A REVIEW PAPER ON FIRE FIGHTING ROBOT

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Abstract - Firefighting robots are becoming increasingly important tools for combatting fires, particularly in hazardous environments. This paper reviews the latest advancements in real-time wireless firefighting robots. We explore the design considerations, functionalities, and sensor technologies employed in these robots. The paper highlights the importance of autonomous navigation, fire source detection and localization, and fire suppression mechanisms for effective firefighting. We discuss various fire extinguisher options beyond traditional water-based systems to address the limitations of water in extinguishing specific fires. Additionally, the paper examines the role of real-time communication for remote control and data transmission, enabling firefighters to make informed decisions and ensure their safety during operations. Finally, the review concludes by emphasizing the potential of real-time wireless firefighting robots to revolutionize fire response strategies and improve firefighter safety.

- ***Key Words*:** Firefighting robots, localization, fire suppression mechanisms

1. LITERATURE SURVEY

Prashant Badoni [1] The controller is a vital subsystem of the robot that is designed to help the system in order to achieve stability, good disturbance rejection and minimum tracking error. This paper focuses on the effective control techniques for robotic systems. It analyses the classical as well as intelligent controllers with study of the control system.

Michael Shneier [2] Mobile robots are devices that can move autonomously to accomplish their goals. This paper provides a review of such robots oriented towards manufacturing applications. It describes the kinds of mobile robots that are used and what criteria are appropriate when deciding to make use of mobile robots. It also covers ways of localizing the robots, controlling them, and addresses their safe use in collaborative applications with humans. The standards covering mobile robots are described and the paper ends with a brief survey of more advanced vehicles and applications.

Deepika Vashist [3] Technology advancements is widening up by the advent of new inventions. Robot is one such invention to overcome ever-present challenges of high cost of labour .It is interdisciplinary field that ranges in scope from the design of mechanical, electrical, electronic as well as computer science. At this time robots help in many fields for human being to make the life reliable as well to deliver fast than a human being.This paper introduces the introduction about robotics technology and science and system. We introduce the history of robotics technology, science and system also we are introduce the structure of the robot, and the components used in manufacturing the robots as well as advantages disadvantages and applications of robotics technology. We included in this paper the uses of robotics technology as, in the current scenario, the Robot vision system is basically used for inspection purposes in industries such as gauging, verification of presence of components, detection of flaws etc. In this paper we are giving brief explanation about the robotics future uses in daily life, i.e. for domestic purpose, as well as commercially uses. “The main aim of our paper is to aware the people about advancement in technology in robotics which help the people which would be a Businessman as well as common people or Scientist and would be Doctors & Engineers also.

Lamber Royakkers [4] This article investigates the social significance of robotics for the years to come in Europe and the US by studying robotics developments in five different areas: the home, health care, traffic, the police force, and the army. Our society accepts the use of robots to perform dull, dangerous, and dirty industrial jobs. But now that robotics is moving out of the factory, the relevant question is how far do we want to go with the automation of care for children and the

elderly, of killing terrorists, or of making love? This literature review attempts to provide an engaged but sober (non-speculative) insight into the societal issues raised by the new robotics: which robot technologies are coming; what are they capable of; and which ethical and regulatory questions will they consequently raise?

Sai Priya. T.S [5] In this research paper, a system is proposed that focuses on the concept of how to control a robot with a human voice4300. Voice-controlled robots are just a practical example of controlling simple robot movements by giving routinely-used voice commands. The system uses his Android app as his medium for sending human commands to the microcontroller. The controller can connect to the Bluetooth module using the UART protocol. Audio is received by Android app and processed by the speech engine.

LEE [6] This article is a systematic literature review of service robots. Service robots are robots that are designed to perform tasks that are useful to humans, such as cleaning, delivery, and assistance for the elderly and disabled. The article reviews the different types of service robots, the applications of service robots, and the challenges and opportunities of service robots. There are two main types of service robots professional service robots and personal service robots. Professional service robots are designed to be used in commercial and industrial settings, such as hospitals, factories, and warehouses. Service robots are used in a wide range of applications. In healthcare, service robots are used to assist with patient care, surgery, and rehabilitation. In logistics, service robots are used to pick and pack items, transport goods, and deliver packages. In agriculture, service robots are used to harvest crops, milk cows, and perform other tasks. In the home, service robots are used to clean, cook, and provide companionship.

Xi VincentWang [7] The research delves into the impact of the COVID-19 pandemic on the acceleration of digitalization and automation, particularly in the field of robotics. Before 2020, progress in this area was hindered by factors such as high robot costs, hesitancy to replace cheap labour, and legal and societal concerns. However, the crisis prompted a degree of digital transformation globally. The study reviews achievements in robotics during the pandemic, analysing literature on supporting technologies, technology readiness levels (TRL), and future trends. Notably, robots have been deployed worldwide for crisis response due to their ability to provide physical functionalities while maintaining effective social distancing in healthcare settings.

LAMBER ROYALLAK [8] This article discusses the social implications of new robotics. It explores how robots are being used in new areas, such as the home, healthcare, and the military. It also examines the ethical and regulatory questions that these new applications are raised. One of the key points from this article is that robots are becoming more sophisticated and capable. As robots become more intelligent and autonomous, they are able to perform a wider range of tasks and be used in more applications. This is leading to new opportunities and challenges for society. One of the challenges raised by the use of new robotics are the ethical implications. For example, there are concerns about the potential for robots to be used to replace human workers, and about the potential for robots to be used for harmful purposes. The article concludes by arguing that it is important to start thinking about the ethical and regulatory implications of new robotics now, before these technologies become more widely adopted.

CARLO WEIDEMENN [9] This is an article about using robotics to teach computational thinking to young children. It discusses what computational thinking is and why it is important. It also reviews research on using robotics to teach computational thinking. The article then describes a specific robotics device that was designed to teach computational thinking to young children. Finally, the article discusses the benefits of using robotics to teach computational thinking. The article begins by discussing what computational thinking is and why it is important. Computational thinking is the process of breaking down problems into smaller, more manageable steps. It is an important skill for everyone to have, but it is especially important for children to learn. Computational thinking can help children to develop problem-solving skills, creativity, and critical thinking skills. The article concludes by discussing the benefits of using robotics to teach computational thinking.

MUHHAMAD ULLINAUHA [10] This article discusses the benefits and challenges of collaborative robotics in industrial

settings. Collaborative robotics, or HRC, is the practice of robots working alongside humans to perform tasks. HRC can have a number of benefits, such as improving the working conditions for humans by taking over dangerous or repetitive tasks. It can also lead to increased productivity and efficiency. However, there are also some challenges associated with HRC, such as the need to carefully design workplaces to avoid safety hazards. One of the key benefits of HRC is that it can improve the working conditions for humans. Robots can take over dangerous or repetitive tasks, freeing up humans to focus on more complex and rewarding work. HRC can also help to reduce fatigue and injuries among workers.

PREETHAM G [11] Expanding human populace and innovative improvement has prompt increment in flame mishaps and dangers. Unavoidable conditions and physical constraints of person make fire extinguishing a testing and demanding assignment. Fire extinguishing is an exceptionally unsafe undertaking and it might likewise include death toll. Robotics is the rising answer to ensure the safety of the surroundings and human lives. Fire extinguishing robot is an equipment model which can be utilized for extinguishing the fire amid flame mischances. It can decrease the blunders and constraints confronted by the people during the extinguishing process. Our outlined robot can seek the zone, find the fire and extinguish it before it turns out to be out of control. It can explore the building while effectively checking for fire. It can be operated remotely by any individual from anyplace on the planet using mobile phone or a laptop. The robot which we have proposed in this paper has discovered its application in flame dousing operations amid flame mishaps where the likelihood of the servicemen to enter the fire inclined region is less.

AKIB ISLAM [12] Increasing human population and technological development has lead to increase in fire accidents and hazards. Adverse conditions and physical limitations of human beings make fire extinguishing challenging and demanding task. Fire extinguishing is a very risky task and it may involve loss of life. Robotics is the emerging solution to protect the surrounding and human lives. Fire extinguishing robot is a hardware model which can be used for extinguishing the fire during fire accidents. It can reduce the errors and limitations faced by humans during fire extinguishing tasks. Our designed robot can search the area, locate the fire and extinguish fire before it rages out of control. Our proposed robot can efficiently extinguish any kind of fire in any geographical location. It is able to navigate the building while actively scanning for the flame. It can send various data from the sensor to the cloud and can be operated wirelessly by any person from anywhere in the world through internet. With the help of Internet of Things, it can send alert and notifications to the user about the status of the fire. The robot which we have proposed in this paper found its application in fire extinguishing operations during fire accidents where the possibility of the servicemen to enter the fire prone area is very less.

ANIL KUMAR INKULU [13] Fire-fighting is a prominent yet hazardous occupation. A fire-fighter must be able to get to a fire place quickly and safely extinguish the fire, inhibiting the further damage and reduce fire causalities. Technology has helped in connecting machines and the occupation of fire fighting, allowing them to work in a effective way. Robots designed to detect fire, before it goes out of control, could work with fire fighters greatly decreasing the chance of injury to victims and with least risky human intervention. The project aims at designing an intelligent live video streaming voice operated fire extinguishing robotic vehicle which can be controlled, that alerts the people if there is any fire detected and sends the live location as well as the image of a fire effected area to the nearby fire station in order to cut down the impact that may cause due to catching fire in large areas.

LOGESVARAN WASUL [14] Fire accidents have become a common problem in human life and may lead to permanent injury or death. The fire fighter robot is developed with the aim to save lives of fire fighters who risk their lives, entering dangerous environments. This paper presents the development of the fire fighter robot, which is suitable to extinguish fire in closed areas and residential areas. The robot's movement can be manually controlled using Flysky GT2 Controller from outside of the affected area. The robot is in the form of a robust and compact vehicle which allows it to move front, back, left and right in small areas with a steady speed. The robot has a 12V water pressure pump capable of shooting water up to 3 to 5 litres per minute which allows it to control large amounts of

fire. The robot also provides live streaming and GPS location tracking services during the movement of the robot. This live recording can be viewed in PC or in the user's mobile phone.

KIRAN [15] Firefighting robots are being developed to address the dangers and limitations of traditional firefighting methods. These robots can be used in situations too dangerous for humans, such as factory fires or remote areas. They can also help protect human life, property, and the environment. This project aims to create a firefighting robot that can navigate a simulated home fire, locate flames, and extinguish them. This project has the potential to save lives and reduce property damage.

POOJITHA BASANI [16] A web-controlled fire extinguishing robot is proposed to assist firefighters and reduce the risks associated with firefighting. The robot uses a Pi camera for navigation and a water pump to extinguish fires. It can be controlled remotely via a web interface, allowing firefighters to operate from a safe distance. This technology has the potential to improve firefighter safety and efficiency.

K. RAJASHEKAR [17] Cameras on firefighting robots offer a valuable solution for effective fire control. Live footage allows firefighters to remotely assess the situation and make informed decisions. Remotely controlled water sprayers further enhance safety by minimizing risk to firefighters while extinguishing blazes. This technology holds promise for reducing firefighter injuries, deaths, and fire damage.

MOHAMMAD MAHFUJUL ISLAM [18] The aim of this paper is to explore a new model to extinguish fire without much human effort. There has been a renewed and sustained interest towards safety in both public and private sectors. During the year 2016, 3,515 people died by fire or fire related injuries in the USA alone. The total estimated economic value of fire related damages in 2017 exceeds $300 billion. Industries are the most possible places of fire accident particularly those related to chemical/hydrocarbon manufacturing and or processing. An advanced autonomous fire extinguishing system can combat fire accidents and minimize damage to both human lives and property without exposing fire fighters to additional risks. The proposed robot can autonomously detect and extinguish fire before it spreads. The robot can, without any human input, navigate through hallways or corridors of any complexity, even places unreachable by a human, to reach the origin of the fire before it is allowed to spread further. The robot can automatically recognize and avoid obstacles to reach its destination. The robot, therefore, can not only be used to effectively fight fire but can also be deployed to assist in search and rescue operations at natural disasters such as floods, hurricanes, tornadoes, volcanic eruptions, earthquakes, tsunamis, and other geologic processes. It can also be utilized to carry up to 1kg of equipment or emergency supply to hard to reach places. Its camera view can be live streamed, and if needed controlled by an authorized personal using a smartphone from a safe place through its wireless capabilities.

NADIAH KAMARUZAMAN [19] Fire accidents have become a common problem in human life and may lead to permanent injury or death. The fire fighter robot is developed with the aim to save lives of fire fighters who risk their lives, entering dangerous environments. This paper presents the development of the fire fighter robot, which is suitable to extinguish fire in closed areas and residential areas. The robot's movement can be manually controlled using Flysky GT2 Controller from outside of the affected area. The robot is in the form of a robust and compact vehicle which allows it to move front, back, left and right in small areas with a steady speed. The robot has a 12V water pressure pump capable of shooting water up to 3 to 5 litres per minute which allows it to control large amounts of fire. The robot also provides live streaming and GPS location tracking services during the movement of the robot. This live recording can be viewed in PC or in the user's mobile phone.

YASH SHARMA [20] Over the scope of the latest decade, we have seen numerous mishaps caused due to fire. These fire mishaps are one of the most significant reasons for human fatalities in India and abroad the world. The current fire prevention framework isn't equipped for giving a quicker reaction to fire accidents. There are two significant reasons for the late reaction to the fire mishaps - the first is the traffic confinements inside the city and the subsequent one is the small narrow streetsinside the city. If the fire engines reach on time to the accident spot, then likewise, they can't go into the streets. It takes a lot of time for them to lay their hoses from the truck

to the affected spot. For this issue, we have made a robot that can be utilized by anybody to go about as first aid and attempt to extinguish the fire. It can be controlled by our smartphones. we can have a live view of what is there in front of the robot. It comprises a two-way audio communication framework that will help the controller to communicate with the person stuck inside the fire.

SEN LI [21] Indoor fire accidents have become increasingly common in recent years. More and more firefighting robots have been designed to solve the problem of fires. However, the indoor environment is very complex, with high temperatures, thick smoke, more turns, and various burning substances. In this study, a firefighting robot with autonomous inspection and automatic fire-extinguishing functions intended for use in unknown indoor environments was designed. Considering water's poor efficiency and its inability to extinguish some combustion materials, other fire extinguishers were applied to design the extinguishing system. The robot can install four different extinguishers as required and select the appropriate fire extinguisher to spray it automatically. Based on the Cartographer SLAM (simultaneous localization and mapping) theory, a robot map-building system was built using Lidar scanners, IMU (inertial measurement unit) sensors, encoders, and other sensors. The accurate identification and location of the fire source were achieved using an infrared thermal imager and the YOLOv4 deep learning algorithm. Finally, the performance of the firefighting robot was evaluated by creating a simulated-fire experimental environment. In an autonomous inspection process of the on-fire environment, the firefighting robot could identify the flame in real-time, trigger the fire-extinguishing system to carry out automatic fire extinguishing, and contain the fire in its embryonic stage.

LAKSHIT EKKALDEVI ASHOK [22] This research paper describes a new Autonomous Firefighting Robot designed to be a major advancement in fire response. The paper first discusses the need for new firefighting technology and then explains how this robot works, including its sensors, fire suppression mechanisms, and fire-resistant design. The paper also highlights how this robot's features can be used in real-world situations.

KIRAN [23] Firefighting is dangerous and current methods are ineffective. Robots can be used in hazardous situations. This project proposes a firefighting robot with an embedded system to fight simulated home fires. The robot will navigate a model floor plan and extinguish flames. It can also serve as a path guide in normal situations.

SHUO ZHANG [24] This paper proposes a new intelligent firefighting robot that can operate autonomously. The robot uses multiple sensors (like cameras and thermal imagers) to navigate its environment and fight fires. The robot also uses an improved planning algorithm to find the best path to take, and can locate fire sources quickly. This allows for faster firefighting and rescues.

NINAL S. SURVE [25] Our project surveillance fire fighting robot is among the valuable system in a security based monitoring. This project design to develop Robot with night vision camera, smoke sensor, gas sensors, water tank, dc motor, pump motor, solar panel. The main need is to design and develop a portable and efficiently useful surveillance fire fighting robot for security. This project allows a user to monitor all activities and control a fire fighter equipment with water tank and remotely wirelessly for extinguishing fires. Wireless camera used for monitoring purpose and user can watch live streaming display on the mobile application. Two DC motors were used to control the motor movement while the robot is on operation mode to extinguish the fire. It can be used in industry and for security \ purpose.

3. CONCLUSION

Real-time wireless firefighting robots offer a promising solution for mitigating the dangers associated with fire emergencies. Advancements in sensor technology, autonomous navigation algorithms, and fire suppression mechanisms are paving the way for intelligent robots that can effectively detect, locate, and extinguish fires. The real-time communication capabilities of these robots allow for remote control and data transmission, enhancing firefighter safety and operational efficiency. As research in this field continues to progress, real-time wireless firefighting robots have the potential to become a

vital tool for fire departments worldwide, saving lives and minimizing property damage.

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