IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

SURVEILLANCE AND FIRE FIGHTING ROBOT

[1]P. Madhuri, [2]P. Harsha Veena, [3]K. Amrutha, [4]T. Meghana, [5]D. Aishwarya
[1]Asst. Professor, [2]Student, [3]Student, [4]Student, [5]Student
Department of Electronics and Communication Engineering,
G. Narayanamma Institute of Technology and Science (For women), Hyderabad, India.

Abstract: All areas of robotics and automation have undergone a qualitative change as a result of technology. Robots are widely utilized in a variety of fields today, including the military, academia, business, and research and development. A spy robot is a computerized device that is carefully programmed to carry out all of the programmed tasks, aiding in the replacement of human tasks with extremely accurate outcomes and easily surpassing human limitations. Disasters can be averted with little risk to human life by building and implementing an autonomous robot capable of surveillance, detection, and extinguishing flames. The goal of this project is to create a robot using an Arduino, an ESP32 camera, DC motors, sound sensors, fire sensors, and a water tank. The Arduino microcontroller is primarily responsible for regulating robot behavior. Our project's goal is to create a robot that continuously monitors all activity in a catastrophe region. It is designed to detect any type of fire with the aid of sensors and extinguish it by constantly sprinkling water until the fire and smoke go out. A camera and wireless transmitter for real-time video with vision capabilities are also included.

The robot is outfitted with a wireless camera that can relay live video of its surroundings. Four DC motors connected to a motor drive make up the robot, which is powered by a single 12V battery throughout. The water tank within can extinguish the fire when it has been discovered by a fire sensor. If the sound is heard, the robotic vehicle travels forward with a certain intention, pauses at a specific location, and then advances to the next place. Then it will use its camera to scan the surroundings to look for any exposed human faces. As soon as a human is captured, the robot immediately begins to transfer that image. In this study, we demonstrate an autonomous robot that can spot interior fires and move towards them to put them out. This enables wireless remote operation of a firefighting robot equipped with a water tank for putting out flames. Following processing of the commands, the DC motors are made to move the robot in the desired directions. In order to spray water, it also drives the pump direction motor and the water pump motor.

Keywords - Surveillance, Fire Fighting, Extinguishing, Robot, Arduino, ESP32 Cam, Sound Sensors, Wireless Camera, Fire Sensor, Water Tank, Water Pump.

I. INTRODUCTION:

The act of surveillance can be carried out by humans or with the aid of embedded technologies like robots and other automation equipment both indoors and outside. Any machine that operates automatically and takes the place of people. Robotics is a growing solution to guarantee the protection of the environment and human life. Robots are utilized in many ways to increase security. They can function in settings where humans are unable to. Firefighters are called in when a fire gets out of hand. But due of the intense fire, rescue workers frequently suffer injuries. A firefighting robot can help prevent accidents of this nature. Although firefighting is a crucial job, it is also an extremely risky one. Robots are made to locate fires before they spread out of control as a result. It could be utilized in conjunction with firemen to lessen the possibility of injuries to both victims and firefighters.

The term "autonomous fire fighter robot" refers to a robot that can detect and put out fires on its own. It employs a fire sensor to do so and a fire extinguisher to do so. The sensors mounted on the sides of the robot allow it to spin while actively searching for fire. Once the fire is found, the robot may proceed in its direction, halt in front of it, and activate an extinguisher to put it out. The purpose of this project is to create a fire-extinguishing robot. It is anticipated that this firefighting robot design would result in a little yet incredibly strong and adaptable robot. In the disaster-prone location, it finds fire. This will be put into practice using an Arduino board. By detecting the barrier and moving in the direction where there are no obstacles, the fire detection robot avoids the issue of running into it in this situation.

We have used IOT in the project's functioning model. A network of physically connected, networked objects that can be accessed online is known as the Internet of Things (IoT). The term "thing" refers to an object that has been given an IP address and the capability to gather and send data over a network without the help of a person or human intervention. Examples of such objects are a person wearing a heart monitor or an automobile with built-in sensors. The objects' inherent technology enables them to interact with interior conditions or the outside world, which has an impact on the choices made. In our project, we are in charge of driving our robot and issuing the necessary commands.

II. LITERATURE SURVEY:

In industrial settings and even in homes where there is a higher risk of accidental fire, fire-fighting robots may be utilized. Different sensors are used, and an intelligent algorithm in the Arduino computing platform or soft computing techniques is used to ensure the fusion of their performances. Su et al's Adaptive Fusion Algorithm-based automatic fire detection system (AFA). His research used the Multi-Sensory Fire Detection System (MSFDS) and Visual Basic to receive data, and a general interface for supervised computers was created.

Viguria et al. [2] built a robot team consisting of an aerial and a ground robot for fire detection. They coordinated between airborne and ground vehicles using the S+T disrupted market-based algorithm. Their simulations demonstrated that as the quantity of services expanded, so will the need for communication and energy.

Nam Khoonet.al [3] created an Autonomous Firefighting Mobile Platform (AFFMP) with the goal of early fire detection. The AFFMP is outfitted with the essential fighting tools and may patrol across a dangerous site using a guiding track. When leaving the patrolling route, the AFFMP's tasks include avoiding obstacles, using the front flame sensor to locate the fire source with more accuracy, and putting out the flames. Robots for battling fires outside were the focus of their development. Ko et al. [4] provide a vision sensor-based fire detection technique for early warning. For verifying fire pixels, they created an AVM classifier.

Kim et al. [5] created a portable fire evacuation guide robot who showed how it could be tossed into a fire to acquire information, find displaced individuals, and evacuate them. The robot was built from aluminum compound metal for thermal resistance, waterproofing, and impact resistance, along with an impact distribution frame. A vehicle-mounted firefighting system was created by White et al. [6] and included several flame and heat resistant covers applied to all exposed system components to prevent damage from exposure to severe heat. The main goal is to create a self-contained, autonomous firefighting robot that uses Arduino-based fire detection and extinguishing algorithms and is built from locally accessible fire resistant and water-resistant materials. The robot is built with the ability to protect itself from fire by maintaining a safe distance from the source. Sensitivity tests on the sensors and serial monitor data in Arduino are used to assess how well the robot performs at various fire distances and times of day.

Daniel J. et al. [8] designed an autonomous mobile robot that can navigate through a maze in search of a fire (simulated by a burning candle), find the candle's flame, extinguish the flame, and then return to the maze's specified starting point. The firefighting competition encourages collaborative work across disciplines. Three flame sensors were used in the firefighting robot's design by Kuo et al. [9] to create a fire detecting system. For helping firefighting robots identify fire, the adaptive fusion method was suggested. He enhanced the approach using computer simulation so that it could be utilized for fire detection. He integrated a fire detection system into a firefighting robot and programmed a sensor-based system for fire detection and suppression. Chee et al [10].'s thorough analysis of several technologies and cutting-edge mobile robots for battling fires is available online. The study also describes MyBOT2000, the first mobile firefighting robot created and manufactured in Malaysia.

III. HARDWARE DESCRIPTION:

1 Arduino Uno:

A low-power, 8-bit CMOS microprocessor built on the AVR improved RISC architecture is called the Atmel ATMEGA328P.The ATmega328P balances power consumption and processing performance by processing powerful instructions in a single clock cycle to offer throughputs of over 1MIPS per MHz .

3.2 Sound Sensor:

The sound sensor used to notice the sound. Usually, sound intensity is measured using this module. The main uses of this module are for switches, security, and monitoring. The precision of this sensor can be changed for user convenience. This sensor transmits information from a microphone to a peak detector, amplifier, and buffer.

This sensor picks up sound, processes it, and then transmits an o/p voltage signal to a microcontroller. The appropriate processing is then carried out. Cell phones include an Android app called decibel meter that can detect sound levels in decibels, or dBs, between 3 and 6 kHz, which is roughly the range at which the human ear is sensitive.

A potentiometer is built into the Digital Sound Detector Sensor Module to control sensitivity. When the threshold is reached, the module outputs loudly. Less sensitivity indicates that more sound is required to activate the device when referring to sensitivity. More sensitive equipment requires less sound to trigger it.

3.3 Rechargeable Battery:

An electrical battery might be a storage battery, rechargeable battery, or accumulator. One or more electrochemical cells make up this type of energy accumulator. It is referred to as a secondary cell since its electrochemical reactions are electrically reversible. From button cells to megawatt systems connected to stabilize an electrical distribution network, rechargeable batteries are available in a variety of sizes and configurations.

3.4 DC Motor:

In most cases, the interaction of magnetic fields and current-carrying conductors is how a DC motor converts electrical energy into mechanical energy. An alternator, generator, or dynamo performs the opposite operation, creating electrical energy from mechanical energy. The use of electric motors as generators and vice versa is common. A DC motor receives current and voltage as inputs, and produces torque (speed) as an output.

3.5 ESP32 Camera:

The ESP32-CAM is an ESP32-based, compact camera module with low power requirements. It has an OV2640 camera and an internal TF card slot. The ESP32-Cam can be used for a variety of innovative Internet of Things applications, such as wireless video monitoring, WIFI picture upload, QR identification, and others.

3.6 LED:

The Light-Emitting Diodes (LEDs) are a common source of illumination for electrical equipment. It may support a variety of items, including large advertising billboards and mobile phones. A semiconductor called an LED emits light at a specific wave length, or color. When an LED is turned on, the electrons and holes can join again, releasing energy in the form of photons. This is referred to as the electroluminescence effect.

3.7 Fire Sensor:

A fire sensor is a sort of detector that can both detect and respond to the advent of a fire or flame.. Due to the mechanics it employs to detect the flame, a flame sensor typically reacts quicker & more precisely than a heat or smoke sensor. Flame sensors are typically used to check the efficiency of the furnaces. In an ignition system, these sensors are also employed to get precise actions or, in the absence of such, to alert the operator.

3.8 L239D:

L293D is a popular 16-Pin Motor Driver IC It is mostly used to drive motors, as the name implies. Two DC motors can be operated simultaneously by a single L293D IC, and each motor's direction can be independently regulated.

3.9 Water Tank:

The Water tank is used to store the water which is used to sprinkle on fire i.e., for fire extinguishing.

IV. SOFTWARE DESCRIPTION:

It is a piece of authorized software that Arduino.cc introduced, and it is mostly used for editing, compiling, and uploading code to Arduino devices. With this open source programmed, which is simple to install and use to begin compiling code while on the road, almost all Arduino modules are compatible. Several Arduino modules are available, including the Uno, Mega, Leonardo, Micro, and many others. Each of them has a microcontroller on the board that can be programmed and accepts data in the form of code. A Hex File that is carried to and uploaded into the controller on the board is created by the primary code, also known as a sketch, that is written on the IDE platform. The Editor and Compiler are the two primary components of the IDE environment. The Editor is used to write the necessary code, while the Compiler is used to compile and upload the code into the designated Arduino Module. Both C and C++ are supported in this environment.

V. WORKING:

A surveillance firefighting robot is an automated device that operates in accordance with instructions and moves to its destination by detecting any sounds using sound sensor or fire using fire sensors, or capturing photographs that can be analyzed by the user. Any robot that may be remotely operated to capture photos or video for certain objectives is referred to as a remote-controlled surveillance robot. Remotely controlled surveillance firefighting robots play crucial roles in the areas of security and rescue.

Arduino Uno is the main processing unit for the functioning of Surveillance robot. The transfer of data from robot to user's mobile after connecting the WIFI to the robot which is present in the ESP32 camera. ESP32 camera has inbuilt WIFI module. Firstly, switch on the robot, then the LED will light up which indicates that the robot is in ON condition. Then switch ON the hotspot in the mobile and connect the WIFI module in the ESP32 camera to the robot which is used for transfer of data. The robot has four sound sensors, ESP32 camera, Arduino Uno, two motors, rechargeable battery. There are three 4V 1A batteries which sums up to 12V 1A power for charging the robot. The batteries have to recharged for 6 to 8 hours before using the robot. After switching ON the circuit, the robot has to be placed in the place need to be monitored. When it detects the sound, it moves in that direction and takes the pictures and send them to the registered email id. The pins 0,1 from Arduino uno are digital input and output pins i.e., Tx and Rx are connected to the ESP32 camera. L239D motor is interfaced with the Arduino Uno and A0, A1, A2 and A3 pins of the Arduino are connected to the four sound sensors.

The robot can be operated to detect in case of theft if user is not available at the home. The robot has four sound sensors, if any sound is detected it starts to move in that direction and it captures the images of that area and by sending images to the user's Email Id. A user can operate a firefighting robot equipped with a water tank to put out flames in their region using a surveillance firefighting robot with a vision camera. The system employs an RF remote control for remote control operation and an RF receive-based microcontroller circuit to control the robotic vehicle. Through user commands based on RF, the receiver circuit receives RF signals. Now, the receiver circuit decodes the transmitted data commands. The microcontroller is then informed about it. Now that these instructions have been processed, the microcontroller directs the robot to operate the dc motor in the proper direction. This enables the operator to control the robot while keeping a safe distance from the flames. Additionally, a wireless camera is put on top of this robot body. This camera aids in steering the robot body in the desired direction. This is due to the fact that the wireless camera's captured region can be viewed on a mobile device for reference. As a result, this technology uses the water tank that is attached to the robot body to safely put out fires at a distance.

VI. BLOCK DIAGRAM:

The Arduino Uno is the microcontroller which is used for the working of Surveillance and Fire Fighting robot. Four sound sensors are connected to the robot in four directions to detect the sound. The Arduino Uno is the microcontroller which is used for the working of Surveillance and Fire Fighting robot. Four sound sensors are connected to the robot in four directions to detect the sound. A ESP32 Camera is mounted on the robot for monitoring the surroundings which has inbuilt WIFI module. Two DC motors

are used to drive the robot in the desired direction. And a L239D is used to drive the motors. A fire sensor is connected to Arduino to detect the fire and water pump is used to sprinkle the water from the water tank in case of fire.

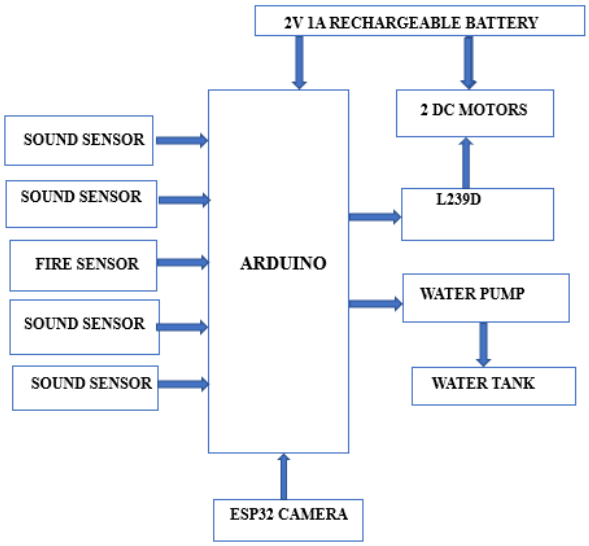

Fig. 1 Block Diagram of Surveillance and Fire Fighting Robot

VII. RESULTS:

According to the project's overview, a surveillance firefighting robot has been successfully capable of detecting robbery and flames putting them out, and successfully taking images using an Android application. When the robot detects sound, it moves in that direction and it captures images and sent images to the Email Id. The robot's mobility is controlled by the motors working together. Upon getting a warning about a dangerous environment i.e., when the fire sensor detects any fire, the motor will begin to rotate and send the robot to that location and start to pump water. This procedure will be carried out repeatedly until the fire or smoke has entirely quenched. The results had appropriate snapshots attached. Consequently, a surveillance firefighting robot has been created to successfully complete the project's goals.

The lives of individuals affected by the fire calamity as well as the lives of those serving as firemen could be saved by firefighting robots in the future. It may be helpful in specific situations where the surrounding environment poses a serious risk to people, such as when radioactivity, toxic materials, or an exploding propane tank are involved. The usage of robots to aid firemen is not a common sight, but there are robotic tools already available for this purpose, such as huge remote-controlled fire extinguishers and bots that can be tossed into a fire site to assess the condition. Where humans are unable to combat the fire, a robot is used. It can locate the fire and move automatically. If there are any obstructions, it can also turn on its own. Once the robot identifies the fire location, etc., it can regularly take several photographs of the fire spot and send them to the central system.

The hardware connections of the robot are shown in fig. 2, whereas the mail received which is captured by the robot when it detects any sound is shown in fig. 3, the picture which is captured by the robot is shown in fig. 4.

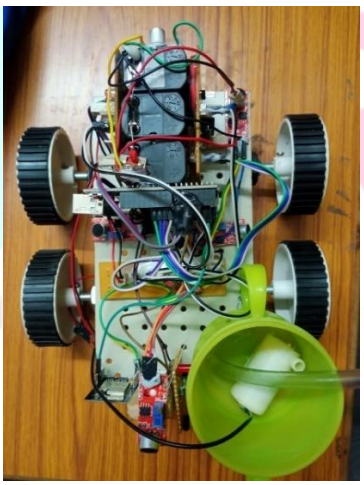

Fig. 2 Circuit Connection

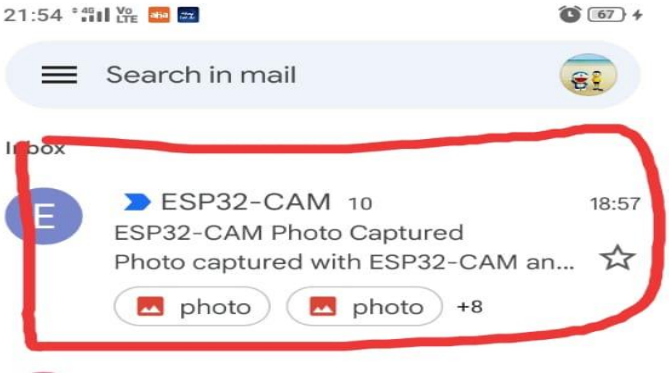

Fig. 3 The Picture of the Received Mail

Fig. 4 Picture Sent to the Mail

VIII. CONCLUSIONS:

The ultimate goal of this experimental robot is to develop a user-friendly spy bot. This surveillance robot can move around with ease, capture images of its surroundings, and wirelessly transmit it. This alerts the user to potentially dangerous situations in the environment and provides a clear picture of the situation. The robot in this instance is built for close-range surveillance while maintaining environmental safety.

Firefighting is the process of putting out fires by dousing them with water. observes the regions that experience natural disasters and bomb explosions. At the location where it is located, the robot measures the temperature. This robot is useful in places that will experience natural disasters and bomb explosions. If a fire is discovered via sensors or manually, a relay circuit activates the water pump mechanism. The effectiveness of the suggested method for both industrial and security purposes has been confirmed. This leads us to the conclusion that a robot can be employed in place of people, lowering the risk to fire fighters' lives. They are useful in our homes, laboratories, offices, etc.

The ESP32 camera assists the user in planning their safety precautions by letting them know about any unexpected activity going on nearby. The surveillance firefighting robot can be manually operated using a laptop or smartphone. Additionally, automatic monitoring is possible. Our suggested robot can fit into spaces that are impossible for humans to access because of its small size. One of the most important technologies in the realm of electronics is wireless technology. This technology is employed as a key component of our project's surveillance strategy. This results in a robot that is highly efficient and economical, which lowers the need for human labor and efficiently performs monitoring tasks.

IX. REFERENCES:

[1] Chinmay Kulkarni, Suhas Grama, Pramod Gubbi Suresh, Chaitanya Krishna, Joseph Antony. “Surveillance Robot Using Arduino Microcontroller, Android Apis and Internet”. Department of Electronics and Communication Engineering, National Institute of Technology, Karnataka, Surathkal, Mangalore, India (2014).

[2] A. Viguria, I. Maza, and A. Ollero, "Distributed service-based cooperation in aerial/ground robot teams applied to fire detection and extinguishing missions," Advanced Robotics, vol. 24, no. 1-2, pp. 1- 23, January 2010.

[3] T. N. Khoon, P. Sebastian, and A. B. S. Saman, "Autonomous firefighting mobile platform," Procedia Engineering vol. 41, pp. 1145- 1153, December 2012.

[4] B. C. Ko, K. H. Cheong and J. Y. Nam, "Fire detection based on vision sensor and support vector machines," Fire Safety Journal vol. 44, pp. 322-329, April 2009.

[5] Y. D. Kim, Y. G. Kim, S. H. Lee and J, H. Kang, "Portable fire evacuation guide robot system."Intelligent Robots and Systems, 2009. IROS 2009. IEEE/RSJ International Conference on, pp. 2789-2794, October 2009.

[6] W. R. White, "Vehicle mounted firefighting system." U.S. Patent No. 5,836,398, November 1998.

[7] Taiser T. T. Barros, Walter Fetter Lages. (2012). Development of a Firefighting Robot for Educational Competitions. RiE 2012,

[8] Prague Daniel J. Pack, David J. Ahlgren. (2004). Fire-Fighting Mobile Robotics and Interdisciplinary Design-Comparative Perspectives, IEEE TRANSACTIONS ON EDUCATION, VOL. 47, NO. 3, AUGUST 2004

[9] KuoL. Su. (2006). Automatic Fire Detection System Using Adaptive Fusion Algorithm for Fire Fighting Robot, 2006 IEEE International Conference on Systems, Man, and Cybernetics October 8-11, 2006.
[10] Taipei Chee Fai Tan, S.M. Liew, M.R. Alkahari, S.S.S. Ranjit, M.R. Said, W. Chen, G.W.M. Rauterberg, D. Sivakumar and Sivarao. (2013) Fire Fighting Mobile Robot: State of the Art and Recent Development, Australian Journal of Basic and Applied Sciences, 7(10): 220-230, 2013 ISSN 1991- 8178