Internet Controlled Vehicle

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Abstract—Inspired by the motive to control robots, drones and other vehicles remotely, this article walks through an experimentation of a similar kind conducted on a prototype of a car. The ever growing need for intelligent systems has led to an idea of controlling a car via the internet. 'unmanned taxi service'- a new age model which works under the concepts of networking, computer logic and electronics elicits the idea of a taxi being controlled by a remote host by making use of a controller.

Keywords— *Prototype, Drones, Raspberry Pi, Communication, 4G technology, Automation, Wireless networks.*

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I. INTRODUCTION

Rapid advancement of technology in every field has resulted in the reduction of human efforts, the main reason being machines getting automated. A machine could be a cell PDS device, a bicycle/motorcycle or even a robot for that matter. These robots, drones, etc. have found an increasing demand for themselves in a wide range of applications. Back then they were built using the existing principles of mechanics. They kept improving over the course of time with the inception of the electronic, software and networking era. The complexity of coding the logic depends on how the robot's tasks are.

The internet has had a lot of changes in itself over the years and has grown constantly with the increase in demand for connection and communication throughout the world. Due to this there arose quite a few limitations with respect to the speed and efficiency of transfer of voice, video and data i.e. Quality of Service. But now these limitations can be solved with the advent of 4G technology. This can be used for many such systems and thereby improve the quality of the systems that people and researchers wish to bring to the world.

In this project, we use the internet to establish a communication between the user and a vehicle such as a taxi. Through a reliable connection and a continuous video feedback, the vehicle is controlled remotely. There have been many projects done and papers written on similar works using GSM technology, Radio Frequency Control, WiFi-control, etc. These conventional wireless robots have the drawbacks of limited working range, limited frequency range and limited control. On the contrary we use the internet and due to this there is no limitation on the range or distance between the controller (driver) and the vehicle. Internet robotics has opened up a completely new range of real-world applications namely remote-surgery, remote-manufacturing, video-training, traffic control, health care, space exploration, disaster rescue etc. and the list is supposed to increase further in the coming years.

II. RELATED WORKS

In the work published by Sourangsu Banerji (2013) on Design and Implementation of Unmanned vehicle using a GSM network without microcontroller[1], in which he proposed a model to remotely control and unmanned vehicle using DTMF technology without a microcontroller. A phone call was made in order to establish a connection between the user and the car. During the course of the call, depending on the tone of the button pressed by the remote user the command was interpreted by the robotic car using a DTMF decoder (MT8870). The output of this decoder was sent to the L293D motor driver IC which drives 2 motors. The vehicle was used to move in all four directions. Advantage of this work was a reduced circuit complexity and manpower but inclusion of a password protection system, sensors and wireless camera was impossible.

Dharmani (2009) on IR Remote Controlled Car[11], used an IR Remote system to control a robotic car which uses two PWM channels of ATmega8 microcontroller for controlling the speed and direction of the car. Although speed control of the car was made possible the car was unable to make a turn. Poor range of control and line-of-sight alignment was also a problem.

In the work published by Robolab Technologies (online) on IR Controlled Robotic Vehicle, a robotic car with infrared TV remote controller was constructed. The car was able to move in all four directions but the IR remote control limits its efficiency as it could not be controlled with an object blocking its line-of-sight from the controller. The robotic car was also not controllable from a considerable far distance. These were the limitations of the system. Thus, after studying all these systems we were able to recognize the work we need to perform for our project and also acquired inspiration to successfully complete our work.

III. PROPOSED SYSTEM

The currently existing systems are mostly working on this concept using RF circuits and GSM technology. Our work overcomes the limited approach of the GSM and RF by using the internet and providing a high end system wherein the distance and range-of-sight would not be of any concern. Our system basically speaks of a vehicle controlled via the internet by a remote host/user/driver. It aims at solving problems at various levels in big corporate and other sectors. This gives us the opportunity to create a taxi service of a different type.

The taxi service is designed to be with the driver's seat left empty in the vehicle and rather controlled by the driver from a far off distance with the help of a screen & an emulator connected to the car via Wireless networks. A constant video feed helps the controller obtain real-time footage of the current surroundings of the vehicle. The video feed obtained from the car is then used by the driver to decide which direction the car must now move in. The car is controlled by sending appropriate control signals to it through the internet by means of a web server. The logic controls are provided to the car by the Raspberry Pi processor. This system is designed as an example which could be implemented for other works as well.

IV. METHODOLOGY

A. *Working*

The first part is construction of the robotic vehicle. Using 4 DC motors, a 9V/12V battery, a webcam, an internet dongle, Raspberry Pi processor and an L298N motor controller we control the car through the internet. At the very initial stage the Raspberry Pi must be booted and then the browser connecting to the main server must auto-connect. Once the auto-connect is complete the vehicle is now ready to be used. Now, only when the vehicle is needed to provide its service will the video-feed begin.

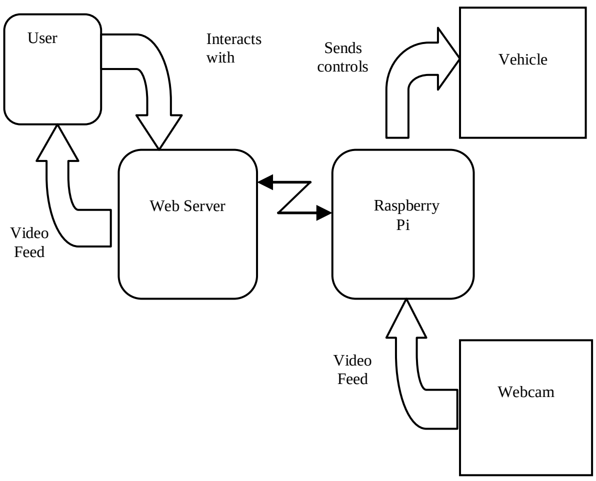

Figure 1 Block Diagram Of The System

The next task is to capture and send live images using internet at a rate sufficient to make them seem like a live video to any human. This video-stream is established by creating a UDP connection with the server.

Although TCP connection is reliable yet it is not as fast and as efficient as a UDP connection with the server. This is simply because the concept of TCP demands an acknowledgement for every transmitted packet over the network and only then sends the next packet.

Our work was initially implemented using LAN before moving on to the internet. The required result was obtained by sending compressed low resolution images so that the transmission would not be affected in case high upload speeds were not available. Then the program was made faster by varying the resolution of the images to be transmitted depending on the upload speed available at that particular time. Like for example in case of availability of good upload speeds, high resolution images will be sent and vice versa in case of low upload speeds.

It explains the manner in which actions will take place. So, initial stage is to capture the data with the help of a camera. Then that data will be transmitted to the monitor side. According to presented situation, user will take necessary actions like which turn to take and other movement of vehicle. But it will be in terms of signals, which will be transmitted through the internet. When these signals are received by the Raspberry Pi placed on vehicle they are then decoded by the Raspberry Pi using the logic written in Python/Java and then sent to the L298N motor driver through its GPIO pins and the vehicle will move accordingly. Again webcam will capture and send images to the user to take action. This cycle will go on. This method will allow a distant user to seamlessly control a vehicle from a remote location while having a complete track of the vehicle. It is preferred to use 3G or 4G technology as the delay, jitter and other factors have been lesser and thereby a real-time and efficient system is obtained.

B. Components Used

1) *Raspberry Pi:* Raspberry Pi 2 model B is used for making the vehicle intelligent and adding logic to its functioning. It requires an SD card to store the Raspbian OS which provides the GUI to interact with the Raspberry Pi. A 5V 800 MHz supply is needed to boot the device. The camera is interfaced to the Raspberry Pi and then the videos are transmitted wirelessly from the vehicle to the user's monitor, from where the user can conveniently control the robotic vehicle's movement. Raspberry pi is connected with the dongle which enables raspberry pi to transmit over the web network. Also the Raspberry Pi is interfaced with the motor controller to enable us to control the movement of the vehicle. The interfacing with the motor driver is achieved by connecting the motor driver with the GPIO pins of the Raspberry Pi.

Figure 2 Raspberry Pi

2) *Web Camera:* Web camera is needed to capture the real time images. Hence the camera should be able to capture It is plugged into the USB port of the Raspberry Pi. The quality of the camera could be further increased depending on the estimated speeds one wishes to achieve thereby enabling the camera to capture the images appropriately.
3) *Vehicle:* The Raspberry Pi would be connected to the vehicle's system. Also a camera *would* be mounted on the top of the Vehicle to capture the video feed. The vehicle used here is a prototype consisting of a chassis and electronic components
4) *Motor Driver:* We use an L298N motor Driver to send controls to the motors *connected* to the wheels of the car. A single motor driver can control at the most 2 motors at any time but by altering certain logic in our connections we have been able to send appropriate signals to all 4 motors. For controlling the prototype car this motor driver sends the logic signals to the motors attached to the wheels of the car. The inputs to this are provided through the Raspberry pi processor. There are 2 enable pins on the motor driver one for each motor and must be set to HIGH or 1 for the driver to work.
5) *System Requirements:* The system running the web client interface must have:

OS Requirement	: Windows XP/7/8
Processor	: Pentium IV
RAM	: Minimum 512 MB
Disk Space	: Minimum 10 GB Free Space
Software	: Java, JDK, Web Browser, Media Player

C. *Design*

Here we speak of the architecture and overall connections of the system describing each module briefly.

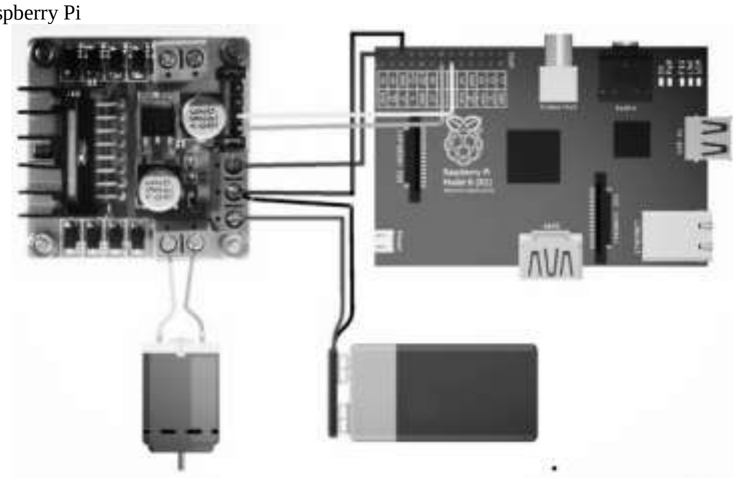

Figure 3 Connection of Raspberry Pi with L298N motor driver[9]

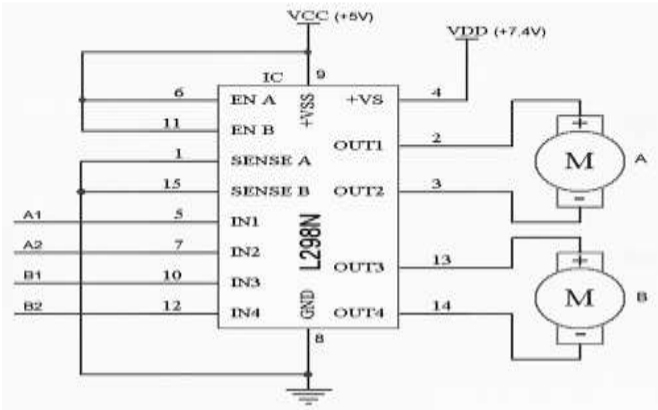

Figure 4 Circuit Diagram of Connection of motor driver with motors[10]

WebRTC modules:

1. *Interactive Connectivity Establishment (ICE) :* This framework allows the web browser to connect with peers bypassing firewalls, gives a unique address as the moving vehicle doesn't have a public IP address, and relay data through server.

2. *Session Traversal Utilities for NAT (STUN) :* This is a protocol to discover the public address (IP). The client will send a request to a STUN server on the Internet who will reply with the client's public address and whether or not the client is accessible behind the router's NAT.

3. *Traversal Using Relays around NAT (TURN) :* This is used to bypass the Symmetric NAT restriction by opening a connection with a TURN server and relaying all information through that server.

4. *Session Description Protocol (SDP) :* is a standard for describing the multimedia content of the connection such as resolution, formats, codecs, encryption, etc. so that both peers can understand each other once the data is transferring.

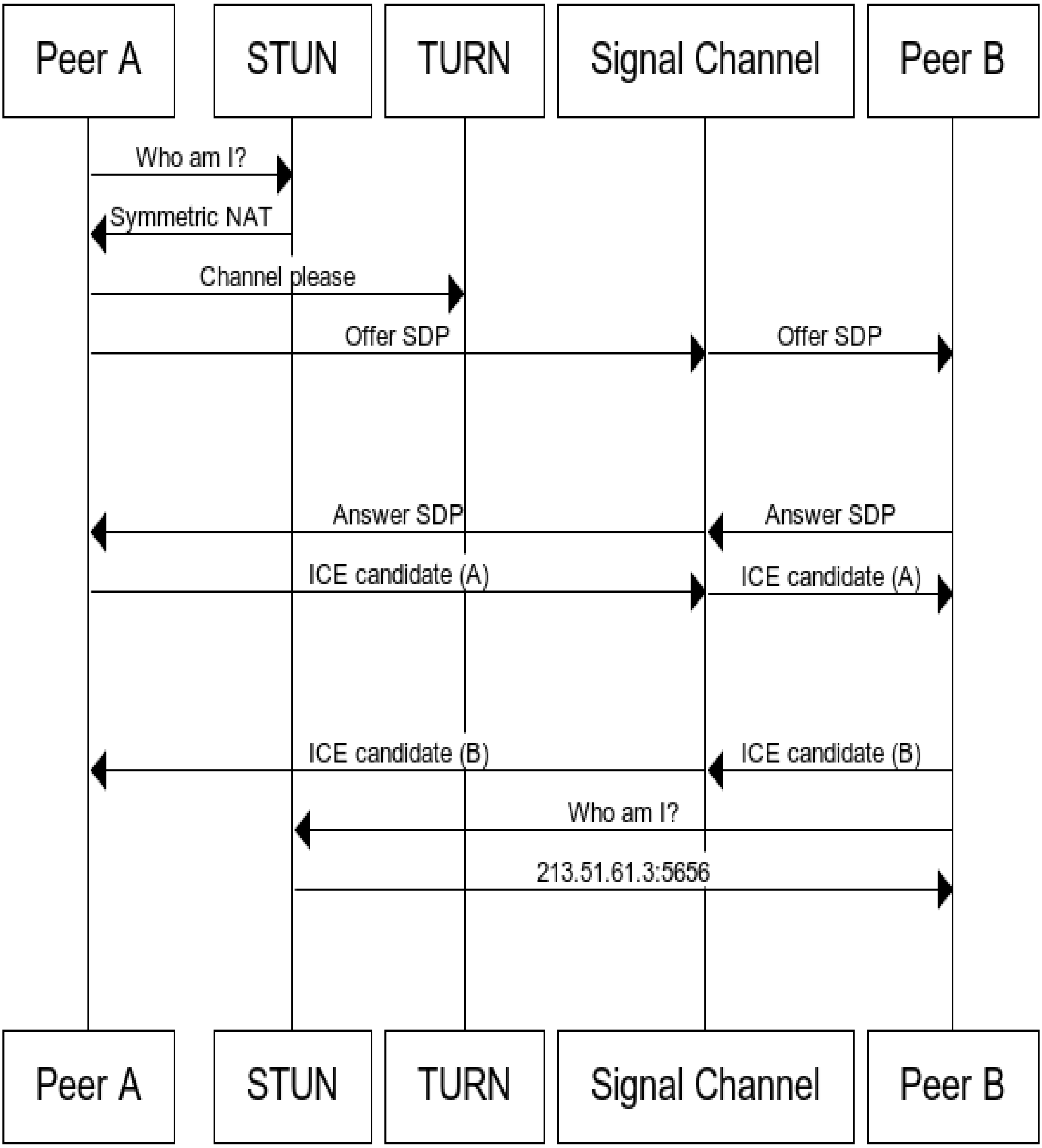

Figure 5 Establishing Connection between Server and Client[12]

V. CONCLUSION

In this article we have broadly explained the implementation of a remotely controlled vehicle through the internet with the help of a live video feed. The work can be enhanced with increase in speed of the internet as delays and jitter can be reduced further. Moreover this concept could be extended to fight the problems of fuel consumption and traffic, to save time, to reduce the cost of production, etc. Defense and other security systems, remote-surgery, remote-exploration, hazardous environment analysis, etc. could be the immediate and most useful applications of this system

ACKNOWLEDGMENT

We would like to thank Dr.Sharmila Gaikwad for her support and guidance throughout the study and implementation of this work and also the Management, The Principal Dr. Udhav Bhosle, HOD Dr. Sunil B. Wankhede for their time to time support in our work.

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