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IOT ROBOT

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ABSTRACT:

The purpose of this project is to control robot with an interface board of the Raspberry Pi, sensors and software to full fill real time requirement. Controlling DC motors, different sensors, camera interfacing with raspberry Pi using GPIO pin. Live streaming, Command the robot easily, sends data of different sensors which works automatically or control from anywhere at any time. Design of the website and control page of Robot is done using Java tools and HTML. This system works on IoT concept which is Internet of Things, where all the physical devices will connect with digital systems. This will enable raspberry pi to be used for more robotic applications and cut down the cost for building an IoT robot.

Keyword: Raspberry Pi, Controlling DC motors,

1. Introduction;

The research and development of raspberry pi controlled IoT based robot. It works as buddy or family member. IoT is Internet of thing where all the physical devices connects with digital systems, such as Refrigerator, TV, AC, Washing machine, Music system which can works automatically or control from anywhere. Data says by 2020 50 billions device will connect. Raspberry Pi is a credit-card sized computer. It is connected with the Internet and robot can be control as per my command.

User can see live streaming from computer device as website or phone application as camera is attached. Different buttons are there such as Forward, Reverse, Left, Right and Stop to control the Robot. Different sensors are attached with the device such as Ultrasonic sensor, IR sensors to detect obstacle and distance and generate notifications and sends data to user. In smart home concepts it can add value in it. Security is always important at all the time, so there is

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unique login ID and password to control the Robot. First user have to sign up and using unique ID they will able to control it from anywhere at any time.

To develop an IoT technology based Robot can be controlled by a mobile devices/ Laptops over the Wi-Fi from anywhere at any time.

The technology used in the project is Javas the libraries available are only in pi4j. Also it allows creating a user interface so that the user can see and control certain movements of the robot. We use the wireless technology to transmit data of the raspberry pi to the users system.

2. Design Methodology;

The design consists more on actual planning of hardware part than the code to be created. A number of software and hardware implementation techniques were used to design and develop the system.

This section can be divided into many parts: Raspberry pi controller, Wifi dongle, Camera design, Power supply adapter, Ultrasonic sensor, IR sensors, and Motor control design.

The initia block diagram for IOT Robot

Components Details:

Different components of block diagram is described in details below.

a. Raspberry pi 2

The Micro SD card is used for installing OS and the complete project will be done with python coding. The board has specification:

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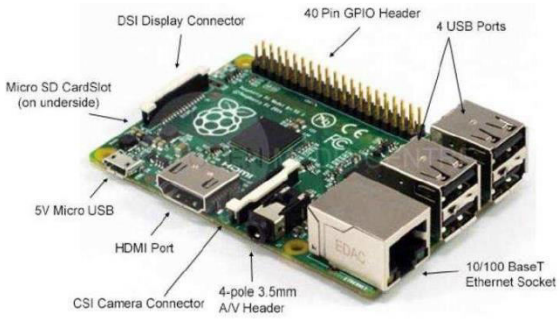

b. WiFi Dongle

Wireless-N USB adapter is used to connect Raspberry Pi with Internet. Standards are IEEE 802.11n,802.11g, 802.11b and frequency range is 2.4 GHz. Its 150Mbps Nano USB adapter. Support the systems as XP, Vista, WIN 7, WIN 8, and Linux.

c. Raspberry Pi Camera

The Raspberry Pi camera board contains a 5 MPixel sensor, and connects via a ribbon cable to the CSI connector on the Raspberry Pi. In Raspbian support can be enabled by the installing or upgrading to the latest version of the OS and then running Raspiconfig and selecting the camera option. The cost of the camera module is 1600Rs. In India (10 May 2015) and supports 1080p, 720p, 640x480p video. The footprint dimensions are 25 mm x 20 mm x 9 mm. Since Raspberry Pi has a ready-to-use socket for camera cable, no extra cables or power supplies are needed.

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d. 5V Adapter Power Supply

Raspberry Pi require power source to turn it on. 5V adapter Power supply is enough to power up. In project I connect Power bank with raspberry Pi, so that it can be put easily in structure.

e. Ultrasonic Sensor

This sensor is a high performance ultrasonic range finder. It is compact and measures an amazingly wide range from 2cm to 4m. This ranger is a perfect for any robotic application, or any other projects requiring accurate ranging information. This sensor can be connected directly to the digital I/O lines of your microcontroller and distance can be measured in time required for travelling of sound signal using simple formula as below. The module works on 5VDC input and also gives an output signal directly for detection of any obstacle up to 4M. As soon as the signals are transmitted the “Echo” pin goes to high

level and remains in high level until the same sound waves are received by the receiver. If the received sound waves are same as what the same sensor transmitted then the Echo pin goes to low level. If no object is detected within 5M after 30ms the Echo signal will automatically go to low level.

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f. IR Sensor

The sensor consists of two eyes. One eye sends the infrared light and the other eye sees the reflection of that infrared light and measures the distance which is then sent to the Raspberry Pi to perform further operations based on the distance. There are three wires coming from the sensor. I.e. Red, Black and White or it can be Red, Brown and Yellow. Red is connected to 5V of Arduino. Black or brown to Ground of Arduino. White or yellow to analog input pin of Arduino i.e. in this case to analog pin 0.

g. DC Motor

Almost every mechanical movement that we see around us is accomplished by an electric motor. Electric machines are means of converting conventional energy. Motors take electrical energy and produce mechanical energy. Electric motor is used to power hundreds of devices we use in everyday life.

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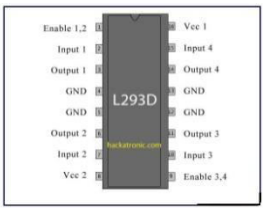
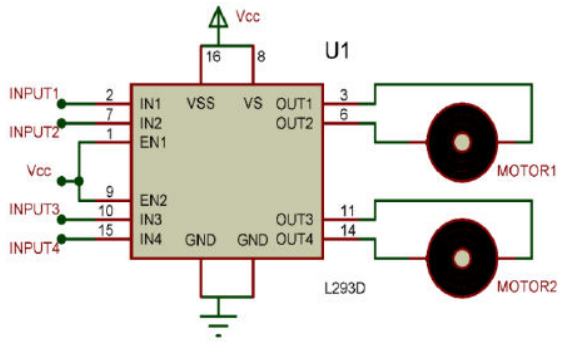
h. L293D Motor Driver IC

A very easy and safe is to use popular L293D chip. It is a 16- pin chip. The pin configuration of a L293D along with the behaviors of motor for different input conditions is given in fig. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. When an enable input is high, the associated drivers are enabled. Also their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications. Design uses GPIO pins 2 and 3 to control the first motor and pins 4 and 5 to control the second motor. The 9V one battery will supply power for both of the motors, and Raspberry Pi will supply power for the motor control chips.



Direction	Motor 1		Motor 2	
	Input 1	Input 2	Input 3	Input 4
Forward	High	Low	High	Low
Reverse	Low	High	Low	High
Left	High	Low	Low	High
Right	Low	High	High	Low

The dc motor and L293D IC has been connected with circuit schematic has been designed using Proteus 7.



3. Software Implementation

It required number of Programming Tools & Languages to build a project. Eclipse Kepler, HTML/CSS, SERVLET/JSP, Java Script, JQuery, Ajax, MySQL database, Tomcat Web Server, MobaXtreme, WinSCP, and Putty.

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a. Eclipse Kepler:

Eclipse is an integrated development environment (IDE) used in computer programming. It contains a base workspace and an extensible plug-in system for customizing the environment.

b. HTML/CSS:

Hypertext Mark-up Language, commonly abbreviated as **HTML**, is the standard mark-up language used to create web pages. Along with CSS, and JavaScript, HTML is a cornerstone technology used to create web pages, as well as to create user interfaces for mobile and web applications.

Cascading Style Sheets (**CSS**) is a style sheet language used for describing the presentation of a document written in a language. Although most often used to set the visual style of web pages and user interfaces written in HTML.

I used HTML and CSS both for the design of website and web page to control the Robot.

c. JSP/Servlet

Java Server Pages (JSP) technology enables Web developers and designers to rapidly develop and easily maintain, information-rich, dynamic Web pages that leverage existing business systems.

Servlets are most often used to process or store a Java class in Java EE that conforms to the Java Servlet API, a standard for implementing Java classes which respond to requests.

d. Java Script

JavaScript is a high-level, dynamic, untipped, and interpreted programming language. JavaScript's typing is dynamic. JavaScript is loaded as human-readable source code. JavaScript's are prototype based.

e. jQuery

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JQuery is a cross-platform JavaScript library designed to simplify the client side scripting of HTML. JQuery is the most popular JavaScript in use today.

f. Ajax

Ajax is **asynchronous JavaScript and XML**) is a set of web development techniques using many web technologies on the client-side to create asynchronous Web applications. With Ajax, web applications can send data to and retrieve from a server asynchronously (in the background) without interfering with the display and behavior of the existing page.

When any button is pressed to control the robot, the whole page will not refresh and action is executed with the help of Ajax.

g. MySQL

MySQL is an open-source relational database management system. MySQL is a popular choice of database for use in web applications, and is a central component of the widely used LAMP open-source web application software stack. LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python".

h. Pi4j

Pi4j is intended to provide a friendly object-oriented I/O API and implementation libraries for Java Language to access the full I/O capabilities of the Raspberry Pi platform. This project abstracts the low-level
native integration and interrupt monitoring to enable Java programmers to focus on implementing their application business logic.

i. Debian Raspberry PI Language

Debian is a Unix-like computer operating system that is composed entirely of free software, most of which is under the GNU General Public License, and packaged by a group of individuals known as the Debian Project. Raspbian Jessi Lite version 4.1 is installed in Raspberry Pi 2.

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j. Apache Tomcat

Tomcat implements several Java EE specifications including Java Servlet, Java Server Pages (JSP), Java EL, and Web Socket, and provides a "pure Java" HTTP web server environment in which Java code can run. User have to install Apache in Eclipse and Raspberry Pi to run the java code. If the version is different and it will cause error to run different version Java code.

k. Linux

Linux is a Unix-like and mostly POSIX-complain computer operating system (OS) assembled under the model of free and open-source software development and distribution.

l. WinSCP

WinSCP (*Windows Secure Copy*) is a free and open source SFTP, FTP, WebDAV and SCP client for Microsoft Windows. Its main function is secure file transfer between a local and a remote computer. Beyond this, WinSCP offers basic manager and file synchronization functionality. For secure transfers, it uses Secure Shell (SSH) and supports the SCP protocol in addition to SFTP. Raspberry Pi to Laptop file transfer WinSCP is used in project.

m. MobaXterm

MobaXterm is your ultimate toolbox for remote computing. In a single Windows application, it provides loads of functions. Raspberry Pi is open in the MobaXterm application and it's easier to open Remote Desktop or code in the Raspberry Pi.

n. Putty

Putty is an SSH and telnet client, developed originally by Simon Tat ham for the Windows platform. Putty is open source software that is available with source code and is developed and supported by a group of volunteers. IP address of Raspberry Pi have to enter and raspberry pi is ready for programming.

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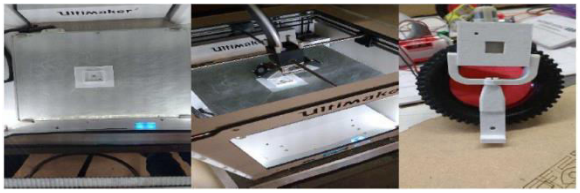
4. Implemented System:

The system is implemented with Laser cutting tool and 3D printing tool. Robot chassis is designed with Laser cutting and Ultrasonic sensor and Camera case is designed with 3D priming.

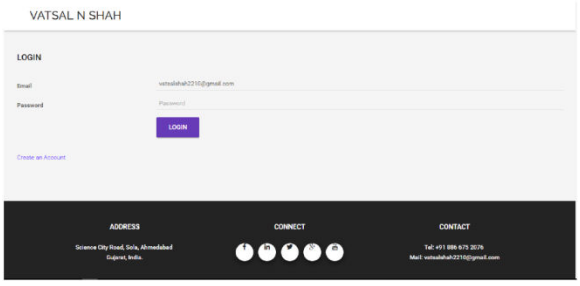
Laser cut Chassis



3D printed Case

5. Results:

The aim of the project is to develop a Robot on IoT based concept. It is working as buddy or family Member because you have to command it and control from anywhere at any time. If a personal wants to find something he/she has to command it from live steaming can see the actual scenario at that place and easily find out that object. It works as to take care for children's, pet at home, too.



Login Page for Robot Control

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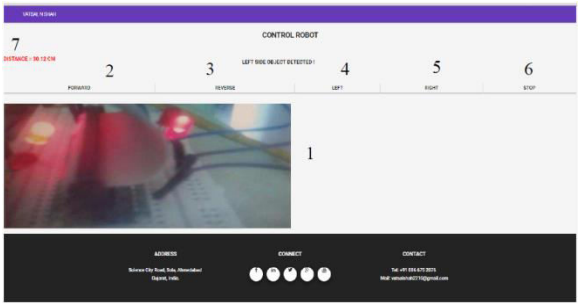

Control page of Robot Control

IOT Robot Structure

6. Conclusion:

During the whole period of the project I gained of lot of knowledge on the raspberry pi, motors and programming in java, MySQL. If we talk about the achievements out of the project when starting to do the project it was to control the motors using raspberry pi on a robot and transmit that data via any wireless technology to another device and able to collect the data and control the robot or raspberry pi in a real time instance. Out of which all the work was completed. The main achievements that I gained out of the project were that I got to learn programming in kava and could learn how to program a user interface web page. Another main achievement was I could learn and understand the raspberry pi technology, the wide applications of raspberry pi and IoT. There are lots of many other areas where the raspberry pi could be used for robotic applications and that are the reasons for me to choose this project.

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To get to the aim of a project there will be always a set of objectives, to achieve that objectives we need to know how where and with what resource is the step towards completing the objectives taken. Now in this

project too to get to the aim of the project there was a set of objectives, which gradually changed as the project research was completed and then while testing a certain technology the objectives again changed due to the failure of the method. Now the first thing of the project is a good research, I had to do a wide and a strong research before I started to put my objectives as this technology was new in market. The research for the project was done using Advanced Google search and also from the search engines available in the student portal like tutorials, pi4j, w3school and raspberry pi. The Google advanced search is the one that was more widely used as it is a new technology and there are very

less articles or journals published regarding the raspberry pi technology and IoT. Each stage of the project was tested after every part of it was completed and then moved on to the next one. During the course of the project I gained knowledge of Java I also gained knowledge of the raspberry pi technology and what the small computer is capable of. After knowing the capabilities of raspberry pi and the applications it could have in the field of robotics, and IoT it actually has made me to think of doing more

research work on the raspberry pi for the robotic and IoT applications. The challenges that I faced during the course of the project were that of the time constrain, as I had to learn about the raspberry pi and then learn programming in Java and HTML. Then during the programming of the server client interfaces the problems of calling functions with a button press. One of the main challenges that No output comes when some functions are called from software side. Other than the small problem the buddy robot works fine and meets all its purpose. If given an opportunity to work again on the same technology i.e. the raspberry pi and IoT technology or on a project like this where the raspberry pi is used for any kind of application I would be happy to take it up.

In the future this raspberry pi technology can be used in various different fields of work. The buddy robot can be made autonomous with the help of more sensor, gyroscope, compass and a GPS. So that it can be set to a target or a specific area where in can monitor. The robot can also be developed into an advanced robot toy for young people. Others future works described below: Face recognition: All the family members face images are stored in controller when an unknown

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- person will come at door, it will create alert and click the image and send it to user.
- In changing the Mechanical design work using the same concept, different functions as Open the door, Turn on/off switch, bring newspaper for user, etc work can be done.
- Adding the Pneumatics design in Mechanical design robot can walk, go up and down and it will be control from anywhere at any time.

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