Web Based Surveillance and Human Detecting Robot using PIR Sensor

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Abstract— In this paper, we have developed a platform to remotely control surveillance robot controlled over web network. It will enable us to monitor the activities in the remote and sensitive areas such as naxalite areas and etc. This will provide great advantage and ease in monitoring with wireless control and surveillance. The proposed system uses Microcontroller, Raspberry Pi, Pyroelectric Passive Infrared (PIR) Sensor and other elements. This system uses PIR sensor to detect human beings in the near surroundings of the robot. The camera on the robot can be moved upward and downward direction and also in the horizontal direction. Raspberry Pi is used to establish wireless connection with the robot and the user who uses the web page to control the robot and monitor the surroundings and detect the human beings. The range of operation is not limited as long as there is internet connection available in the area. Also we can use military frequency in the remote areas of border. This robot can be sent into the areas of surveillance where it is not possible to traverse the area.

***Key words*:** Pyroelectric, Sensor, microcontroller

I. INTRODUCTION

Robots are being used increasingly into our everyday life and also in the industrial applications. Robots are used in the hazardous work environment thus eliminating the harm to the human lives. These robots, which work in such unfriendly conditions for humans, are controlled wirelessly with the help of Bluetooth, Zigbee [1], RF modules and WiFi, etc. In the early robot wireless communication systems, infrared (IR) technology was applied in a large scale because of its low cost. But infrared wave cannot pass through obstacles and infrared systems have poor quality (rain effect) and communication rate. Radio frequency (RF) technology is preferred in the design of mobile robot communication system. Internet technology provides a way for us to develop an integrated network environment for the different applications of different robotic systems. The concept of web based robots is new and it does not have the limitations of the range of operation. In traditional systems, the security forces need to patrol the remote areas in order to protect any illegal persons coming into our territory but it is not possible for them to patrol the whole area as it may be not possible to reach there. In traditional security systems, monitoring devices are usually mounted on fixed locations [2]. In such cases, we may use the proposed robotic system which will go into those areas and provide us with the videos of those locations. When someone enters such secured places, the PIR sensor senses it and immediately it will send an indication to the user through wireless communication and is indicated to the user through alarm. Meanwhile, the camera mounted on the robot will keep on capturing the videos from the surroundings to keep a record of the details of the incident happened and this is readily available to the user.

II. SYSTEM OVERVIEW AND DESIGN

In this proposed system, the Robot is mounted with the camera, used for monitoring the areas, is interfaced with the Raspberry Pi. The robot is controlled by the user with the help of internet and user able fetch the videos made available to him or her by the camera mounted on the robot.

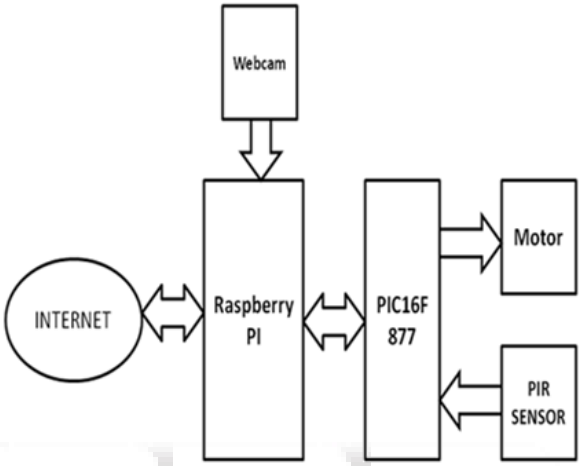

Fig -1: Block Diagram of Web Based Robot.

Robot uses DC motors for its movement and stepper motors are used to control the movement of camera mounted on the robot. Both, DC and stepper motors, are interfaced to the microcontroller PIC16F877. Motors are interfaced with the help interfacing circuits. DC motors use L293D for interfacing and stepper motors use TIP122 and MCT2E i.e. optocoupler for interface. PIR sensor, used for the detecting the motions, is also interfaced to the microcontroller.

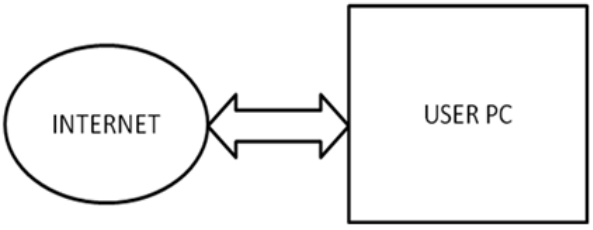

Fig -2: Block Diagram of User Unit

User unit consists of user PC or any device that can access internet. User will access the robot with the web browser with given IP address. The web page will have the live video streaming of the robot's surroundings and also it will give information about any motion detected. Web page will also have options of forward, reverse, left, right and stop for the movement of robot. It will also have options to move the camera in the desired direction.

III. HARDWARE REQUIREMENTS

Raspberry Pi is used for making robot wireless and web based. Webcam is interfaced to the Raspberry Pi and then the videos are transmitted wirelessly from the robot to the User's web browser, from where user can conveniently

control the robot movement and also the camera movement. Raspberry pi is connected with the WiFi module which enables raspberry pi to transmit over the web network.

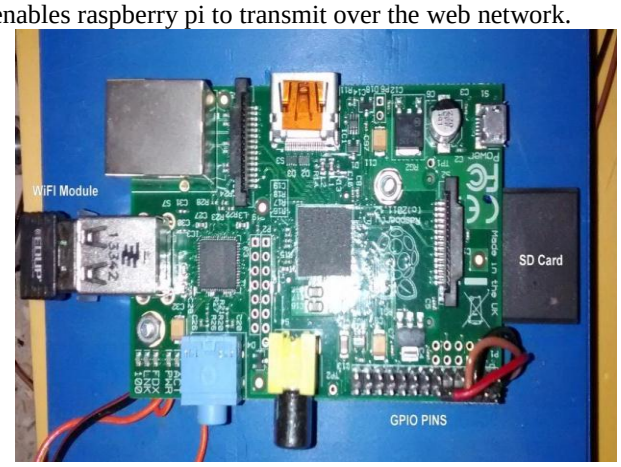

Fig -3: Raspberry Pi Board.

Raspberry Pi requires 5 volt supply with minimum of 700-1000 mA current and it is powered through micro USB cable. ARM11 only requires 3.3 volt of supply which it takes with the help of linear regulator. 5 volt is required for the USB ports. It operates at 700 Mhz. We use embedded C to write the code into the raspberry pi. It has a strong processing capability because of using the ARM11 architecture and Linux-based system. In terms of interface and control, it has1 SPI, 1 UART, 1 I2C and 8 GPIO, which basically meet the control requirement. There are easy-used open source peripheral driver libraries.

IV. SYSTEM IMPLEMENTATION

Raspberry Pi is used to have wireless communication between robot and user. PuTTY is used to have SSH connection with the Raspberry Pi but before that we assign a static IP address as every time we connect Raspberry Pi it will be assigned IP address dynamically. We have assigned 192.168.137.2 address to the Raspberry Pi, so every time we use this IP address to login with PuTTY.

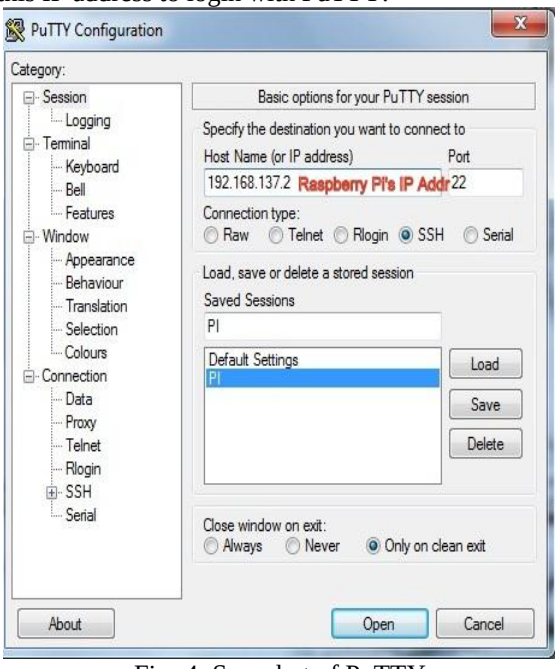

Fig -4: Snapshot of PuTTY

TightVNC is used to access the GUI of Raspberry Pi. TightVNC is used to have access to the remote clients. With this remote client we get full access to our raspberry pi on any user device.

To write code in raspberry pi, C is used. HTML is used to create the interface between user and the robot. WiFi dongle is used to communicate wirelessly with the user. PIC16F877 is used for control of motors and access the data given by the PIR sensor. MPLAB is used for programming the PIC microcontroller.

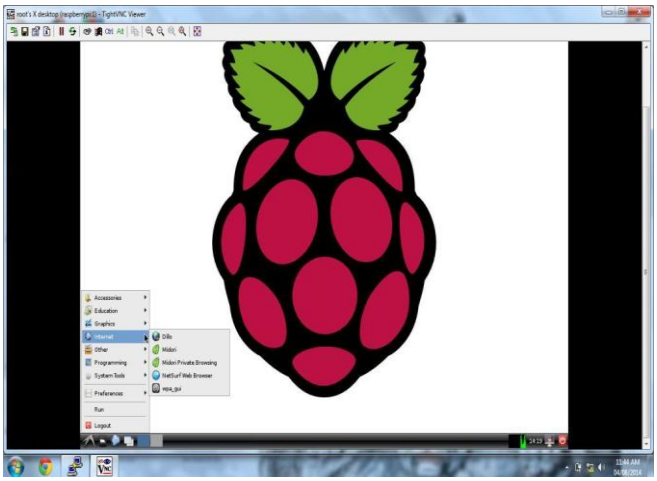

Fig -5: Snapshot of Raspberry Pi's GUI using TightVNC

Stepper motor use motor driving circuit using TIP122 and MCT2E. TIP122 is NPN epitaxial Darlington Transistor and is mostly used in power switching applications. It is required when stepper motor with high current rating is used. MCT2E is optically coupled isolator.

Fig -6: Motor Driving circuit for Stepper motors.

As PIR sensor is a digital sensor it directly connected to microcontroller.

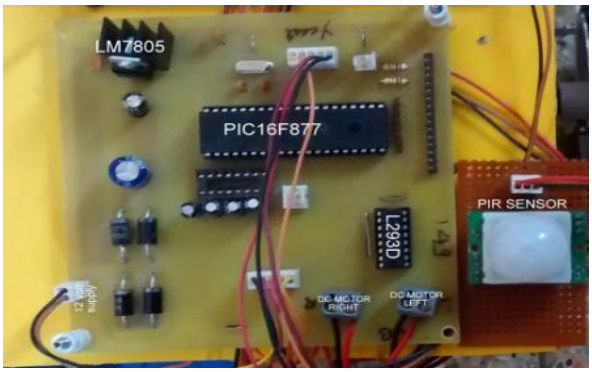

Fig -7: PIC circuitry interfaced with PIR Sensor.

When motion is detected by the PIR sensor by sensing the infrared radiations from the human body it will give signal to the microcontroller. PIR sensor senses the area with the radius of 5m of itself. PIR sensor's data is

displayed on the web page and it web page takes the data from the PIR sensor every 5 seconds. If any motion is detected by the PIR sensor it is displayed with the message 'Motion Detected' on the webpage otherwise 'Motion Not Detected'.

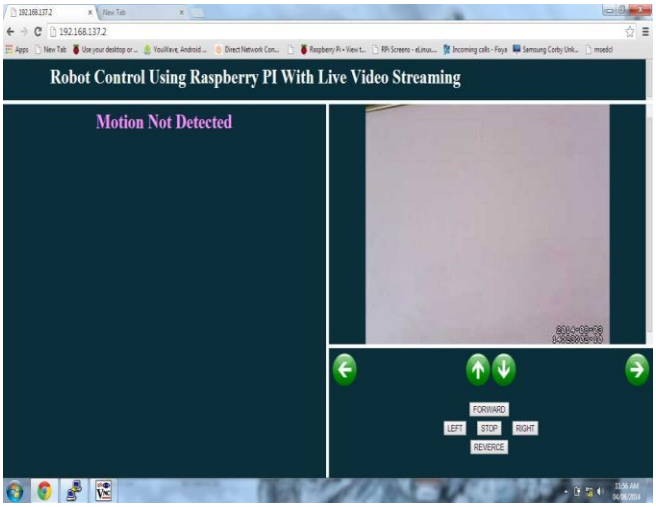

Fig -8: Snapshot of webpage showing live video along with PIR sensor information and robot and camera movement controls.

V. RESULTS

With the implemented system we control the robot movement through internet but there is a delay in the execution of commands. After the command is given through the web page to robot for its movement or the camera movement, there occurs a couple of seconds delay until the command execution at the robot end.

Motors	Response Time(Wireless)	Response Time(LAN)
Stepper Motor for Vertical Movement	2 sec	0.8 sec
Stepper Motor for Horizontal movement	1.8 sec	0.7 sec
DC Motors for wheel	1.7 sec	0.7sec

Table -1**:** Response time of motors at the robot end

Thus, it is evident with wireless communication there comes the delay in the response time of the motors in the execution of user's commands.

VI. CONCLUSIONS

This robotic system will be very much helpful for the security forces to find any infiltration across the borders. This system can be used any conditions and areas where it is difficult for the security forces to reach it can monitor the areas. As the communication is done with the help of internet so limitation of range of operation does not arise and thus we can monitor any remote areas.

VII. FUTURE SCOPE

The time delay which occurs in the execution of commands has to be reduced and thus we can have real time access to the robot. With reduced time delay we can have faster operation and quick response to any illegal activities in the monitored area. This system can also be used in the disaster (earthquakes, mine collapse) areas to find any injured persons and give information to rescue teams. Also it can be used as a spy robot.

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