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Design and Analysis of IoT-Based Critical Path Plotting Subordinate for Military Real-Time Monitoring, Survival and Rescue

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Abstract: The primary goal of this research is to demonstrate that the existing reality of Indian conflict situations is dangerous and unpredictable by humans. Also, with proper modernization of safety measures, there is a need to lower the troop fatality ratio and provide security to the nation without the casualties. In today's environment, everything is delegated to robots and technology to carry out daily tasks. As a result, this article explains how current technology can aid in the protection of the country and our military by making part of their field job easier by combining technology with defence and military. Technology has evolved into a critical component of human life and using it to our advantage in the future is a good decision. When it comes to making quick decisions on the traverse, unmanned pseudo artillery means that the subordinate is driverless and can only operate as a weapon by surveying, tracking, path mapping, data streaming, sensing, and thinking to some level. This contemporary robot will assist us in locating fault sites, assisting injured soldiers, surveying pre- or post-war areas, detecting explosives, visioning the location. The users can control this subordinate from the station controller, which is utilised to stream data and serves as a vision for the controller/soldier. Sensors to identify faults and explosives, as well as a GPS system. This work focuses on the design and implementation of a mobile robot for real-time obstacle detection and prevention.

Keywords: Security, Surveillance, IoT, Robot, Esp32.

I. INTRODUCTION

The mechanical technology and mechanisation area, which spans a wide variety of locations, has seen a dynamic and significant development as a result of innovation. Surveillance is the process of maintaining a close purposeful perception or supervision over an individual, gathering, or other object, particularly one who is in custody or under suspicion.

Surveillance is traditionally carried out via equipment deployed in all security-sensitive sectors. High-quality cameras, many computers for monitoring, and servers for storing the recordings are the essential components of these systems [1]. Installing these systems all over the place is a difficult undertaking that also needs a lot of upkeep. Surveillance is therefore most commonly required in areas where frameworks cannot be installed, such as outskirt zones, open spaces, workplaces, and business ventures. It is typically used for viewing sports activities. People or implanted frameworks, such as robots and other robotized equipment, can demonstrate monitoring both indoors and out in open spaces. A robot is simply a programmable electronic machine capable of doing a variety of tasks, therefore replacing human labour, producing extremely precise results, and efficiently overcoming human limitations. People are being replaced by robots in this way, and it is one of the most amazing advancements in mechanical autonomy. The robot is equipped with a Esp32 microcontroller, which is used to make it remote and online, and the recordings are sent from the robot to the client's screen. This robot also has DC engines, a wheel casing, a battery, a Wi-Fi module, and several sensors, including an ultrasonic sensor for obstacle detection and a metal sensor for detecting pits and explosives. We may manually control the robot by utilising keys to provide commands. IoT innovation is playing a key role in the advancement of several commercial fields, including business leaders, manufacturing, advanced vehicle frameworks, agriculture, automobiles, and even mechanical technology. Users can speak with the robot or obtain information about the region where the robot is sent for surveillance using the Internet of Things idea. IoT software called Firebase is used to construct IoT applications. The orders are given to the robot through software and received by Esp32 via Wi-Fi module in this programme. A GPS system is used to track the location of the subordinate as well as other important locations. When things are offline, the database is stored in Firebase, and an application is used to operate the device and track the status of everything. The subordinate's vision made use of a low-cost, low-power camera that can video stream at 90 frames per second, thereby helping to meet the criteria.

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This robot's main purpose is to remotely monitor locations and provide audio or video as information from the environment to the user. The robot in this project can be operated via Web of Things (WoT) on a mobile device or a workstation, and it can also provide live video streaming with the help of a remote camera implanted in the robot. With the help of the Esp32 microcontroller, the robot may be commanded both manually and automatically. This robot also uses several sensors to collect data and communicate it to the Esp32 microcontroller, which controls the robot's actions. In addition, a live video yield was obtained. The activity of observation can be carried out along these lines. With more progress in our enterprise, we may be able to provide surveillance even in natural protection zones.

Our key contribution is the creation of a low-cost IoT-based surveillance robot capable of monitoring and controlling the system. The rest of the paper is arranged as follows: A literature section is offered in Section II, as well as crucial facts regarding the status and environmental circumstances. Section III focuses on the proposed system. In Section IV, we'll talk about how to put the system in place. Section VI contains the conclusions and recommendations for further work.

II. LITERATURE AND MOTIVAION

Surveillance is carried out in a variety of sectors using devices deployed wherever they are required. These devices only monitor the area in which they are mounted, therefore their range is restricted. We used to have to install these systems everywhere, which came at a great cost and required a lot of upkeep. However, in today's world, we want systems that can wander the globe, surveying the environment and providing live streaming footage of that area. The answer to all of these problems is to create a surveillance robot that can move about and watch any location. When an intrusion occurs, the user can be notified. The user may keep an eye on the robot from afar. As a result, any user may simply operate the robot. We can operate the surveillance robot using our phones or computers, allowing us to control it from anywhere. If a crime occurs, we can capture pictures and film videos to collect evidence. We'll need a Esp32, a Esp32 camera, a force supply for the Esp32, a Robot skeleton, and an Android phone for live streaming and controlling our robot to complete this project. We utilise a motion programme for recording video from our mobile phone and a Linux-based Working framework for Esp32 and Esp32 camera configuration files.

In the paper [3] that was presented, “A survey in adaptive hybrid wireless Sensor Network for military operations” published in IEEE in the year 2019. In this paper, in today's military actions that need situation awareness (SA) in a battle zone, a Sensor Organization is a critical hotspot for gathering data. Sensor hubs come in a variety of shapes and sizes, with different capacities for different types of sensors. One type of sensor cannot satisfy both the requirement for a social event and the requirement for reviewing data about the field. A few sensors should have been placed and configured to provide suitable detection so that the whole data for the field may be gathered. In this paper, the authors presented “Design and Analysis of IoT-Based Robot for Real-Time Monitoring and Control” This study is primarily concerned with the security, remote surveillance, and home monitoring provided by surveillance robots. Over the last decade, remote monitoring has been the most essential study issue. We propose a surveillance robot in this work that may be employed in household settings and a variety of other settings. Robots can be controlled manually or automatically, depending on the needs of the humans. This work focuses on the design and implementation of a mobile robot for real-time obstacle detection and avoidance.

In the paper [4], “Development of a Framework for Effective Surveillance and Human Intrusion Detection in Border regions covered with Dry leaves” in the IEEE in the year 2020 The suggested framework is a part of the panchendriya system, although it is only used to identify a human gate crasher in a line covered in dry leaves. By integrating various sensors and remote technologies, this system intends to reduce the work force and expense of traditional border reconnaissance. The mouthpiece sensor is used to detect the presence of a human intruder in dry leaves via stride signal discovery, and the observation camera sensor is used to get visual evidence of the interruption in the line area. By putting these sensors into a microcontroller advancement board with high computing capacity, the whole framework execution is enhanced. When a human disruption in a line district covered in dry leaves is detected, the framework is activated.

A. Existing System

Surveillance robots, which rely on RF Innovation, ZigBee, and Bluetooth, have a restricted range of correspondence. They have a short-range remote camera, so they won't be able to capture images that aren't protected by the camera's location. These machines are intelligent. may only be operated manually, which necessitates the use of a Throughout the whole observation process, there is human oversight.

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III. PROPOSED SYSTEM

In this project, we create a military subordinate with the ability to see and sense with the use of an attached camera. This robot is controlled from a remote place using a station installed on a laptop, mobile phone, or tablet. The user can see what's going on based on the robot's setup. The robot uses a tilt motor to rotate the camera around so that the user can view everything that is going on from the robot's perspective. It links to Wi-Fi, allowing us to operate the robot from a mobile device or a computer. We're using an esp32 installed on a robotic truck to create a remote-controlled wireless surveillance monitoring system. This may be a useful and affordable security and spy tool with a variety of adjustable options. To build this Mechanical vehicle in this IOT project, we largely used esp32, esp32 web camera, and two DC engines with Robot casing. We'll develop a robot that can be used for video surveillance and inspection and can be operated using a graphical user interface. A visual transmission facility is provided for the control component. For all intents and purposes, video transmission is performed by quick picture transmission. Figure 1 depicts a block schematic of the proposed system. Figure 1 depicts the block diagram of the proposed system, which employs the esp32 as a processing unit to link the sensors and make decisions based on physical quantities.

The robot is equipped with sensors such as the Ultrasonic Sensor, which detects motion and other disturbances in the environment. Metal detector: searches for subterranean mines, GPS: for acquiring directions, and L293D IC: for controlling movement with dc engines. The ESP32 module collects data from these sensors and sends it to Google Firebase, where it is temporarily stored before being sent to the MIT programme on your phone, laptop, or tablet. The robot's mobility may be controlled via the MIT application. The ESP32 camera can capture images, record videos, and broadcast live video.

The suggested framework is depicted in the block chart below. The ESP32 Wi-Fi module and microcontroller are the main components. The robot is equipped with a webcam that captures and live broadcasts the surrounding area.

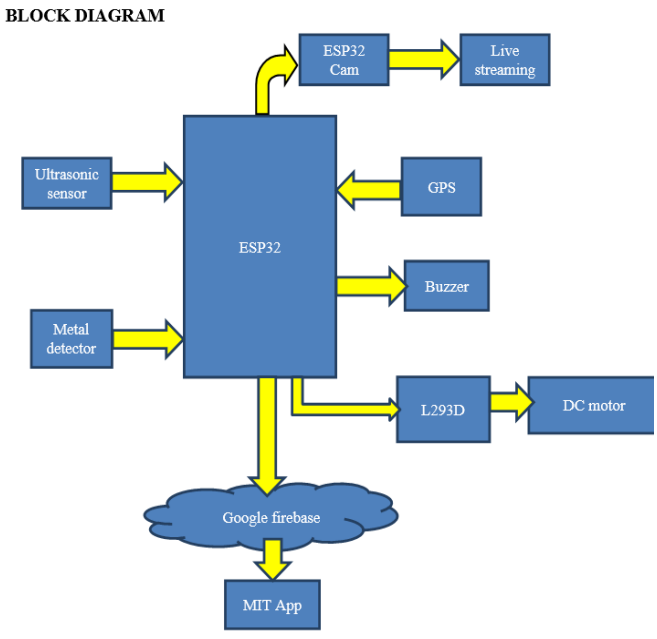

Fig. 1 Block Diagram of the Proposed System

These robots have greater flexibility than stationary cameras. It is stated that wheel robots are the most often employed surveillance robots. Robots with wheels are more suited to flat platforms. The movies taken by the wheel robot may now be seen remotely on a PC or laptop thanks to advancements in wireless connection and the internet.

The surveillance robot's structure consists of chassis and locomotion. The body of a robot is made up of robot chassis. This category also includes roll cages, bumpers, and other body additions. This chassis plate is utilised with our robot platform that has a configurable length. The robot moves according to the barriers it encounters using locomotion.

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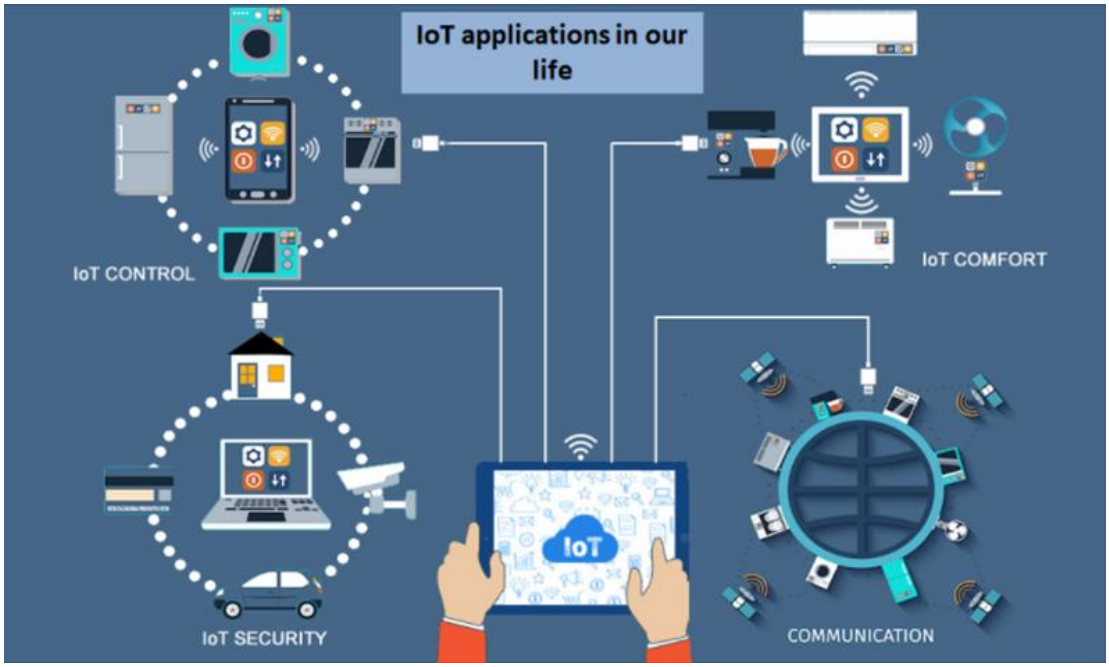

Fig. 2 Overview of IoT based control

Figure 2 depicts the system's robotics process and how it works and monitors the actual environment. Sensors such as PIR sensors, Ultrasonic sensors, and others are utilised to perceive the surroundings and provide instructions to the robot.

The HC-SR04 High Performance Ultrasonic Range Finder's distance sensor. On one pin, the sensor sends distance as an analogue output, and there are other pins for power and toggling the sensor on and off. The analogue pin is linked to the microcontroller's analogue to digital (ADC) pin. The microcontroller system in which the programming is done to generate the specific output is the robot's brain. The ESP32 is a tiny computer the size of a credit card that can perform a variety of functions in surveillance systems, military applications, and other areas. By adding Wi-Fi, this makes Internet of Things devices cable-free. Its benefits include a low-cost wireless connectivity with good dependability. For the locomotion we use the motor driven by L293D driver.

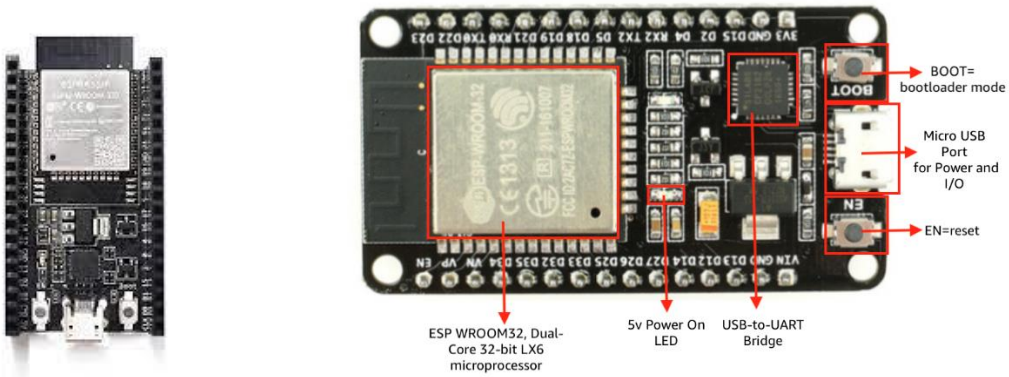

Fig. 3 ESP32

Figure 3 depicts the ESP32 and its components, which are linked to various sensors. The robot is driven by a DC motor with a rotational speed of 500 rpm. The diameter of the wheel and the rpm of the motor determine the motor's speed. The engine driver integrated circuit L293D is a dual H-connect engine driver (IC). Because they take a low-current and flow control flag and convert it to a higher-current and flow signal, engine drivers act as current amplifiers. The engines are driven by this greater current signal.

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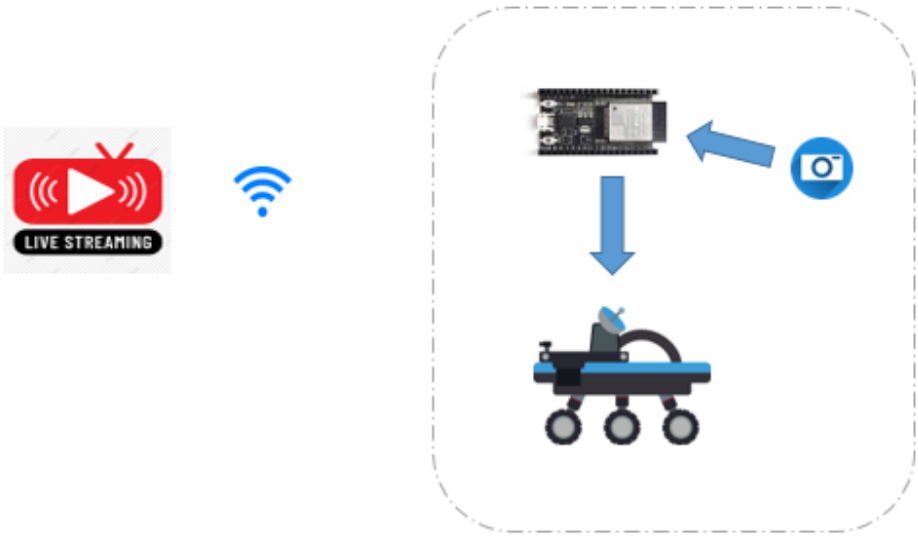

Fig. 4 Overview of the proposed model

The fundamental concept of the system linkages and interdependencies of each block on each other is shown in Figure 4. The IC driver L293D receives power, which is then distributed to two dc motors. For surveillance, a camera module and an ESP32 are attached to the robot.

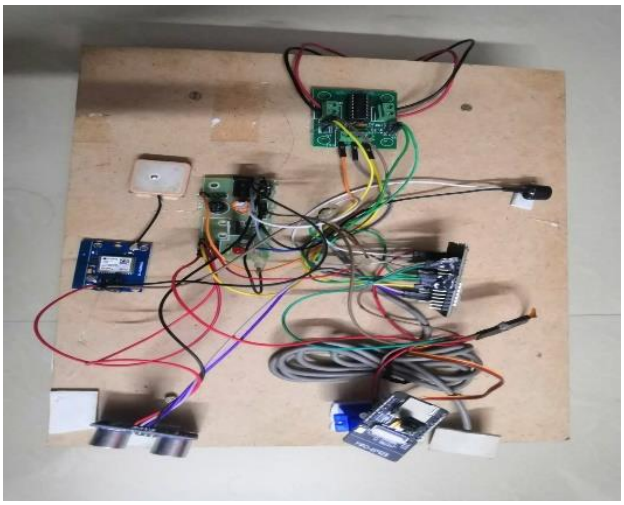

Fig. 5 Internal Circuit of IoT Based Robot

The internal circuit of the suggested robot system is depicted in Figure 5. Here, we link all sensors to the central processing unit and make choices based on the acquired data.

A. Path Planning Algorithm

This section explains how to use a path planning algorithm to find a path that is free of collisions. The most important component of designing a robot is navigation, and path planning is an important part of that. As a result, path design approaches are employed to reduce distance, collision risk, and offer a speedy means for the army to flee the threat and give medical care to the injured.

The Worldwide Positioning System (GPS) is a satellite-based navigation system that provides global coordinates of an autonomous robot's present location. The user obtains the robot's current coordinates through GPS and enters the coordinates of the end destination where the robot must arrive with the least amount of distance covering and avoid colliding with surrounding objects.

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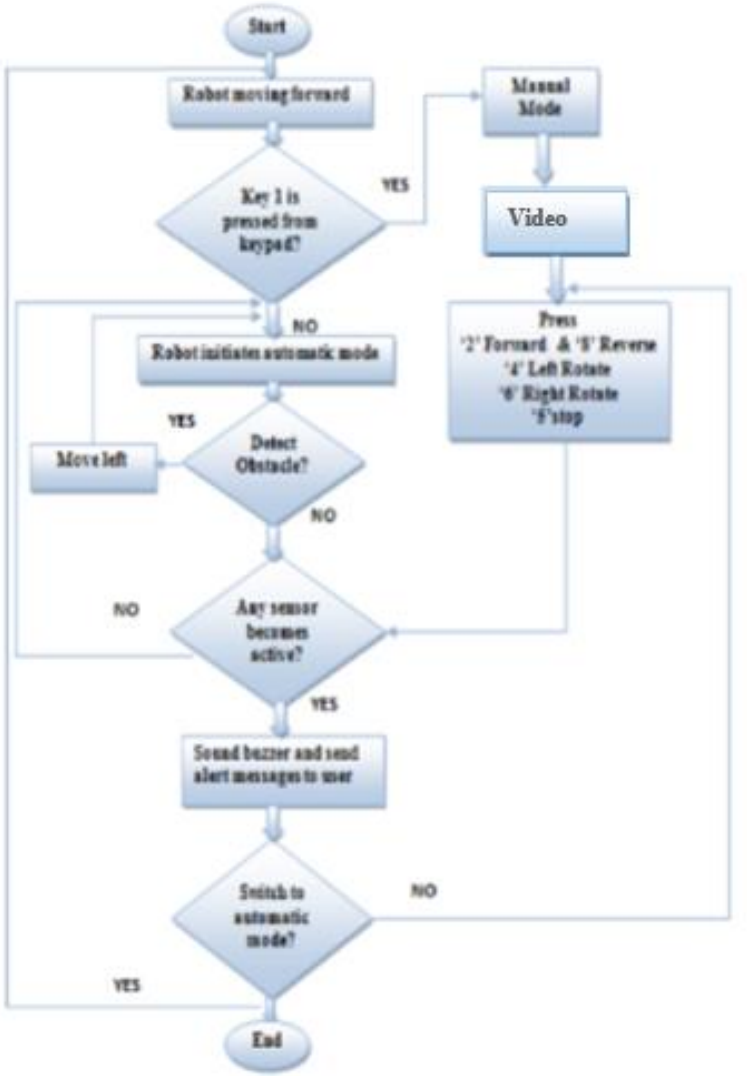

Fig. 6 Internal Circuit of IoT Based Robot

Figure 6 depicts the proposed system's process flow and how information should flow. All of the data from the sensors was input into the board, and the central unit determined the robot's movement.

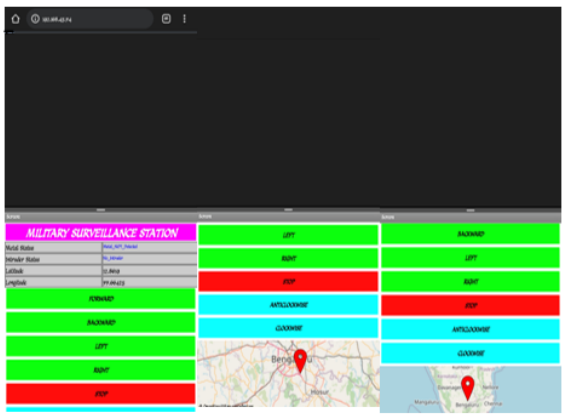

Fig. 7 Control station

The above image is the control station used to watch the live video captured by the camera present on the military subordinate. And the station also has buttons to control the robot as well as the GPS location viewer to identify the fault site based on the commands of the robot.

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IV. RESULTS AND ANALYSIS

We reviewed the planned research work's outcome analysis in this part. As a result, we've seen that our Robot detects the existence of an opponent, a metal object, and toxic substances in the fighting zone. All of these metrics are presented on the control station's display, and in dangerous situations, we receive an alarm to inform the operator. This system has a wider range of features and is in better shape to save troops' lives and army equipment, as well as to give assistance when it is most required. Instead of a human soldier, this robot will be used. There is a robot that keeps an eye on things. We utilize both software and hardware tools to build this robot. We also utilize this robot instead of a border region where humans are not available.

V. CONCLUSION

We present the structure for building a surveillance robot in this study. The surveillance robot will be designed to provide a reasonable level of efficacy and ease of use to each customer, resulting in a simplified client experience. The surveillance robot is designed to provide thorough vision and movement checks. The surveillance robot is designed to be extensible and take into account future control overhauls, thus boosting the client's openness and providing a competent route out of the custom framework, based on measured structures and full adaptability. This results in a highly efficient and financially smart robot that replaces human work, reduces human effort, and successfully performs checking tasks. Android is the operating system of modern mobile phones, and it can support appealing controller programs. At the same time, this application makes use of a Wi-Fi connection to communicate with a robot. It has shown to take into account major two-way communication between the Android phone and the robot. The Multi-Purpose Military Service Robot has been designed to meet the needs of the military, law enforcement, and military. It has a wide range of uses and may be used in a variety of scenarios. For example, it is frequently used by the military for military objectives in one location, but it might also be used for spying purposes in another. Another application may be to provide current info in a Hostage situation.

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