Spy Bot

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Abstract. In various situations, there are times when a person is unable to physically check or provide assistance, leaving a specific action undone. However, with the use of robots, such issues can be resolved, and lives can be saved. To address this need, we have proposed the development of a surveillance robot that can stream real-time videos, transfer audio, and navigate around obstacles. Our aim is to design a system that allows us to wirelessly send commands to the robot, which it will follow accordingly.This proposed system consists of three main parts: the transmitter, receiver, and live streaming section. In the transmitter section, individuals can provide commands to the robot through various means such as gesture or motion tracking. In the receiver section, signals are received and decoded before being sent to the controller, which then directs the robot. Finally, the system is designed to allow for live video streaming to the person monitoring the robot. To achieve this, a common network, such as Wi-Fi, a laptop, and Arduino Uno, will be utilized to enable the surveillance feature for the user.With the implementation of this proposed system, individuals will have access to a reliable and efficient way of remotely checking and assisting in situations where physical presence is not possible. This will provide an effective solution to various problems and, most importantly, save lives.

Keywords. Spy-robot, ESP32, flex-controls, Wi-Fi, Bluetooth, Accelerometer, Arduino Uno, Motor Driver, Live Video Streaming.

1 Introduction

Robots have become an integral part of various sectors due to their ability to perform multiple tasks. However, the traditional way of controlling them is becoming less efficient due to their bulky nature and the long wires required. To address this issue, enhanced controlling features have been introduced, including wireless control through an individual, gesture, or motion tracking.

Moreover, live monitoring and surveillance have become crucial in our daily lives. To meet this demand, the proposed system uses a robotic vehicle with a connected camera that can capture live video footage in any direction. The wireless live streaming capability of the

system also makes it suitable for hazardous environments, where sending humans would be risky. Robots have several benefits compared to humans, as they can work in dangerous environments, reducing the risk to human life.

In conclusion, the proposed robotic system offers an efficient and safe alternative for surveillance and control in various industries, including hazardous environments. The wireless control and live streaming features make it a valuable addition to the world of robotics.

2 Literature Review

Conventional Robotics refers to the process of controlling robots through circuits such as RF circuit, Bluetooth, ZigBee, and RF. These technologies are used to operate and control robots over a certain distance. However, there are various limitations associated with these technologies. One such limitation is their inefficiency in covering large distances and their high cost. Another major drawback of using RF technology is security concerns. There is a risk of unintended users accessing information or attempting to communicate with the robot. Traditional robots were only capable of performing limited operations. Tasks such as real-time video streaming, audio streaming, and image transfer were challenging. The size and battery life of robots were also significant factors to consider. While using Arduino Uno provides faster live video streaming, programming it can be difficult for beginners. A robot typically consists of a microcontroller, motor drivers, and motors. It is capable of surveillance and transmitting video.

[1] Letian et al. have discussed about a robot which performs the image processing through the camera mountedon the top.

[2] Sri et al. have presented a surveillance robot for home security.

[3] Muhammad Hamza, M Atique-ur-Rehman, Hamza Shafqat, Subhan Bin Khalid [2019] proposed an idea about a platform to remotely control a surveillance robot over the internet. It will enable us to monitor the activities in the remote and sensitive areas. In traditional security systems, fixed locations are used for monitoring and spying purposes. For such cases, our robotic system is mobile and it can go into those areas where human access is risky, impossible or not suitable and provide us with the footage of those locations. The camera mounted on the robot keeps on capturing the video. This live video from the robot will be streamed on the webpage and it will be used for both surveillance and controlling the robot movement accordingly. The movement algorithm of the robot is implemented using CGI scripts and the monitoring is done by utilizing the MJPG video streamer. The aim is to control the robot from anywhere in the world via webpage and to make thedelay time as little as possible.

3 Technologies Used

3.1 ESP 32

The ESP32-CAM is an economic development board that is based on the ESP32 microcontroller and comes equipped with a camera module. This board is particularly suited for projects that necessitate a small-sized camera module and WIFI connectivity, such as home security systems, surveillance cameras, and video streaming applications. The OV2640 camera module integrated into the ESP32-CAM board can capture images with a maximum resolution of 2 megapixels. Furthermore, it has a built-in WIFI and Bluetooth module that enables easy internet and device connectivity. Apart from the camera and wireless capabilities, the ESP32-CAM board also includes 20 GPIO pins that can be employed for a variety of purposes, such as controlling other devices or sensors. Additionally, it features a microSD card slot, which can be used for storing images and videos. The ESP32-CAM board's feature set makes it an excellent choice for individuals who are looking to develop projects that incorporate camera capabilities and wireless connectivity. The board's small size and cost-effectiveness make it particularly useful for projects that require a low-cost solution without compromising on features. Overall, the ESP32-CAM board is a versatile and capable development tool that can help individuals create innovative projects.

FIG 3.1 ESP 32

3.2 Arduino UNO

The Arduino Uno is a versatile and user-friendly microcontroller board that has gained widespread popularity since its introduction in 2010. Its open-source nature, combined with the simplicity of its interface and programming tools, has made it accessible to a broad range of users, including hobbyists, students, and professionals. The Uno's ATmega328P microcontroller provides ample computing power, and its 14 digital input/output pins and 6 analog inputs offer flexibility for a wide range of projects. The board's other features, such as the USB connection, power jack, and reset button, add to its ease of use. The Uno's versatility and accessibility have made it a go-to choice for many applications, from simple projects to complex systems.

FIG 3.2 Arduino UNO

3.3 Arduino IDE

The Arduino IDE (Integrated Development Environment) is a software application used for programming and uploading code to Arduino boards, an open-source electronics platform based on easy-to-use hardware and software. Designed for artists, designers, hobbyists, and anyone interested in creating interactive projects, the IDE offers a simplified interface for writing, compiling, and uploading code to the board. Its features include a text editor for writing code, a compiler for converting code into machine language, and a programmer for uploading the code to the board. The IDE also includes a serial monitor for communicating with the board and debugging the code. The programming language used in the IDE is based on Wiring and is similar to C++, making it easier for users to create interactive projects without needing deep knowledge of electronics or programming. The Arduino IDE is available for free on Windows, macOS, and Linux, and there are many third-party plugins and extensions available to enhance its functionality.

FIG 3.3 Arduino IDE

4 Proposed Work

The project focuses on the wireless robot, which is essentially a small pseudo bot that has the capability to stream live video, capture images and videos, and store them on a cloud database. The bot can be controlled through several methods, including individual commands, gesture control, motion tracking, and auto operation. The main objective of the project is to develop a cost-effective mini pseudo bot that can perform a variety of tasks. To accomplish this goal, the bot will be designed using a microcontroller.

One of the key features of the surveillance robot that is being proposed is the ability to stream real-time video, transfer audio, and avoid obstacles along the way. This system is designed to allow the individual monitoring the bot to view the video feed in real-time. By using this technology, the bot can effectively navigate through its environment and perform its intended tasks.

The transmission and reception of signals to the other components are managed by the microcontroller. It primarily makes use of a power bank, a microprocessor, an ESP32 camera module.

As mentioned above bot can be operated in following ways

a) **Gesture Control:** To establish communication with a digital device, it is necessary to convert human gestures into a signal format. This entails utilizing sensors to capture analog data, which is then transmitted to the actuators. The analog gesture signal is subsequently converted into a digital signal. Once the gesture signals are in digital format, they can be employed to control various appliances such as automated homes or substitute traditional interfaces like keyboards to interact with computers. A gesture refers to an analog action that can be perceived through vision or physical observation. Various sensors can be utilized to capture these signals, including accelerometers, gyroscopes, cameras, and infrared or ultrasonic proximity sensors. Hand gestures were used as control signals for the spy robot. The robot's movements were directed using a variety of gesture commands. The study utilized five different commands to control the spybot, including moving it forward, backward, left, right, and stopping its movement.

b) **Auto Operation:** Auto operation is a term used to describe the capability of a robot or bot to move on its own without any external guidance, detecting obstacles in its path. This is accomplished using ultrasonic sensors, which emit sound waves and measure the time it takes for them to bounce back off nearby objects. By calculating the distance of these objects, the bot can adjust its course accordingly, either by slowing down or changing direction. This makes auto operation a vital feature in applications such as exploration, navigation, and surveillance, where robots need to navigate complex environments and avoid obstacles to complete their tasks efficiently and safely.

c) **Motion tracking:** Motion tracking refers to the process of monitoring the movements of a person or object and using that information to control the behavior of another system. In the context of robotics, motion tracking is used to enable robots to follow and mimic the movements of humans or other objects. During motion tracking, a robot uses sensors to detect the position, velocity, and acceleration of a person or object. This information is then used to generate commands that control the robot's movement. For example, a robot may be programmed to follow a person as they walk or run, keeping a constant distance from them, and adjusting its own speed and direction as necessary.

   By enabling robots to track and mimic human movements, motion tracking

technology opens up new possibilities for applications such as rehabilitation, entertainment, and human-robot interaction. It also has potential uses in fields such as manufacturing and logistics, where robots could be used to transport goods and materials alongside human workers.

d) **Individual Command:** To control the robot, individuals can issue individual commands for their movement using a variety of methods, such as mobile devices. These commands can be specific and detailed, allowing the robot to move precisely and accurately. For example, a person can command a robot to move forward or backward, turn left or right, or stop completely. Such individual commands enable people to interact with robots in a more natural and intuitive way, making them an essential part of our modern lives.

5 Result

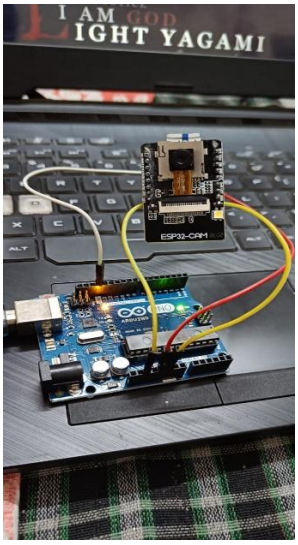

FIG 5.1 ESP 32 with Arduino Uno to capture real time visuals

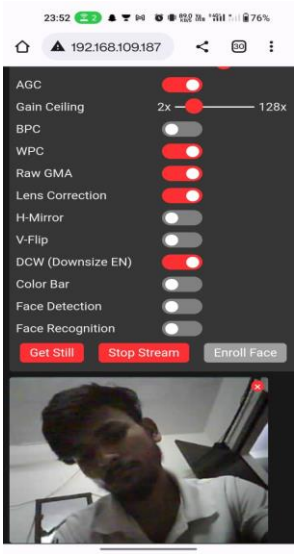

FIG 5.2 Live video streaming

The movement of the robot is based on the user's instructions and can be executed in various directions such as forward, backward, left, right, or stopping altogether. In addition, the ESP32 cam enables the transmission of live video footage over the internet, which can be viewed on a laptop screen. The quality of the video depends on multiple factors such as the camera resolution, internet speed on the Arduino Uno side for uploading, and internet speed on the user's side for live streaming. It is worth noting that live streams tend to have lower quality compared to recorded videos, and due to the robot's constant movement, the images or videos transmitted may blur. Nevertheless, these challenges can be overcome by ensuring a robust internet connection and setting a sufficiently high frame rate for the stream. In this case, the video was transmitted over a constant Wi-Fi connection of 72.0Mbps.

6 Future Scope

We can expect improvements in the sensors used by spy bots. Future models are likely to have sensors that are more sensitive and precise, which will enhance their surveillance capabilities. We can also expect spy bots to be equipped with additional sensors that can detect a wider range of environmental factors, such as air quality and radiation levels.

In future, with the help of ESP32's processing power, the bot can perform image recognition and analyse images in real-time, identifying objects and people and alerting its operator of any potential threats.

7 Conclusion

The concept of security surveillance has evolved tremendously over the years. Traditionally, security surveillance was carried out through fixed CCTV cameras, which provided limited visibility and scope. However, with the advancement in technology, there have been numerous innovative approaches to security surveillance. One such approach is the use of a robotic vehicle equipped with a webcam to transmit live video footage to a user's laptop in real-time.

The robotic vehicle is designed to move in any direction with the hand movements of the user. The webcam is installed on the top of the robotic vehicle, and the footage is transmitted to the user's laptop through an Arduino Uno and a common network. This allows the user to have continuous real-time access to the footage, enabling them to monitor any area of interest. In situations where it is difficult or dangerous to send humans to observe precarious places, the robotic vehicle can be utilized to provide real-time footage of those areas. This makes the approach particularly useful for security surveillance in areas where human presence may be hazardous or difficult.

Overall, the use of a robotic vehicle equipped with a webcam offers a reliable, flexible, and efficient approach to security surveillance. With the ability to monitor areas in real-time, it is a valuable tool for enhancing security and surveillance in various settings.

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