Advance IOT Rescue Surveillance Robotic Car

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***Abstract*—With the rapid growth of new technologies, the use of Internet of Things (IoT) has numerously increased in every aspect of life, to cope with the change in technology, the robotics industries are also changing its trend from conventional hard-wired robots to more advanced sophisticated autonomous robots. The automation of robots' ranges in all the sectors from the household products to the defence sectors. Nowadays, robots are also being controlled by the Android application which makes handling easier for the user. The objective behind introducing this robot is for surveillance of human activities in critical areas or situations. This paper introduces the Surveillance robot car based on Arduino Due by using IoT technology. The IoT technology is implemented by using Wi-Fi module to control the robot from the ground station, night vision camera is used to transmit the live video surveillance to the Android application to capture the images and transfer it to a remote server where they are stored in the database. The robot car allows multiple options for dealing with an ultrasonic sensor and atmospheric temperature. Face Detection Algorithm is implemented to detect the suspected people in the active zone region. This project uses modern engineering techniques to yield better implementation and improved results. The robot will serve efficiently for the defence sector to reduce the loss of life and also to prevent illegal activities.**

***Index Terms*—IoT, Android application, Surveillance, Arduino due, Wi-Fi, Defense sector**

I. INTRODUCTION

The growing global demand for sustainable and renewable energy sources has spurred innovative research and development in the field of energy harvesting. One area of interest is the utilization of human kinetic energy as a potential power source. Among various approaches, the harnessing of footstep energy has emerged as a promising avenue for generating electricity from everyday human activities. The concept of generating electricity from footstep energy is rooted in the principle of piezoelectricity. Piezoelectric materials have the unique property of generating an electric charge when subjected to mechanical stress. By integrating these materials into flooring or shoe systems, it becomes possible to convert the mechanical stress produced by human footsteps into usable electrical energy. The advancements in piezoelectric materials, coupled with innovative engineering designs, have led to the development of an advanced footstep power generation system. This system aims to capture and convert the energy generated by footfalls into a renewable and sustainable source of power. To optimize energy conversion and ensure a seamless integration with existing infrastructure, sophisticated power conditioning circuits are employed. These circuits process the generated electrical energy, converting it into a suitable form for immediate use or storage. Energy storage units, such as batteries or supercapacitors, are utilized to store excess energy for later use, enabling a consistent power supply during periods of low foot traffic or increased power demand.

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electricity from footstep energy is rooted in the principle of piezoelectricity. Piezoelectric materials have the unique property of generating an electric charge when subjected to mechanical stress. By integrating these materials into flooring or shoe systems, it becomes possible to convert the mechanical stress produced by human footsteps into usable electrical energy.

The advancements in piezoelectric materials, coupled with innovative engineering designs, have led to the development of an advanced footstep power generation system. This system aims to capture and convert the energy generated by footfalls into a renewable and sustainable source of power. To optimize energy conversion and ensure a seamless integration with existing infrastructure, sophisticated power conditioning circuits are employed. These circuits process

the generated electrical energy, converting it into a suitable form for immediate use or storage. Energy storage units, such as batteries or supercapacitors, are utilized to store excess energy for later use, enabling a consistent power supply during periods of low foot traffic or increased power demand. Internet of Things (IoT) can be defined as a network of interconnected physical objects that are accessible through the internet. Basically, IoT is an ecosystem in which all the physical devices are connected to the internet through network devices and exchange data. Today, IoT is a major technology by which we can produce various useful internet applications. IoT is a top-notch technique which reduces human effort and provides easy accessibility to physical devices. IoT allows physical devices to be controlled remotely across existing network infrastructure. “Things” in the IoT sense, is the mixture of hardware, software, data, and services.

These devices gather useful data with the help of various existing technologies and share that data between other devices.

Examples include Surveillance robot car which uses Wi-Fi, GPRS or Bluetooth for exchanging data between various devices [5].

Robotics is a multidisciplinary field of science and engineering which includes mechanical, electronic, information and computer science engineering. It deals with the design, development, execution, and manipulation of robots, as well as computer systems for their control, information processing, and sensory feedback.

Indian Armed force is the world’s 4th active defence force as per the man- power and weapons we have. But technology wise we are too behind. All the technical equipment and weapons we have are either adopted or borrowed from other nation. Indian forces have many equipment for aerial as well as naval surveillance and many of them are self-made. In border areas, if there is any kind of suspicious activity then our soldiers have to search that place manually which has a huge risk of life during encounters with the attackers. This kind of situation also occurs during hostage situations. But we can make improvement by using a land-based surveillance system.

With the terror always being India’s first enemy, robots are the only option that can be used to save human life. India is still enduring and suffering from regular threats and terror attacks from neighbouring nations. The recent terror attacks in Kashmir and Mumbai terror attack have consummated that the future of warfare will be handled by the robot and automatic machines as far as possible to protect human life. Currently, the Indian Army has DRDO Daksh Military robot used for locating, handling and destroying hazardous objects safely in the battlefield. With the rapid proliferation of technology in the automation field by incorporating Military Robots as Soldiers in the war field to diminish injury and demise in war fields [7].

The project aims in designing a Surveillance Robot Car which can be controlled from anywhere around the world by using the IoT technology. Wi-Fi module will be installed on the robot car to control it from the ground station and also receive the live video surveillance via the android application.

Various sensors are installed on the robot car to sense or detect the atmosphere and its surrounding environment and act accordingly. Face Detection technique is implemented to detect and recognize the suspected people in the surveillance region and to store the image in the database for future use. The component used for this robot car are Arduino Due, 32-bit ARM Processor development environment released by the Arduino community, the motor driver module L298N can control either two DC motors or one bipolar stepper motor, the direction and motor speed can be controlled by L298N H-bridge module.

Wi-Fi module provides an internet connection between a user or ground station and the robot car to transmit live videos of active zone and to receive the commands given to it from the user or ground station.

II. SCOPE OF THE PROJECT

This system deals with the design of a Surveillance Robot Car which can be controlled from anywhere around the world by using the IoT Technology. Wi-Fi module is used to control the robot car from the ground station and also to transmit the live video surveillance to the android application. Face Detection technique is implemented to detect and recognize the suspected people in the surveillance region and to store the image in the database for future use. Various sensors are installed on the robot to sense or detect the atmosphere and its surrounding environment.

III. RELATED WORK

Robotics, in the field of surveillance and rescue, is very popular. A lot of studies and research had been conducted on the transmission of live videos, on the wireless control system of robots, to establish long-range and reliable communication. The most common method is to use a wireless camera along with costly sensors and mount them on the robot to get the live video and other environment parameter details. Controlling of the robot is done either by Bluetooth or Zig-Bee module [8].

The use of Android smartphone allows the use of many applications that can be effective in surveillance and rescue operations. Instead of using various costly sensors and camera differently, Benedict Ebinesar.J and Vijay Nagaraj [2] have provided the solution to use a smartphone which has all the capabilities, the use of Smartphone allows the user to get live data from the environment. The robotic arm facilitates picking up objects like radioactive and other harmful objects. Inbuilt sensors in the smartphone receive Acceleration and GPS data. It can also detect humans if present in the vicinity. The robot can be controlled from a Laptop as well as Tablet, solving the problem of portability of controlling system. The main disadvantage of using this solution was to use the “firebird- V”, which is costly to buy and using a smartphone as a camera is not apt for every surveillance and rescue operation.

K.Anil Bablu Louis suggested the cheaper way for controlling the surveillance robot by using the Bluetooth module. Smartphone sends the command to the Bluetooth module by using an android app to move the robot forward, backward, right and left. An RF receiver is used for the camera so that the feed from the camera can be shown in the laptop which is done by using the TV Tuner [3].

Mr. P. Surendra Kumar and Ms. S. Geetha Priyanka had proposed to use AV camera instead of RF receiver since AV cameras has their own network. The AV camera was wirelessly connected to the sensors and the whole vehicle is operated by using the Zigbee technology. Here laptop acts as a transmitter which sends the signals to the robot as well as camera and the robot acts as a receiver which receives the signal and act upon the command given to it by using the Zigbee module [4].

Aditya Sundaram, Monel Gupta, K Chandrasekaran from the Department of Computer Science and Engineering, NITK, India had proposed the architecture that consists of a centralised application server which runs on the cloud and also renders web interface for the user so that the user can connect to the robot, remotely. Then the application server is responsible for firstly, transmitting visual feedback to the user and present it in the browser and secondly, receive the control inputs from the client side (users) and forward them to the control server that handles the communication between the application server and the robot. After receiving the signals from the application server, the control server sends the command to the robot for performing the desired action and also to transmit video from the camera to the application server [6].

A. Existing System

The existing system consists of Raspberry pi and Arduino which was used to build the SMART- I server. The robot consisted of motor drivers, servo motors, sensors, and an infrared sensor that was connected to the Arduino using a separate battery for line tracing. Raspberry pi was used as a server which was connected to the Arduino via serial communication port or the USB port. It was an IoT based surveillance robot with client-server based robot architecture. The existing system includes its

own server for which the IoT is used and it provides not only smartphone app client but web- based client also. Both the smartphone based and the web- based client can control and monitor the robot using Internet.

The robot had its own server through which it communicated with PC or Smartphone using Wi-Fi. It consists of a webcam that uses Apache server port 8080, to capture and transfer the image to the server which further stores that image in the database that are viewed by the client in the real time. Node.js server was built and, OpenCV and C++ was used for the image processing. Here the image stored in the database and the recently taken image was compared by using image processing techniques, if any anomaly or abnormal state occurs then the user or client was notified about the anomaly via notification sent from the car to the user's smartphone or to the web- based app.

This Intelligent robot had two phases, In the learning phase the image of the normal state is stored in the original data table. In context-aware phase, the robot compared the monitoring image of a particular location with the original image. If the image similarity is lower than 80 %, an abnormal state is identified, and the robot can notify the abnormal state to the user. While SMART-I was driving and monitoring, the sensing value from the various sensors could be used to make an event. If the event occurred and context value was not under the threshold value set by the user, it could be sent to the user as a notification.

IV. PROPOSED SYSTEM

First, the system architecture explains the plan of an IoT controlled surveillance robot car which is manually controlled by an android application and monitoring system. The later section describes the framework of the proposed robot car and the requirement analysis. The design of an IoT controlled surveillance robot car is proposed below.

A. System Architecture

The below figure shows the architecture of the proposed system. In this, the base of the architecture is IoT through which the user connects to the car and can control it.

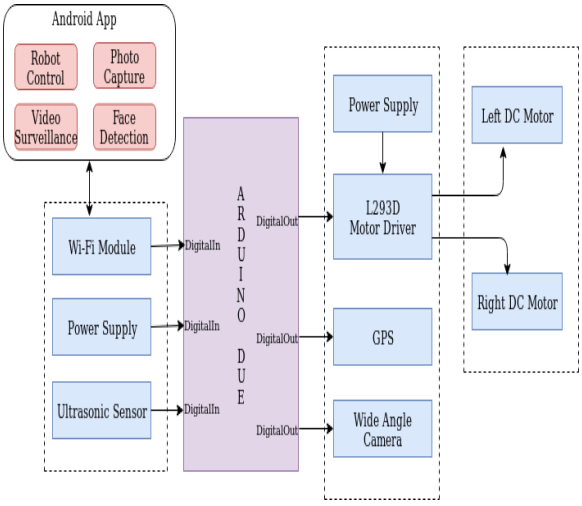

Figure 1. Architecture of the proposed system

Android phone must be connected to the internet, which will be used to communicate with the robot car for performing the tasks, from the base station. The robot car will send the images and the live feed via Wi-Fi to the server and will store the surveillance video as well as image in the database for further use. Robot car will be connected to the internet using Wi-Fi module so that it can function according to the user's requirement through Arduino Due.

Android application is used for streaming the live video from the camera mounted on the robot car and also to control the robot. Access of the android app will be given to the specific user. GPS module is used for getting the exact location of the robot car.

Face Detection Module is used to detect the face of any person. The rotational angle of the camera is controlled by a servo motor. Camera is used for the real time surveillance and the captured images are verified with the images stored in the database to get the information about the person. A fter verifying the captured images with the database, appropriate commands are issued to the robot using the android application. The car is powered by 4000mAh Lithium polymer battery. Temperature Sensor is used to detect the temperature around the car. If by any situation camera is not responding or is damaged, ultrasonic sensor is used to detect the obstacle in front of the car so that the user will be able to drive the car safely to the base station.

IV. RESULT

A scheme for modern surveillance system is defined here with its real time implementation and experimental result. An integration of Wi-Fi module, Ultrasonic sensors, GPS and Wide-Angle camera is deployed and tested with the help of the interface designed for the surveillance purpose. The Arduino will continuously receive and transmit the values detected by ultrasonic sensor. Based on detection of the object in front of the ultrasonic sensor, the values will be generated and will be displayed on the application. The live video is transmitted to the android app via the in- built transmitter on the camera. The receiver is connected to the android mobile to receive the transmitted signal and display it on the android application.

The android application is implemented to control the robot car. By using the horizontal and vertical buttons, to the left of the screen, motion of the camera is controlled and control buttons are provided on right side of the screen to control the motion of the robot car. To detect the faces from the camera, face detection module is integrated with the android app and there is a separate button to capture the photo. The images and videos are recorded at controller side and stored in the database. The image and video files which are stored in mobile memory is capable of opening and accessing the files in an Android mobile itself.

V. ADVANTAGES

- Boosting Productivity with Robotics. ...
- Lower Operational Costs through Automation. ...
- Improved Quality and Consistency with Robots. ...
- Enhancing Workplace Safety Using Manufacturing Robots. ...
- High Initial Costs of Robotics Implementation

VII. FUTURE SCOPE

There are several developments in this paper which can be executed as a future scope. The future scope is related to the strength and reliability of the robot car, live video surveillance, face recognition, etc.

The strength of the robot car can be upgraded by placing a sturdier chassis so that it can work on terrains which include mountains, muddy and sandy terrains, which is not feasible with the chassis currently installed on the robot car.

There is a lag in live video surveillance which is caused because of network congestion or traffic, this can be improved in the future. The face detection module can also be improved to not only detect but also recognize the faces with the help of multiple images which is already stored in the database. To increase the security of robot car, while in the hostile situations a fail-safe method can be used which is activated when an assailant tries to access the system by connecting its computer or laptop to the Arduino Due. By using a metal detector on the chassis, we can detect the Land Mine with the help of robot. The experimental graph given above describes the efficiency of the detection of the face using the camera to the distance (in feet) of the victim from the camera. As the distance progresses between the camera and the face, the detection rate will be lower. The detection rate will also be depending on the time (day or night) the images or the videos are recorded.

VIII. CONCLUSION

IoT controlled surveillance robot is designed and built to provide surveillance in dangerous situations like border patrolling and rescue operations and can also be used in hazardous situations like mining, explorations, etc. The Camera mounted on the robot sends the live surveillance to the Android application via the Wi-Fi module installed on the robot. The face detection technique is used in the system to detect the faces and also to store it in the database.

In conclusion, the implementation of enhanced control and real-time video streaming for espionage and security applications with an IoT-based wireless surveillance robot represents a significant advancement in surveillance technology. By integrating hardware components such as motor drivers, DC motors, and a camera module with software functionalities for remote control and live video streaming, the system offers unparalleled capabilities for monitoring and safeguarding various environments. The ability to remotely control the robot\'s movement and view live video feeds in real-time provides users with enhanced situational

awareness and flexibility in surveillance operations. Moreover, the discreet and portable nature of the surveillance robot makes it well-suited for espionage and covert security applications. Overall, the system\'s effectiveness, cost-effectiveness, and scalability make it an asset for addressing the evolving security challenges faced by modern organizations and institutions

As technology continues to advance, the IoT-based wireless surveillance robot stands poised to play a crucial role in enhancing security measures and ensuring the safety of individuals and assets in diverse environments.

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