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Wireless Remote Controlled Multi-Purpose Robot using Raspberry PI

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Abstract: *Over the past five decades, robotics and associated technologies have evolved into indispensable components across numerous industries, particularly in advanced manufacturing. Moreover, their application has extended beyond production-centric domains to encompass pivotal roles in military and law enforcement sectors, owing to advancements in sophistication, reliability, and compactness. This paper proposes the implementation of a real-time object detection system capable of precisely identifying and locating recognized objects, presenting a significant and practical advancement. Integrating various modules such as GSM and GPS with a Raspberry Pi, along with an array of sensors including metal and flame sensors, an L293 Motor driver, HC-SR04 Ultrasonic sensor, and HC-05 Bluetooth, this system facilitates seamless recognition and localization of objects in real-time. The Bluetooth connectivity feature enables remote control of the device, while a built-in camera captures images of unidentified individuals, thereby enhancing its surveillance capabilities. The incorporation of a motor driver ensures secure and controlled movement of the robot, while the ultrasonic sensor detects obstacles within its proximity. Additionally, the metal sensor swiftly identifies metallic objects, relaying their locations to the administrator, whereas the flame sensor promptly detects fires, enabling the system to dispatch location data for immediate response. This holistic approach renders the proposed system a versatile tool applicable across a spectrum of scenarios, ranging from security and surveillance operations to emergency response initiatives.*

Keywords: Raspberry Pi, Buzzer, Metal Sensor, Flame Sensor, GSM, GPS, L293 Motor driver, HC-SR04 Ultrasonic sensor, HC-05 Bluetooth, Camera.

I. INTRODUCTION

These robotic assets serve as pivotal instruments in alleviating risks inherent in perilous tasks, such as bomb disposal, mine clearance, and reconnaissance missions within hostile territories.

Robots serve as indispensable assets in military endeavours, significantly bolstering capabilities in reconnaissance, surveillance, and various operational tasks while mitigating risks to human personnel. Outfitted with state-of-the-art sensors, cameras, and communication systems, these machines empower military operators to remotely control and manoeuvre them in the most arduous environments, such as urban landscapes or hazardous zones. Highly adaptable, these robots can be tailored with an array of attachments and tools to execute multifarious functions, ranging from bomb disposal and mine clearance to providing critical medical aid on the battlefield. Leveraging their seamless wireless connectivity, these robots facilitate real-time data transmission, equipping military personnel with vital insights to make informed decisions based on the rich stream of information garnered by these robotic assets.

The system incorporates metal and flame sensors to efficiently detect the presence of metallic objects and fire hazards. Upon detection, it triggers an alert system by activating a buzzer to notify nearby individuals. Additionally, it initiates a communication process to inform registered users about the detected event and its exact location. This communication is made possible through the integration of GSM and GPS technologies. Through the GSM module, the system sends

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out a message detailing the detected metal or flame, while the GPS module ensures precise location information is included in the message. This comprehensive approach not only ensures timely alerts via the buzzer but also enables remote notification to registered users, significantly enhancing the system's effectiveness in detecting and communicating potential dangers.

The integration of Bluetooth connectivity within the device empowers users with remote control functionalities, augmenting its operational versatility. Concurrently, the incorporation of a built-in camera significantly amplifies its surveillance capabilities by enabling the capture of images depicting unidentified individuals within its vicinity. Furthermore, the inclusion of a precision motor driver ensures the robot's movement remains secure and precisely controlled, thereby optimizing its efficiency and reliability in navigating diverse environments. Complementing this, the utilization of an ultrasonic sensor facilitates real-time obstacle detection, further fortifying the device's ability to navigate through complex and dynamic surroundings with heightened accuracy and safety measures. S. L. Bangare et al. [22-26] worked with machine learning, P. S. Bangare et al. [27-30] done IoT research work. K. A. Sultanpure et al. [31] and K. Gulati et al. [32] given research contribution.

II. LITERATURE SURVEY

Paper name	Year of Publication	Authors	Comparative Study
A Multipurpose Robot for Military–Tribute to Defence Ministry	2013	P. Balaji and H. Goutham	*Existing System:* ***Name**: Security Warrior,* ***Component**:* *Vision system for human detection and tracking,* *Motion system for real-time motion planning,* *Under R&D by US Defence, intended for implementation by 2015* *Proposed System :* *Enhancements:* *Control from remote location with user and automatic modes,* *Additional features: bomb detection, diffusion, fire detection, intruder detection,* *Increased reliability compared to existing system*
Arduino Controlled War Field Spy Robot using Night Vision Wireless Camera and Android Application	2015	J. Patoliya, H. Mehta, H. Patel, and V. T. Patel	*Focuses on the utilization of robotics and automation in various sectors including household, defense , and law enforcement.,* *Describes the components of a war field robot including Arduino Uno board, L293D motor driver ICs, HC-05 Bluetooth module, and DC motors.,* *Mentions the application of robotics technology in the Sydney Siege police operation, where a robot with a laser beam light and bomb disposal kit was deployed to minimize human risk.*
War Field Spying Robot with Wireless Night Vision Camera	2017	P. Yadav, L. Chaudhari and S. Gawhale	*Focuses on the development of a robotic vehicle using RF technology for remote operation and surveillance purposes.,* *Utilizes an ATmega16 microcontroller for controlling the vehicle and wireless camera.,* *Features wireless camera with night vision capabilities for spying purposes, especially in war fields.*
Military Spying and Bomb Disposal Robot Using IOT	2018	C. Jadhav, S. Gibile, S. Gaikwad, and N. Dave	*Focuses on bomb disposal missions and challenges faced by personnel.* *Describes the use of remote-controlled robots and human bomb disposal experts.* *Mentions the use of protective gear and tools for bomb*

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			disposal tasks.
Innovative Design for Portability of Unpowered Military Load Exoskeleton Robot	2018	A. Zhu, H. Shen, Z. Shen, J. Song and Y. Tu	***Main Focus****: Portability of unpowered military load exoskeleton robot* ***Key Concepts:*** *Exoskeleton technology, Portability challenges ,TRIZ conflict resolution theory* ***Innovative Method:*** *TRIZ conflict resolution theory*
Military Spying Robot	2019	S. Hammed, M. Khan, N. Jafri, A. Khan and M. Bilaltaak	*Focuses on the utilization of robots in military and industrial settings, emphasizing their role in replacing humans.* *Describes the challenges in monitoring international border zones and proposes the use of robots for security purposes.* *Mentions the use of RF technology for data communication, CCD camera for real-time video transmission, and PIC microcontroller for system control*
Military Spying and Metal Mines Detection Wireless Robot with Night-Vision Camera	2019	A. Shingankar, R. Ingole, N. Roy, S. Chavan and V. Nagrale	***Focus:*** *Surveillance and detection using robotic methods for safety and efficiency enhancement.* ***Features:*** *Continuous monitoring,* *Live streaming to authorized persons, Miniature size for accessibility in various environments, Integration of sensors for specific detection purposes,Utilization of wireless communication for remote control and data transmission*
Design and Implementation of Spy Robot	2019	M. Shunumathi and N. Tamilarasan	*Focuses on the different types of automation: Hard automation, Programmable automation, Autonomous* *Describes the typical industrial robot with six joints powered by various types of motors.* *Discusses the advantages of robots over human work, including flexibility, precision, and adaptability.*
A Semi-Autonomous Tracked Robot Detection of Gun and Human Movement Using Haar Cascade Classifier for Military Application	2020	M. Islam, A. Ahsan and R. Acharjee	*Emphasizes the need for risk avoidance for military personnel through robotics and AI.* *Highlights the importance of pre-knowledge about crime zones and criminals' positions for successful missions.* *Describes the capabilities required in an all-terrain spy robot, including climbing stairs, human detection, and gun detection using image processing algorithms.*
Military Education Robot Based on Wireless Signal	2020	Z. Xu	Designed for children's education and playful learning Integrates military toy interests with technology learning (programming, app development) Utilizes Arduino as the embedded hardware platform
Multipurpose Military Spying Robot	2020	P. Khokarale, S. Bangar, A. Lohokare and S. Patil	*Android smartphone control via Bluetooth module,* *Metal detector and ultrasonic sensor for bomb detection,* *Wireless PC connectivity for detailed vehicle movements.*
War Spying Robot with Wireless Night Vision Camera	2020	Divya Sharma and Usha Chauhan	Focuses on the development and application of robotic technology in border security and military operations. Emphasizes the use of Wi-Fi and Bluetooth technology for remote operation. Describes the components and functionality of the robot, including cameras, motor drivers, and sensors.

Radio-Controlled Intelligent UGV as a Spy Robot with Laser Targeting for Military Purposes	2023	Abdu H. Gumaei and Nasir Ahmad	*Emphasizes the use of robots in armed forces for reducing human casualties.* *Focuses on the evolution of military robots from conventional to modern UGVs.* *Highlights advancements in control features, including wireless and live video transmission.*
Smart Spying Robot with IR Thermal Vision	2021	Aarthi V and Visali R	*Focuses on the need for improved surveillance systems due to an upsurge in violent crimes and violations.* *Emphasizes the importance of border management for regulating cross-border movements and preventing illicit activities like trafficking, terrorism, smuggling, and illegal migrations.* *Highlights the need for remote surveillance in disaster-hit zones to gather information, interpret the impacts, and aid in rescue efforts.*
Design and Implementation of War Field Spy Robot using Android Application	2023	Pushpalatha O and Abhishek Patil	*Focuses on the development of a spy robot for monitoring war fields.* *Emphasizes real-time data gathering and wireless transmission for informed decision-making.* *Highlights the impact of smartphones and Android OS on robotics applications.*
Military Spying Robot with Multipurposes in Security Applications	2021	Pro. Sneha Farkade and Prakash Naikwadi	*Focuses on the humanitarian aspect of mine disposal and the challenges associated with it, emphasizing the need for technological solutions.* *Proposes a system involving remote-controlled robots for mine disposal, controlled via an Android application and utilizing Bluetooth technology.* *Highlights the importance of additional features like cameras, ultrasonic sensors, and bomb detectors for effective mine disposal operations.*
Design and Development of Spherical Spy Robot for Surveillance Operation	2020	Irfan Rangapur, B.K. Swathi Prasad and R. Suresh	Focus on developing a spherical spy robot for surveillance operations in various environments. Identifies critical issues faced by human operators in surveillance operations. Proposes a pendulum-based drive system for the spherical spy robot.
War Field Intelligent Spy Robot	2023	Harshitha S, Preetham J R, Tejas Bhavasar S, Rohan B S and Vinay V R	***Functionality****: Remote control of spy/soldier robot with wireless connection, Live video transmission from wireless camera for surveillance, Fire and metal detection with alert notifications,* *Utilization of Android OS for robot applications.* ***Objectives****: Autonomous Navigation, Environmental Awareness, Real-time Data Collection, Data transmission, User Interface and Control, Robustness.*
Spying Robot	2023	Roger Lokku and Neha Phadtare	***Robots****: Customized machines substituting human efforts.* ***Applications****: Performing monotonous and risky tasks, Aerial, submerged, or ground-based operations for surveillance, patrolling, etc.*
Military Spying and Bomb Disposal Robot	2021	Shruti Vasanwala and Dhrumil Patel	*Focuses on bomb disposal missions and high-risk scenario* *Describes the process involving remote-controlled robots and human bomb disposal experts* *Highlights the use of protective gear and equipment for bomb disposal experts*

An IOT Enabled Military Spying Robot Using Raspberry Pi	2020	S K Mohan, Dr T Magesh, Harikrishnan S, Ashlin Felix R and Gokulnath G	*Mentions the inclusion of night vision cameras and robotic arm controlled via an Android application Integrates Raspberry Pi and internet-controlled features for enhanced capabilities Emphasizes on controlling robotic arm and vehicle movements wirelessly through the Android application*

III. METHODOLOGY

The proposed system includes Raspberry Pi, Metal sensor(KY-036),IR Flame sensor, Buzzer and GSM&GPS.

Raspberry Pi

The Raspberry Pi 3 is a compact single-board computer with the dimensions of a credit card. It is equipped with a 1.2 GHz quad-core ARM Cortex-A53 processor, providing computing power for various applications, and significant performance boost compared to its predecessor. It is equipped with 1 GB of RAM, offering ample memory for various computing tasks. One notable improvement is the inclusion of built-in Wi-Fi (802.11n) and Bluetooth 4.2 capabilities, eliminating the need for external dongles. The board also includes a set of GPIO (General Purpose Input/Output) pins, enabling users to interface with a wide range of external devices and sensors. The Raspberry Pi 3 supports various operating systems, with Raspbian being the default and widely used choice. It has become a popular platform for DIY projects, educational purposes, and embedded systems due to its affordability, versatility, and a supportive community that continuously develops and shares projects for this compact computing device.

To connect metal sensor, flame sensor and buzzer to a Raspberry Pi 3, you will utilize the GPIO (General Purpose Input/Output) pins on the Raspberry Pi board. Begin by identifying suitable GPIO pins for each sensor, referring to the GPIO pinout diagram specific to the Raspberry Pi 3 model. For the metal sensor, connect its VCC (power) pin to a 3.3V GPIO pin on the Raspberry Pi, the GND (ground) pin to any ground (GND) pin on the Pi, and the sensor's signal pin to a GPIO pin for digital signal reading. Similarly, for the flame sensor, connect its VCC pin to a 5V GPIO pin, GND pin to any ground pin, and the signal pin to another GPIO pin. [1,14,19,20]

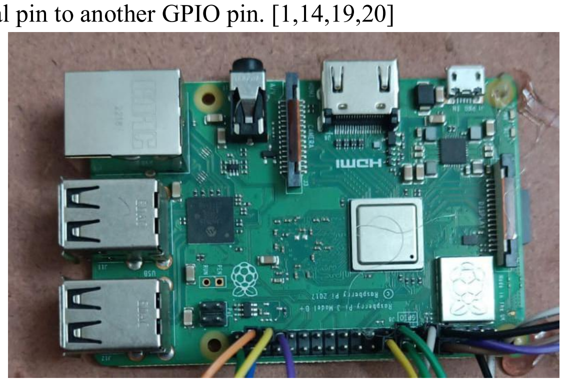

Fig1.Raspberry Pi

Metal Sensor (KY-036)

Metal detectors typically use electromagnetic fields to identify the presence of metal objects. When a metal object is within the range of the sensor, it disturbs the electromagnetic field, triggering an alert or response from the detector. Metal detectors typically use electromagnetic fields to identify the presence of metal objects. When a metal object is within the range of the sensor, it disturbs the electromagnetic field, triggering an alert or response from the detector.A metal detector robot is a device operated through an Android-based smartphone designed to identify the presence of metal, particularly landmines, within a specified area. The significance of detectors lies in their role in mitigating the risks associated with the use of landmines, which can result in injuries and fatalities. This robot, equipped with a metal detector, primarily serves the purpose of identifying buried bombs or landmines in the surrounding terrain, contributing to enhanced safety measures.

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The metal detector comprises a handheld unit and a sensor unit. When the sensor unit detects metal, it signals the presence of metal through changes in sound or a blinking light. This device aids in metal detection, triggering a buzzer when metal is identified. The Metal Detector Robot is a device controlled by an Android-based smartphone designed to identify metal, particularly landmines, in a specified area. The conventional method of landmine detection, such as direct sweeping, poses a significant risk of unintentionally triggering a landmine.*[4,7,11,12,15,16,18,20]*

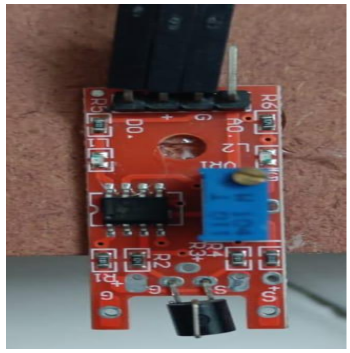

Fig2.Metal Sensor (KY-036)

IR Flame Sensor

Flame sensors are capable of detecting both fire and light sources within the wavelength range of 760nm to 1100nm. They exhibit effectiveness in diverse environmental conditions, including the presence of oil, dust, water vapor, and ice. Its responsiveness is often superior to that of heat or smoke sensors due to the mechanisms employed for flame detection. The utilization of UV (Ultraviolet) or IR (Infra-Red) or UV-IR technology enables flame sensors to swiftly and accurately detect flames, sometimes within a fraction of a second. The output from a flame sensor can be either digital or analog, making it versatile for applications such as flame alarms or integration into firefighting robots.

Flame sensors are equipped with components that can detect the specific wavelengths of light emitted by flames. When a fire occurs, the sensor can identify the presence of these wavelengths, signalling the potential danger. Upon detecting a flame, the robot's control system could be programmed to initiate specific actions autonomously.

Flame sensors contribute to the overall situational awareness of the military robot. By detecting fires in the environment, the robot can provide valuable information to operators for decision-making. It coordinates response with other sensors. In a military robot, the flame sensor could be integrated into the robot's control system. This integration may involve wireless communication components, allowing the robot to transmit data about detected flames to a central command or control centre.*[1,12,15,16,18]*

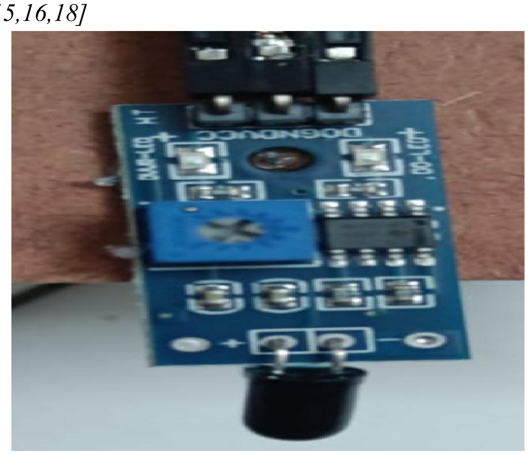

Fig 3. IR Flame Sensor

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GSM and GPS

GSM, or Global System for Mobile Communications, is a widely used standard for cellular networks that facilitates mobile communication services around the world. GSM provides voice and text messaging services and enables data transfer at relatively low speeds, making it suitable for applications like short messaging service (SMS) and basic internet connectivity.

GPS is a satellite-based navigation system widely used in various applications, including military hardware within the Internet of Things (IoT) framework. In military contexts, GPS serves as a critical tool for enhancing navigation, tracking, and situational awareness. IoT-based military hardware models leverage GPS technology to enable precise location determination, facilitating efficient movement across diverse terrains. Real-time tracking of assets, such as vehicles, equipment, and personnel, enhances overall operational awareness for military commanders. GPS data plays a crucial role in mission planning by providing accurate geospatial information, optimizing routes, and aiding in strategic decision-making. In weaponry, GPS contributes to precision targeting, ensuring accurate delivery and minimizing collateral damage. The technology is instrumental in search and rescue operations, allowing for the rapid location and retrieval of military personnel in emergency situations.

The system operates by taking input from metal and flame sensors, which are designed to detect the presence of metal objects and flames, respectively. When the sensors identify the existence of metal or flames in their vicinity, a triggering mechanism is activated. This mechanism turns on a buzzer, providing an audible alert to indicate the detection of either metal or flames. Simultaneously, the system initiates a communication process through a GSM module. The GSM module is responsible for sending a pre-configured message to registered users, notifying them of the detected event including the nature of the threat (metal or flame) and the specific location of the detection. This integrated approach ensures a swift and comprehensive response to the presence of metal or flames, combining both audible and remote notification mechanisms for enhanced security and user awareness. [13,14,15,16,18,19].

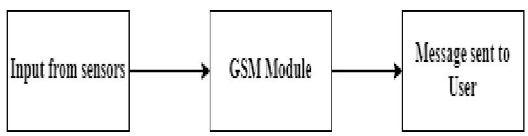

Fig 4. GSM& GPS module

Buzzer

A buzzer is a simple electronic device that produces a buzzing or beeping sound when an electrical current is applied. It typically consists of a resonator, an electromagnet, and a diaphragm. When the current flows through the electromagnet, it attracts the diaphragm, creating a sound wave that produces the audible buzzing or beeping noise. Buzzers can be integrated into the systems to provide audible notifications for specific events or alarms. In military scenarios, these events could include the detection of intruders, the activation of security protocols, or the occurrence of critical conditions that demand immediate attention. The use of buzzers in IoT-based military hardware adds an extra layer of situational awareness by providing real-time, audible feedback.

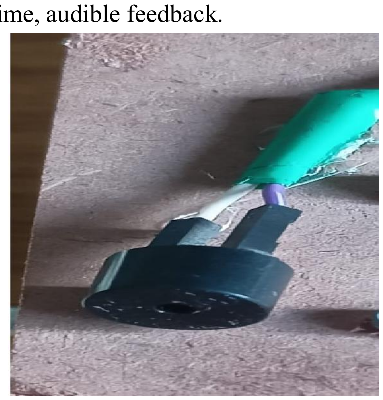

Fig 5. Buzzer

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The functionality of the system relies on the input received from specialized metal and flame sensors. These sensors are meticulously engineered to recognize the presence of metal objects and flames within their designated range. Once the sensors successfully identify the existence of either metal or flames, a responsive mechanism is initiated. This mechanism activates an audible alert system, manifested through the activation of a buzzer. The purpose of this alert is to audibly signal the detection of metal or flames, providing a clear and immediate indication of the identified threat.

L293 Motor Driver

The L293 motor driver is a crucial component in robotics and automation applications, widely used for controlling the direction and speed of DC motors. This integrated circuit (IC) offers a convenient solution for driving small to medium-sized motors with ease. Its design incorporates dual H-bridge configurations, enabling bidirectional control of two motors or unipolar control of a single stepper motor. The L293 features built-in diodes to prevent damage from back electromotive force (EMF) generated by the motors during deceleration. Moreover, its compatibility with various microcontrollers and logic circuits makes it a versatile choice for hobbyists and professionals alike. With its straightforward interface and reliable performance, the L293 motor driver continues to be a staple in the realm of motor control, facilitating the implementation of robotic systems, automated machinery, and other electromechanical projects.

Fig 6. L293 Motor Driver

HC-SR04 Ultrasonic Sensor

The HC-SR04 ultrasonic sensor is a popular choice for distance measurement in various applications due to its affordability, simplicity, and reliability. Consisting of an ultrasonic transmitter and receiver, it operates on the principle of sending out ultrasonic pulses and measuring the time taken for the echo to return after bouncing off an object. This time difference allows for the calculation of distance using the speed of sound in air. With a typical range of 2 to 400 centimeters and an accuracy of around 3 millimeters, the HC-SR04 sensor finds widespread use in robotics, automation, security systems, and even hobbyist projects. Its ease of integration with microcontrollers like Arduino, Raspberry Pi, and other platforms, along with its low power consumption and compact size, make it an attractive choice for both beginners and experienced engineers alike. However, there are some potential limitations such as sensitivity to ambient noise, limitations in detecting certain materials, and the need for adequate calibration for precise measurements in different environmental conditions.

Fig 7. HC-SR04 Ultrasonic Sensor

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HC-05 Bluetooth

The HC-05 Bluetooth module is a widely used component in the realm of wireless communication. It facilitates seamless Bluetooth connectivity between devices, enabling data transmission over short distances without the need for physical cables. Its compact size, low power consumption, and ease of integration make it a popular choice for students, and professionals alike in various fields such as robotics, home automation, and Internet of Things (IoT) applications. One of the notable features of the HC-05 module is its versatility. Moreover, the HC-05 module supports the Bluetooth Serial Port Profile (SPP), which simplifies data exchange between devices by emulating a serial communication interface. This compatibility with the SPP protocol ensures seamless integration with existing systems and programming languages, making it accessible to a broad audience with varying levels of expertise.

In terms of technical specifications, the HC-05 typically operates in the 2.4 GHz ISM (Industrial, Scientific, and Medical) band and has a maximum communication range of approximately 10 meters, although this range can vary depending on environmental factors such as interference and obstacles. It communicates with host microcontrollers or devices via UART (Universal Asynchronous Receiver-Transmitter) serial communication. The HC-05 Bluetooth module serves as a reliable and cost-effective solution for enabling wireless communication in a wide range of applications. Its ease of use, compatibility with standard protocols, and robust performance make it a valuable tool for researchers, developers, and enthusiasts seeking to incorporate Bluetooth connectivity into their projects.

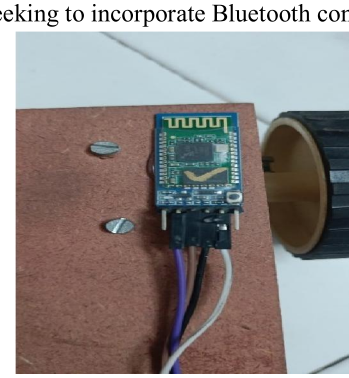

Fig 8. HC-05Bluetooth

Software Requirements

For Software Interfaces:

- Operating System: Windows 10(64 Bit)
- IDE: python IDE
- Programming Language: Python

Architecture Diagram

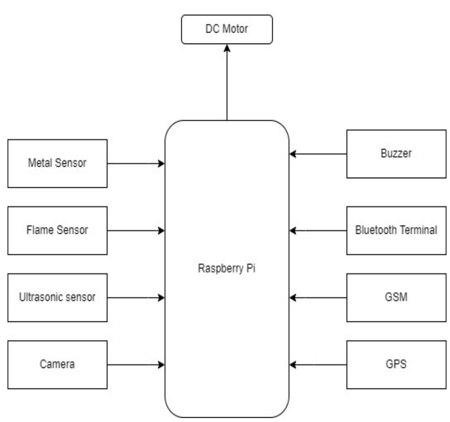

Fig 7. Architecture Diagram

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IV. FUTURE ENHANCEMENT

In the future, an advanced robotic system is envisioned to play a pivotal role in search and rescue missions as well as bomb defusing operations. This cutting-edge robot is expected to be equipped with sophisticated gas sensors, enabling it to swiftly detect and assess harmful or hazardous gases in its operational environment. Beyond traditional control methods, the robot is anticipated to respond to voice commands, providing a more intuitive and user-friendly interface. Moreover, as technology continues to evolve, the potential for further improvement lies in leveraging satellite communication to control the robot remotely. This integration with satellite communication is poised to enhance the robot's capabilities, allowing for seamless operation in diverse and challenging scenarios. The envisioned advancements hold promise for a more efficient, responsive, and adaptable robotic system in the field of search and rescue and bomb defusal in the future.

V. RESULT

Metal detection: -

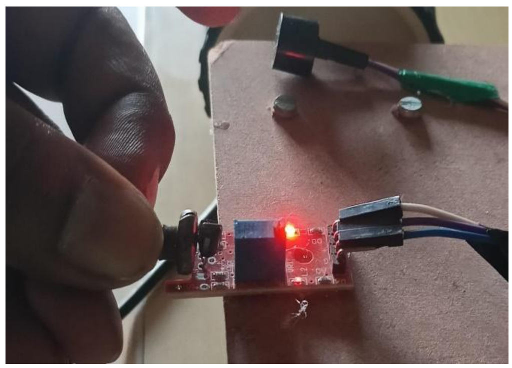

Fig 8. Metal detection

Metal Object	Successful Detection	Unsuccessful Detection
Iron Nail	Yes	No
Aluminium Foil	Yes	No
Copper Wire	Yes	No
Stainless Steel	No	Yes
Zinc Coin	Yes	No
Gold	Yes	No
Silver	Yes	No

Table. 1: Flame detection

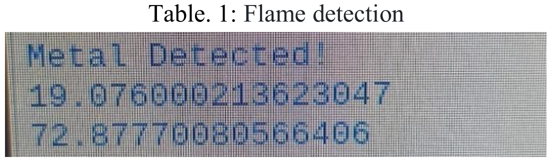

Fig. 9

On our system, we did run few test cases using Iron nail, Aluminium foil, Copper wire, Zinc coin, Stainless steel, Gold, Sliver. All of the objects are detected by metal sensor except stainless steel. Though there were times in performing test cases where result is accurate and we weren't able to get expected result. Like while detecting gold or silver objects, the successful detection was 2 out 3 times. Therefore, we can say that accuracy of metal sensor is 88.73%.

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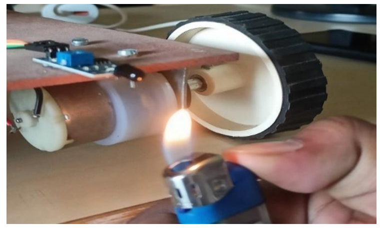

Fig. 10

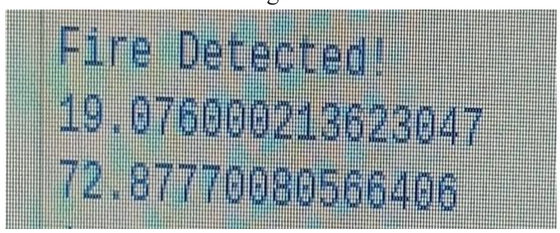

Fig. 11

The sensor in this proposed system is able to detect flame till 20 cm. As the intensity is low, there was no further detection of flame. The intensity of IR Flame sensor can be adjusted as per use.So, we have decided to keep this intensity till 20 cm.

Distance (cm)	Successful Detection
2	Yes
4	Yes
6	Yes
8	Yes
10	Yes
12	Yes
14	Yes
16	Yes
18	Yes
20	Yes
22	No
24	No

Table. 2

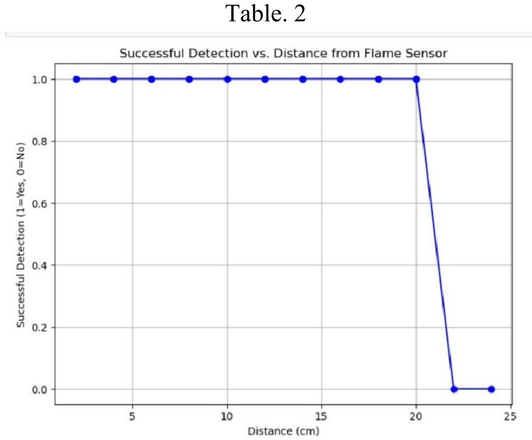

Fig. 12

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Face detection:-

The face detection process starts when an ultrasonic sensor detects any object with in range of 20 cm.When an object gets detected by sensor, camera shut on, and verify person face with the provided dataset. We provide dataset with person images containing 81 images of one person. Every image capture person different characteristic which helps in differentiate authenticated n un-authenticated person. So after performing this, we have following results,

Known person:

Fig.13

Known person output:

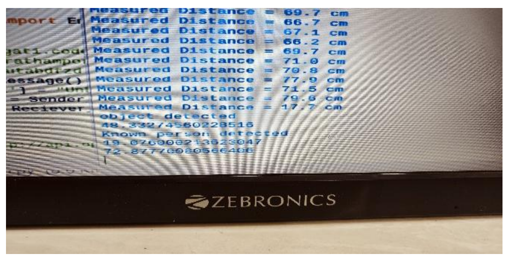

Fig.14

Unknown Person:

Fig.15

Unknown Person Output:

Fig.16

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VI. CONCLUSION

In conclusion, our robotic model represents a cutting-edge integration of advanced sensors and electronic components, harmoniously interfaced with a Raspberry Pi. The incorporation of a metal sensor facilitates precise detection of metallic objects, enhancing the model's capabilities for applications such as security and surveillance. Furthermore, the integration of a flame sensor adds a crucial layer of safety by identifying potential fire hazards, contributing to the overall robustness of the robotic system. This amalgamation of sensors and control mechanisms not only ensures adaptability but also underlines the model's effectiveness in diverse scenarios, from industrial automation to safeguarding environments against potential threats. In addition to its sensor-rich architecture, our robotic model stands out with its utilization of GSM and GPS technologies, allowing for real-time tracking and precise localization of objects.

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