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IOT Based Robotic Vehicle Surveillance System Using Raspberry Pi

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ABSTRACT: Military personnel face many unique challenges on a daily basis in their work compared to civilians. Many of these challenges can be aided or overcome by having more information at the right times. Intelligence is generally gathered in many ways including covert operations, communication interception, aerial surveillance, and ground surveillance.

Ground surveillance is so key because there is no more reliable intelligence than a person on the ground having visual confirmation of a target. Unfortunately, ground surveillance can also be the most dangerous form of intelligence gathering because of the proximity to the target that is required by the personnel on the ground.

Our project seeks to improve the solution of robotic ground surveillance by developing a robotic vehicle using (open CV) computer vision and ultrasonic sensors that will aid the military personnel in finding a point of interest such as an injured individual, bomb, enemy combatant, vehicle, and much more. The main purpose of the robot is to roam around in each environment while transmitting back real time data (video) to the ground station.

KEYWORDS: Robot, Militaryvehicle, Raspberry Pi, Surveillance.

I. INTRODUCTION

Surveillance literally means to watch from a distance, while surveillance robots are used to monitor the behaviour, activities, and other changing information that is gathered for the general purpose of managing, directing, or protecting one's assets or position.

Surveillance cameras and facial recognition are used to monitor public and private spaces and to identify people. The city of the future is likely to place a lot of emphasis on security. So, robots may well be performing dangerous jobs normally done by the police, and automated incident detection cameras will be used to enable fast intervention by security personnel.

Robots have also started to be used for surveillance purposes in the private sector as well and robot guards are currently being tested all over the world. US-based Gamma 2 Robotics has developed Ramsee, a machine resembling a small cosmonaut that does the security patrol rounds at sensitive sites.

The proposed system consist of two units mainly a robotic unit and a remotely control unit. The robotic unit is consisting of the webcam, sensors and the heart of the project, raspberry pi along with the PCB containing motor driven IC and voltage regulator circuitry.

The Raspberry Pi is a series of credit card-sized single board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intent to promote the teaching of basic computers. It also plays high definition video. This device does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage. The Raspberry Pi is the heart of the project here where all the process of monitoring, controlling the appliances and update the status to cloud.

II. LITERATURE SURVEY

In [1], the author discusses a system for observing the human movement in the war field and border regions which can reduce the risk of human life as soldiers of armed forces can assess the condition of the territory before entering it. The war field robot comprises Arduino uno board which is fitted with L293D motor driver, HC-05 Bluetooth module and night vision wireless camera. Camera is mounted on the top of the robot and can monitor minimum of 100 m transmission distance. It has the feature of rotating 360 degrees by the means of android application. That android application is created through MIT app inventor and is used for the total navigation control of the robot.



In [2], the author proposed a robot to execute the act of continuous surveillance in the domestic areas. It is capable to reduce the human labour as well as human error. The robot is controlled by mobile or laptop through Internet of Things by the means of Cayenne software which is used to send commands to the robotic system. Arduino interfaced with ESP-8266 Wi-Fi module for unlimited range of operation receives those commands. DC motors, ultrasonic sensor to detect any obstruction, IR sensors and wireless camera that provides audio and video streaming data to the user end are used in this project. Arduino Integrated Development Environment which is a cross platform application is used for writing codes for Arduino board.

In [3], the author presents a cost effective robot using Arduino Uno microcontroller which can carry out the act of surveillance as well as rescue operation. The robot is equipped with passive infrared sensor, ultrasonic ranging module, DHT11 temperature and humidity sensor, MQ-135 air quality sensor, accelerometer sensor, gyroscope sensor, magnetometer sensor, GPS sensor, Bluetooth and WIFI module, motor driver and robotic arm. The robotic arm is a type of jointed arm and consists of gripper to pick up objects with ease. It is controlled remotely by end user via internet. Solar panel is also connected to provide with the facility to charge battery with solar power.

III. PROPOSED SYSTEM

As the system uses Raspberry Pi, Relay circuit, Pi camera are the main part of the project here the Raspberry Pi acts as a web server and as well as microcontroller for programming. As per the Programming done in the Microcontroller, the Web page is displayed on the screen in which the buttons are viewed as Front, Back, Left, Right and Surveillance. When clicked on these buttons, this feedback is given to the microcontroller. There are 15 GPIO pins which are defined in the microcontroller i.e. pin 5, pin 6, pin 13, pin 19 are connected which are given to the 2 DC Motors and Servo motors as shown in the setup figure 1, pins 17 & 23 for servo motors to control pan and tilt movements, pins 27 & 22 for ultrasonic sensor, pins 20 & 21 for PIR sensor and Buzzer respectively. Through HTML & PHP language when the respective button is pressed, the data is passed into the server. When clicked on button, their respective pin goes high and operates.

The proposed system consists of Raspberry Pi, Pi camera, PIR sensor, Ultrasonic Sensor, Servo motors, Web server.

Raspberry Pi: The Raspberry Pi is a credit card sized, single board computer developed in the UK by the Raspberry Pi Foundation. The Raspberry Pi has a Broadcom BCM2835 System on a Chip (SoC), which includes an ARM1176JZF-S 700 MHz processor. It has an internal storage of 512 MB, external storage supported up to 32 GB, 1 Ethernet port, 4-2.0 USB ports, 1 micro SD card slot, DSI display connector, 1 HDMI out port, 1 CSI Camera connector, 5V USB power, RCA The Raspberry Pi2 B model CPU is of ARM 11 family operates at 700MHz. The GPU having Broadcom Video core-IV, open GLES 2.0, 1080p30, H.264/MPEG-4, AVC high profile decoder and capable of 1Gpixel/s, 1.5 G Texel/s (or) 40 GFLOPs of general-purpose (GPIO) compute. It operates 2A at 5V power supply. With the help of GPIO pins we can control the devices from any place

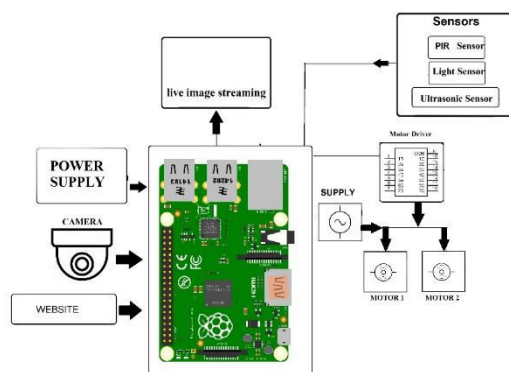


Figure 1: Block Diagram of of Proposed system

Pi Camera: The Raspberry Pi Camera module is connected to CSI port of raspberry pi. This is an 8 Megapixel night vision camera used to broadcast a live stream to webpage through raspberry pi, thus, we can watch live stream of our home from anywhere in the world. This camera is attached to servo motors to rotate (right, left, up and down) the camera.

Ultrasonic Sensor: An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

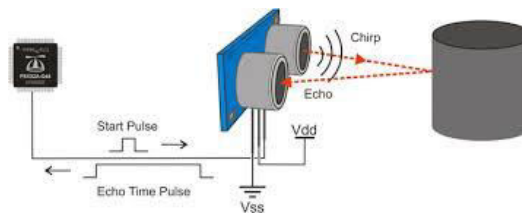


Fig.2: Ultrasonic sensor basic Concept

Since it is known that sound travels through air at about 344 m/s (1129 ft/s), you can take the time for the sound wave to return and multiply it by 344 meters (or 1129 feet) to find the total roundtrip distance of the sound wave. Roundtrip means that the sound wave traveled 2 times the distance to the object before it was detected by the sensor; it includes the 'trip' from the sonar sensor to the object and the 'trip' from the object to the Ultrasonic sensor (after the sound wave bounced off the object). To find the distance to the object, simply divide the roundtrip distance in half.

The Ultrasonic sensor is used to find the water level in the water tank. By calculating the distance of water level from the top we can control the motor by using microcontroller.

PIR Sensor: A PIR (Passive Infrared) sensor is a motion detector which detects the heat (infrared) emitted naturally by humans and animals. When a person in the field of vision of the sensor moves, the sensor detects a sudden change in infrared energy and the sensor is triggered (activated). They are commonly used in security lighting and alarm systems in an indoor environment. The PIR sensors have a range of approximately 6 meters, depending on conditions. The sensor adjusts to slowly changing conditions that occur normally within the environment but shows a high output response when a sudden change takes place.

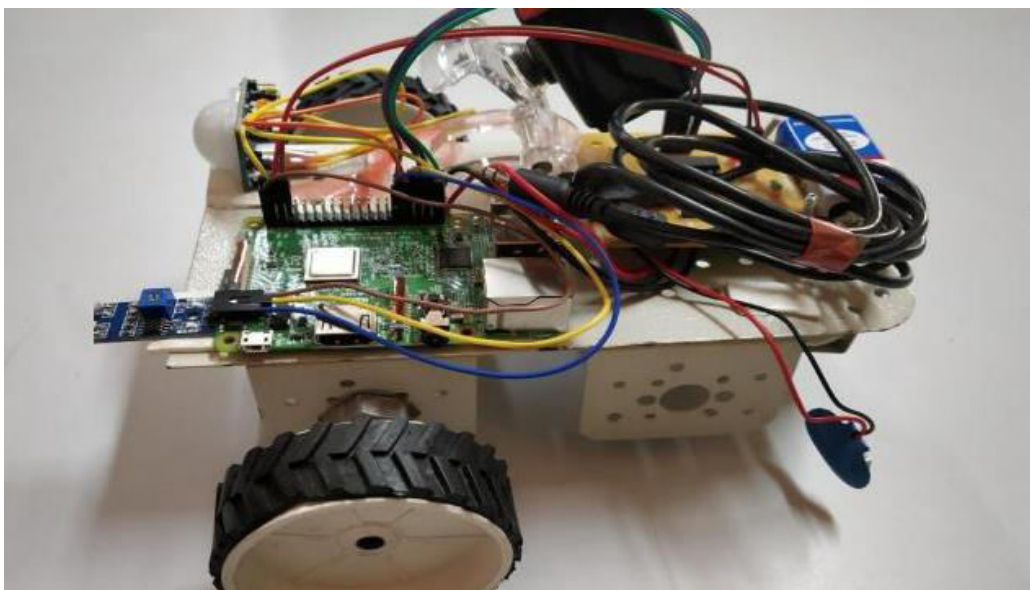


Fig.3: Experimental setup



Web Server: Web server is a program that uses HTTP to serve files that create web pages to users in response to their requests, which are forwarded by their computers HTTP connection. Any server that delivers an XML document to another device can be a Web server. A better definition might be that a Web server is an Internet server that responds to HTTP requests to deliver content and services.



Fig.4: Example for Web Server

For an example, I can say if you are in front of your computer, browsing your Web, and you get a message from a friend saying, "I had just read a great article! You can check it from the following URL. It'sat<http://www.fastwebhost.in/blog>"So you will type that URL into your browser and press enter.

And that's it, no matter where the website hosted in the world, the page will be displayed on your computer screen. Always a web server is connected to the internet. Every Web server that connects to the Internet will be provided with a unique address which was arranged with a series of four numbers between 0 and 255 separated by periods. Also, web server enables the hosting providers to manage multiple domains(users) on a single server. A web host is a company that leases out space on a cluster of servers to empower people to serve their own content & webpages.

IV. EXPERIMENTAL RESULTS

The Raspberry Pi is programmed using HTML which is passed using 'PHP' 'Java script' language. Here a webpage has been created to continuously monitor the through camera that will be displayed to the user wherein the user has to establish connection with mobile or PC remotely accessing robot. Figure 5 shows the browser page which we designed using HTML language as a home page, Once the home page is loaded, the user need to enter IP address (192.168.0.103) to facilitate the further access to control the robot.

In the proposed system the movement is controlled by movement page, on this page we can control robot using 2dc motors just by clicking the buttons on the web page, initially all pins will be in off State i.e. '0' state. The user can access this system using PC/Mobile. Using this GUI, user interacts with the system to control devices. When '0' state means the pin will OFF when '1' state means pin will be 'ON'. So, in this way we can control the movement of the robot. If passive infrared sensor (PIR sensor) sense movement of people, animals, or other objects it rises an alarm took pictures and send the status to web page.

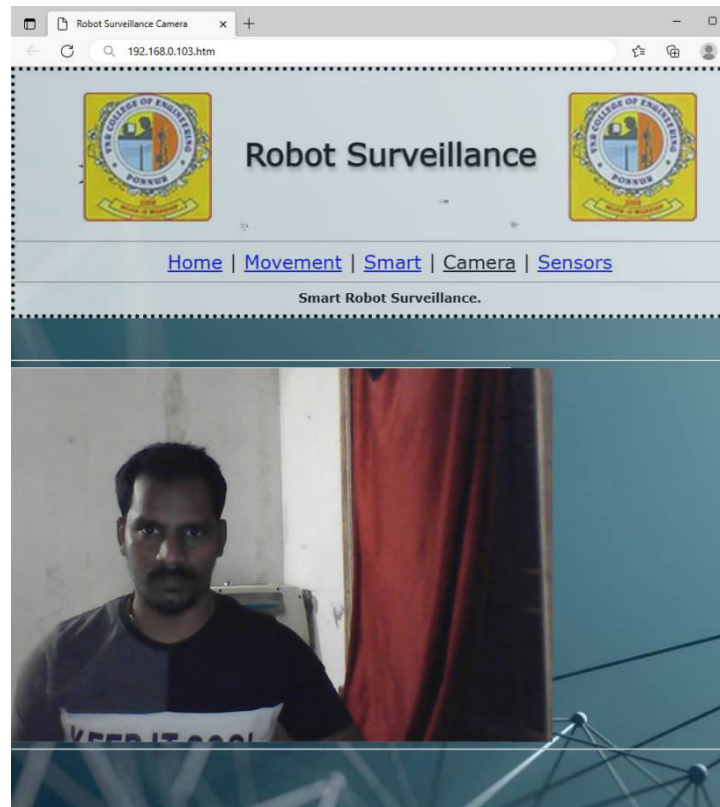


Fig.5 Screen shots of the proposed smart robot web page

V. CONCLUSION

The conclusion is that the proposed system is completed successfully. The motion of the robot vehicle is being controlled manually using a webpage. According to the movement, we could control the wheel and hence the movement of the robot through the webpage by using IOT. The input given to the webpage is sent through the internet and desired movement occurs at the robot end. The robot vehicle can capture the photos and store them and can able to transmit the live video.

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