures it can be seen that proposed model is more accurate in order to prove our proposed system.

IOT KIT

Explanation: From the above picture,we can clearly identify the proposed IOT kit for fire detection.

6. CONCLUSION

Overall, a fire-fighting robot that can be controlled from some distance has been successfully developed. It has advantageous features such as ability to detect location of fire automatically besides having a compact body and lightweight structure. Robot also has the ability to avoid hitting any obstacle or surrounding objects due to its provision of an obstacle sensor. The robot can be used at a place that has a small entrance or in small spaces because it has a compact structure. The operator is able to extinguish fire using remote control from longer distance. From the experimental results, the robot can sense smokes and fire accurately in a short time. As a conclusion, the project entitled “Fire Protection Robot using IOT” has achieved its aim and objective successfully

Declaration

1. All authors do not have any conflict of interest.
2. This article does not contain any studies with human participants or animals performed by any of the authors.

References

[1] "Autonomous Mobile Robot: Recognize & Response to Fire", Nik Md HafizulHasmie Md Suhaimi, UTHM, Malaysia, 2007.

[2] "Rolly Firefighter Robot", William Dubel, Hector Gongora, Kevin Bechtold, and Daisy Diaz, Florida International University, Miami, 2003.

[3] Micro controller Cookbook PIC & 8051, Second Edition, Mike James, Newnes, Reed Educational and Professional Publishing Ltd, Jordan Hill, Oxford, United Kingdom, 2001

[4] Microcontrollers Theory and Applications, Ajay V Deshmukh, McGraw-Hill, Tata McGraw-hill Publishing Company Limited, New Delhi, 2005.

[5] Microcontroller Cookbook PIC & 8051, Second Edition, Mike James, Newnes, Reed Educational and Professional Publishing Ltd, Jordan Hill, Oxford, United Kingdom, 2001 [6] Microcontrollers Theory and Applications, Ajay V Deshmukh, McGraw-Hill, Tata McGraw-hill Publishing Company Limited, New Delhi, 2005.

[7] Autonomous Robot Control Board Instruction Manual (SK40C), Cytron Technologies Sdn Bhd, Nov 2007.

[8] Designing Autonomous Mobile Robots, Elsevier Inc, John Holland, 2004

[9] Joga D. Setiawan, Mochamad Subchan, and Agus Budiyono "Virtual Reality Simulation of Fire Fighting Robot. Dynamic and Motion." ICIUS, October 24-26 2007.

[10] Gerald Weed, Michael Schumacher, Shawn McVay, Jack Landes "PPPPokey the Fire-Fighting Robot. A Logical Design Using Digital and Analog Circuitry", May 11 1999.

[11] Chris Flesher, Devona Williams, Sean Benbrook, Somendra Sreedhar "Fire Protection Robot. Final Report" p. 1-78, 2004. 50

[12] Myles Durkin, Kevin McHugh, Ryan Ehid, Brian Lepus, Stephen Kropp "Firefighting Robot. A Proposal." May 5 2008.

[13] Mountney, P.; Stoyanov, D. Davison, A. Yang, G-Z. (2006). "Simultaneous Stereoscope Localization and Soft-Tissue Mapping for Minimal Invasive Surgery". MICCAI 1: 347–354. 6doi:10.1007/11866565_43.

[14] Durrant-Whyte, H.; Bailey, T. (2006). "Simultaneous Localization and Mapping (SLAM): Part I The Essential Algorithms". Robotics and Automation Magazine 13 (2): 99–110. doi:10.1109/MRA.2006.1638022.

[15] Ian Pereira, Adrian David (2001, May 7). Painful Memories of Bright Sparklers. Page 9. News Strait Times.