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DESIGN OF A ROBOT FOR APPLICATION IN THE ELECTRICAL FIELD WITH NARROW AND HAZARDOUS SPACE

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Abstract:
Human exposure to poisonous gases while working in underground tunnels may create fatal effects. To avoid such cases we have to automate the system with the application of certain Robots. The robot here detects the hazardous gas and monitor using a wireless control like Bluetooth in mines. The MQ-4 sensor detects the level of methane (CH4) and the Wireless Camera which is used to monitor the operations in the mines. In various mining areas, industrial applications and garbage places this robot can be used. It can be enabled to detect other gases like Carbon Monoxide, Carbon Dioxide, Low O2 content, Smoke and other gases. Robot can provide the prior knowledge to the workers about the level of danger and so the workers can have preparatory plans which will reduce loss of human life due to disaster by enhancing the effective operation in mines. Human beings and all the living organisms in this world needs fresh and healthy air to survive. In recent years, with the increase in gas consumption, gas leakage has become a problem. Leaked gas causes gas waste, especially because of its combustible property, it can harm living organisms and various industries. All components are controlled by an Arduino which acts as the central processing unit of the setup. When the sensor detects a leak of the many combustible gases, it sounds an alarm with a buzzer. This alarm supports a small LCD that displays the amount of the gas leak and alerts personnel to turn on the exhaust fan or stop the incoming gas at a particular section.

1 INTRODUCTION

The Internet of Things strives to make life easier and faster by automating all the small tasks involved in human life. Today technological advances like IOT are making everything smart. Since IoT is very beneficial in automating tasks, the advantage of IoT can also help improve convenient security methods. Security performs a significant role at the same time as constructing homes, buildings, and industries in addition to towns. The enlarged focus of certain gases within the surroundings are maybe exceptionally unsafe. Nowadays, everyone wishes for a facility that reduces effort and time as well as expects their work to be as easy as possible. The prime aim of the paper is to alert people with the help of a buzzer and detect the hazardous gases present in the air. This is done using an MQ5 sensor. The MQ5 sensor is used to detect gas leakages for various applications. The MQ5 sensor detects the concentration levels of the gases and outputs an analog value which can be later converted into a digital signal. As soon as the gas is detected by the MQ5 sensor it displays alert messages on the LCD screen. The user will get alerted via messages on the LCD screen. This is an efficient way to automatically detect and control gas leaks. It also prevents accidents. The idea of gas detection and control can be implemented on a large scale in various industries. The system can be installed in kitchens, hostel cafeterias, etc. This helps reduce accidents caused by gas leaks in homes and commercial facilities. This system is low cost, so it is affordable, prevents many accidents, saves many accidents, saves many properties and lives. The MQ5 sensor is used to detect H2 (molecular hydrogen), LPG, CH4 (methane), CO (carbon monoxide), and alcohol. This system is not only capable of detecting a gas leakage as well as alerting the user of the gas leakage through a buzzer Coal mine is an underground tunnel system. The tunnel is narrow if there are some accidents the workers are easily tapped inside and it is very difficult for the workers to get out of the mines. In some situation the workers cannot escape from it. There may be sudden landslides or collapse in the mines. Dangerous accidents occur in mines due to gas explosion, CO,CO2 poison gas, low O2 content, high temperature, smoke, fire, water, etc.CH4 (methane gas) is poisonous .CH4 is an intergrowth with coal. During the process of mining CH4 may be released from the coal layer into the environment. The gas diffuses throughout the tunnel and it causes gas explosion. As the pathway of the tunnel is narrow the gas explosion may destroy the devices and workers present in the mines. The gas cannot be pushed out from the tunnel and it creates harm to the workers. Besides the poisonous gas coal mine also has some dangerous like low O2 content and coal dust. During mining dust is created as the tunnel is narrow it gets accumulated in the tunnel. Detection of the explosion is the first problem in mines. Communication is another problem because electromagnetic waves are absorbed and reflected in the mines. Because of many corners in

the tunnel, Wave cannot cross these corners. The modern world and its researches has made a tremendous change in the field of computer science and engineering. The mining industries are facing many problems due to explosion and gas leakage in mines. To overcome this problem robot has been developed .Robots are developed to work in mines so human work is replaced by robots. This mine detecting robot is used for detect the gas leakage using MQ-4 sensor and wireless camera take picture of mines. This robot can move in any type of field and also capable of climbing steps. The movement of robot is controlled by a remote which communicate with the robot through blue tooth.

2 LITERATURE SURVEY

Belkacem K has proposed in an endeavor on the concept of multi-robot intellect referred to as SR(swarm robotics), inspired by the nature and observing groups such as groups of ants, flock of birds, schools of fish and groups of bees. In SR, if a group of robots performs a task in an intellectual approach then they are referred to as SI (swarm intelligence), it is a passive networking system in which every distinct bot of the group interacts with one another and with the outside ambiance. The field deals with the design of a large number of simple robots, their physical properties, and their controlling behavior. There are various simulation platforms that are used to test the structure and algorithm of swarm robots.

R. Imtiaz, has proposed a work on implementing two different kinds of robots, which included an explorer robot and a carrier robot. In this configuration there are four robots, one master robot or explorer robot which works as the leader and three slave robots or carrier robots. The explorer robot travels the entire path set towards target and gives the instruction about the path to the carrier robots. Carrier robots follow the path according to master robots command. Thus, any work can be completed in less time and much efficiently. Zigbee module is used as the communication device for the intercommunication between robots, and is used in each robots.

Mohd. Daneel Khan, et al has proposed work on the application of S-bots in disaster management. Swarm intelligence provides a collective work to perform a certain task which is much accurate and efficient. During earthquakes when large number of buildings fall down and lots of people are trapped under the building swarm it is impossible by humans to reach that places and rescue people. In this situation swarm of learning, birds can be used to provide the information about the areas and give data to make accurate decisions. It is also used for locating a safe location and to give the exact path of the location.

Abhishek, P. Bharath, et al gas leakage can be detected by using the gas sensor, when a small amount of gas is brought near the sensor it starts alerting the user about the leakage of the gas using iot. P. M. Vidya, S. Abinaya,

G. G. Rajeswari, and N. Guna, et al has suggested that the leakage of the gas can be detected by using various gas sensors

Kavitha B et al has designed an alarming system for the industry based on the huge amount of leak of gas from the container

alpesh Gupta et al has designed an automatic window opening system when the gas is leaked at a certain amount of volume continuously.

Fraiwan, L., Lweesy, K., Bani-Salma, A., & Mani,N. (2011, February). A wireless home safety gas leakage detection system. In 2011 1st Middle East Conference on Biomedical Engineering (pp. 11-14). IEEE

Faisal, M. M. A., & Rahman, S. M. (2017). Arduino based gas leakage detector with short message service and sound alarm. Journal of Emerging Trends in Engineering and Applied Sciences, 8(3), 113-116.

Vijayalakshmi, S. R., & Muruganand, S. (2016). Real time monitoring of wireless fire detection node. Procedia Technology, 24, 1113-1119.

Nagaosa, R. S. (2014). A new numerical formulation of gas leakage and spread into a residential space in terms of hazard analysis. Journal of hazardous materials, 271, 266-274.

hen, T. H., Yin, Y. H., Huang, S. F., & Ye, Y. T. (2006, December). The smoke detection for early firealarming system base on video processing. In 2006 International Conference on Intelligent Information Hiding and Multimedia (pp. 427-430). IEEE.

Nahid, A. A., Hasan, M. T., & Bairagi, A. K. (2019, December). Simpler Design for Liquid Supply Line Leakage Monitoring. In 2019 International Conference on Sustainable Technologies for Industry 4.0 (STI) (pp. 1- 5). IEEE.

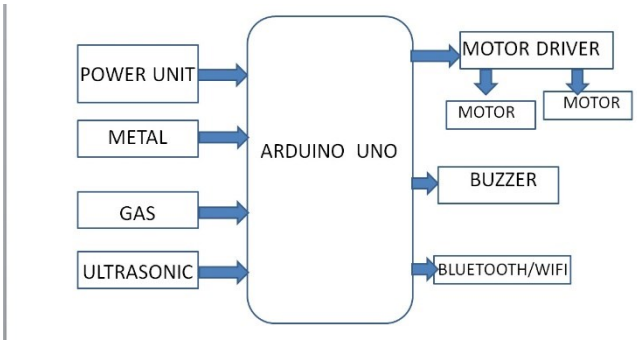
Hazardous Gas Detecting Rescue Robot In Coal Mines T S Kumar Reddy, G Bala Siva Krishna describes that it is harmful for the rescures to get into the mines without the prior knowledge of the environment. Because explosion may occur at time. The explosion may be landslide, gas leakage, high temperature and others. To detect the explosion such as toxic gas and high temperature a robot is developed. This robot has a wireless camera for monitoring purpose.

Coal Mine Robot For Detection Of Hazardous Gas S. D. Mitragotri, Dr.A.R. Karwankar describes that safety of human is important. Accidents occur due to poisonous gas (CH4), CO, CO2 and low O2 content. The robot moves inside the coal mines it detects the gas

leakage and transmits the leakage range through Zigbee.

Hazardous Gas And Mine Detecting Robot Sharathsethuraghavan, Jasim M describes that gas detecting robot is a new generation robots which provides an answer to the problems ofcoal mines and provide an ease to the militant operations in war fields. The robotic vehicle is attached with sensor and wireless camera .Sensor detects the poisonous gas and camera is used for capturing pictures and videos. Advanced Rescued and Monitoring for Coal Mine Jayant Nivritti Patil describes that rescue operation in coal mine is extremely dangerous. It is danger for the workers to get into the mine without any prior knowledge of the environment in mines. Explosive may occur at any time so to detect the explosive like toxic gases, high temperature and others robot is used in mines.

3. PROPOSED METHODOLOGY



The proposed Arduino-based robotic system provides several advantages tailored to the unique demands of the electrical field. By integrating a metal sensor, gas sensor, ultrasonic sensor, buzzer, and Wi-Fi module, this robot is specifically designed to operate safely and efficiently in narrow and hazardous electrical environments. Key advantages of this proposed system.

Enhanced Safety for Operators The proposed system significantly reduces the need for human entry into hazardous and confined spaces by automating inspection and hazard detection. The metal and gas sensors detect potential risks, such as live electrical wires and toxic gases, minimizing human exposure to dangerous conditions. By enabling remote monitoring and control through Wi-Fi, operators can assess risks and manage the robot's movements from a safe distance.

Real-Time Hazard Detection and Alerting Equipped with a metal sensor and gas sensor, the robot provides real-time hazard detection for potential electrical and gas threats. The buzzer serves as an immediate alert system that activates upon detecting hazards, giving real-time feedback to both the robot and the remote operator. This instant response mechanism helps prevent accidents by quickly notifying the operator and facilitating prompt decision-making.

Efficient Navigation in Confined Spaces The ultrasonic sensor allows the robot to navigate in narrow and complex environments, enabling it to avoid obstacles and adapt to confined spaces common in electrical facilities. This capability is crucial in settings like substations, cable ducts, and transformer rooms, where maneuverability and obstacle avoidance are essential for safe operation.

Remote Monitoring and Data Transmission The Wi-Fi module enables the robot to transmit sensor data to a remote operator, allowing for real-time monitoring and control. This feature not only enhances safety by keeping operators at a safe distance but also provides continuous data logging for analysis and maintenance planning. This advantage is especially valuable in industrial facilities where predictive maintenance is essential for operational efficiency.

Cost-Effectiveness and Flexibility Built on the Arduino platform, the proposed system is highly cost-effective compared to specialized industrial robots. Arduino's versatility allows for easy integration of various sensors, and the platform's programmable nature enables modifications and customizations as needed. This flexibility ensures that the robot can be adapted to various applications within the electrical field without incurring excessive costs.

Reduced Maintenance Downtime By offering real-time data on environmental hazards and structural conditions, the robot enables predictive maintenance. Operators can identify and address potential issues before they become severe, thereby reducing unexpected breakdowns and maintenance downtime. This proactive approach to maintenance helps extend the lifespan of electrical equipment and improves overall operational efficiency.

4 CONCLUSION

This paper aims to ensure the monitoring and detection of hazardous gases to meet safety standards. The system detects gas in the atmosphere and continuously updates and displays the gas values which can be easily viewed by the user via a LCD screen. The system is quite responsive and can stop crisis situations more quickly than manual methods. The system alerts and responds to leakage by alerting the user. In the future, this system will be packed with advanced features to provide users with greater security and

relaxation. The popularity of handheld devices has advanced the field of smart gas sensors, greatly expanding the range. The need to ensure workplace safety is expected to be the main driver of the market in the upcoming years.

This paper presents a robotic system designed for electrical field applications in hazardous and confined spaces. The integration of multiple sensors, IoT-based monitoring, and a robust mobility system ensures efficient fault detection and remote diagnostics. Future work will focus on AI-driven autonomous navigation and enhanced energy efficiency.

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