

Design of a remote sensing and security application based spy robot for smart surveillance system

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Abstract-*Due to increase the terrorist activities throughout the world, it is very important to control and monitor their activities and quickly execute the required plan accordingly. This paper presents a smart Global Positioning System (GPS) based surveillance robotic system using Raspberry Pi for security application and remote sensing. This robotic system is fully controlled wirelessly via internet web browser and android apps. A camera is attached with a gripper, so that it can view the surrounding environment and disposed the object under consideration. An ultrasonic sensor and GPS module is attached with it which helps in measuring the distance and tracking the location continuously. The whole system is implemented on raspberry pi 3 which has Linux OS and the python language is used to write a program of the various peripherals of this robotic system. Video surveillance is the process of monitoring a situation, an area or a person. This generally occurs in a military scenario where surveillance of borderlines and enemy territory is essential to a country's safety. Human surveillance is achieved by deploying personnel near sensitive areas in order to constantly monitor for changes. But humans do have their limitations, and deployment in inaccessible places is not always possible. There are also added risks of losing personnel in the event of getting caught by the enemy. With*

advances in technology over the years, it is possible to remotely monitor areas of importance by using robots in place of humans.

I. INTRODUCTION

Now a days, Artificial Intelligence analysis targets principally on the style and development of autonomous and compliant movable robots for unstructured and natural environments like planet surfaces instead of structured industrial environments. These robots will accomplish the tasks like security, police work in unstructured and natural environments. This category of robots will be used for tasks within the venture of some environments where human isn't capable of monitoring [1].

Now a days the surveillance in military areas is required but the quality of that surveillance is not up to the level of expectation. This is resulting in the increasing ratio of lives of the soldier in danger. So as to improve the quality of surveillance there should be system which is able to mobile anywhere with effective surveillance. The surveillance can be made effective with the help of high quality video transmission. The quality of video is improvised in the proposed system. The ground bot is able to move on the various surfaces such as muddy areas, staircases, heels. The past few years has seen a lot of technical advancements in

surveillance, by the introduction of types of Closed Circuit Cameras. These have assisted in solving crime scenes and yet, the crime rate has not reduced because of the immobility of the surveillance equipments. In any given hostage situations security cameras are the first to be targeted by the felons to protect their identity. So the need for the development of mobile surveillance equipments is at stake. This paper deals in the development of a mobile robot capable of capturing real-time images and videos for surveillance. As by its name, Snitch is capable of going beyond enemy lines to know their secrets and identities for added tactical advantage for its user. Mobility is a major factor of Snitch, and it has to surpass the current hurdles in the field of mobile robotics. There was a boom in development of mobile robots and their capabilities in doing house-hold works like vacuum cleaning to military applications like disarming explosives. BigDog robot [2] , RoboSapien [3] are some of the mobile robots developed in the last decade that are capable of doing a specific task, but most of these robots are capable of functioning only in a controlled environment and are confined only to the horizontal surface. But few robots are capable of climbing on to the vertical surface like Caterpillar Robot [4]. They use Bernoulli Effect, Tracked Wheel Mechanism, Electrically Controllable Adhesion technology, Electrostatic Adhesion Force, Aerodynamic Attraction and Vacuum suction [5] to achieve desired adhesive force to climb on vertical surfaces. But most of them lack the ability to transit from one dimension to the other without any human effort. The robot described in this paper is capable of moving on both horizontal and

vertical surface with ease and transit between two surfaces automatically without the need of human help to achieve hassle free mobility while performing the tasks at hand [6]. As the growth rate of crime has been increased in past years, as a result, everyone is concerned about their safety and security. Due to this reason, people started to consider the significance of surveillance systems [7]. The majority of the people are doing Internet Protocol (IP) based installations rather than analog because of IP-based installations are from anywhere [8]. In order to make the IP-based systems affordable for the people having a low budget, we need to develop a system which is cost effective and portable. This paper describes the system which acts as a robot .This robot uses raspberry pi model B for making this real-time surveillance possible by providing the installing and processing high resource software's which makes it possible to live streaming & controlling the robot.

II. PROPOSED SYSTEM

This project aims to develop a robot which can be used for video surveillance & monitoring which can be controlled through a GUI interface. The control mechanism is provided with a video transmission facility. The video transmission is practically achieved through high-speed image transmission. Initially, the robot will be equipped with a camera which will capture the scenes and transfer the images to the server on which the user will be controlling and watching the live feed.

The brain of the circuit is Raspberry pi. It is single board credit card size computer based on

A 900MHz quad-core ARM Cortex-A7 CPU with 1GB RAM. It is also equipped with two IR obstacle sensors which allow it to see the obstacles that you can't, because well, you're not there. It will detect an object and if the object detected, it will change its direction. As stated before, the robot has quite a few sensors on board. It also has a camera which can be used for video surveillance of human beings. This system has also used a motion sensor to detect human movement. If a human is detected, the system will enable a camera module. It also has an L293 motor driver to allow sufficient current to power the motors via the Raspberry pi GPIO. We have established IoT server which enables to controlled robot from a remote place.

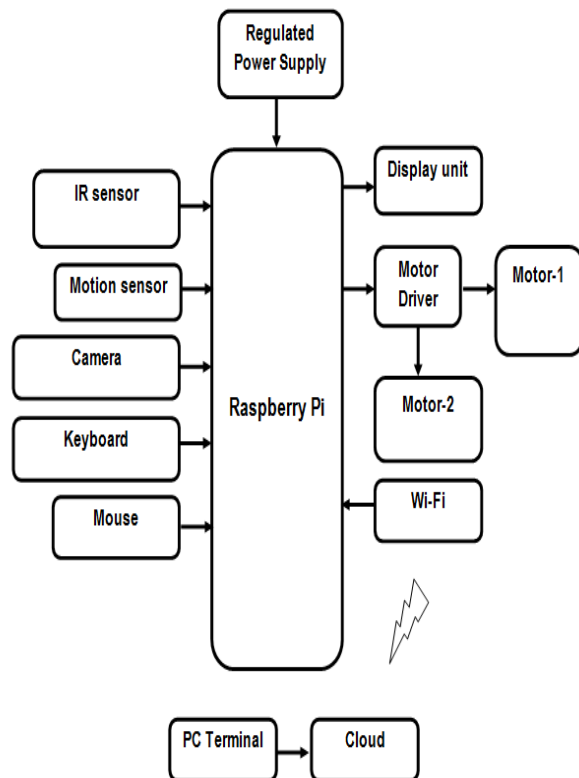


Figure 1: Block diagram of the proposed model

A. DC Motor Driver

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers as they take a low-current control signal and provide a high current signal. This high current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits used to drive the motors. The DC motors can be driven simultaneously i.e. Both Forward or backward direction in its common mode of operation.

B. USB CAMERA

The camera board is a small PCB that connects to the CSI-2 camera port on the Raspberry Pi using a short ribbon cable. It provides connectivity for a camera capable of capturing still images or video recordings. The camera connects to the Image System Pipeline (ISP) in the Raspberry Pi's System On Chip (SoC), where the incoming camera data is processed and eventually converted to an image or video on the SD CARD.

C. SD Card

The Raspberry Pi 2 Model B (second generation) require the smallest one, the MicroSD.SD cards come in a range of storage sizes. Generally, micro SD card we require is more than 2GB.

III. WORKING PRINCIPLE

In order to control the robot from Internet, we have written a python script which will read web link continuously, and do necessary movement according to the input received from the web link. We are using 6 Tab in our GUI

(Graphical User Interface) forward, backward, right, left, stop and camera. When the user gives a particular input from the webpage, it will be stored in a text file on the server, at the robot end python script is running continuously which will read that text file and make movement decision according to user input. Raspberry pi will give output to L293D which will be used for controlling direction of motor according to received input from Raspberry pi.

Hence when the user clicks on the forward button, the robot will move in the forward direction and website will redirect to the index.html page so that user can give another command. Let's say if the user hits the right button, in this case, only one motor (back-left motor) will be enabled and the robot will move in the right direction.

In order to turn on camera user will have to click on Turn On button provided in GUI. Once camera gets turned on, user able to see the front view from robot by pressing the camera button. The user can see the front view of the camera from anywhere just user need to have connected to the internet. We have implemented a python script which turned on camera automatically when the object is detected by IR sensor.

IV. RESULTS

The system has been implemented and the following results have been observed.



Figure 2: Experimental implementation

We have flash Raspbian OS in micro SD card. Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. We have to control robot from webpage so we need to install necessary package related to server.

For installation of the apache server do following steps

- `sudo apt-get install apache2 -y`
- To allow your Apache server to process PHP files you'll need to install PHP5 and the PHP5 module for Apache. Type the following command to install these:
- `Sudo apt-get install php5 libapache2-mod-php5 -y`
- After installing apache2 server on raspberry pi we can test it by running following link from browser. `http://localhost/` OR `http:// " IP Address of Raspberry Pi"`

Browse to the default web page either on the Pi or from another computer on the network and you should see the following:

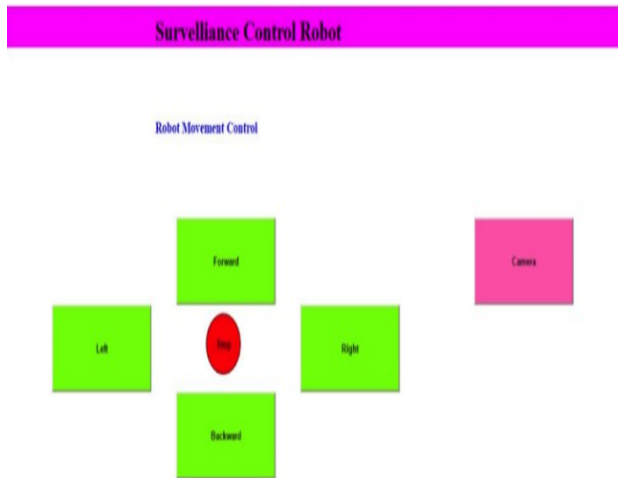


Figure 3: Web page in Raspberry Pi

For live streaming the user should select the live streaming option, the live streaming is monitored through the HTML page designed.



Figure 4: Live streaming through web page

Applications:

- At the time of war where it can be used to collect information from the enemy

terrain and monitor that information at a far secure area, and safely devise a plan for the counter attack.

- Tracking locations of terrorist organizations and then plan an attack at a suitable time.
- Making video surveillance of any disaster affected area where human beings can't go.

V. CONCLUSION

In this paper a variety of surveillance techniques are discussed which consist of development of different robots using the raspberry-pi technology. For each of the robot detailed discussion consists of the working of the approaches which are used to fulfill requirements of the surveillance. This also includes the advantages and shortcomings of all developed robots. Some of the techniques work only for small areas or for some specific environmental conditions which overcome by the other robots. The surveillance robot serves as a security monitoring device which replaces the human security at less critical areas where humans are really not necessary without compromising security. The outcome of this project deals with the recorded evidences of images when an unusual activity occurs and alerts to the remote host immediately.

Future Work

The future work of robot will solely be limited by our imagination. This extremely customizable chassis was designed in order that the user will easily add on components. The map creation ought to be added and rover ought to be able to return to the source. A night vision mode might even be enforced in addition to

video streaming instead of image being sent to remote host.

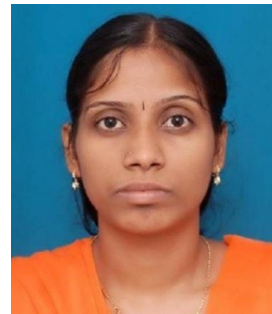
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