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# Raspberry PI Based Robotic Vehicle with Continuous Visual Feedback

**Albin George Eldhose[1], Gavin Francis[2], Mobin P Abraham[3], Sachin K S[4], Jinto Mathew[5]**

UG student (ECE), Dept. of ECE, MBITS Engineering College, Nellimattom, kerala, India[1,2,3,4]

Assistant Professor, Dept. of ECE, MBITS Engineering College, Nellimattom, Kerala, India[5]

**ABSTRACT:** In this paper, we have developed a system for the continuous surveillance and to monitor remote areas with the Tele robotic mechanism to visualize the situation happened in remote areas with internet based communication with the concept of controlling a Tele robotic system with web server to operate with a webpage based controlling automation system. This technology will also play a prominent role for the better surveillance through the Polaroid. We are interfacing Polaroid with the Robotic systems. Robotic field got a good revolution in the industries for their enhancement in production of various products. With the combination of Robotic system, Polaroid with the inter-networking through the webpage can resolve insecure issues. This paper have wide application in the field of Tele robotics via web server. We use this technology in the defence system and at the borders to restrict intruders into the country. This gadget can operate from anywhere in the world through webpage.

**KEYWORDS:** Raspberry Pi, webpage, Polaroid, Robotic system, Surveillance, Wi-Fi dongle.

## I.INTRODUCTION

Robotics is one of the important field in the concern of industrial usage and daily life and the robotics may effect on the various fields in the technological manipulations and that can be intelligent with advancement of various areas like sensors, memories. The early robots are controlled through Infrared Technology, but later the advancement areas in the technology to lead robotics as embedded to the fields of service, security and safety. They can be vastly used in the distributed computer systems, surveillance cameras and these robotic intelligent system can be used till now in the pick and place, combining subsystems and these systems can be used where the hazardous places to complete the works where human can affect by that work environments.

As many of researchers are interested on web based robotics as these are very new interest. It became an open research to all web based robotics unless for operating in hazardous environments that are traditional tele-robotic areas, Internet robotics has opened up a completely new range of virtual world applications, namely tele-manufacturing, tele-training, tele-surgery, museum guide, traffic control, space exploration, disaster rescue, house cleaning, and health care. Automated video monitoring is an important research area in the commercial sector as well.

With the popularity of internet, users can start thinking with widespread of technology advancement to usage of network related applications. Also, users can spent more time on internet compared to their sleep also. It can reflect the design such as applications for purpose of remote surveillance and can reduce the hazardous work environment to humans. Imagine the case where the robot is controlled with remote area accessing through webpage is the advancement of such, technically improve the tasks of controlling from remote end. In the robotic field, tele-robotics is such a wonderful platform to improve the usage of robotics in every field. Here, telerobotics is the mechanism of controlling a mobile robot with web server to corresponding visual feedback approach methodology.

The Tele-Robotics is the combining a robotic arm and web server with real time visualization of range of distance based applications. Tele-operation can be effect to improve robotics vastly improve or enhance the quality or value of the range of practical use or relevance. Tele-robotics is referred to control a robot from remote end. Robotics are used in the field of space, underwater, power plants, hazards handling and medicine. One way of controlling robots

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through wirelessly by zigbee technology and Radio frequency. But robot cannot be controlled from remote end.

Another method of robotic arm controlled by the haptic technology and it is also referred as tactile feedback technology. This technology is expensive because haptic devices are costlier. A web server is setup on the single board computer named Raspberry Pi, a tight VNC Server is used for controlling remote end applications. The applications can be controlled by Raspberry Pi with a web server to remote client computers to access the data and web page by remote server.

The latest incarnation of the Raspberry Pi, 'model B+' is used here. The Raspberry Pi foundation recently launched the last evolution of the original Raspberry Pi called 'The new Raspberry Pi Model B+'. This Raspberry Pi Model B+ has 26 GPIO Pins. L293 motor driver used for controlling robot and Arm can control from server.

## II.MATERIALS AND METHODS

### 2.1. Raspberry Pi:

Raspberry Pi is a low power consumption, lower cost and it is a single board computer with small size like pocket size minicomputer. It can be used for a many applications like audio, HD video, games etc. Raspberry pi has advantage of running like a desktop pc and consists of operating systems like raspbian, pidora, Arch Linux these softwares are included in the NOOBS (New Out Of the Box Software) and the latest development in Raspberry Pi models is model A, model B can be remodified as a Model B+.

The model B+ consists of BCM2835 Application processor with 512 MB of RAM. In model B+ have advanced features like more GPIO Pins, More USB, microSD, low power consumption, better Audio, Better Performance measure compared to model B.

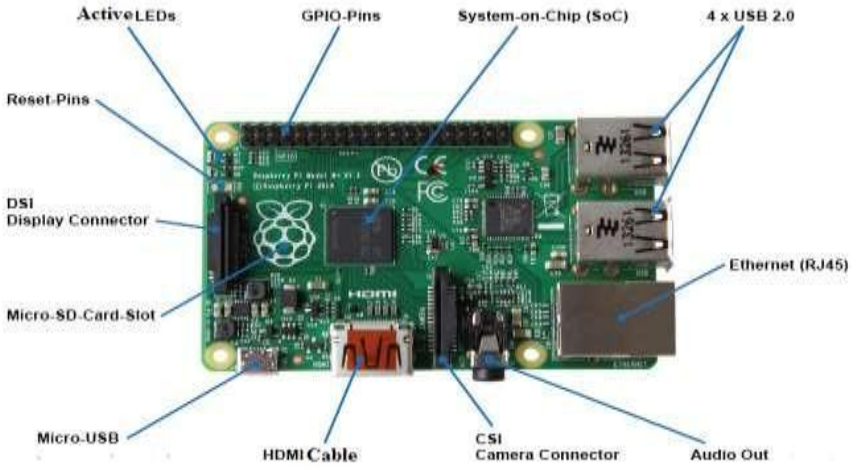


**Fig 1: Raspberry Pi Model B+**

The architecture to develop Pi is ARM 11 with the CPU speed of 700 MHz low power ARM1176JZFS core. Raspberry Pi acts as a mini computer through their internal developments of operating system boots from microSD card, running a version of linux operating system.

### 2.2. Pi camera:

Pi camera is the interface module related to Raspberry Pi hardware. Pi camera has the advantage of high-definition video enabled service and can be enable to operate through Raspberry Pi. After enabling camera then we suppose

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to develop code for motion streaming through MJPG Streamer.

**2.3. Robotic Arm:**

A robotic arm is a mechanical manipulator with similar functions of human arm with the rotation of wrist and moving hand with appropriate gripper. Robotic arm can have two joints with an appropriate mechanism and can have various directions like forward, backward, upward, and downward. The parts can be connected with DC Motors and are interfaced with Motor driver IC i.e., L293D. IC can be connected to Raspberry pi GPio Pins and can be operated with programming languages like Python C. The complete Arm setup can be controlled through webpage according to user choice and that can improve the mechanical feasibility to operate these devices.

**2.4. Operating System:**

Raspberry pi essentially uses linux kernel based systems software, but ARM11 can't be working on the popular versions of linux includes ubuntu. Now Raspberry Pi developers can suggest the some supportive software i.e., NOOBS. The NOOBS can include Archlinux ARM, pidora, puppy linux, Raspbian but depending on user's choice exclude the software from Noobs and that can acts as operating system. Raspbian linux operating system is recommended for the robotic applications. Raspbian can be extracted as a image file to write on SD card. SD card can be used as a image file reader and can convert to read image file through SD card Formatter. After completing the formatting, the image file of operating system can be read through win32 Disk imager.

**2.5. PuTTy:**

PuTTy is a standalone tool, open source terminal emulator and network file transfer application. It supports several network protocols including SCP, SSH, Telnet, rlogin and raw socket connection. It can be used for the interlinking of Raspberry Pi to a windows PC and its main purpose is to connecting server through secure shell(SSH) and port address. Whenever login through puTTy; the Raspberry Pi ip address and windows pc ip address matches and communication path could be established .

**2.6. Tight VNC server:**

Tight VNC server is a platform to manage Raspberry Pi in remote accessing purpose. It can act as remote desktop software, cross platform, open source remote desktop software and virtual network computing to control another computers screen remotely. Client can control the server through Tight VNC Server.

**2.7. Wi-Fi dongle:**

The Wi-Fi module that is attached to the wlan port of the Pi is configured to the address 162.148.43.9.8080. By enabling this IP address, we can access the image captured by the Pi. By using the IP address generated by the Pi, we can control the robot with the help of the webpage.

## III.BLOCK DIAGRAM

The Raspberry Pi is connected via Local Area Network (LAN) and client device can connect through LAN or Wifi and Pi camera is used for the purpose of visual feedback to control robotic arm through webpage. All are working according to user inputs with a network medium.

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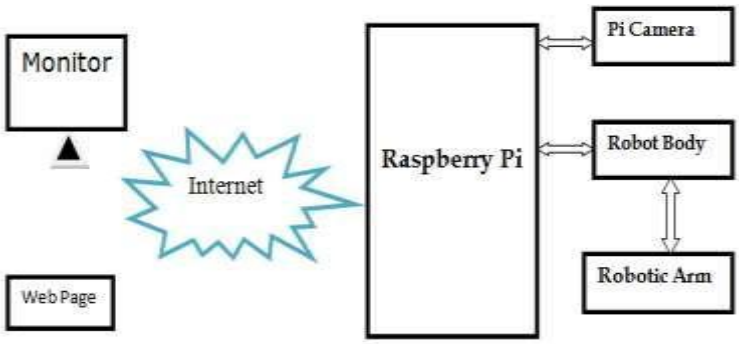


**Fig 2 : Block diagram**

**Hardware &Software Requirements:**

[1] Raspberry pi
[2] SD memory card Minimum 8 GB (class 10 is preferable)
[3] Micro USB power cable or micro USB type mobile charger (5 V)
[4] Ethernet cable
[5] Pi camera
[6] Robot Body
[7] Robot Arm
[8] Raspbian Wheezy Operating System
[9] SD Formatter Tool
[10] PuTTy
[11] Win32 Disk imager
[12] Wi-Fi dongle

## IV.WEB SERVER

The main role of web server to implement the relation with hardware module through the internet. Here the web server can be developed through the apache, MySql, PHP. Webpage can be developed through HTML; it can have images, styles, scripts relate to text content. The different web servers are Apache, Nginx, lighttpd, LAMP

**Raspberry pi web server:**

If we are used to develop a cheap web server, to create testing environment or to store the data, the Raspberry Pi is perfect. Once the configuration of Raspberry Pi is completed, it is linked with static web ip address that can be hosted in Raspberry Pi server through SSH and port address. The host address can be written as 192.168.1.2, port address as 22 and set SSH in the puTTy configuration tool. Once the IP config completes then Raspberry Pi can be command through the local host address. Web server is also supports as a backend system for storing and retrieving data and apache web server is setup in the project for the purpose of communicating with hardware with the following command sudo apt–get install apache2 php5 lipapache2-mod-php5. Similarly, PHP also installed though above command and after reboot Raspberry Pi to change the settings. We develop MySql server for the data base of running applications with the command sudo apt–get install mysql-servermysql-client php5-mysql The default directory for storing web server file is /var/www. Whatever data we develop within the directory can be served on the request of path name to client.

## V.RESULTS AND ANALYSIS

Raspberry Pi can setup with the wheezy operating system was installed on SD card, because of internal memory of Raspberry Pi is 512 MB. An external memory can be requested for the operations perform in the system. Raspberry

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Pi B+ is a single board, credit card sized computer with the 4 USB slots to use for external accessories and the HDMI slot for connecting any display module or TV. Ethernet cable can be used to connecting Raspberry Pi to laptop with LAN cable. After connecting Pi, we create a local host address with Internet protocol version4(IPV4) in the network and sharing center; by click on IPV4 and gave a static IP address 192.168.1.2,then this address is local host for LAN cable connected to Raspberry Pi. Now communication can be established with puTTy. Now Raspberry Pi can be connecting through puTTy with username as pi and password as raspberry. After connection established between Raspberry Pi, click sudoraspi-config, sudo apt update and sudo apt upgrade to convert Raspberry Pi as a new version of tools required to development applications.

Raspberry Pi acts as webserver for the application of webpage controlled robotics. Web server can be developed through different scripting language. Here, main implementation relate to video streaming, the entire experimental setup as shown in fig

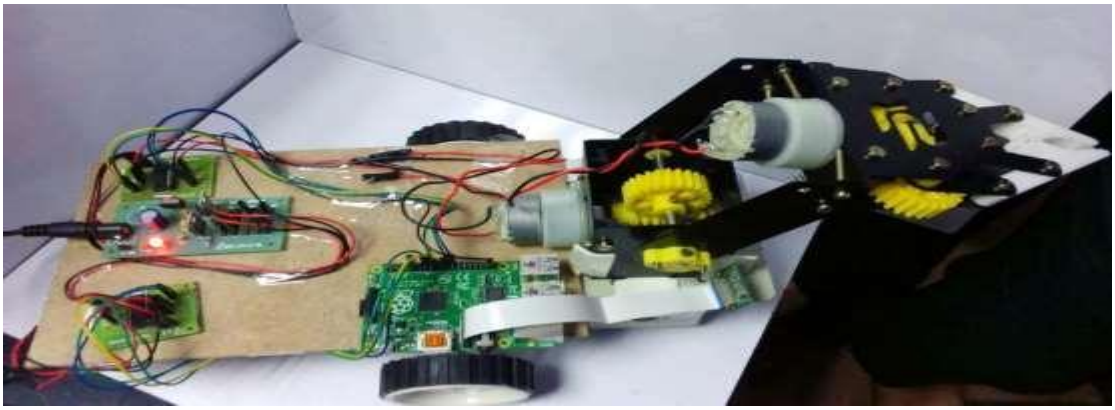

**Fig 3: Hardware implementation of the system**

The experimental setup can be revealed that raspberry pi acts as server for our application and develop the code for interfacing various hardware modules like pi camera ,robot body , robotic arm the usage of these modules in this project can be correlate to develop an application to operate robot with motion streamer continuously to control robot. here robot setup can be shown in figure. The connections of motors of robotic body and robotic arm can be shown in figure.

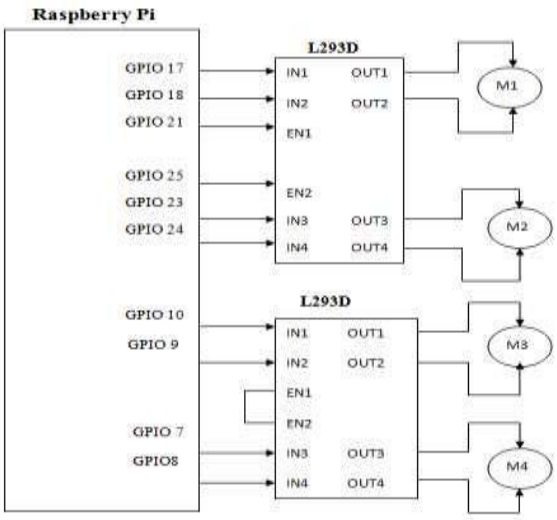


**Fig 4: Dc motor driver IC's connecting with GPio pins of Raspberry Pi**

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The whole setup of robot body and robotic arm having 4 motors that are connected to l293D motor driver. L293D is interface between Raspberry Pi GPIO pins, robot body & robotic arm. L293D board can be used to operate the motor in various directions like forward and backward. In L293D enable is set high for motor operations. A total of 10 GPio pins used for motors controlling and a power supply board is used for giving power supply to l293D board to operate motors. DC motors operate through 5v or 12V. Adapter can be connected to power supply board then whole setup can be enabled. A microUSB slot can be used to giving power supply to raspberry pi.

**Flow Diagram:**

It represents the operation of controlling robotic arm through webpage

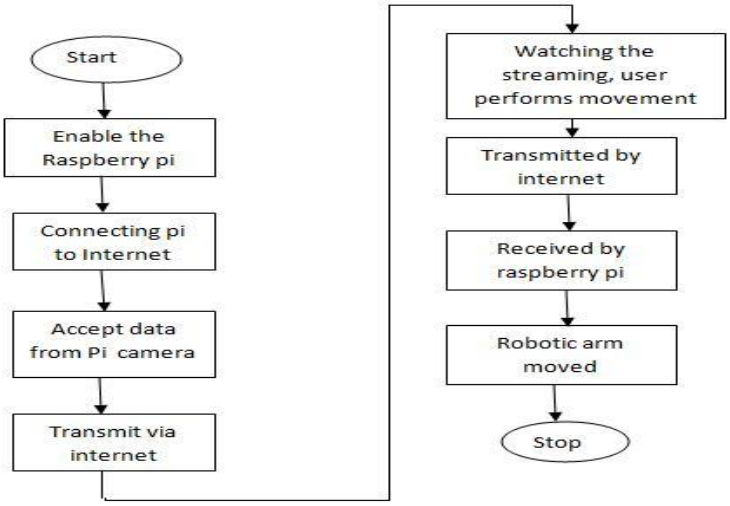


**Fig 5: Flowchart for System**

## VI.IMPLEMENTATION

### a. Live video streaming

Here the video streaming is one part of the project to develop the purpose of visual feedback of the hardware operating to the given instructions. The video streaming can be enabled to pi camera. In the programming part of Raspberry Pi, we enable the camera first and the code is developed for the purpose of motion streamer with MJPG-streamer coding. The streaming can be viewed in webpage with local host address is 192.168.1.2:8000 to visualizing video streaming of pi camera.

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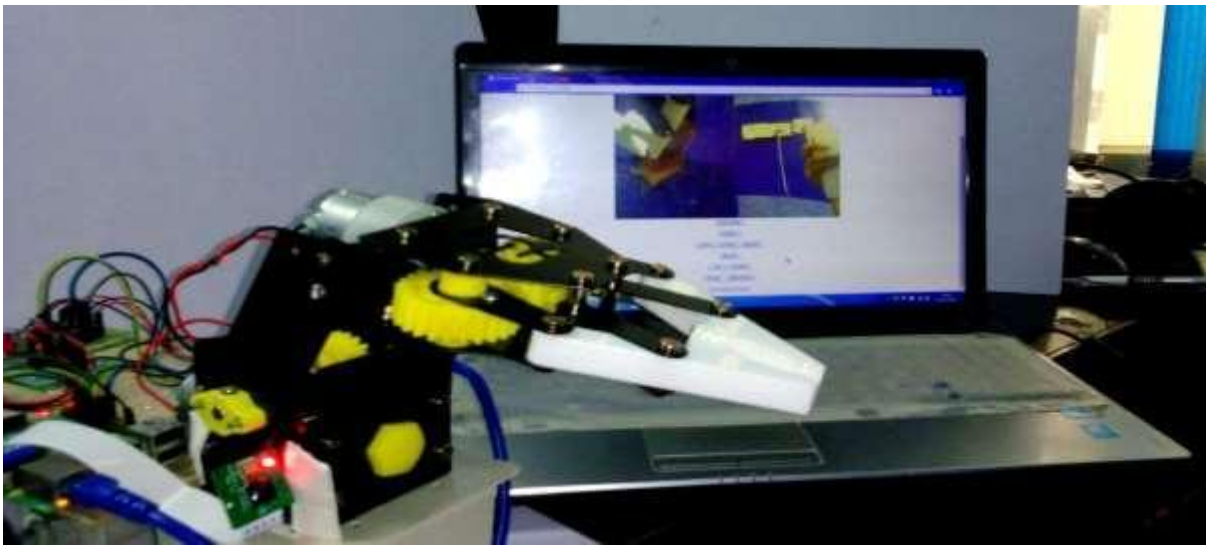

**Fig 6: Live Streaming of web server**

**b. Robotic Arm Control with Live Streaming:**

The whole robot vehicle setup is at remote end and the connection among GPIO pins and web server with continuous streaming is possible with the application of WebIOpi. In this application we can importing the data from GPIO pins, here GPIO pins are connecting with motors and that motors operation can be connected to web server with a specific webpage address 192.168.1.2:8000. In this webpage development, we create different options to control robot and camera streaming. The buttons can be developed through AJAX and can be controlled through PHP. We develop the code for robot body and robotic arm through python; a scripting language to operate Raspberry Pi. When the buttons can be created using Ajax, the server & streamer can't reload every time, the fig represents the video streaming and robotic arm controlling. The development of this application through static IP address. If we develop dynamic IP address we use another mechanism to control it.


**Fig 8: Control Robotic Arm with Web Page**

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## VII.CONCLUSION AND FUTURE WORK

This paper describes a controlled robotic arm from webpage with continuous surveillance of actions done by the telerobotic arm. Mobile robot can be controlled through webpage connected through wireless dongle and the telerobotic can be visualize the acknowledgement with continuous response from remote end with controlling via webpage. Also, use port forwarding methodology to use any where to control robot. In future work by making this project with extension of GPS to navigate based on the locations given through the network, we can move tele robot to the multipurpose actions among remote surveillance.

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