Remote-Control Car based on IOT using a Raspberry Pi.

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Abstract - There are many robot cars are introduced today with high technology such as IOT based. In a current scenario various technologies are used for implementing robot cars, is built with Bluetooth, WIFI, and ZigBee technology. This is the communication technology of IoT which work at the data link layer. Bluetooth technology operates on the Personal Area Network and has a range of 5 to 10 meters. as well as other WIFI ZigBee operates on a local area network, whereas WIFI has a range of 4 to 20 meters and ZigBee has a range of 10 to 300 meters. This technology has a very limited range. We can't control that robot car from another city using this technology. In this paper, we introduced a new prototype of a remote-control car based on IOT using a Raspberry Pi. The main aim of this work is to broaden its application. I used the internet network, which is a public network with cellular technology (4G). With this network, we can control our robot car (remote control car) from anywhere in the world. This level of network coverage is essential for IOT application that require data access across multiple cities or regions. The infrastructure required for cellular IOT enablement is already in place and does not require any additional investment infrastructural requirement for cellular IOT like cellular and base station are already in place. This robotic car has a several features such as It can record a person's voice using a microphone, speak using a speaker, Surveillance using a camera, and easily track its location using a GPS tracker module, this all features controlled via the internet.

Keywords - Internet of Things (IOT), Raspberry pi, NGROK.

I. INTRODUCTION

The Internet of Things (IOT) is a physical object network. The internet is no longer just a network of computers; it has evolved into a network of devices of all shapes and sizes, vehicles, smart phones, home appliances, robots, cameras, medical instruments and industrial systems, people, and buildings, all connected, all communicating and sharing information based on predefined protocols in order to achieve smart reorganizations, positioning, tracing, safe & control, and even personal real time online monitoring, online upgrade, process control, and process optimization [1].

Today, various crimes are taking place in our city. As an example, theft crime and terrorism. This crime is handled by the crime branch. However, in some cases, the crime branch is unable to keep tabs on the secret thieves, what they are planning and executing. This prototype and model have been designed so that we can use it in the crime branch. For example - Crime branch has to catch the thief and see what he is doing and listen to what he is saying and track the thief where he is. So, we can use our IOT based remote control car in this place and some other places we can use this model. For example, disaster site (earthquake) Some people get trapped in their homes due to earthquake, some find it difficult to go there. So, at this place we can see how many people are trapped through our robot car by using camera. And we can communicate with those who are stuck using speakers and microphones. This is how we can help them.

II. LITERATURE REVIEW

In 2018, D. Kalaiarasi1 et al. [2] the author describes a IOT based motion control system of a robotic car, using Arduino node MCU. Here node MCU is a microcontroller to which different sensors are connected. An app developed allows users to send commands to their car via Bluetooth, Wi-Fi and mobile phones. The way to send commands to the car is to manually click the button that appears in the user interface. where The GPS sensor continuously pings the actual location of the car, and an obstacle sensor measures distance before and after an obstacle. Based on the command received Arduino takes appropriate actions to change the car's direction or state. The GPS data is sent to the android app which updates the UI based on the location of the robotic car. The robot car has a camera attached to it, which lets the user know about the car's motion as well as the environment in which it is being driven. This robot car has a limited range, so can't control it from afar.

In 2018 Zakiah Ayop et al. [3] Author provide a Prototype of Wireless Indoor Surveillance Using Raspberry Pi Robot Car. In this paper, the Raspberry Pi is acting as a controller or a small computer, sending signals to all the hardware devices it is connected to. A wireless IP camera attached to the robot car is used for surveillance. The interface of the robot controller is installed in a laptop or smartphone. The instructions and video feed received from the robot car is enabled through a wireless connection between the Raspberry Pi and the laptop/smartphone. It uses an analog to digital converter to determine the percentage of the robot's battery. Using this monitoring function one can check battery percentage balance and plan recharge. The range of this prototype is extremely limited. It is not remotely controllable. And it isn't even possible to control its features remotely.

III. HARDWARE AND SOFTWARE SPECIFICATION

A List of Hardware/ Description:

- *Chassis of the 4-wheel drive robot:* This is a robotic car body to which many hardware body parts are mounted.

- *Raspberry PI:* Raspberry Pi is a single-board computer. The Raspberry Pi can be used as a mini computer by connecting peripherals such as a keyboard, mouse, and display. Raspberry Pi is a popular platform for real-time image/video processing, IoT applications, and robotics. Raspbian OS is based on Debian and is officially provided by the Raspberry Pi Foundation [4]. They also offer NOOBS OS for Raspberry Pi. Several Third-Party OS versions, such as Ubuntu, Arch Linux, RISC OS, Windows 10 IOT Core, and others, can be installed. The Raspberry Pi board comes in a variety of versions. In our model, I'm using a Raspberry Pi 3 model B. Technical Specification of in this model - WIFI, Bluetooth, Our model has 1024 MB of RAM, four USB ports, one ethernet port, one HDMI port, a microSD card slot, a 5V power supply port, a 64bit quad core Arm cortex A53 processor, and GPIO pins. GPIO pin is a general-purpose input and output pin. There is total 40 pins. GPIO Pins handle both incoming and outgoing digital signals.
- *Motor Driver IC:* Motor Driver IC L293D Which can control four – motor.
- *Jumper Wire:* Jumper Wire for connecting a separate component.
- *Battery:* Battery provides power to all hardware components.
- *Webcam:* This is the camera that can shoot high-definition videos and photos. Webcam are connected with the raspberry pi board. It is used in this project for internet surveillance and streaming (live video).
- *Microphone:* A microphone is a device that translates sound vibrations in the air as an electronic signal or scribes to the recording medium. In this project, which can be used to record a person's voice by robot.
- *Speaker:* Speakers are transducers that convert electromagnetic waves into Sound waves. In this project the speaker is connected in the raspberry pi board.
- *GPS Tracker:* GPS Tracker is used for tracing a location [5]. Various types of GPS tracker are available in the market, we have used a neo6mv2 GPS tracker.
- *4G WIFI Hotspot device:* Hotspot device provide high-speed Internet connectivity Hotspot device that can be easily carried everywhere. Its a very small size. WIFI Hotspot device are connected to raspberry pi because this device allows to provide an Internet connection to raspberry pi.
- *TP4056-Charging module:* the module is capable of charging lithium-ion batteries

B List of Software/ Description:

- *Raspbian OS :*This is the computer's operating system. It is primarily intended for use with the Raspberry Pi board. This is a system software that is open-source and based on Linux. It's simple to get from the Raspberry Pi website.
- *Python :* Python is an object-oriented, high-level, general-purpose programming language that is interpreted. In comparison to C, C++, and Java, this programming language is very simple. because its syntax enables programmers to express ideas in fewer lines of code.
- *Open-CV:* Open CV is a python open-source library, which is used for computer vision in Artificial intelligence, machine learning, face recognition etc [6].
- *Espeak :* With the help of this package, robot can speak. Espeak covert text or string into spoken words out loud on your robot.
- *Integromat:* Integromat is a cloud-Based automation platform designed to connect apps and services with powerful codeless integrations to automate online workflow.
- *Google Sheets*: Google sheet is a cloud-based software. This software is same like Microsoft excel. We can access google sheet through internet.
- *VNC Viewer :* VNC viewer is a piece of software. We can remotely access or control our local machine from another location using this software.
- *Ngrok:* Ngrok is a secure tunnelling service that allows you to access your device online from anywhere. Tunneling is a method of creating aprivate connection between two computers on a public network such as the Internet. A tunnel between two computers must be secure and private, as well as capable of passing through network barriers such as port blocking routers and firewalls. It's a useful service that lets you tunnel requests from a secure Wi-Fi network or the open Internet behind a firewall to your local machine. With this platform, you can easily connect to your Raspberry Pi from outside your home or local network.

IV. HARDWARE COMPONENTS CONNECTION

The chassis of the robot is made of wood. Its size is (15*26) cm. This chassis body is divided into two layers: upper and lower. We connected four gear motors with bolts and screws in the lower layer body chassis, as well as the speaker lithium-ion battery, L239D motor driver, charging module, and DPDT switch. In addition, linked to another module in the upper layer chassis raspberry pi, USB webcam, GPS module, and power bank. The upper

and lower layers of the body (chassis) are connected by a (Spacer stand) with a height of (4) cm.

1) *Connection of battery / charging module / DPDT switch*

To increase the voltage, two lithium-ion batteries (3.7 volts) are connected in series to the battery holder. The TP4056 module is used to charge the lithium-ion battery, but it charges the battery in parallel. We get low voltage when connected in parallel, but I want high voltage. So, in this case, I am putting a DPDT switch. There are two input and four output pins on the switch. I connected the DPDT switch to the (TP4056) module and the lithium-ion battery. When we slide the DPDT switch to the left, our battery is connected in parallel, and it starts charging. When we slide the DPDT switch to the right, our battery is connected in series, and it starts getting high voltage. The TP4056 module has a (+) and (-) battery pin. We have connected the DPDT wire to this pin, and the output pins are OUT (+) and OUT (-) on the other side; We will take the output voltage through this pin. (fig 1) shown Connection of battery / charging module / DPDT switch .

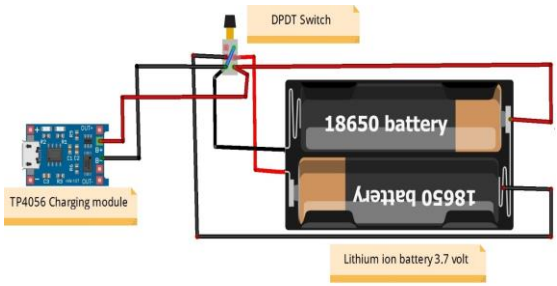


Fig 1: Connection of battery / charging module / DPDT switch

2) *Connection of 4 gear motor with raspberry pi and L239D motor driver, battery*

All four geared motor wires are connected to the L293D motor driver module. There are two output ports on the motor driver. This port sends output signals to the four geared motors, and on the other side of the motor driver are the VCC and GND pins for power. In this pin we give DC voltage of 7.4 volts. The motor driver can be powered by this voltage. Input pins are given right next to the power pins. This pin will receive the signal from our Raspberry Pi. The motor driver has four input pins, all of which are connected to the Raspberry Pi GPIO pins Input 1 = pin 7, Input 2 = pin 11, Input 3 = pin 13, and Input 4 = pin 15. Raspberry pi will give input signal to our gear motor with the help of L293D motor driver [7]. Due to which our motor is forward, reverse, turn left, turn right. (fig 2) shown connection diagram of four gear motor with lithium ion battery.

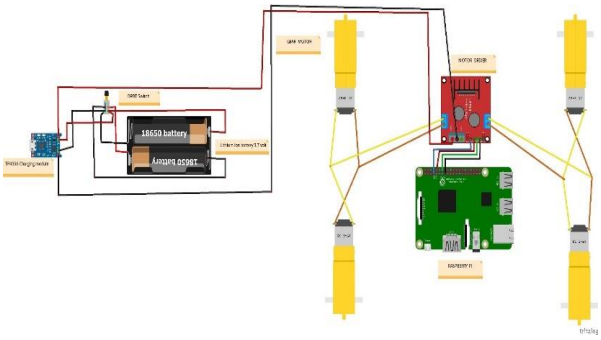


Fig 2: Connection diagram of 4 gear motor with raspberry pi and L239D motor driver, battery

3) *Connection of Speaker / Camera / GPS Module/ USB Microphone*

- *Connection of Speaker with raspberry pi:* We used a 2-watt speaker. Speaker wire is connected to the stereo audio amplifier (PAM8403) module's output (+) and output (-) pins on the left output channel. On the other side of this amplifier module, there is a Left channel input pin. This channel has an aux cable wire connected to it, and the other side of the aux cable audio jack pin is connected to the raspberry pi's aux port. There is also a power pin available in this module (+) VCC pin, (-) GND pin 5 volts shown in (fig3).
- *Connection of GPS module NEO6MV2 with raspberry pi:* There are four pins on this module. VCC, GND, TX, and RX pins In this module, we require three pins. The VCC of the Neo 6M must be connected to the 5v of the Raspberry Pi, the GND of the Neo 6M must be connected to the GND of the Raspberry Pi, and the TX of the Neo 6M must be connected to the RX of the Raspberry Pi so that the GPS module can send data to the Raspberry Pi via serial connection shown in (fig 3).
- *USB webcam and microphone connection with raspberry pi :* connected a USB webcam and USB micrto the Raspberry Pi's USB port connection shown in (fig 3).

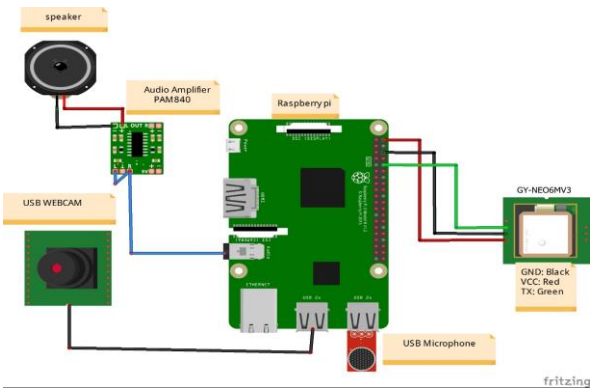


Fig 3: Connection diagram of Speaker / Camera / GPS Module / USB Microphone

V. PROJECT PHASES

1) *Robot car access to a remote location via ngrok:* To operate, we must gain access to our robot car and send a signal from a remote location. So, we can use the ngrok software package. With this software, we can access our local machine (Raspberry Pi) from anywhere in the world via the internet. (fig 4) depicts how we can remotely access our Raspberry Pi.

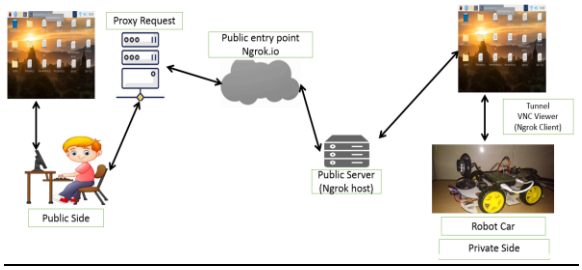


Fig 4: Robot car access to remote place using ngrok

Steps to Begin NGROK Services: First, we must connect our Raspberry Pi to the internet.So I used a 4G WiFi Hotspot for this.we used some commands to install the ngrok package on the raspberry pi board. and entered this command into the raspberry pi terminal after installing the ngrok software.(. /ngrok begin —all) This command tells us whether or not our ngrok software was successfully installed. If our ngrok software has been successfully installed on our raspberry pi (. /ngrok start —all), this command will start all the services. After that, take note of the host address and port number as shown in (fig 5) the image below.

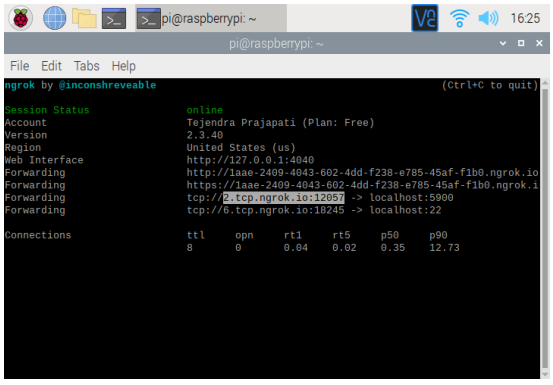


Fig 5: Raspberry pi terminal

To access VNC viewer online, launch a new vnc viewer from any computer connected to the internet, then enter your ngrok host address and port number as shown in the (Fig. 6) image below and click open.

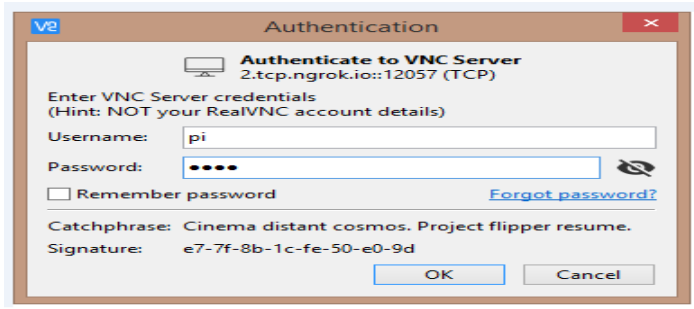


Fig 6: Authentication

When you enter a username and password into the vnc viewer, a security alert window appears. When you try to access your pi from a remote location for the first time, you can use your rsa2 key to store the rsa2 key in your cache for future reference. Request permission, then click Yes to proceed (fig 7).

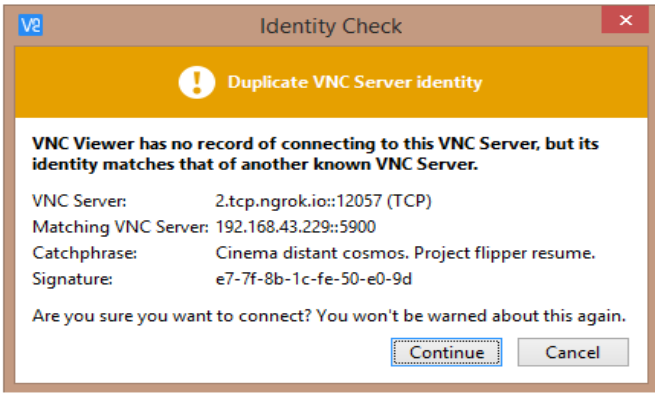


Fig 7: Identity Check

Now our computer is connected to our Pi while it is not connected to our home/local network fig(8).

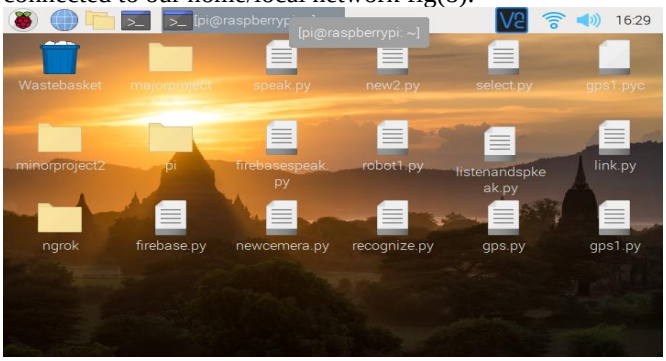


Fig 8: Raspberry pi interface

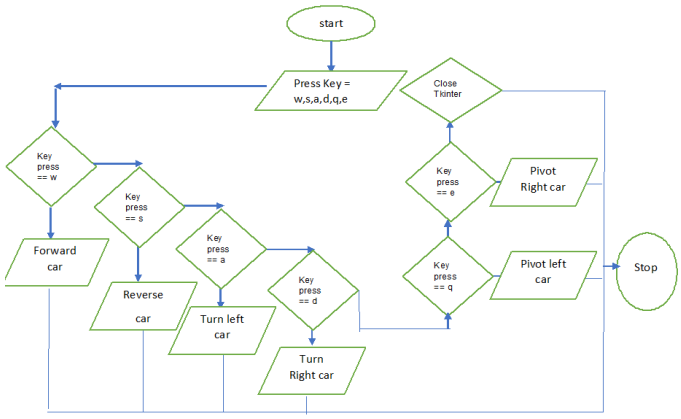
2) *Controlled four gear motor remotely using NGROK;* After installing ngrok software, now is to be able to control our gear motor remotely via internet using VNC Viewer. We written a Python program on

Raspberry Pi board. The file name is Robot1.py. Will execute this python program remotely using a python editor. The logic we have written is contained in this program file. The keyboard is used to provide instructions to the Robot Car. The following are the keys:

TABLE I

Keyword Keys	Movement
w	Forward car
s	Reverse car
a	Turn left car
d	Turn right car
e	Pivot right car
q	Pivot left car

Using flow diagram to demonstrate logic fig(9).



.Figure 9: Flow Diagram of a Controlled Four Gear Motor

Pivot left and right movement we might want our robot car to be able to pivot if we don't to gain as much forward ground as a regular turn would require

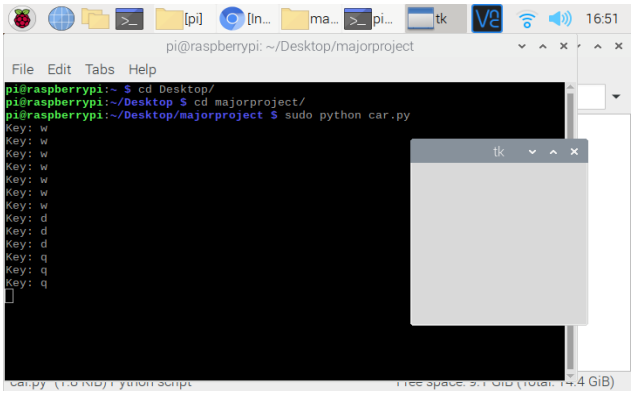


Fig 10: Program output

3) Controlled Speak Robot and voice recording functionality with ngrok:

- *Speak Functionality:* Using ngrok software we can remotely speak our robot car through VNC viewer using internet. (fig 11) shown how robot can speak and show how to send a command.

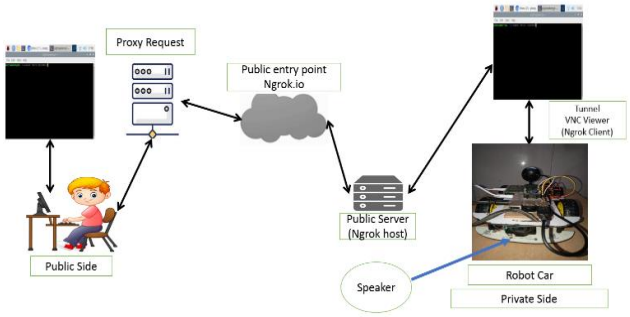


Fig 11: Controlled Speak Robot

The espeak package helps to make the robot speak; With this package, our robot car can communicate. This package adds text-to-speech functionality to the Raspberry Pi terminal. This is a command that will be executed on the terminal shown (fig 12) of the Raspberry Pi. we will run this command from a remote location using the Raspberry Pi terminal.

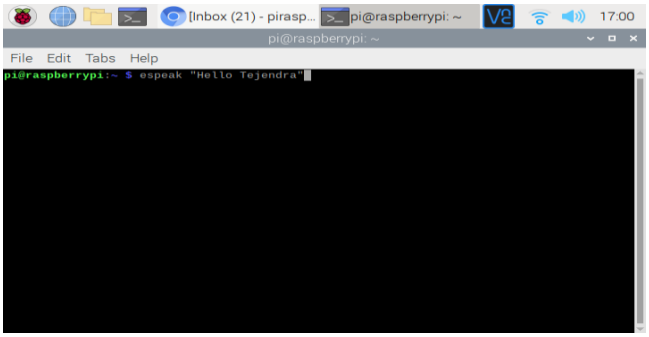


Fig 12: espeak output

- *Recording Functionality:* Using ngrok software we can remotely record anyone's voice with our robot car and listen to anyone's voice through VNC viewer using internet. (Fig 13) shown how to record a person's voice using robot and show how to send a command

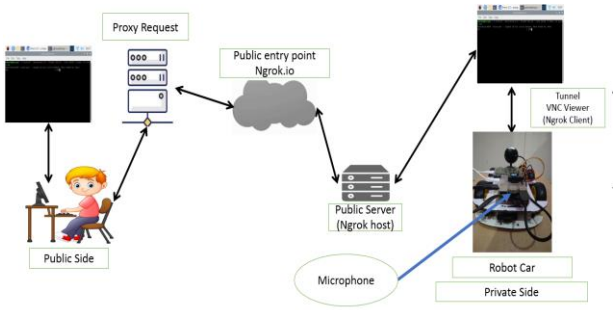


Fig 13: Controlled robot recording

OUTPUT: This is a command that will be executed on the terminal of the Raspberry Pi shown (fig 14). We will run this command from a remote location using the Raspberry Pi terminal. Run the following command in the raspberry pi terminal to begin recording your voice.

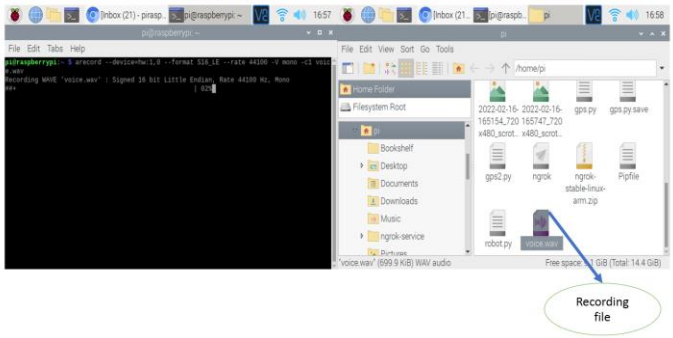


Fig 14: Recording Output

4) *Controlled Surveillance features through USB Webcam using ngrok:*
Using the ngrok software, we can remotely access our robot car camera via the Internet using a VNC viewer. (fig 15) shows how to remotely access robot car webcam.

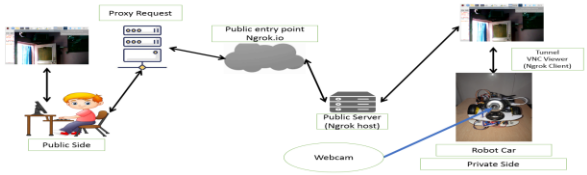


Figure 15: Remotely controlled USB Webcam

On the Raspberry Pi board, I have written a Python program. The file name is (cam1.py) . We will run this python file remote location using the Python editor's VNC viewer [3]. This python file contains the logic that I have written. Using this logic our usb webcam will be activated shown fig(16).

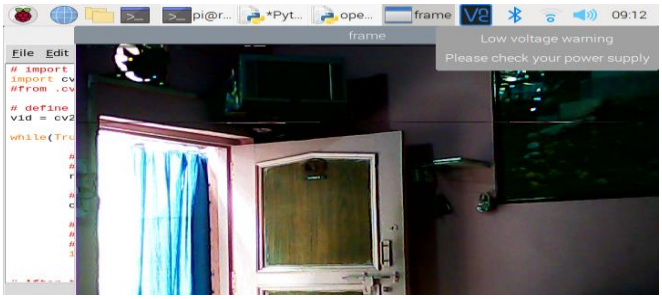


Fig 16: Camera Output remotely

5) *Remotely control the GPS module and track the location:*

GPS module provides latitude and longitude values [2]. Latitude and longitude coordinate system that can be used to determine the position or location of any point on the Earth's surface. This latitude and longitude value is pushed to Google Sheets via the Integromat cloud server. We can use Google Maps (fig 18) to determine the exact location of our robot car using this latitude and longitude value. On the Raspberry Pi board, we have written a python program for the GPS module. Run this python file remote location using the Python editor's VNC viewer. This program returns latitude and longitude values, as well as date and time. This value is pushed to the Integromat cloud server via the Integromat API key. (fig 17) shown how to get latitude and longitude values.

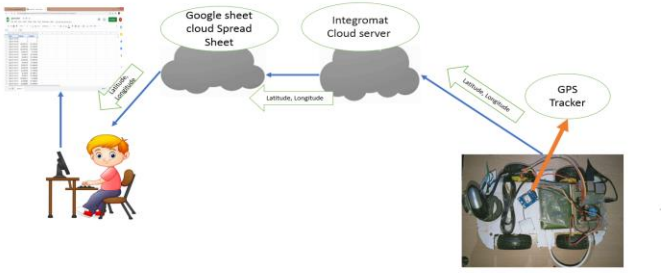


Figure 17: Remotely controlled GPS module

Google Sheets is linked via the integromate cloud platform. So that our latitude and longitude values, as well as the date and time, can be displayed on our Google Sheet shown (fig 18).

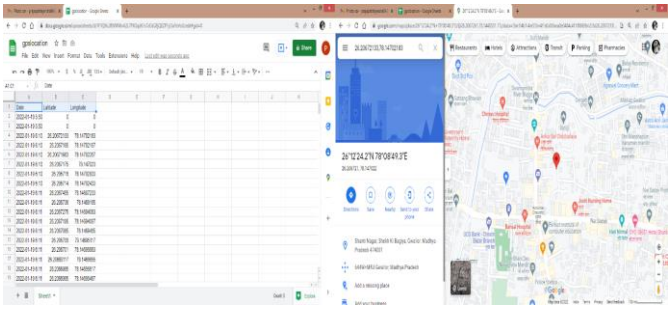


Figure 18: GPS data output

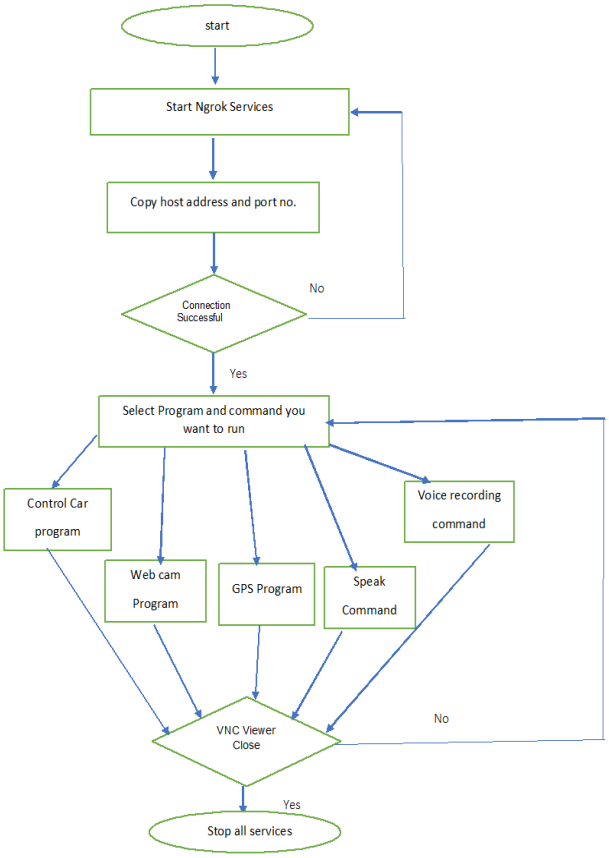


Figure 19: Workflow Diagram

VI. PROTOTYPE RESULTS

Figure 20: Robot Car

VII. CONCLUSTION

A method for creating a self-driving robot car is presented in this paper. Different types of software packages, hardware components and how to connect all the hardware connections are clearly described in this paper. A process of remotely accessing our robot car via the internet is described in detail using ngrok. The flow chart, flow diagram, and connection diagram discussed in the paper have all been successfully implemented on an IOT-powered robot car.

VIII. FUTURE WORK

For this prototype, I will create a GUI-based web application through which the robot will be able to easily access all of the car's features. as well as the install of high-definition night vision cameras will be able to conduct surveillance even at night with the help of this robot. To make this robot more intelligent, I will incorporate object and human detection algorithms, which will allow us to easily recognize and detect thieves.

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