Surveillance Robot For Military Applications Using GPRS And Raspberry Pi With GPS Tracking

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Abstract- *Surveillance in remote areas along the border is a important aspect in military, the solution proposed here is a autonomous robotic platform mounted with a camera for remote surveillance over internet and a web page. The system is designed for surveillance and also for reconnaissance circumstances. The GPS tracking using Google maps enables to know the current location of the robot, the robot continuously takes picture of the area and uploads them to a web-page. The GPS module available on the robot continuously updates the location GPS Coordinates and the real time location of the robot can be viewed on the web-page along with the visual data.*

Keywords- Camera, GPRS and GSM, Raspberry Pi, Real time tracking, Robot, Surveillance.

I. INTRODUCTION

Border patrol and surveillance is one area which is yet to use the advantages of automation, Automation replaces human in hazardous work environments and create safe work place for humans. Robotic systems can be used to replace humans for remote surveillance. Robotic systems can be incorporated with the functions that are required and be deployed in hazardous places for better results.

The Robotic platform proposed here is a autonomous platform which uses ultrasonic sensor to avoid obstacles and move continuously over the area and camera mounted on the system continuously takes pictures of the surroundings, the GPS module provides the real time location of the robot, the GPRS module on the system sends the image and GPS data to the server on raspberry pi.

At the remote control station the web-page hosted by raspberry pi can be accessed, the web page show the Current image taken by the robot and also the current location of the robot can be accessed. On Google maps.

The rest of the paper is as follows, review of the existing systems in section 2, the proposed system architecture in section 3, system implementation in section 4, results in section 5 and the final conclusion and future works are discussed in section 6.

II. EXISTING SYSTEMS

Most surveillance systems for data communication use RF [4] and DTMF [1][4] the control of autonomous operation. Low range of operation of RF Hinders the range of operation between the robot and human. Line of sight communication is not suitable in locations like forests and hills. DTMF for movement control make is semi autonomous, the system proposed in [1][3] use mobiles phones which increase the cost of operation and lower the system quality and such systems are not feasible in practical purpose.

III. PROPOSED SYSTEM ARCHITECTURE AND IMPLEMENTATION

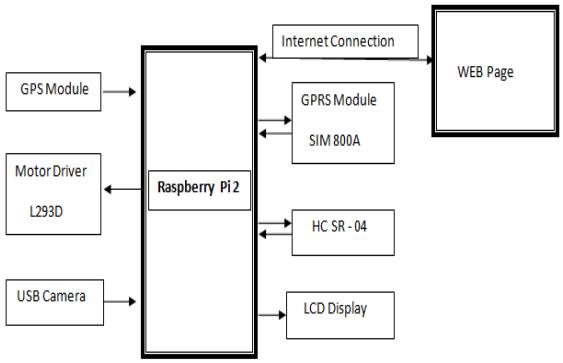

Fig 1: Block representation of system architecture.

The block diagram of the system is represented in figure 1; Raspberry pi2 is the heart of the system. The autonomous functionality of robot is achieved with the ultrasonic sensor which senses the presence of obstacles and the data is used by the raspberry pi to control the movement of the robot around the area. The USB camera takes pictures continuously and sends them to the memory, the GPS module sends the real time location to the server, and the GPRS module sends the data to the server using the data connection. The GPRS module has the IP address assigned every time by the cellular operator which is used as the ip of the server, the

same IP address is displayed on the LCD Display module and when the ip is entered on the web browser the image taken by the browser and the location of the robot on Google maps can be seen.

The modules used in the system are as follows

3.1 RASPBERRY PI 2

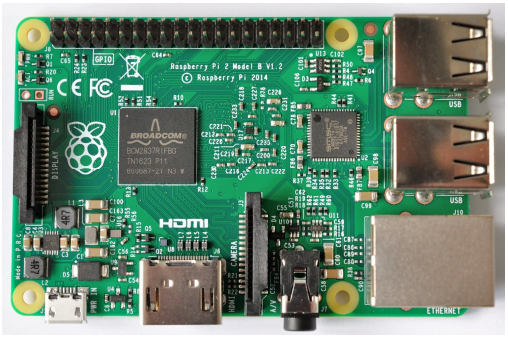

Figure 2: Raspberry Pi 2 SoC top view

Raspberry pi is a credit card sized powerful computer based on BCM2836SoC with Quad core ARMv7 architecture. 1GB RAM on the soc greatly improves the performance with quad core processor. the power draw is minimal, with just having pi run without HDMI has a power draw of 200Ma, with LAN connected adds 40mA more. The main improvement in pi2 over its previous versions is performance. The pi2 has four processors on one chip with 1GB of RAM, these improvements mean a lot of improvement in performance, and use of pi2 as a standalone computer has a smooth run with minimal lag.

The features of Pi 2 are as follows:

- 40GPIO header for all the external circuit connections you want to make.
- 4 USB ports for connecting peripherals like keyboard, wireless mouse.
- 1 LAN connector to connect to a wired connection.
- 1 HDMI port to connect to a display device.
- Audio connector for audio input and output.
- Micro USB socket 5V1 2.5A for power supply to the board.
- For connecting to internet LAN may be used or USB WiFi dongles can be used.
- The GPIO Header provides SPI, I2C, USRT Ports for different protocols.

3.2 GPRS MODULE

Figure 3: SIM800 GSM Module

SIM800 is a complete Quad-band GSM/GPRS solution. SIM800 support Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS and data information with low power consumption. With tiny size of 24*24*3mm, it can fit into slim and compact demands of customer design. Featuring Bluetooth and Embedded AT, it allows total cost savings and fast time-to-market for customer applications.

The GPRS module has internal tcp/ip stack which enables to connect to internet using GPRS. The GSM/GPRS module is used to connect the robot to connect to the internet and send the image and GPS data to the webpage.

3.3 GPS MODULE

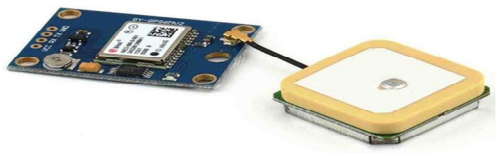

Figure 4 : Neo 6M GPS Module

GPS (Global Positioning system) is a satellite based navigation technology. Location of some place in terms of latitude and longitude is provided by the GPS Revceiver.GPS also can do accurate time calculation in terms of GMT. After the data is received, the position is calculated and is sent serially. The data from serial has information like latitude, longitude, altitude, time position etc. Neo 6M GPS Module is used in this robot which is interfaced with raspberry pi using serial interface, the ublox 6 series gps module is a high powered and accurate GPS receiver, the miniature size helps in achieving strict size constraints. The data received from the GPS Receiver is parsed to get latitude and longitude values

which are then used in Google maps API to show the real time location of the robot.

3.4 ULTRA SONIC SENSOR (HC-SR 04)

Figure 5: Ultrasonic Sensor

Ultrasonic sensors are used to measure distance from a target, as name suggests, ultrasonic sensors measure distance using ultrasonic waves. The distance is calculated using the time taken between the incident wave and the reflected wave. Distance calculation can be done using the formula **D=1/2*T*C** where T is the time between emission and reception of the signal wave and C is the sonic speed. Time T is multiplied by half as time is both for go and return. Typical characteristics of ultrasonic sensors are:

- **Transparent Object detection:** Ultrasonic waves can reflect off a glass or liquid surface and return to the sensor head, even transparent targets can be detected.
- **Resistant to dirt and mist:** Detection is not affected by accumulation of dirt or dust.
- **Complex shaped objects detectable:** Presence detection is possible even for complex shaped objects like mesh trays or springs.

3.5 MOTOR DRIVER (L293D)

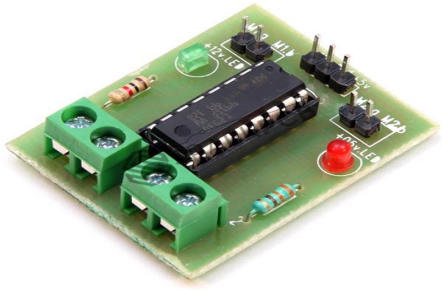

Figure 6 L293D Motor Driver PCB board

Autonomous robots use motor drivers predominantly. Microprocessors' and controllers use low currents to operate, the current required to operate motors is relatively high. The microprocessor cannot supply such high voltages and currents, motor drivers are used to suffice the requirements.

L293D is such motor driver IC which takes control signal from microcontroller and transmits relative current/ voltage to motors. The L293D switches the output signal according to the input signal from the microprocessor. L293D simply transmits the signal it receives from the processor; it does not alter the signal in any form.

3.6 GOOGLE MAPS API

Google maps API is a free open source API which can be used to show real time location on a webpage, here the API uses the GPS coordinates from the GPS module to show the real time location of the robot on a webpage. The GPS coordinates obtained from the GPS receiver are parsed using a python script which is then supplied to the webpage to show the real time location on the map.

IV. SYSTEM PROTOTYPE AND RESULTS

Fig 7: Front View of the robot

Fig 8 : Images from the robot on the webpage.

As proposed in the section 3, the system is implemented and the implemented system is shown in figure 2 and figure 3. The GPS module for tracking, GPRS module for data connection and the camera, sensors tor surveillance are interfaced with Raspberry pi as shown in figure 2. The ultrasonic sensor is responsible for autonomous movement of the robot, The camera continuously takes the pictures and saves them to the system memory which is uploaded to the local server which can be accessed over the internet. On the webpage the current image taken can be seen and also the real time location of the robot on the field can be seen using Google maps API.

V. FUTURE ENHANCEMENTS

As future enhancements to the project the following can be done, the first is implementation of control of movement of the robot as such the rbot can be made to go in to areas in a controlled path, this can be achieved using the GPS and internet. The GPS coordinates can be saved to a data base and be used to track the movement or the path traced by the robot and the same can be used to make the robot retrace the route.

The robot can also be controlled using the internet by developing algorithm to be able to control the robot from the web page, in this case on the webpage the control can be defined and depending on the image data on the web page, the user can take decision to make robot move in a direction by selecting the appropriate control on the web page.

VI. CONCLUSION

The real time system proposed in this paper is suitable to replace human with effectiveness, the system works well in the open space or open grounds. The GPS tracking will give false location in situations like when the robot is under confined place, and GPRS connectivity may also be slow when in similar situations, the use of cellular data is a bit expensive and is recommended to use wifi when possible. The autonomous operation is achieved by Ultra sonic sensor may be replaced with Image processing to achieve more accuracy.

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