Design and Implementation of e-Surveillance Robot for Video Monitoring and Living Body Detection

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Abstract- Presently the surveillance of International border areas is very daunting task. The security forces are patrolling the border in hostile conditions. They are getting help from surveillance cameras already mounted but they cover very limited areas. The cameras already mounted at a fixed position, is not of much use as we cannot change the camera view in real time. Also it is not possible to mount the cameras in the forest areas as the trees obstruct the view of the camera. This paper explains how to design and implement wireless robot which will enable us to control the robot with the help of internet and it will be able to detect the living bodies with the help of PIR sensor. It will help in rescue operation and user can access the video transmitted from the remote area such as the sensitive areas or areas which are beyond our reach. The total system contains mobile robot, controlled with the Internet, which has camera mounted on it and also it has a PIR sensor for detection of living bodies. User will be able to control the robot through internet, thus, providing user with wireless control of robot. Also information regarding the detection of living bodies will also be given to user on the webpage from the PIR sensor and simultaneously user is able access the video transmission from the robot. The camera mounted on the robot is able to move horizontally around its vertical axis and vertically along its vertical axis. Camera movement is controlled through webpage at the user interface, thus, providing user with enhanced view of the surroundings.

Index Terms- Internet, PIR Sensor, Raspberry Pi, Robot.

I. INTRODUCTION

Robots are being used in variety of industrial applications for various activities like pick and place, painting, assembling of subsystems and in hazardous places for material handling etc. Robots are becoming more and more intelligent as technology advances in the areas of CPU speed, sensors, memories etc. And there is ever demanding applications even in defense. With the rapid growth of the Internet, more and more intelligent devices or systems have been embedded into it for service, security and entertainment, including distributed computer systems, surveillance cameras, telescopes, manipulators and mobile robots. Although the notion of Internet robotics or web-based robotics is relatively new and still in its infancy, it has captured the huge interest of many researchers worldwide. Except for operating in hazardous environments that are traditional telerobotic areas, Internet robotics has opened up a completely new range of real-world applications, namely tele-manufacturing, tele-training, tele-surgery, museum guide, traffic control, space exploration, disaster rescue, house cleaning, and health care. Automated video surveillance is an important research area in the commercial sector as well. Technology has reached a stage where mounting cameras to capture video imagery is cheap, but finding available human resources to sit and watch that imagery is expensive. Surveillance cameras are already prevalent in commercial establishments, with camera output being recorded to tapes that are either rewritten periodically or stored in video archives.

Figure 1: Overview of System.

In this implementation of robotic system, when a person enters a monitored area, PIR motion detectors are commonly used in conjunction with different parts of the war field. When someone enters secured places, immediately it will send an indication to the control room section through wireless communication and is indicated to the control room through alarm. The concerned people can understand that an eventuality has happened in the host section. At the same time web camera connected to the microcontroller keeps on capturing what is going on there at the host place and saves it into the computer. When the security people in supervisory room, get an indication to the host section by alarm, they log into the host section computer through internet, and view all information of the war field section videos by PC.

II. IMPLEMNETATION

In this project, control of robotic unit is from remote end with the use of Internet and also we are able to get the videos from the robot end for the purpose of surveillance. At the user PC, we will have videos on the web browser and also we are able to control the robotic movement and also the camera movement in vertical direction and horizontal direction. DC motors are being used for the movement of robotic wheels and stepper motor is used for camera movement i.e. for vertical movement and horizontal movement. The PIR sensor on the robotic unit gives us the information about the Living bodies. Motors and PIR sensor are being interfaced to PIC microcontroller. Raspberry Pi is used for video processing and sending the processed video to user PC with the help Internet. The use of Internet does not bring the limitation of range into consideration as if we have the internet access, we can control the robot from anywhere.

The images captured by the camera should be processed very fast to provide real time visualization of environment to the user. For this purpose along with low cost we think to use ARM

based Processors. Some of the reasons for the proliferation of ARM-based processors include: low cost, low-to-very-low power consumption, decent processing power, and open development environment. The Raspberry Pi is a credit-card sized computer that plugs into your TV and a keyboard. It is a capable little computer which can be used in electronics projects, and for many of the things that your desktop PC does, like spreadsheets, word-processing and games. It also plays high-definition video.

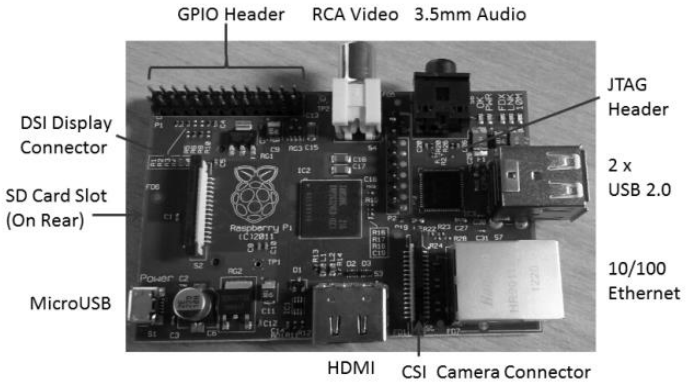

Figure 2: Raspberry Pi Board.

Raspberry Pi has a strong processing capacity because of using the ARM11 architecture and Linux-based system. In terms of control and interface, it has 8 GPIO, 1 UART, 1 I2C and 1 SPI, which are basically meet the control requirement. There are simple and easy-used open source peripheral driver libraries.

The wheels of robot are controlled by DC motors and stepper motors are used for the movement of camera. The user controls it with the help of web browser, where it also shows the video streaming of the environment. At the robotic unit, PIC microcontroller is used for the control of DC motors and stepper motors.

PIR (Pyroelectric Passive Infrared) sensor is used for living body detection. Passive infrared sensor designed to pick up heat radiation of wave lengths in a band around 10 microns. It contains two active elements configured as balanced differential series opposed type. This results in good compensation of environmental temperature and excellent sensitivity for small changes of a spatial temperature pattern. Thermal signals far below one microwatt are sufficient to trigger a sufficient output voltage change.

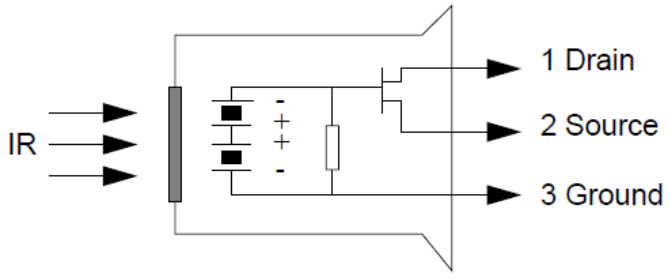

Figure 3: Working of PIR Sensor.

If the active elements of the PIR sensor are exposed to a change in the surrounding temperature field, electrical charges are separated within the sensor elements. The voltage across the sensors controls a J-FET source follower impedance converter and thus modulates the output current of the PIR detector.

III. BLOCK DIAGRAM

Robotic unit is consisting of PIR sensor and camera which is movable around its axis and also vertically. PIC16F877 is used for controlling the dc motors which used for robot wheels and also for the camera movement. PIC16F877 is also used for collecting data from the PIR sensor for detection of living body. Raspberry Pi is used for video processing and sending the video to the user through the internet. MAX232IC is used for communication between PIC16F877(Microcontroller) and Raspberry Pi(ARM Processor). Motor driving circuits are used for operating motors. LCD screen is used for the testing purpose i.e. to test the communication between hand unit and robotic unit.

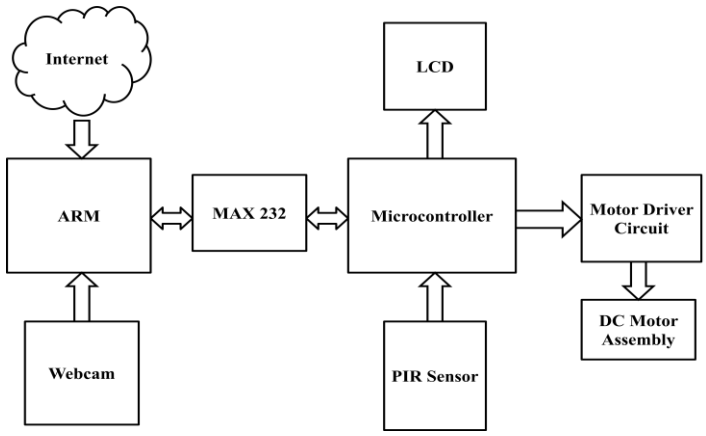

Figure 4: Block Diagram of Robotic Unit.

User unit consists of a PC with internet connection. HTML page is designed having options of controlling the dc motors and stepper motors. It shows the live video streaming of the environment. Also there is provision of alerting the User when PIR sensor detects any living body around the robot.

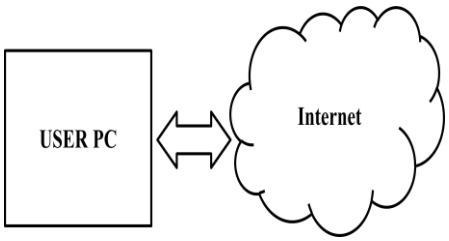

Figure 5: User Unit.

User unit communicates with robotic unit with the help of Internet which is provided by the WiFi dongle connected to Raspberry Pi.

IV. CONCLUSION

Using this proposed technology, it gives a helping hand to our security forces in detection of intruders. This robotic system can also be used in high altitude areas where it is difficult for humans to survive as some of our border areas fall into high altitude areas. The proposed robotic system can also be used in finding the injured persons during disasters such as earthquakes, collapsing of building and also in the mining fields and it can be used as a spy robot.

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