

Internet Mobile Robot for Industries

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Abstract— In the recent years, the increasing use of wireless applications and the demand for a system that could easily connect devices for transfer of data over a long distance without cables became worldwide. This paper presents the Build and interface of a real time wheeled mobile robot installed above it an arm and a camera. Software system can be built in three various programming languages and controlled via the internet using webpage protected with a username and password to make sure it cannot be hacked. The webpage is designed to control the mobile robot remotely through the internet by any web browser such as Mozilla Firefox. Camera is mounted on the animated base in two axes in order to have better visibility. The designed mobile robot can be remotely operated from everywhere around the world without being near the robot. It can be controlled by using any device, whether a laptop, a mobile or a tablet. It can move forward, reverse, turn right and left for a specific distance according to the controller specification. The mobile robot system is used to transfer foreign objects and access to areas that are unable to be accessed by humans. It is also used for purposes of monitoring to fit a camera. The development of this robot is based on Arduino Mega platform which will be interfaced with the microcomputer that is placed on the robot running as a server. After completing the design and testing the robot, time delay is calculated in different cases (LAN and WAN) network. Finally, this prototype of the robot is expected to solve many problems such as placing or picking objects that are far away from the user, picking and placing hazardous objects in the fastest and easiest way.

Keywords: Internet Mobile Robot, Raspberry Pi, Arduino.

1. Introduction

The term robot comes from robota which is a Czech word meaning forced labor. For Swedish roboticists, the word robot in Swedish is also used for military missiles. Automated software programs that crawl the Internet are also called robots. Mobile robots are generally those robots which can move from place to place across the ground. Mobility gives robot a much greater flexibility to perform new, complex, exciting tasks. The world does not have to be modified to

bring all needed items within reach of the robot. The robots can move where needed. Fewer robots can be used. Robots with mobility can perform more natural tasks in which the environment is not designed especially for them. These robots can work in a human-centered space and cooperate with men by sharing a workspace together. Nowadays, robots are increasingly being integrated into working tasks to replace humans specially to perform repetitive tasks. The mobile robots are currently used in many fields of applications including office, military tasks, hospital operations, dangerous environment and agriculture. Besides, it might be difficult to the worker who must pick and place something that can affect badly, such as Welding is considered as a dangerous task for a humans because of toxic gases emissions, Painting has similar problems to welding due to the use of toxic chemical products, assembly operation: When we assemble a chip we need to be very precise because of very fine wires which require very precise and accurate tasks which a human cannot handle but, on the other hand, is easy for a robot and space missions to gather samples from other planets and to analyze them from remote distances. Therefore, a locomotion robot can replace human to do work. The robot is wireless controlled to ensure it can be used a long way from the user.

This paper describes building a real time mobile robot system based on using internet communication. This paper shows how to implement mobile robot system by interfacing the microcontroller (Arduino) with microcomputer (Raspberry Pi) by using serial port. The microcontroller is programmed in Arduino C language and the microcomputer is programmed in python language, the mobile robot system contain camera moving in two axes and 5-DOF arm robot to hold objects. The mobile robot can be controlled by web page programmed in java script language. Necessary programs are installed to run server and camera correctly, then the system is connected wirelessly via internet and time delay is calculated in different cases (LAN and WAN) network. Mobile robots are generally those robots which can move from place to place across the ground. Mobility give a robot a much greater flexibility to perform new, complex, exciting tasks. The world does not have to be modified to bring all needed items within reach of the robot. The robots can move where needed. Fewer robots can be used. Robots with mobility can perform more natural tasks in which the environment is not designed

especially for them. These robots can work in a human-centered space and cooperate with men by sharing a workspace together. A CCD camera is mounted on the mobile robot to acquire information, which is displayed inside the browser for the remote operator’s operation. The designed mobile robot can be remotely operated from anywhere around the world as long as there is a set of computers with keyboard, mouse, display and connection to the Internet. This paper is a robotic vehicle that can be controlled remotely by Skype text messages. A wireless webcam is mounted on the robot, and a live video/audio stream is relayed back to the remote operator via Skype video chat. The robot is wirelessly connected to its host PC with two Xbee modules. The remote operator PC and the local host computer are connected by two Skype clients via the Internet. More sensors and servos can be added to the robot, and controlled remotely by Skype text messages.

2. LITERATURE SURVEY

In this work communication between the remote user and the home devices is implemented using restful based Web services.

In the first paper **Wu Yi, Wu et.al [1]. “Robotic System using GSM Based message System”** In this system multiple sensor is monitored by the controller. Short Message is automatically send to the user through system when the value of sensor exceeds the preset threshold value. Manager control the device by sending text message (SMS) to the system. The real-time information of system is obtained on the display. Samsung S3C2440 microprocessor used as a Central controller which used ARM9 control unit. Chipcon’s CC2430 ZigBee Network module for wireless connection and GSM module for message transmission and receiving.

In the second paper **Sarthak Jain et.al [2]. “Raspberry Pi based Mobile Robot System through E-mail”** the algorithm developed such a way that it read the subject of E-mail or in other word we can say that, home application controlled through E-mail by reading the subject. The basic application has been implemented and used efficiently. Robo Automation implement through web based it consumes more space for web server storage, if it is SMS based then in DTMF call drop is major problem both these disadvantages eliminated through propose method using Raspberry pi.

In the third paper, **Rozita Teymourzadeh et.al [3]. “Microcontroller 8051 using Arduino based Robot System”** this system uses the multiple sensors, here controlling the robot through microcontroller using Arduino and it embedded with only C language, it will be controlled only some limited area. It cannot be access from remote desktop.

3. Methodology

3.1 Project overview

In this paper, the hardware and software function are combined to make the system reliable. The Raspberry pi and Arduino Mega will be the interfacing for the mobile robot and can be controlled wirelessly through the Internet by using webpage. The project overview is shown in Fig (1).

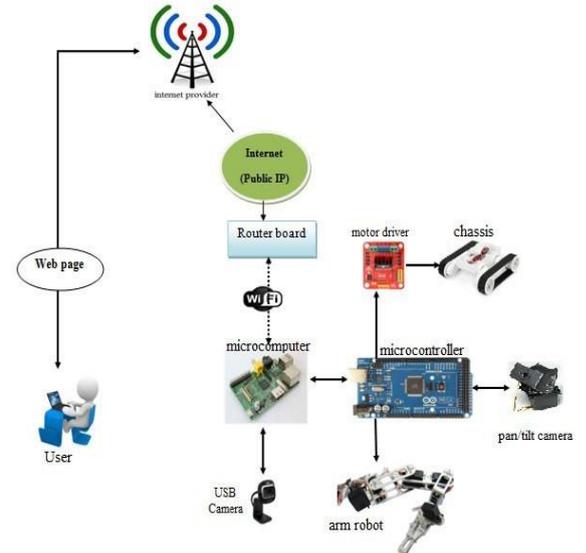


Fig (1). overall system design

The fig 1 describes how overall design looks like. The user and robot are connected using ip address. The robot contains microcomputer, microcontroller, USB camera, arm, pin/tilt camera.

3.2. System structure

The main objective is to illustrate some significant aspects of the project to ensure that the project is feasible also suitable for use in the market.

Table 1 Specification of internet Mobile Robot Arm.

Module	Specification
Microcomputer	Raspberry Pi
Microcontroller	Arduino Mega
Programming language	Arduino language + Python +Java script
Actuator	Servo motor + DC motor
Robot Arm	5DOF arm with gripper
Motor driver	L298N

3.3. Software development

Software is a set of programs, procedures, algorithms and its documentation concerned with the operation of a data processing system. In this case, software is needed in order to complete task for the project.

Arduino IDE: Arduino hardware is programmed using a Wiring based language, similar to C++ with some slight simplifications and modifications, and a Processing-based integrated development environment. Arduino is programmed using Arduino IDE that has been developing using Java and other open source software.

WebIOPi: Is a web application which allows you to control your Raspberry Pi. Just install it on your Pi, and use any browser from your network.

Motion Program: motion program is going to be set up so the garage door's status can be checked up using a webcam.

Putty program: A special program to control of Raspberry Pi Wirelessly. Putty is a free and open source terminal emulator, serial console and network file transfer application. It supports several network protocols.

3.4. Software Algorithm

The theoretical work in this paper is represented by many programs. Java script program, Python program, Arduino program and motion program for camera. These programs must work as one unit for the success of the work, as shown in Fig. (2) Illustrates the flow chart of software algorithm.

Step1: The user and robot are connected and ready.

Step2: The live streaming video is sent to the user wirelessly.

Step3: The commands are sent by the user to the server using the java script code.

Step4: The commands are processed using python program.

Step4: The code is send to the microcontroller.

Step5: The code is processed using the arduino program.

Strp6: Finally the code is run using the c program.

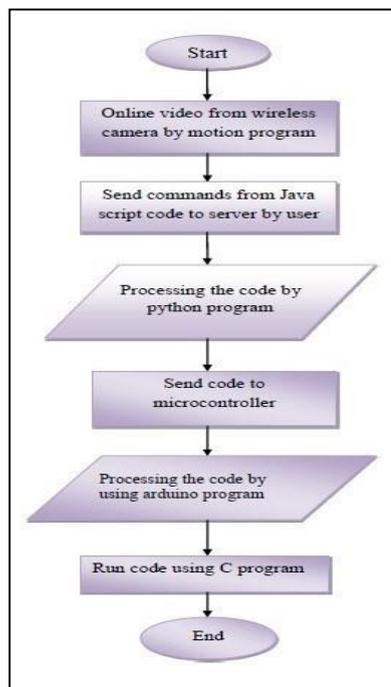


Fig. (2) Flow chart of software

4.MICROCOMPUTER/RASPBERRY PI

To connect the mobile robot to the Internet and the installation of the various programs, we need a certain computer specification, in this project we used microcomputer called ‘Raspberry Pi’ because of its good specifications and possibilities and high flexibility in dealing with different programs. Fig. (3) Shows the Raspberry Pi Model B.

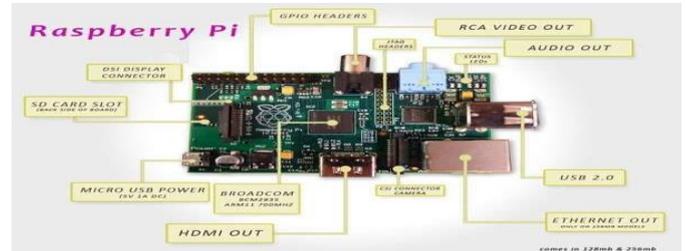


Fig. (3) Raspberry Pi Model B

5. PAN/TILT TURRET

To allow control of the camera position without moving the robot frame, a pan-and-tilt base for the camera is needed as shown in Fig. (4). the pan-and-tilt functions are achieved using two standard sized hobby servo motors to create X and Y axes with 180-degrees rotation along either axis. This setup gives a full view of anything in front of the robot and enables much more precise movement than is provided by the robot base and the ability to look up and down.



Fig. (4) Two standard servos mounted on top of each other for pan/tilt motion.

6. Electrical Interface

6.1. Arm Robot Interface

The six servos arm robot is controlled in the same way of the pan/tilt. A PWM signal of microcontroller (Arduino mega) with a pulse width of the servo motors of the arm robot. An increase or decrease of the pulse width will increase or decrease the servo angle respectively up to a maximum of about ±90° from center position, to as shown in

Fig.(3) and Fig. (5)

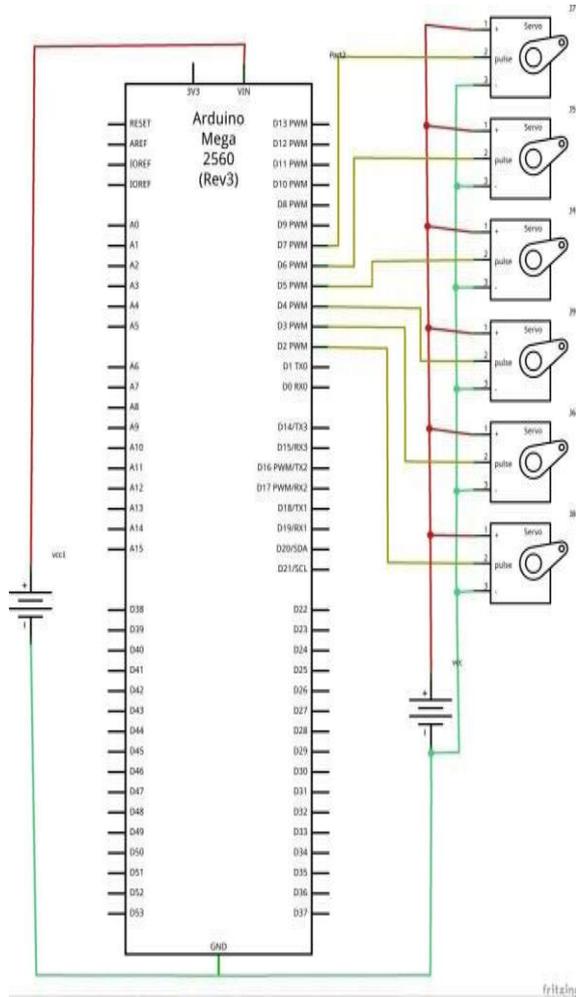


Fig (5).Arduino mega pin diagram

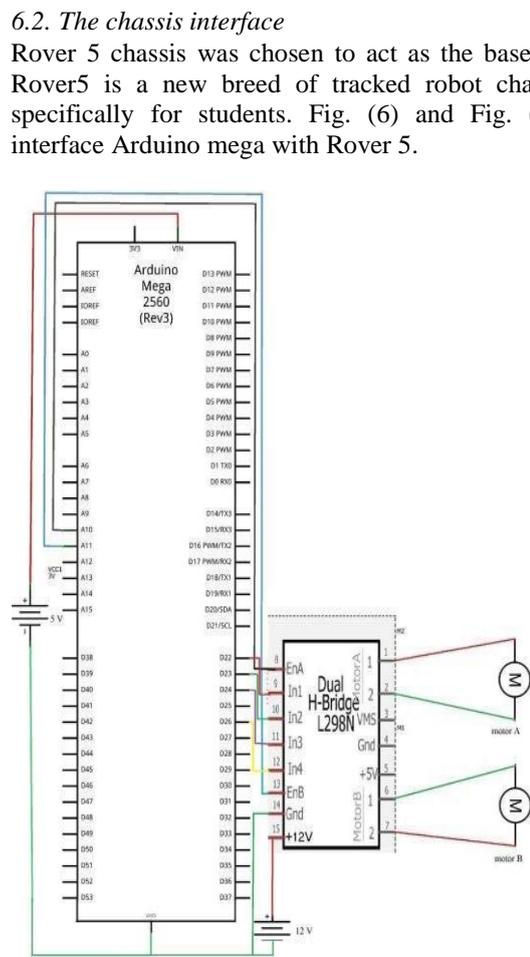


Fig (7) Schematic chassis interface.

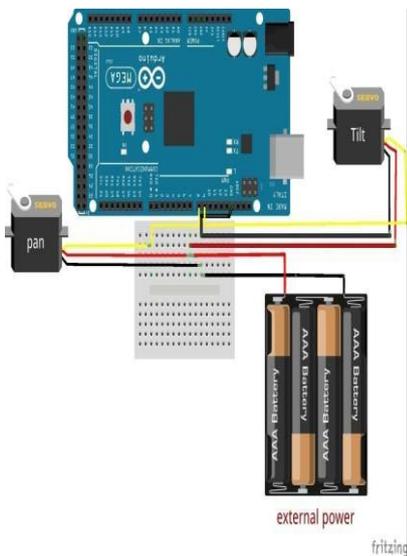


Fig.(6) Breadboard Pan/tilt interface.

6.2. The chassis interface

Rover 5 chassis was chosen to act as the base of the robot; Rover5 is a new breed of tracked robot chassis designed specifically for students. Fig. (6) and Fig. (7) show the interface Arduino mega with Rover 5.

7. GRAPHICAL USER INTERFACES (GUI)

Web page is the visible part of the programming, which has been programmed in Java Script, and by which the robot is fully controlled. It also can be seen from the camera image on Android phones and moved as needed, and from which it can also move the robot and control it fully.

8. SYSTEM FLOWCHART

The mobile robot system is consisting of two sections, theoretical and experimental work. Theoretical work involved building programs for graphical user interface using JavaScript language, server using python language , camera settings using motion program and Arduino using C language. The experimental work consists of building the mobile robot by connecting the arm and camera above the robot and Work Interface between various electronic circuits. illustrates the flowchart of the overall system. The server is run using the static ip address .Connection is established using lan. If the connection is unsuccessful the server is run again. If the connection is successful open the web browser using the static ip. The live streaming video and control command are

available in web browser. wait for the command from user if not received the robot is in idle state. the command are received from the user. the command is decoded from the server. Send the command to microcontroller. the command is executed.

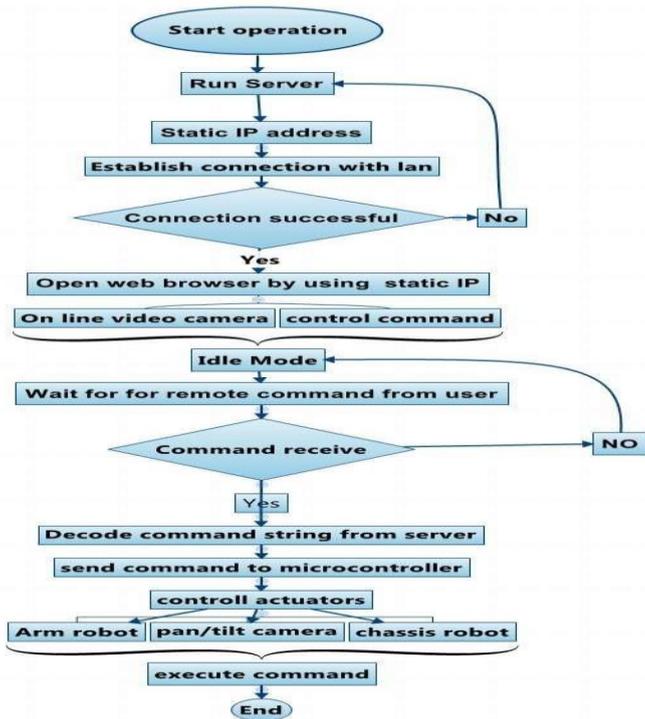


Fig. (8) Flowchart of overall system.

9. WIRELESS COMMUNICATION MEDIA

Wireless communication is a transfer of information between two or more points that are physically not connected. Wireless communications also permit services, such as long range communications, that are impossible or impractical to implement with the use of wires. The distances can be short, as a few meters, or long, ranging from a thousand to millions of kilometers from around the world. Wireless communication could be found in various types of fixed, mobile, and portable two ways radios, cellular telephones, Personal Digital Assistants (PDA), and wireless networking.

9.1 TCP/IP

The TCP/IP suite has become the industry standard method to interconnect the hosts, internet and networks. It is the engine behind the networks and Internet worldwide. Even though TCP/IP supports a host of applications, standard and nonstandard, the applications may not exist without the foundation of a set of core protocols.

8.2. Internet Protocol (IP) Addresses

Because TCP/IP networks are interconnected across the world, each computer on the internet must have a unique address (called an IP address) to make sure that transmitted

data reaches the correct destination. Blocks of addresses are assigned to organizations by the internet Assigned Numbers Authority (IANA). Individual users and small organization

may obtain their addresses either from the IANA or from an Internet Service Provider (ISP). The IP uses a 32 bit address structure.

10. EXPECTED OUTCOME

10.1. Complete designing robot

The robot mechanical structure is completed as shown in Fig. (13) and interface of wireless mobile robotic arm. The camera is mounted in the front of the mobile robot and can rotate in two axes (X &Y) in order to be of good visibility for the user and see objects in sides without the need of rotating the robot. When the robot is not working, the dimension of it will be (24.5 X 22.5 X 55) cm and the weight 3.25kg.

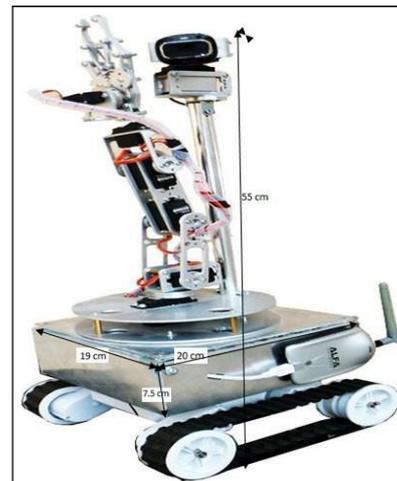


Fig. (9) Completed wireless mobile

10.2. Calculate Time Delay through Wireless Monitoring. After designing the network for case studies, the configured network has been examined by sending the data packets from one host to another destination host in another location and receiving the destination host reply to these sent data packets. This test verifies the true design of the network since the wrong design does not enable the successful reply of the sent data packets over the designed network. The achievements of this test can be done by using the (ping) command in the originating data packet's host, by entering the destination host IP address in the command line prompt (Linux environment), and by writing the ping command followed by the IP address of the destination host. The time delay will be studied in each case separately. The time delay can be calculated from the Ping instruction by taking the average time delays for any system that has its own IP address then the response of the system can be estimated. The average time can be calculated by the following equation.

$$T \text{ delay (AV)} = \frac{\sum_{i=0}^K (\text{Round Trip Time })}{K}$$

Where: Delay (AV): Average time delay, K: Number of round-trip tests

9.2.1. Case Study 1: calculate time delay in the wire LAN. In this case, the system has been linked with router, which is linked to the server (Raspberry Pi) through Ethernet cable.

9.2.2. Case Study 2: calculate time delay in Wireless LAN. The server will be linked (Raspberry Pi) with router by using Alfa Wi-Fi card. The network is connected wirelessly.

9.2.3. Case Study 3: calculate time delay in WAN. The time delay is calculated and studied through the World Wide Web for many different distances using public IP (can be obtained from the Internet service provider). From case studies the results are summarized in the table (2).

Table (2) a summary of the cases that have been studied

	Min (ms)	Max(ms)	Avg (ms)
Case study 1	0.137	0.217	0.151
Case study 2	0.143	0.448	0.165
Case study 3			
Distance in Km	Min (ms)	Max (ms)	Avg (ms)
271	9	13	9
356	8	16	12
375	7	19	9
549	9	22	12

From table (2), it can be noticed that the value of average delay time in the case of wire LAN is **0.151** ms which is a very small value as it approaches largely the value of the time delay in the case of a wireless LAN **0.165** ms.

In the third case WAN, the time depends on the type of the network and the speed of the Internet. This time will cause a delay in monitoring and control of the robot system at the client site and cause distortion of response we note increase the value of the time delay and differ depending on the speed of the Internet and distance between the user and the robot system.

11. CONCLUSIONS

The main objective of this project has been achieved which is to build Internet mobile robot and to interface hardware and

software for mobile robot arm controlled via the internet from any place, Controlling the robot does not require specific software. It just demands Internet service. Overlap does not occur when a command is sent to the robot from a server and an image is sent to a server from the robot. Easy to control without the need of any complex hardware and only the need of laptop or smart phone. Generally, the robot server runs smoothly as planned and also the controller. By analyzing and comparing the time delay, it has been noticed that it would be very small in case of LAN (wire and wireless). The increase depends on the distance, type and strength of the Internet package used. The use of a secure wireless connection (username and password) helps to minimize the penetration by hackers.

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