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Security Robot and Surveillance

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Abstract: ***From the recent years, robotics has turned out to be an ingredient over which many people had shown their interest. Robotics has gained popularity due to the advancement of many technologies of computing and nano technologies. So, we have decided to design something that can make humans life easier and comfortable. There are many possibilities a fire can start in an industry or in any remote area. For example, in cotton mills, garments, fuel storages, etc., electric leakages can lead to huge damage. Fire incident is a disaster that can potentially cause the loss of life, property damage and permanent disability to the affected victim. Fire fighters often exposed to higher risks. With the advent of technology, humans are replaced with robots in life-threatening situations. We aim to design a robot capable of detecting fire and smoke. By designing and implementing a security robot capable of detecting fire, disasters can be avoided with minimal risk to human life.***
Keyword: Robot, Detection, IOT, Embedded system,

I. INTRODUCTION

Security is a top priority for businesses, organizations, and homeowners alike. With the increasing risks of fire outbreaks and other hazards, it has become imperative to invest in cutting-edge technologies that can provide reliable security solutions. That's where the Arduino-based security robot comes in - an innovative, next-generation solution for fire detection and obstacle avoidance.

The Arduino-based security robot is a powerful, advanced system designed to navigate through complex environments with ease while detecting fire hazards in real-time. It utilizes state-of-the-art technology to provide a comprehensive security solution for various industries and sectors. With a wide range of sensors, this robot can detect fire hazards in their early stages and alert the user to take necessary action. It can also detect obstacles in its path and intelligently navigate around them, ensuring it can move freely and avoid any potential hazards. This security robot is designed to be user-friendly, making it easy for anyone to set up and use. The robot can be programmed to move around a specific area, such as a warehouse or building, ensuring comprehensive coverage of the space. In the event of a fire, the robot will automatically detect the threat and send an SMS alert to the user, providing crucial information to take action. This feature ensures that the user is informed of the fire outbreak in real-time, allowing them to take prompt action to contain the fire. The robot's flexibility and versatility make it an essential addition to any security system. It can be integrated with other security systems such as CCTV cameras, access control systems, and other sensors, creating a comprehensive security solution. This robot's adaptability also means that it can be used in various sectors, including industrial, commercial, and residential properties. In conclusion, the Arduino-based security robot is a cutting-edge solution that provides reliable security against fire hazards and other potential hazards. Its advanced features, including fire detection, obstacle avoidance, and SMS alerting, make it an essential addition to any security system. Investing in this security robot ensures that you have a reliable system in place to protect your business, property, and people against unforeseen events.

A. Problem Definition

To develop an Arduino based Security robot that is able to detect fire and able to send alert SMS to the user.

II. LITERATURE SURVEY

A. A Tranquil Smart Robot for Home Security using Arduino by Kranthi Kumar K, Pamireddy Sindhu

The use of robotics has become increasingly popular in recent years, and robots have been developed for various purposes, including home security. The development of robots for home security is important to provide people with an additional level of safety and security. Various approaches have been proposed to develop robots for home security, and one such approach is proposed in the paper "A Tranquil Smart Robot for Home Security using Arduino" by Kranthi Kumar. The paper presents a smart robot that can be used for home security and is designed using an Arduino board and various sensors such as PIR, Ultrasonic, and LDR sensors. The robot can be controlled remotely using a smart-phone application and has features such as motion detection, intruder alert, and automatic lighting. The robot is equipped with a PIR sensor, which can detect the motion of humans and animals within its range.

The Ultrasonic sensor is used to measure the distance of the object from the robot, and the LDR sensor is used to detect thelight levels in the environment. The robot candetect when it is dark, and it will turn on the lights in the area to alert the homeowner. The paper also presents the experimental results ofthe robot, which showed that the robot was able to detect motion accurately and send alerts to the homeowner. The robot was also able to turn on the lights automatically when itwas dark. The results of the paper showed thatthe robot was effective in providing an additional level of security to the home.

B. Design and Fabrication of Robot for Surveillance using Arduino by N. Pugazhenthi , K.VinuLakshmi, V.Preneeth,K.Shrivani

The paper "Design and Fabrication of Robot for Surveillance using Arduino" by N. Pugazhenthi, K. VinuLakshmi, V. Preneeth, and K. Shrivani proposes a robot for surveillance that is designed using an Arduinoboard and various sensors such as Ultrasonic, PIR, and LDR sensors. The robot can be controlled using a smart phone applicationand can move autonomously. The robot can also detect and track objects, and it can send live video footage to the user. The experimentalresults of the robot showed that it was effective in detecting and tracking objects and sending live video footage. The related works in the field, such as "Design and Implementation of Wireless Controlled Surveillance Robot usingArduino" by N. V. Patil et al., "Design of a Mobile Robot for Surveillance" by A. E. Balasubramanian and S. Balasubramanian, and "Design and Implementation of a RoboticPlatform for Remote Surveillance" by A. A. Oke et al., have also proposed robotic systems for surveillance using different boards and sensors. These works have demonstrated the potential of using robots for surveillance and the effectiveness of different approaches.

In conclusion, the development of robots for surveillance has gained attention due to their ability to operate autonomously, cover a large area, and gather data in real-time.The paper "Design and Fabrication of Robot for Surveillance using Arduino" by N. Pugazhenthi, K. VinuLakshmi, V. Preneeth, and K. Shrivani proposes

C. Surveillance Robot Using Arduino Microcontroller, Android APIs and the Internet" by Durgesh Chandraker and Shirpad Desai

The paper "Surveillance Robot Using Arduino Microcontroller, Android APIs and the Internet" by Durgesh Chandraker and Shirpad Desai presents a surveillance robot that is designed using an Arduino microcontroller, Android APIs, and the internet. The robot can be controlled using an Android application and can move autonomously. It can also detect and track objects, and send live video footage to the user. The design of the robot is described in detail in the paper, along with the experimental results. Previous works on using robots for surveillance include "Design and Implementation of Wireless Controlled Surveillance Robot using Arduino" by N. V. Patil et al. (2017) and "Design and Fabrication of Robot for Surveillance using Arduino" by N. Pugazhenthi et al. (2020). These papers also propose surveillance robots that are designed using Arduino boards and various sensors, and can detect and track objects while sending live video footage to the user. The use of robots for surveillance has gained popularity due to their ability to operate autonomously and gather data in real-time.

D. IOT Based Surveillance Robot by Anandravisekar, Anto Clinton, Mukesh Raj, Naveen,

The use of Internet of Things (IoT) in robotics has resulted in the development of intelligent and efficient surveillance robots. These robots can gather data, perform real- time analysis and communicate with other devices, making them useful for surveillance and security applications. In this literature survey, we will discuss the paper "IoT Based Surveillance Robot" by G. Anandravisekar, A. Anto Clinton, T. Mukesh Raj, and L. Naveen, all undergraduate students. The paper presents a surveillance robot that is designed using IoTtechnology. The robot uses a Raspberry Pi as its main controller and various sensors such as Ultrasonic and PIR sensors to detect and trackobjects. The robot can be controlled remotely using an Android application and can also send live video footage to the user. The paperdescribes the design of the robot in detail and presents the experimental results of the robot.

III. EXISTING SYSTEM

There are various types of security robots that are equipped with fire detection sensors and can detect fires in different environments. Here are a few examples:

1) *Knightscope K5:* This security robot is equipped with thermal imaging cameras that can detect heat signatures and identify potential fire hazards. The K5 can alsoalert security personnel or emergency services in case of a fire.
2) *Rovenso Firebot:* The Rovenso Firebot is a wheeled security robot equipped with a thermal camera and gas sensor that can detect and locate fires. The Firebot can also be programmed to navigate through smoke and flames to provide real-time information to emergency responders.
3) *UVD Robots:* The UVD Robot is a disinfection robot that can also be used forfire detection. The robot is equipped with athermal camera that can detect temperaturechanges and alert the user if a fire is detected.

4) *Robo-Team Probot:* The Robo-Team Probot is a multi-functional security robot that can be equipped with a range of sensors, including fire detection sensors. The robot can detect smoke and fire, and can also be programmed to activate sprinkler systems or fire suppression equipment in case of a fire. Overall, security robots equipped with fire detection sensors can help to improve safety and reduce the risk of fire-related incidents in various environments.

A. Disadvantages

1) *Limited Effectiveness:* Security robots rely on sensors and cameras to detect fires, which means that their effectiveness can be limited if there are obstructions or if the sensors are not calibrated correctly. In addition, certain types of fires may not be detected by these sensors, such as slow-burning fires that produce little smoke or heat.
2) *Maintenance and Calibration:* Security robots require regular maintenance and calibration to ensure that their sensors and cameras are functioning properly. This can be time-consuming and expensive, and if the robot is not properly maintained, it may not be able to detect fires accurately.
3) *Cost:* Security robots equipped with fire detection sensors can be expensive to purchase and maintain, which may make them cost-prohibitive for some organizations.

IV. PROPOSED SYSTEM

The proposed project is an Arduino- based security robot that is designed to detect fire, send an SMS notification to a user when fire is detected, and provide live view. The robot is equipped with a flame sensor that can detect the presence of fire, When a fire is detected, the robot will send an SMS message to a user, alerting them to the danger. Overall, this project aims to create a useful tool for fire prevention and management that can be automatically operated by Arduino to minimize damage and prevent loss of life in the event of a fire.

1) The robot is equipped with a range of sensors and components to detect fires and obstacles. IR sensors to detect obstacles, and motor drivers to control the movement of the robot.
2) The implementation of this robot will increase the safety of fire fighters and therefore help mitigate deaths from unsafe conditions.
3) The whole and sole purpose behind making this robot is to ease the human workload.
4) This will help people to easily prevent the fire without any problems. The whole and sole purpose behind making this robot is to ease the human workload.

V. BLOCK DIAGRAM

1) The main brain of this project is the Arduino, but in-order to sense fire we use the Fire sensor module (flame sensor) these sensors have an IR Receiver (Photo-diode) which is used to detect the fire.
2) We detect the direction of the fire we can use the motors to move near the fire by driving our motors through the motor controller of DC.
3) Fire sensor: A Flame Sensor is a device that can be used to detect presence of a fire source or any other bright light sources. There are two types of implementations of Flame Sensors using YG1006 Photo Transistor: one is with both Analogue Output and Digital Output while the other is with only the Digital Output.
4) SIM module: When the fire is detected the SIM module is responsible for sending alert messages to the user.

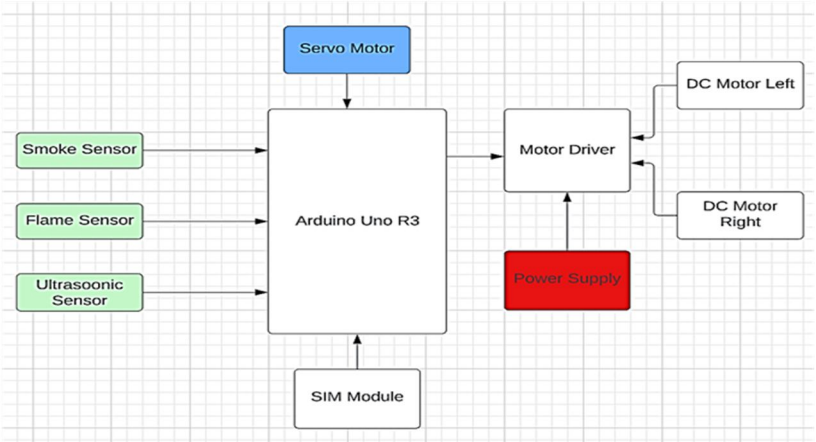

Fig. 1: Block diagram

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VI. CIRCUIT DIAGRAM OFOBSTACLE DETECTION:

An Arduino-based security robot is a robotic device designed to provide security surveillance by detecting and avoiding obstacles while moving. The robot is equippedwith an ultrasonic sensor that emits soundwaves and measures the time it takes for the waves to bounce back from any nearby obstacles. The time it takes for the sound waves to return to the sensor is used to calculate the distance between the robot and the obstacle.

The working of the Arduino-based security robot can be broken down into severalsteps. First, the hardware setup involves connecting the two DC motors to the motor driver and connecting the motor driver to the Arduino. The ultrasonic sensor is then connected to the Arduino board. Once the hardware setup is complete, the next step is initialization. During initialization, the motor driver and the ultrasonic sensor are initialized to prepare for operation. After initialization, the ultrasonic sensor measures the distance between the robot and any obstacles within range. The sensor sends this information to theArduino, which then analyses the data to determine whether there are any obstacles within a specific distance range that require the robot's attention.

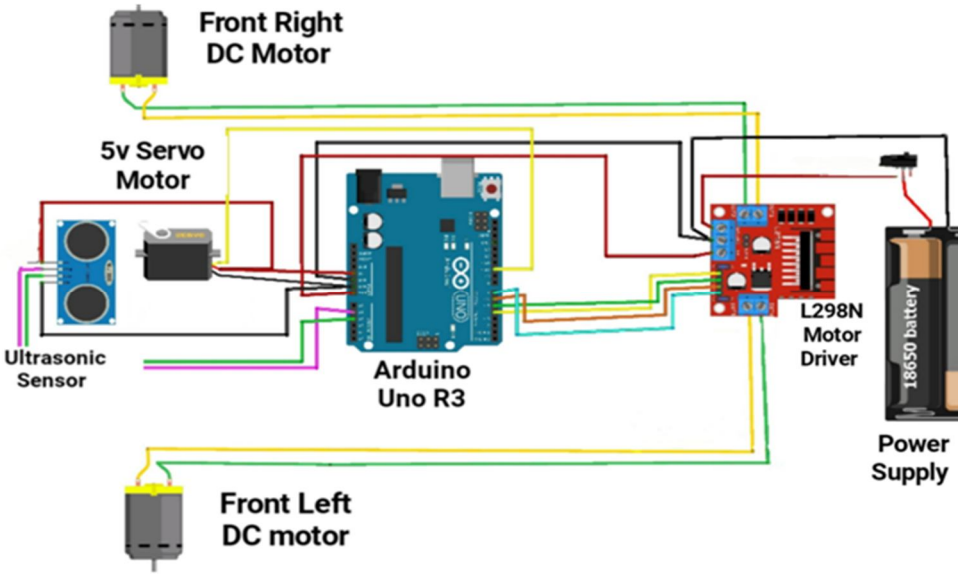


Fig.2: Circuit Diagram of Obstacle avoidance

If an obstacle is detected, the Arduino sends signals to the motor driver to control the movement of the robot. The motor driver controls the speed and direction of the two DC motors connected to the robot. The robot will then move in the direction away from the detected obstacle.

The process of measuring distance and detecting obstacles, followed by controlling the movement of the robot using the motor driver, is repeated in a loop. This ensures that the robot is continually scanning for obstacles and making the necessary adjustments to avoid them while moving.

In summary, an Arduino-based security robot that uses an ultrasonic sensor to avoid obstacles while moving is a complex system that involves several steps. The ultrasonic sensor measures the distance between the robot and any obstacles, and the Arduino analyzes this data to determine whether there are any obstacles within a specific distance range.

If an obstacle is detected, the Arduino sends signals to the motor driver to control the movement of the robot, which then moves away from the obstacle. This process is repeated in a loop, ensuring that the robot is continually scanning for obstacles and making the necessary adjustments to avoid them while moving.

VII. CIRCUIT DIAGRAM OFFIRE DETECTION

The board has a micro-controller unit, which can be programmed using the Arduino IDE software to perform specific functions.

The smoke sensor is a key component of the fire detection system. It detects smoke particles in the air and sends a signal to the Arduino Nano when smoke is present. The sensor can be connected to the Arduino usingdigital or analogue pins. The Arduino reads the sensor output to determine if there is smokepresent. The smoke sensor used in this systemis typically a photoelectric sensor, which usesa light source and a photosensitive element todetect smoke.

The SIM800L GSM module is a communication module that allows the Arduino to send text messages and make phone calls. It is connected to the Arduino

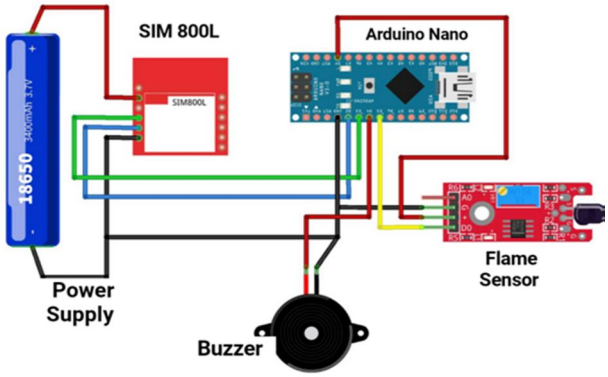


Fig.3: Circuit diagram of Fire detection

Nano through serial communication and is programmed to send a message to the user's phone number stored in the code. The modulerequires a SIM card to work, and the user mustset up a data plan to send text messages and make phone calls.
When smoke is detected, the Arduino sends an alert message to the user's mobile phone using the SIM800L module.. Additionally, the system can also be programmed to make a phone call to the user's phone number to alert them about the fire.
The buzzer is another key component of the fire detection system. It is connected to the Arduino and is triggered when smoke is detected. The buzzer provides an audible alarm to alert people in the vicinity about the fire.

VIII. SURVEILLANCE MODULE

The process begins with the cameramodule capturing an image and storing it in the memory of the ESP32 module. The ESP32-S module is a powerful micro- controller with dual-core processors, Wi-Fi, Bluetooth, and numerous GPIO pins, which makes it easy to integrate into various projects. The camera module, on the other hand, features an OV2640 camera sensor, which supports a maximum resolution of 1600x1200and can capture images and video at high frame rates. Once the image is stored in the memory, the OpenCV library is used to analyzeand detect objects in the image. The OpenCVlibrary is an open-source computer vision and machine learning software library that is widely used in object detection, face recognition, and image processing applications. It provides various algorithmsand techniques for image processing and computer vision, which makes it an ideal choice for object detection on the ESP32- CAM. The OpenCV library uses algorithms toprocess the image data and identify objects based on their characteristics such as shape, colour, and size. It can detect objects in real- time and can be customized to detect specific objects based on user-defined parameters. After the object detection process is completed,the results are typically sent to a connected device such as a computer or a mobile phone for further processing and visualization. The ESP32-CAM can send the data using various communication protocols, such as Wi-Fi, Bluetooth, or Ethernet. If the ESP32-CAM is connected to a Wi-Fi network, it can use the network to send the data to a server or a cloudplatform for further processing and analysis. This allows for real-time monitoring of the detected objects from remote locations. The ESP32-CAM is highly configurable and can be programmed using the Arduino IDE, making it accessible to both beginners and experienced developers. It also supports a range of programming languages, including MicroPython, Lua, and JavaScript. This makesit easy to customize the object detection process and integrate it with other projects.

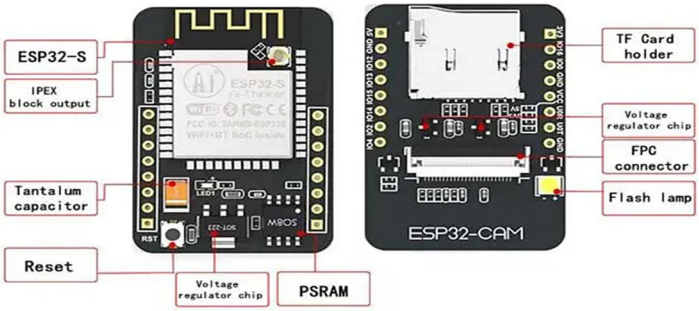


Fig. 4: ESP32 Cam

In summary, data travels in an ESP32- CAM that is set up for object detection using OpenCV by capturing an image using the camera module, processing the image using the OpenCV library to detect objects, and then sending the results to a connected device or a remote server for further processing and analysis using various communication protocols. The ESP32-CAM is a versatile and powerful development board that can be used for a wide range of projects, including those requiring wireless communication and image processing.

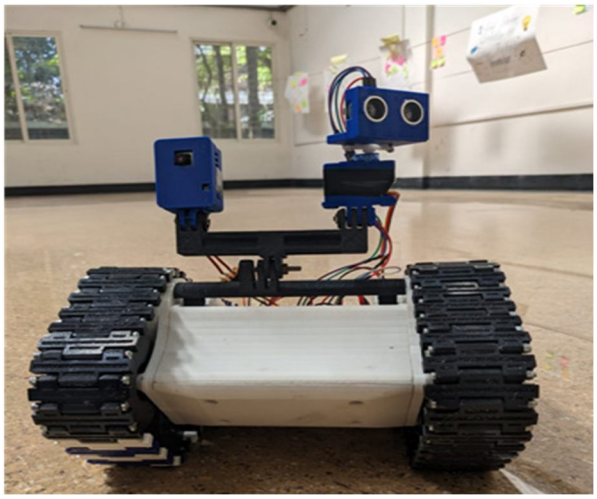
A. Advantages Of ProposedSystem

1) Analyzing and locating fires. Monitoring hazardous variables.
2) Provide live view of the environment
3) Can provide precise location of the fire and alert the user.
4) Fast response time

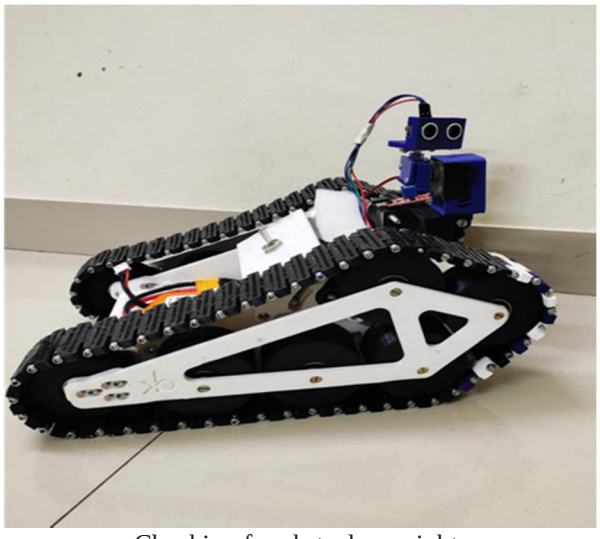
B. Limitations

1) Not able to detect the cause of the fire short circuit, gas, etc.
2) Very little working time – As the system works on batteries the working time is small.

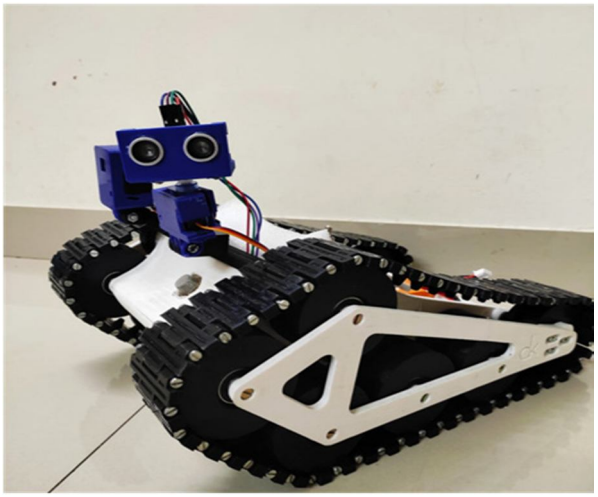
IX. RESULT AND OUTPUT



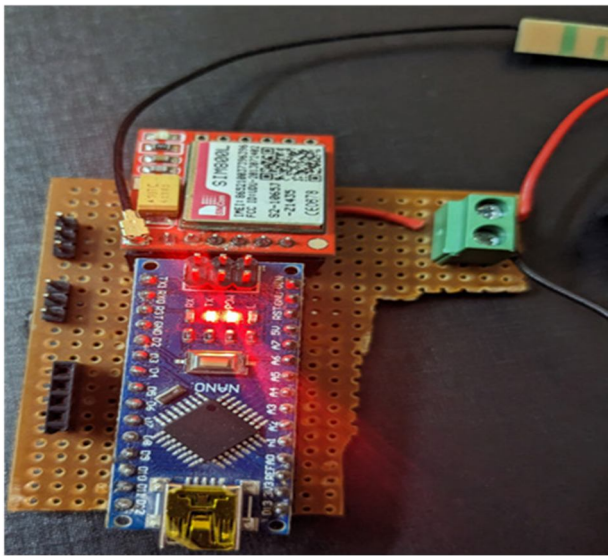
Checking for obstacles on Left



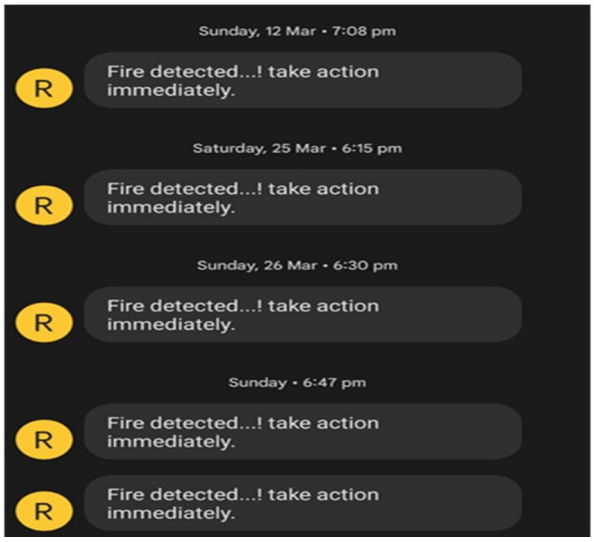
Checking for obstacle on right



Obstacle Detected on Left hence robot issearching for free path on right



Fire Detection Module Working



Fire alert SMS sent by Robot

X. CONCLUSION

In today's world, safety and security have become a top priority for individuals andorganizations alike. The rise of technology has given us the ability to monitor and control ourenvironment in ways that were once thought impossible. One such technology is the Arduino microcontroller, which has become increasingly popular due to its ease of use, flexibility, and affordability. Combining the power of Arduino with other components suchas fire sensors and ESP32 cam modules, we can create a sophisticated security system thatcan detect fire, send SMS notifications to the user, and provide live footage of the situation at hand.

The Arduino-based security system with fire detection is an excellent example of how technology can be harnessed to keep us safe. The system comprises of various components that work together to detect any potential fire hazards and provide real-time updates to the user. The fire sensors are the first line of defence, constantly monitoring the environment for any changes in temperature that may indicate the presence of fire. Once a fire is detected, the sensors send a signal to the Arduino microcontroller, which then triggers a series of actions to alert the user and preventthe fire from spreading.

One such action is the ability to send SMS notifications to the user, alerting them tothe presence of a fire and providing informationon the location and severity of the situation. This feature is critical, as it allows the user to take immediate action and notify emergency services if necessary. The system also has theability to provide live footage of the situation using the ESP32 cam module, allowing the user to see the extent of the fire and assess thesituation in real-time.

The benefits of an Arduino-based security system with fire detection and SMS notifications are many. Firstly, it provides a level of safety and security that was once only available to larger organizations. This system is affordable and easy to install, making it accessible to anyone who wants to improve their home or workplace security. Secondly, the system provides peace of mind, knowing that you are always aware of any potential firehazards and can take immediate action if necessary. Finally, the system is customizableand adaptable, allowing for upgrades and improvements as technology evolves.

In conclusion, an Arduino-based security system with fire detection and SMS notifications, along with live footage using anESP32 cam, is an innovative and practical solution to enhancing security in homes and workplaces. The combination of fire sensors, Arduino microcontroller, and ESP32 cam module offers an efficient and effective way tomonitor and respond to emergencies in real-time, providing valuable insights into potentially dangerous situations. This system is an invaluable tool for enhancing security and keeping people safe, and its benefits make it an ideal solution for any security-consciousindividual or organization.

XI. FUTURE SCOPE

1) *Integration with Artificial Intelligence (AI):* AI algorithms can be used to improvethe accuracy of fire detection and enhancethe robot's ability to make quick decisionsin critical situations.
2) *Integration with Internet of Things (IoT):* The robot can be connected to other smartdevices and systems, allowing it to receive and transmit data in real-time and respondmore effectively to fires.
3) *Wireless Communication:* The robot can be equipped with wireless communicationtechnology, enabling it to communicatewith other robots and fire-fighting equipment for coordinated fire-fighting operations.
4) *Improved Power Management:* The robot can be designed with more efficient power management systems, allowing it to operate for longer periods of time and perform more tasks.

XII. ACKNOWLEDGMENT

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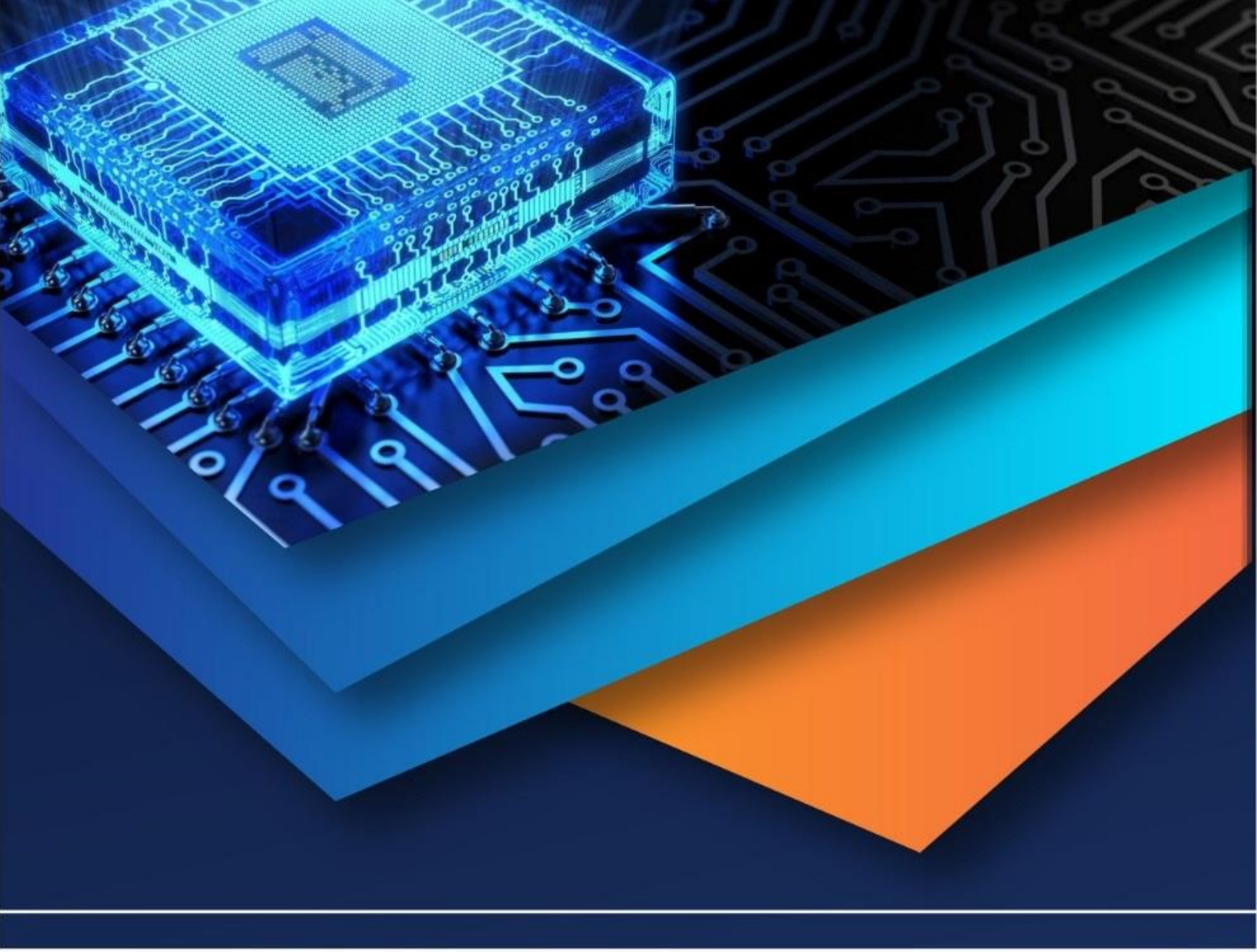

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