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CREATING A MULTI-PURPOSE INTERNET OF THINGS(IOT) BASED SURVEILLANCE ROBOT

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***Abstract*—**The main design behind this paper is to develop a robot that acts as the surveillance in domestic areas. Nowadays robot plays key role in our day to day life activities thus reducing the errors and increasing the accuracy. Robots can be controlled manually or automatically using android phones.. The purpose of this robot is to roam around and provide information from the given environment and to send that obtained information to the user. In this project, one can control the robot with the help of mobile or laptop through Internet of Things (IoT) and also can get the images if any kind of obstacles are present both in daytime as well as at night with the help of wireless camera from the robot. The robot can be controlled both in manual as well as in automated mode with the help of ESP32 microcontroller. This robot also uses various sensors that collects data and sends it to the ESP32 microcontroller which controls the robot behavior. Along with the spy camera, user can also obtain the presence of metal bombs& it detects if any kinds of dangerous metalbombs are planted with the help of proximity sensors .GSM &GPS modules are present to track the location of the robot.Thus the action of surveillance can be performed. Further advancement in our project can provide surveillance even in defense areas.

***Keywords*— IOT , Solar panel, NodeMCU(ESP32) , GSM module , GPS module , IP camera , Arduino IDE software , proximity sensor , IR sensor.**

I. INTRODUCTION

Robots are becoming increasingly important in people's daily lives as a result of rapid development in the areas of automated technology and robotics, which allows them to do tasks formerly performed by humans but with far fewer opportunities for error. The term "surveillance" refers to the practise of keeping a watchful eye on a suspect or a suspected location.

Defence, public, industries, and workplaces are some of the most common settings where monitoring is essential. The key benefit of using this robot for surveillance is that it eliminates the need for human workers. Using Internet of Things (IoT) technology for motion control, this robot gets beyond the problem of short-range technologies.

A wireless nocturnal camera provides a actual feed of the robot's environment, allowing for vision-based control. The wheels of a robot are directed by an android/PC in the Defence control unit, which is connected to the Internet of Things. The robot's solar panel, which charges its battery, solves the problem of where to get electricity. The robot's PIR sensor and metallic detector sensor detect movements and locate hidden landmines. When sensors trigger a stop in the robot's movement, GSM technology sends a signal to the control unit. The GPS receiver not only keeps tabs on the robot but also alerts the user to the precise position of the landmine or bomb.

The robot consists of ESP32(NODEMCU)which known as the heart of the robot. This robot also consists of DC motors, wheel chassis, battery, Wi-Fi module and various types of sensors such as an ultrasonic sensor for obstacle Detection, IR sensor. The robot can either operated automatically or manually. User end communicates with the robot by implementing the concept of the Internet Of Things.

This can be achieved through blynk software, which is used for IOT developing projects. Here we send the commands to the robot by means of blynk software and they are received by Arduino microcontroller via Wi-Fi module since both are interfaced with each other. Thus we can control the robot in a wireless manner. In this project, we use a wireless transmitting camera that provides audio and video information that can be received at the user end and action of surveillance can be performed.

II . LITERATURE SURVEY

A robot with a metal detector below it and a night vision camera to feed live footage of the area has been reported by AhsanulHoque1 et al. The IP cameras they use for business do not have built-in microphones or speakers[2].Robotic movement was invented by JigneshPatoliya and company, and it is operated through Bluetooth via an Android app. Their work was constrained by the robot vehicle's limited capacity for communication [3, 4].

Arduino software, an android app, is believed to be utilised in other works in the same vein to manage the robot's mobility through the Internet of Things. The cayenne programme is used to send instructions to the microcontroller across the Wi-Fi module, a wireless network [5]. Robots equipped with PIR sensors have been reported by Shuddha Chowdhury et al.[6] to aid in the recovery of victims of natural disasters such as cyclones, earthquakes, landslides, and so on. The suggested robot had a severe flaw in that it was difficult to monitor its whereabouts in real time. Researchers have described many prototypes of landmine detecting robots [7-10].

The robot used a solar panel for energy and a global positioning system (GPS) for navigation and tracking. In their article [11], Souvik Saha et al. described a surveillance-based robot built using a Raspberry Pi, with software implemented using the Linex operating system with the Python programming language. R.Praveen Kumar and Dr.S.Smys reported on the evolution of the IoT, its significance, and the protocols it uses[12].

J. Gao, X. Gao, W. Zhu, J. Zhu and B. Wei [13], have proposed a new snake robot with all body drive system based on rope system. This is a disaster management device and can climb into ruins to detect people Sushant Kumar and Dr S. S. Solanki [14], 2016, discuss a system developed for remote surveillance of homes using an Arduino, IP camera and Team Viewer to monitor the system. A DTMF controlled remote is used to switch on the PC, camera and robot.

K. Mohammad Shoeb Shah, P.B. Barole[15] , 2016 represents a low-cost, cost-effective robot using microcontroller Arduino UNO which can perform the act of tracking as well as rescue act. The robot is equipped with a passive infrared sensor, ultrasonic range module, temperature and humidity DHT11 sensor, air quality sensor MQ-135, accelerometer sensor, gyro sensor, magnetometer sensor, GPS sensor, Bluetooth and WIFI module, motor controller and robotic arm.

G. Anandravisekar, A. Anto Clinton, T. Mukesh Raj, L. Naveen, M. Mahendran [16] , designed a robot that perform surveillance in the household areas. The robot is controlled by a mobile phone or laptop via IoT using Cayenne software. Used to send instructions for a robotic system. Arduino connected with Wi-Fi module ESP-8266 for an unlimited range of operation accepts these commands.

S. Jagadesh et al [17-18] , designed this robotic vehicle using Wi-Fi technology for remote control of a wireless camera mounted on the robot. This robot uses a Node MCU ESP8266 microcontroller for the desired operation. The Wi-Fi module device receives the commands from the ESP8266 microcontroller.

PROBLEM STATEMENT:

In previous work we do not have the automatic controlled robot some need to control the machines of military vehicles by this lead to death of the solders if any bomb are available. Military vehicles cannot detect the bombs and any other metal contacts and they cannot know the location also. To avoid this we are implementing a new technique.Because of this, many soldiers may have been killed in prior projects because they lacked access to the automated controlled robots needed to operate the machinery of military vehicles. Bombs and other metal contacts are invisible to military vehicles, and they also have no idea where they are. We're trying out a new method to prevent this from happening.

III. IOT BASED MULTIFUNCTIONAL SURVEILLANCE ROBOT

The suggested robot has the potential to lessen casualties in border regions and other spots where military monitoring is important. The operator may now roam any uncharted territory and conduct a rescue with the aid of live

broadcasting. Landmines can be located using the robot's metal detector, and their exact locations can be pinpointed using the GPS tracker it carries.

The design of our project i.e., IOT based Multipurpose Surveillance robot encourages the development of a robotic vehicle based on Wi-Fi technology for remote operations connected with the phone that acts a camera mounted on the robot for monitoring/surveillance purposes.

This IoT based Multipurpose Surveillance robot has or is embedded with a Node MCU (ESP32) microcontroller for the desired operation and is generally used for monitoring purposes. The transmitting module on PC consists of push buttons that send commands to the receiving module for controlling the movement of the robot either to right, left, forward or backward. In the receiving module of this Surveillance robot, 2 DC motors are interfaced with the Node MCU(ESP32) microcontroller to control its movement via motor driver IC(L298N). The Wi-Fi control transmits the signals to the receiver and has a range of up to 400m.

The receiver collects and decodes the received signal's before feeding them to the Node MCU (ESP32) microcontroller to drive the DC motors via motor drivers(L298N). Interfacing is done between the device and the Wi-Fi module. Wi-Fi module device receives the signals or commands from the ESP32 microcontroller.

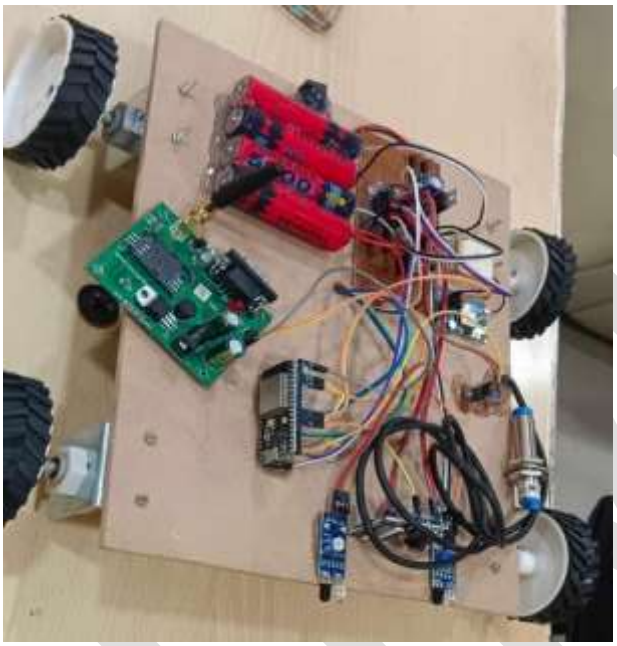

Fig 1 : IOT based surveillance robot

Thus in order to increase the range system we can go connecting the user section with the internet which is the main concept of the Internet of Things. For connecting the user system with the internet, here we have used Blynk software to develop IoT applications. Thus through this Blynk software, we can easily send commands and can easily control the robotic vehicle.

BLOCK DIAGRAM :

This IoT based Multipurpose Surveillance Robot Block Diagram is as follows shown in Figure:

- The main components of our block diagram are Node MCU (ESP32), Metal Detector, Motor Driver(L298N), Battery(12V), IR sensor, DC Motors and IP camera as shown in Fig - 2. DC motors are used for controlling robot's direction. Metal detector is used for detecting land mines which are placed on the ground during rescue operations. IR sensor is used to determine if the robot is near to an object. BLYNK app is used to control our robot.

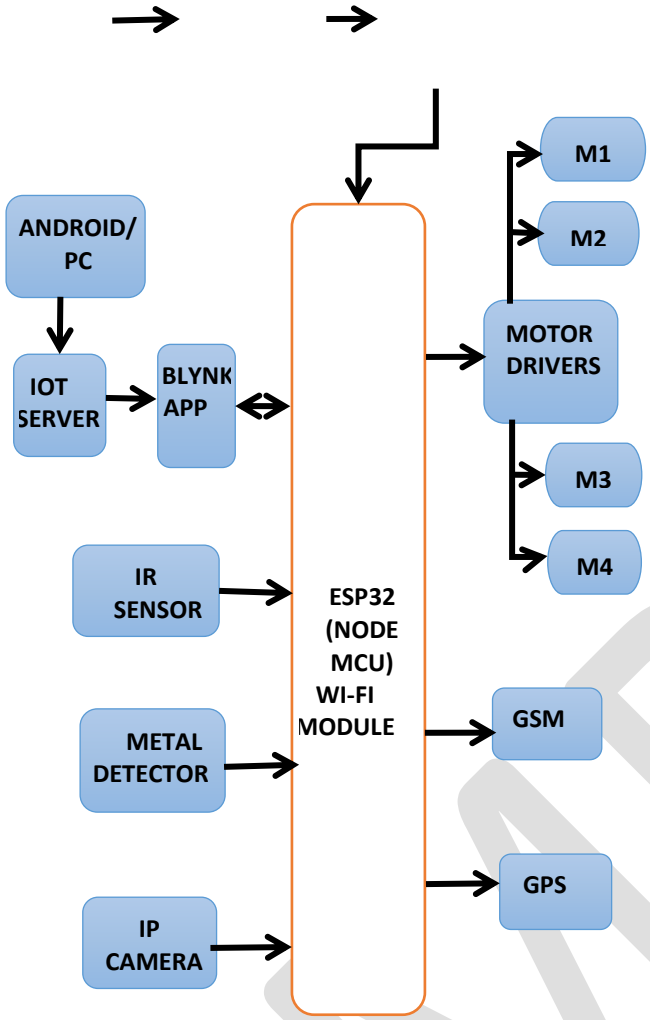

Fig 2 : Block Diagram of the robot

IV.DESIGN & IMPLEMENTATION:

For designing and implementing IOT based multifunctional surveillance robot there are few hardware and software required :

A) HARDWARE REQUIREMENTS ARE AS FOLLOWS:

1. **ESP32 Wi-fi module:** ESP32 is a low-cost, low-power Microcontroller with an integrated Wi-Fi and Bluetooth. It is the successor to the ESP8266 which is also a low-cost Wi-Fi microchip albeit with limited vastly limited functionality.It is an integrated antenna and RF balun, power amplifier, low-noise amplifiers, filters, and power management module.

2. Motor Driver:
An electric motor is a machine that does just that, turning electrical energy into useful motion. Electric motors, from a technical standpoint, are devices that transform electrical energy into motion in matter.

3. Proximity Sensors :

Proximity sensors can detect a substance without really touching it, so they won't scratch or otherwise harm it. Proximity detectors are able to sense the presence of an object electrically, without touching it, unlike devices like limit switches.

4. IOT Server:

The term "Internet of Things" (IoT) is used to refer to the interconnected network of gadgets, appliances, and other "things" that are outfitted with electronics such as sensors, processors, wireless network modules, and other similar components. These gadgets vary from the commonplace to the highly specialised.

5. GPS:

Position and time data can be obtained through the GPS (Global Positioning System), which is a satellite-based navigation system. Anyone with a receiver for GPS and a clear view of at least four GPS satellites can use the system at no cost. By accurately timing the signals transmitted by GPS satellites, a GPS receiver can determine its location. These days, a GPS receiver is almost required for each modern smartphone.

6. GSM:

GSM, which stands for Global System for Mobile Communications, is a standard for cellular network communication widely used for mobile phones and other devices. It uses a SIM card to connect to a GSM network, allowing the device to send and receive data, make phone calls, or send SMS messages. This capability enables remote monitoring and control of the device, making it suitable for applications where internet connectivity may not be available or reliable.

For example, in the context of a surveillance robot, integrating a GSM module can provide an alternative means of communication when Wi-Fi or other internet connectivity is not accessible. It allows the robot to send status updates, transmit captured images or video, and receive commands or instructions from a remote control station or a designated mobile device via SMS or voice calls.

7. Solar Pannel:

Solar panels are made up of photovoltaic (PV) cells, which absorb sunlight and turn it into usable power. PV cells are constructed from photovoltaic materials, which produce electrons when bombarded by light. The electricity known as direct current (DC) is generated when electrons move across a circuit; this current can be used immediately or conserved in batteries for later use. Solar panels can also be referred to as solar electric panels, PV modules, or solar cell panels.

Solar panels provide several benefits, including the use of a clean and abundant energy source, the decrease of carbon dioxide emissions, and the decrease of power costs. Cons include costly setup costs, dirty components that need regular maintenance, and limited use during peak sunshine hours. Besides their commonplace usage in homes and businesses, solar panels are increasingly being put to use in transportation and even outer space.

8. IR Sensor:

IR sensors are now often utilised as motion detectors, which may be found in lighting control systems and security alarms. The sensor components pick up on the shifts in radiant heat (infrared radiation) across time and space caused by people's motion within a predetermined angle range.

A) Software requirements are as follows:

1. Arduino IDE: - Arduino IDE is an open-source software. It makes it easy to write the code and upload it to the board. This Arduino IDE software can be used with any Arduino board. It is open source software that is used to write codes and upload it to the Arduino board. The Arduino IDE contains a text editor for writing codes, a message area, a text console, a series of menus along with toolbar with buttons. The programming codes are known as sketch. The sketches are
saved with the file extension .ino. It runs on Windows,
MAC and LINUX. Thus through this software we can code for the robotic movements and also for the sensors interfaced with the arduino board.

2. BLYNK: - Blynk is a platform with IOS and Android apps to control Arduino via the internet. It's a digital dashboard where we can build a graphic interface for projects by dragging and dropping widgets.Blynk is a popular IoT (Internet of Things) platform that provides a simple and user-friendly way to build mobile applications to control and monitor IoT devices. It allows you to create custom mobile apps for iOS and Android devices that can communicate with hardware devices via the internet.

B) FLOWCHART:

The following Figure shows the flow chart of the working of IOT based Multipurpose Surveillance Robot. The battery is connected and the robot is initialized or made ready to perform the action according to the code loaded into the robot.

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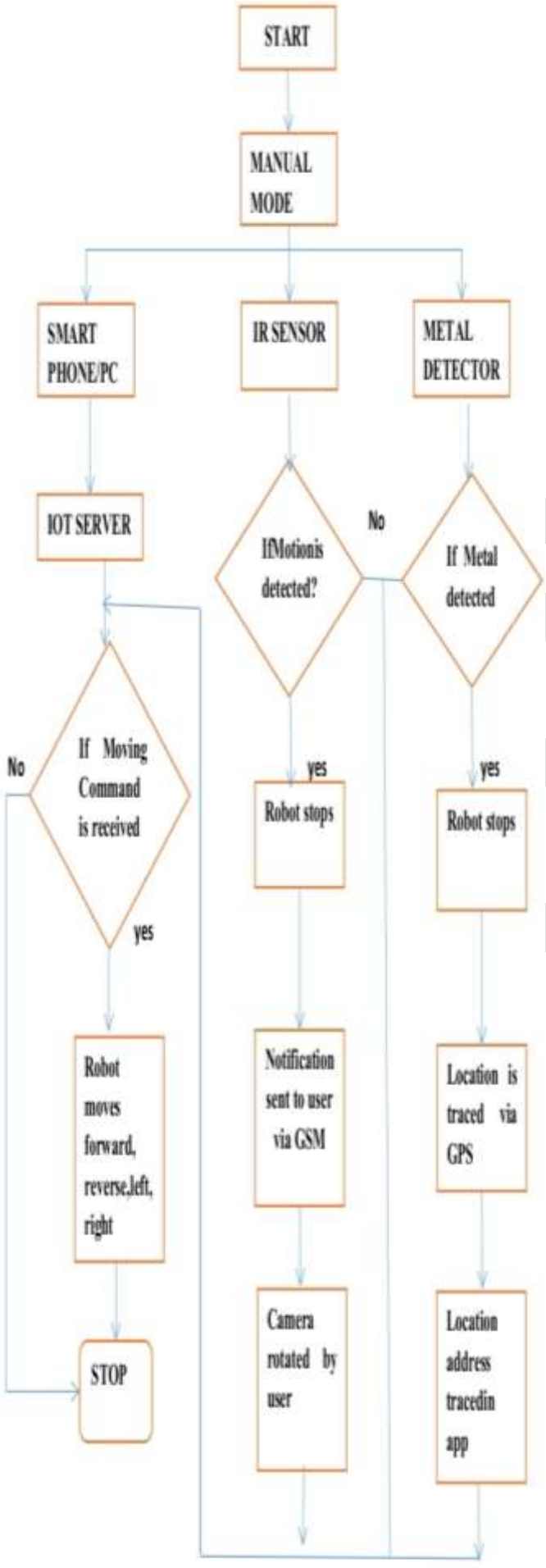

Fig 3: Flowchart of robot working process

V. RESULT& DISCUSSION:

Once the hardware components are assembled on the robot carrying vehicle, the software was integrated into the Arduino microcontroller and ESP32 Wi-Fi module of the robot components. The sensor systems were mounted on the carrying vehicle and the power supply was switched on the robot. 4G data was enabled on Android phone and the Wi-Fi hotspot was turned on to facilitate the ESP32 Wi-Fi module of robot to get connected with the Internet Cloud platform.

This is the best way for IOT integration for any robots in the world. Immediately the robot connected to the Internet Cloud platform using Wi-Fi hotspot of android phone. The Wi-Fi module of robot was displayed as
Wi-Fi hotspot user in the Tethering section of Wi-Fi settings. This confirmed the online coming of the Wi-Fi robot and connectivity to outside world of Cloud technologies.

When the robot is turned ON , ESP32 wi-fi module gets activated through hotspot network and provides power supply to the robot.

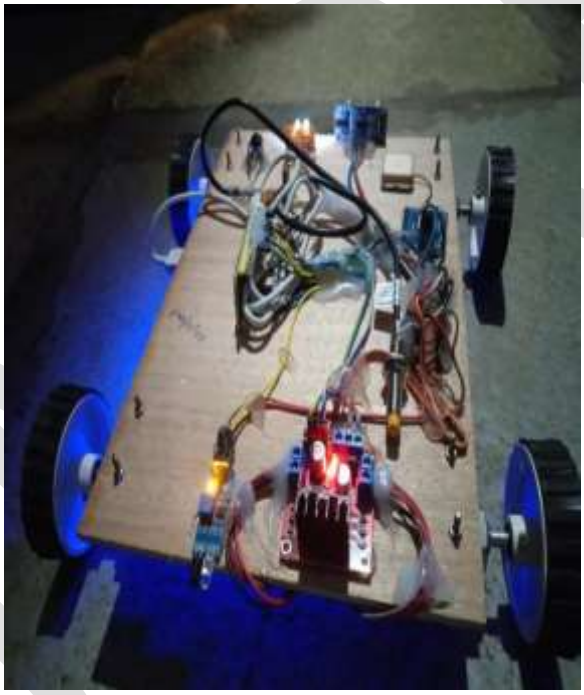

Fig 4: IOT surveillane Robot

- The robot detects obstacle and any other objects through its way and detects them through IP camera and sends object detected images to telegram app as shown in figure:

Fig 5: Object detection output shown in telegram

- When robot gets activated through smartphone by using Blynk app we can operate movement of it and detection of metals can also be performed:

Fig 6:Robot Detecting metal shown in Blynk app

Fig 7: Metal detected at Loaction: https://www.google.com/maps/?q=17.42,78.29

Fig 8:IR sensor detection shown in Blynk app

- The robot model can be reported to build a robot whose motor movement and mode of operation i.e. manual or automated are controlled by using a cayenne software that is used to build IoT based application. The wireless night vision camera is used for video recording and the live stream of the video can be viewed through an android application known as V380.
- The IR sensor used on the robot sense the motion in its vicinity and notifies the same to the operator on the android phone or PC by short message service (SMS) through GSM service module equipped on the robot. The robot proposed can reduce the loss of life of on border areas, and other locations where military surveillance is required. With the help of live video streaming the operator can perform the patrolling duty and recce any unexplored area.

VI.CONCLUSION:

It was hypothesised that this system Researchers and scientists have developed robots as technology has advanced. In hazardous environments, these robots are a lifesaver. The military is a major topic of focus nowadays. When a task is too dangerous or complicated for humans to undertake, military robots are sent in. The role of a soldier's aide is taken over by these robots. Many military groups today rely on military robots to carry out dangerous tasks. Video displays, sensors, grippers, and cameras are common components of the integrated system utilised by military robots. diverse military robots have diverse functions, hence their designs vary accordingly. In other words, military organisations have benefited greatly from the use of these robots.

FUTURE SCOPE:

The further research can be carried out to make robot to move in rain. We can enhance the system by equipping and increasing the sensors and its capabilities and to give greater accuracy by using the artificial intelligence.

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