

# **VIRTUAL TELEPRESENCE ROBOT FOR MINE INSPECTION**

**A Project Report Phase-II**

**Submitted in partial fulfilment of requirements for the award of Bachelor of  
Engineering in Electronics and Communication Engineering**

by

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## **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade “A” by NAAC**

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**APRIL - 2023**



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### **BONAFIDE CERTIFICATE**

This is to certify that this Project Report is the bonafide work of **N.VIJAYA DURGA (39130322)** and **E.HARSHITHA (39130163)** who carried out the project entitled "**VIRTUAL TELEPRESENCE ROBOT FOR MINE INSPECTION**" under my supervision from NOVEMBER 2022 to APRIL 2023.

**Internal Guide**

**Mr.K.T.ILAYARAJA, M.E., (Ph.D.),**

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**Submitted for Viva voce Examination held on** \_\_\_\_\_

**Internal Examiner**

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## DECLARATION

We, VIJAYA DURGA.N (39130322) and HARSHITHA.E (39130163) hereby declare that the Project Report entitled "VIRTUAL TELEPRESENCE ROBOT FOR MINE INSPECTION" done by us under the guidance of Mr.K.T. ILAYARAJAA, M.E., (Ph.D.), Assistant Professor, Dept. of Electronics and Communication Engineering, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

**DATE:**

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**SIGNATURE OF CANDIDATES**

1. 
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## **ABSTRACT**

This project presents a brief discussion of the requirements for user interfaces for teleoperation of mining vehicles and systems. Current commercial interfaces are relatively simple, evolving from line-of-sight remote control systems with the addition of video displays. This level of sophistication has nonetheless allowed teleoperation to be a viable and profitable technique. Exploration and Mining research into interface design currently concentrates on fusion of non-visual feedback to the operator and efficient presentation of such information. The purpose of the user interface is to satisfy the major client requirements for mining systems of robustness, reliability and ease of use by site operational and support personnel. Here we implement this using a rover whose movement is controlled using mobile. This project uses arduino for controlling robot and ESP32 cam for video capturing and live streaming is also made possible.

## TABLE OF CONTENTS

| CHAPTER<br>NO | TITLE                                                                                                                | PAGE<br>NO |
|---------------|----------------------------------------------------------------------------------------------------------------------|------------|
|               | <b>ABSTRACT</b>                                                                                                      | v          |
|               | <b>LIST OF FIGURES</b>                                                                                               | ix         |
| <b>1</b>      | <b>INTRODUCTION</b>                                                                                                  | 1          |
|               | 1.1 Problem Statement                                                                                                | 4          |
|               | 1.2 Objective of the work                                                                                            | 4          |
| <b>2</b>      | <b>LITERATURE SURVEY</b>                                                                                             | 5          |
|               | 2.1 Introduction                                                                                                     | 5          |
|               | 2.2.1 Connecting Motion control mobile robot and VR Content                                                          | 5          |
|               | 2.2.2 Using Industrial robots as Hap tic devices for VR Training                                                     | 5          |
|               | 2.2.3 Robot Competition of evaluate guidance skill for general users and VR environment                              | 6          |
|               | 2.2.4 Towards Robot arm Training in virtual reality using partial least squares regression                           | 7          |
|               | 2.2.5 VR based remote control system for rescue detect robot in coal mine                                            | 7          |
|               | 2.2.6 Telepresence virtual control system for Robot using mems based sensor                                          | 8          |
|               | 2.2.7 Tele operation of mobile mining robot using a panoramic display: An explanation of operators sense of presence | 9          |
|               | 2.2.8 Towards virtualization of Underground mines using mobile robots from 3D Scans to virtual mines                 | 9          |
|               | 2.2.9 Coal mining robot                                                                                              | 10         |
|               | 2.2.10 A Telepresence robot and Real time detection                                                                  | 11         |

|          |                                          |           |
|----------|------------------------------------------|-----------|
| <b>3</b> | <b>EXISTING SYSTEM AND ITS DRAWBACKS</b> | <b>12</b> |
| 3.1      | Existing system                          | 12        |
| 3.1.1    | Disadvantages of Existing system         | 12        |
| 3.1.2    | Block diagram of Existing system         | 12        |
| 3.2      | Software Required                        | 13        |
| 3.2.1    | Python IDE                               | 14        |
| 3.2.2    | PHP                                      | 14        |
| 3.2.3    | Python                                   | 14        |
| 3.2.4    | Arduino IDE                              | 15        |
| <b>4</b> | <b>DESCRIPTION OF PROPOSED SYSTEM</b>    | <b>17</b> |
| 4.1      | Proposed Methodology                     | 17        |
| 4.1.1    | Advantages of proposed methodology       | 18        |
| 4.1.2    | Block diagram of Proposed Methodology    | 18        |
| 4.2      | Hardware Required                        | 19        |
| 4.2.1    | Rover Chasis                             | 20        |
| 4.2.2    | Gear Motor                               | 20        |
| 4.2.3    | Screw, Nuts, Bolts                       | 21        |
| 4.2.4    | Motor driver module (L298N)              | 22        |
| 4.2.5    | H-Bridge Techniques                      | 23        |
| 4.2.6    | ESP8266Node MCU                          | 25        |
| 4.2.7    | ESP32CAM                                 | 29        |
| 4.2.7.1  | Features                                 | 30        |
| 4.2.7.2  | Specifications                           | 30        |
| 4.2.7.3  | Applications                             | 31        |
| 4.2.8    | Cam driver YP-05                         | 32        |
| 4.2.9    | Li-ionic Cell 3.7V                       | 32        |
| 4.2.10   | Battery Holder                           | 33        |
| 4.2.11   | VR Glass                                 | 34        |
| 4.2.12   | Connecting wires                         | 35        |
| 4.3      | Software Required                        | 38        |

|          |                                      |    |
|----------|--------------------------------------|----|
| 4.3.1    | Arduino IDE                          | 38 |
| 4.3.2    | Thing speak IOT Platform             | 39 |
| <b>5</b> | <b>IMPLEMENTATION ANALYSIS</b>       | 41 |
| 5.1      | Working                              | 41 |
| 5.2      | Implementation                       | 41 |
| 5.2.1    | Power movement                       | 41 |
| 5.2.2    | Live streaming                       | 42 |
| 5.2.3    | Gas detection working                | 43 |
| 5.2.4    | Streaming the video in the VR mode   | 43 |
| 5.2.5    | Sending captured visuals to Telegram | 44 |
| <b>6</b> | <b>RESULT AND DISCUSSION</b>         | 46 |
| <b>7</b> | <b>CONCLUSION</b>                    | 48 |
| 7.1      | Conclusion                           | 48 |
| 7.2      | Applications                         | 48 |
| 7.3      | Future Scope                         | 48 |
|          | <b>REFERENCES</b>                    | 50 |

## LIST OF FIGURES

| FIGURE<br>NO | FIGURE NAME                                                     | PAGE<br>NO |
|--------------|-----------------------------------------------------------------|------------|
| 3.1          | Block diagram of Existing Model                                 | 12         |
| 4.1          | Block diagram of virtual telepresence robot for mine inspection | 18         |
| 4.2          | Rover chasis                                                    | 20         |
| 4.3          | Gear motor                                                      | 20         |
| 4.4          | Screw, nuts, bolts                                              | 21         |
| 4.5          | Motor drive module (L298N)                                      | 22         |
| 4.6          | Motor drive module (L298N) H- Bridge case -1                    | 23         |
| 4.7          | Motor drive module (L298N) H- Bridge case -2                    | 24         |
| 4.8          | Motor drive module (L298N) H- Bridge case -3                    | 24         |
| 4.9          | ESP2866Node MCU                                                 | 25         |
| 4.10         | ESP32 CAM                                                       | 29         |
| 4.11         | Cam drive YP-05                                                 | 32         |
| 4.12         | Li – ionic cell 3.7V                                            | 32         |
| 4.13         | Battery Holder                                                  | 33         |
| 4.14         | VR Glass                                                        | 34         |
| 4.15         | Connecting Wires                                                | 35         |
| 5.1          | Node MCU – car for controlling rover                            | 41         |
| 5.2          | Live streaming can be viewed in either pc or in mobile phone    | 42         |
| 5.3          | Report on Carbon monoxide on Think speak IoT Platform           | 43         |
| 5.4          | Playing the downloaded video in VR mode                         | 44         |
| 5.5          | Downloading the captured visuals in the Telegram                | 45         |
| 6.1          | Rover with components assembled                                 | 46         |
| 6.2          | Getting connected to Wi-Fi                                      | 47         |
| 6.3          | Rover with torch to view dark environment                       | 47         |
| 6.4          | Downloading visuals captured by rover in Telegram               | 47         |

## **CHAPTER 1**

### **INTRODUCTION**

Nowadays time is precious for all humans. In order to avoid to avoid the difficulties and make the life easiest way we introduce robots to the world. In our project we are planning to monitor a different place which is far away from the user so in order to save the time from travel from his origin place to desired monitoring place we are introducing the virtual telepresence robot. To meet our expectations, we can use both technologies and they are virtual reality and direction controlled robot. Virtual reality has been seen from past few years, they had been widely used in some different fields like chemical field and the field of graphics and video games.

The virtual reality gives the person a special effect that makes the person attain the emotions that the user could feel it as real. Basically robot can be controlled using different methods here we can control our robot using a remote or from our smart phone screen by providing the directions as input. As we already know robot are invented to reduce the work load of human and make the work in faster way. Robots are nonliving things; they work according to the data or program which is initially installed or stored in it.

This project gives the user with advantages of virtual reality which makes user as if being present in the desired location without physically being there and control the robot from a far distance the robot can move by the commands of user on which direction he wants to move the robot. Here ESP32cam will be placed on the robot for capture the image or video and send it back to the data to the user on his smart phone or display.

A Telepresence Robot is a videoconferencing bot that revolutionizes the way you feel. It enables people to be at more than one place at a single time. It helps one feel more connected by giving a physical presence where one can't be in person. Driving your own virtual presence robot means you are free to roam around the office, attend meetings, visit work sites, attend class and do much more from anywhere at anytime.

We have implementing the following features in our virtual presence robot:

- Live screening from a remote location
- Control the robot using smartphone
- Real time response to users head movement
- Video output on virtual headset and webpage

In the field of Mobile Robotics applications dedicated to inspection or intervention in hostile, unreachable or unstructured environments, human operators are "processed" in the control loop developed for a TelepresenceSystem. On the one hand, dynamic situations suffer from a lack of automation degree by mobile robots, but on the other hand, a complete task robotization can run counter to economic or human constraints. In mine clearance activity for instance, mobile robots and especially teleoperated semi-legged robots can be seen as a solution, not to replace the mine clearance specialists but as a safe tool for human operators in some well- defined situations. Different investigations are possible when dealing with legged robots and dedicated tasks.

Time is a valuable commodity in today's world. Robots have been introduced into the world in an effort to simplify living and eliminate complications. The goal of our project is that we are introducing the virtual telepresence robot to replace the need for the user to travel to a remote location that requires constant monitoring.Both technologies, virtual reality and direction-controlled robots, can be used to live up to our expectations.

Since a few years ago, virtual reality technologies have been employed extensively in a variety of industries, including the domains of graphics, video games, and chemistry.Virtual reality has a particular effect that enables the user to feel the emotions necessary to perceive it as genuine.Fundamentally, there are several ways to control a robot. Here, we can use a remote control or the screen of our smartphone to give the robot instructions.As is well known, robots were created to lighten human labour and speed up processes. Our main aim is to save the lives of humans who work in mines from poisonous gases and also from other activities that happen in mines.

Robots are the nonliving objects; means they work according to the data or the software which is first installed or stored in it. This project offers the user the benefits of the virtual reality, which provides the user the impression that they are physically there at the desired area without actually being there. They can also control the robot from a distance, and it may move in the direction the user instructs.

Here, an ESP32cam will be mounted on the robot to capture images or videos and send the information back to the user for display on his phone or other device. A videoconferencing bot that revolutionises your experience is called a telepresence robot. It makes it possible for people to be in multiple places at once.

By providing a physical presence where one cannot be there in person, it makes one feel more connected. You are free to move around the office, attend meetings, visit job sites, go to class, and much more when you have your own virtual presence robot that you control. The following features have been added to our virtual presence robot. Live broadcasting from a distant area.

Smartphone control of the robot and real-time head movement reaction. Human operators are "processed" in the control loop designed for a Telepresence System in the context of Mobile Robotics applications devoted to inspection or intervention in hostile, inaccessible, or unstructured situations. Dynamic situations suffer from mobile robots' lack of automation, but on the other hand, total task robotization can conflict with human or financial limitations. Mobile robots, particularly teleoperated semi-legged robots, can be considered a solution in the mine clearance industry, not as a substitute for the mine clearance professionals but rather as a safe tool for human operators in select well specified circumstances. While working with legged robots and certain tasks, several research are feasible.

## **1.1 PROBLEM STATEMENT**

Today remote human-to-human communication is usually done through voice or video. With the emerging VR technology a more immersive option for communication is made possible, telepresence. This thesis aims to build a communication solution which utilizes state-of-the-art VR technology combined with Voysey's live 360° video stitching and teaming solution.

However telepresence may not necessary be a better option for human-to-human communication. In order to evaluate this new communication method, this thesis will compare it against an existing communication method such as video communication. A set of measurable variables on communication will be produced and used for this evaluation.

## **1.2 OBJECTIVE OF THE WORK**

- local host webpage based robot controlling and video feed
- sensor based mine air and environment quality monitoring
- Rover movement is controlled according to the commands of user
- mobile wireless rover and virtual reality based rover control

## **CHAPTER 2**

### **LITERATURE SURVEY**

#### **2.1 INTRODUCTION**

The following shows survey done for mine inspection. The most popular of the existing techniques has been discussed as follows.

#### **2.2 LITERATURE SURVEY**

##### ***2.2.1 Connecting motion control mobile robot and VR content***

In the year 2017, the authors Byeong-Hyeon Moon, Jae-Won Choi, Kun-Tak Jung, Dong-Hyun Kim, Hyun- Jeong Song, K-Jong Gil and Jong-Wook Kim <sup>1</sup> proposed the paper which suggest the contents using robots in accordance with the virtual reality(VR) approach. This contents share the robot's vision by attaching the camera at a mobile robot that can control wireless controller of the wearable form using sensors such as gyro sensor. The experimental result shows that the user can feel like boarding on a robot using the VR. If the development of VR technique is improved and the precision of robot motion, we will be able to confirm the possibility of applying VR technology to a new robotics area. The techniques followed are VR, robot wearable, control, video.

##### **Pros**

It will improve the accuracy of motor control and enhance the reality of sharing robot's view by using the 360 degree camera.

##### **Cons**

As we mentioned the motion is not stable with some vibration because of sensitivity of IMU sensor and the fact that the camera is not full 3D.

##### ***2.2.2 Using industrial robots as Hap tic devices for VR-Training***

In the year 2018, the authors Sebastian Knopp, Mario Lorenz, Luigi Pelliccia, Philipp Klimant proposed that many VR-Training application require the integration of haptic, i.e. for surgical training. However, surgical VR training is still limited to minimal invasive surgeries. For surgeries where high forces occur, like hip replacement, no

VR training applications have been developed. One cause for this is the lack of appropriate haptic devices which can deliver high forces. Novel industrial collaborative robots can provide high forces. Although, they lack control interfaces allowing to use them as haptic devices. We present four approaches for using these robots as general, multipurpose haptic input and output devices. The implemented approach was integrated into a VR hip replacement training application. An initial assessment demonstrates the general feasibility of our solution.

### **Pros**

It can be used for Haptics, Industrial robot, Virtual reality, Surgery, Medicine, Training.

### **Cons**

Designed for a specific purpose.

## ***2.2.3 Robot Competition to Evaluate Guidance Skill for General Users in VR***

### ***Environment***

In the year 2017, the authors Tetsunari Inamura, Yoshiaki Mizuchi proposed that Robot competition such as RoboCup@Home is one of the most effective ways to evaluate the performance of human robot interaction; however, it takes a lot of costs for real robot maintenance and the practice of evaluation sessions. We have proposed a simulation software to evaluate human-robot interaction in daily life environment based on immersive virtual reality. In this paper, we design a task named 'human navigation in which the evaluation requires a subjective impression by the users. Through a substantive experiment, we confirmed that the proposed task and system reduced the task for the practice of the competition.

### **Pros**

It gives the more detailed analysis of the behavior of test subjects in VR environment and the investigation of the evaluation criteria.

### **Cons**

No camera based but at the same time, integrated the multi-dimensional data for dynamic modelling, It can update the environment in a real time to achieve effective

remote intervention in human-compute collaboration.

#### ***2.2.4 Towards Robot Arm Training in Virtual Reality Using Partial Least***

##### ***Squares Regression***

In the year 2018, the authors proposed Nor Aini Zakaria, Fatin Nadia Binti Mohd Saleh, Mohd Azhar Abdul Razak proposed the paper which suggests that the body temperature of the baby is an important element that will inform the actual health condition of a baby. Parents and care giver occasionally do not aware of drastic increase in body temperature in a short of time and febrile seizure may be happened that could lead to epilepsy. In Malaysia that could monitor the infants body temperature is already available. However, the device could not continuously be used for a long hours and create discomfort to the babies due to its size of devices. Therefore a small, light weight device that continuously monitors the body temperature and comfortably used by baby is developed.

##### **Pros**

It can be used for remote health monitoring.

##### **Cons**

Only for monitoring a specific health parameter.

#### ***2.2.5 VR Based Remote Control System for Rescue Detection Robot in Coal***

##### ***Mine***

In the year 2017, the authors Zhang Xuhui, Dong Runlin and Liu Yongwei proposed the paper which suggests to improve the motion efficiency of the rescue detection robot under the environment of disasters in coal mine, Virtual Reality Technology was used to build the remote control systems(RCS) in this paper. By using virtual simulation technology to achieve the intuitive expression the position, orientation and surrounding of rescue detection robot, combining dynamic modelling technology to reconstruct the rescue zone, the RCS based on VR makes information consistent between VR surroundings and reality environment.

## **Pros**

It fully integrates the information of human machine and environment, improves the rescue efficiency and provides a new way for the rescue work of robot.

## **Cons**

Need to use a smartphone.

### ***2.2.6 Telepresence Virtual Control System for Robot using MEMS based sensor***

In the year 2004, the authors Hung Duy Pham, Vu Viet Hung, Nguyen Vinh Quang, Tran Quang Vinh proposed the paper which suggests that the control of a remote robot through an wireless communication channel or computer network allows the human operator to interact with remote environments. In this paper we present the research and development of a Telepresence Virtual Control System for a remote robotic arm. Using MEMS-based accelerometer sensors mounted on the arm and hand of a human operator with a vision monitoring system, the operator can control the movement of the remote robot effectively. It is useful to use such a system for tasks in nuclear control industry, space exploration, in hazardous environments as well as tele-medical operations, etc.

## **Pros**

It is useful to perform the tasks in nuclear control industry, space exploration, in hazardous environments as well as tele-medical operations, etc.

## **Cons**

- It requires sufficient bandwidth to have feel of physical presence.
- It requires extremely less delay over the IP connections between two end telepresence systems.
- User experience may suffer when two telepresence systems from different vendors communicate in spite of having same protocols.

### ***2.2.7 Tele-operation of a mobile mining robot using a panoramic display: An exploration of operators sense of presence***

In the year 2011, the authors Craig James, Tomasz Bednarz, Kerstin Haustein, Leila Alem proposed the paper which suggests that the mining industry is interested in tele-operation systems to remove mining operators from hazardous or inconvenient environments without losing efficiency. The increased availability of high-speed wired and wireless data networks is promoting the use of immersive environments, but there is not enough evidence yet to support whether such environments significantly improve the field-tested performance of tele-operation systems or not.

We are interested in investigating a mixed-presence, tele-operation scenario involving an offsite operator remotely operating a robot as well as an onsite operator co-located with the robot. These scenarios are common in industry, yet poorly researched. We have conducted a trial to explore the effects of immersion on operator spatial awareness, sense of presence and satisfaction, in a mixed presence tele-operation scenario. This paper presents the results of our trial using a panoramic display system that provides some level of immersion. The outcome of our work provides a first step in the exploration of cost effective technologies of potential value to the mining industry.

#### **Pros**

It can traverse obstacles more than the size of the wheel diameter.

#### **Cons**

It requires a differential mechanism for stability of the main body.

### ***2.2.8 Towards virtualization of underground mines using mobile robots – from 3D scans to virtual mines***

In the year 2015, the authors Steve Grehl, Mark Sastuba, Marc Donner, Marvin Ferber proposed the paper which suggests that the Virtual reality (VR) simulations involving highly detailed, realistic 3D models of underground mines offer significant cost and safety benefits in many application areas, including equipment prototyping, operator training, rescue simulations, and education. However, the generation of high-

detail models of real mines is a time-consuming task. Conventional approaches involving total stations and/or laser scanners require extensive manual post-processing while offering only limited texture detail. In contrast, an approach for mine virtualization based on video data is proposed.

A mobile robot carries a sensor bar, composed of a stereo camera system and lighting unit. While traveling the mine, the robot captures stereo images several times per second. During post-processing, algorithms from the field of computer vision are used to extract a photorealistic 3D model of the mine. Experiments have been conducted at the local Research and Educational Mine 'Reiche Zeche' in Freiberg, Germany. The virtual mine model can be easily imported into common 3D software tools, such as CAD systems, air flow simulations, games engines, and immersive VR applications.

### **Pros**

- A single or multiple users can explore the virtual mine, using a CAVE (left) or HMD (right).
- Benefits of such display devices include the high degree of immersion enjoyed by the user.

### **Cons**

High initial investment. Robots typically require a large upfront investment.

#### ***2.2.9 Coal Mining Robot***

In the year 2016, the author S Rajan proposed the paper which suggests that the coal mining robot detects the toxic gases emitted from coal mine. Coal mines are prone to fires this is due to the fact that coal itself is a combustible matter. Coal fires can be severe that mining operations may have to cease. The severe consequences of fires may be coal dust explosion and burning of coal seams. The need for designing and implementing safety measures and systems to prevent and mitigate the impact of fires is of utmost importance.

This paper elucidates the causes of fires in coal mines, the detection methods, the prevention methods, fire suppression methods, alerting and evacuation during fires,

latest technological trends. From this paper the conclusion is that we will get a brief discussion on the new technology that will enhance and effectively monitor the environmental conditions of coal mines.

### **Pros**

It is used to detect the level of temperature and humidity inside the coal mine and it is also to detect the fire inside the coal mine and extinguish it.

### **Cons**

Overburden storage instability. Dust and noise.

#### ***2.2.10 A Telepresence Robot controlling and real time detection***

In the year 2017, the authors K S Suresh and Kataru Venkata Kavya proposed the paper which suggests that the field of versatile mechanical tele presence is in fast development, with an expanding measure of business frameworks and quick extensions. This paper suggested that there are two techniques to control the robot in which one is a wired and the other is wireless. Customarily, they are called as LAN and IOT. An advanced mobile phone individual hotspot is used to control and screen the robot. Consequently, the Raspberry Pi board and PC are associated with advanced mobile phone.

### **Pros**

It has some sensors and actuators which are more capable than humans.

### **Cons**

Robots can only do what they are told to do. They can improvise which means that the safety procedures are needed to protect humans and other robots.

## CHAPTER 3

### EXISTING SYSTEM AND ITS DRAWBACKS

#### 3.1 EXISTING METHODOLOGY

The aim of the existing methodology is to build a robot which gets into the places like abandoned mines. As time passes abandoned mines grow more hazardous for personnel to enter and conduct surveys. Sending in a mining robot is much safer alternative.

- Remote control robot
- Wireless module based controlling
- Static monitoring system
- No video feedback

##### *3.1.1 Disadvantages of Existing methodology*

- not possible get any video
- not mobile
- very costly
- Line of sight communication

##### *3.1.2 Block Diagram of Existing methodology*



Fig: 3.1:Block Diagram of existing model

This robot with a camera is placed in a remote location to capture the environment in visual form using Raspberry Pi (RPi). The captured visuals are displayed on the user's virtual reality (VR) headset. An added feature allows the camera to move in the direction of the user's head movements. This gives the user a real-time experience as if he is present where the virtual telepresence robot is located.

The virtual telepresence robot can also be moved in any direction through an app installed in the user's smartphone. In this RPi is the brain of the system. It receives input from the smartphone via Wi-Fi, and then sends controlling pulse to the servo motors to move the RPi camera. The smartphone also provides input to the Arduino Mega (Board2) for the purpose of navigation or movement of the virtual telepresence robot. The motor driver IC and geared motors are connected at the end of the navigation circuit.

The commands to run the virtual telepresence robot can be sent via Bluetooth or RF module from the smartphone. In this example, Bluetooth is used. The existing system has following sections: 12V charger, 8V power supply, Raspberry Pi board, Arduino Mega 2560 board, servo motors, DC geared motors and Bluetooth module. Along with these you also require an Android smartphone with relevant app, Python and PHP codes for Raspberry Pi, and Arduino sketch for Arduino board.

### **3.2 SOFTWARE REQUIRED**

- Python IDLE
- PHP
- Python
- Arduino IDE

### **3.2.1 Python IDLE**

IDLE stands for Integrated Development and Learning Environment. The Raspberry Pi gets the first half of its name from a long-standing tradition of using fruit to name new computing systems— from classic microcomputers like the Acorn, Apricot and Tangerine to more recognizably modern brands including Apple and BlackBerry—but the second half comes courtesy of the Python programming language.

### **3.2.2 PHP**

PHP is an open-source server-side scripting language that many devs use for web development. It is also a general-purpose language that you can use to make lots of projects, including Graphical User Interfaces (GUIs). The abbreviation PHP initially stood for Personal Homepage. But now it is a recursive acronym for Hypertext Preprocessor. (It's recursive in the sense that the first word itself is an abbreviation, so the full meaning doesn't follow the abbreviation). The first version of PHP was launched 26 years ago. Now it's on version 8, released in November 2020, but version 7 remains the most widely used. PHP runs on the Zend engine, which is the most popular implementation. There are some other implementations as well, like parrot, HPVM (Hip Hop Virtual Machine), and Hip Hop, created by Facebook. PHP is mostly used for making web servers. It runs on the browser and is also capable of running in the command line. So, if you don't feel like showing your code output in the browser, you can show it in the terminal.

### **3.2.3 Python**

Python is a high-level, interpreted, interactive and object-oriented scripting language.

Python is punctuation, and it has fewer syntactical constructions than other languages.

- **Python is Interpreted:** Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- **Python is Interactive:** You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- **Python is Object-Oriented:** Python supports Object-Oriented style or technique

of programming that encapsulates code within objects.

- Python is a Beginner's Language: Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

Python's features include:

- Easy-to-learn: Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
- Easy-to-read: Python code is more clearly defined and visible to the eyes.
- Easy-to-maintain: Python's source code is fairly easy-to-maintain.
- A broad standard library: Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.
- Interactive Mode: Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.
- Portable: Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
- Extendable: You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.
- Databases: Python provides interfaces to all major commercial databases.

### **3.2.4 Arduino IDE**

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port.

The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

The Arduino Integrated Development Environment - or Arduino Software (IDE) – is used for writing the code.

Arduino program can be divided in three main parts:

- Structure
- Values (variables and constants)
- Functions

## **CHAPTER 4**

### **DESCRIPTION OF PROPOSED SYSTEM**

#### **4.1 PROPOSED METHODOLOGY**

In this project robot with a camera is placed in a remote location to capture the environment in visual form. The captured visuals are displayed on the user's virtual reality headset. It gives the user a real-time experience as if he is present where the virtual telepresence robot is located. The virtual telepresence robot can also be moved in any direction through an app installed in user's smartphone.

It includes both live and recorded streaming, video is captured and sent back to the user, the user can download and view the recorded images on a computer or mobile device, the ambient conditions, as well as the presence of hazardous and deadly gases, are detected and sent, it obeys user commands, and a smartphone is used to control its movement, environmentally sound, will be capable of 360 degree rotation, cheap price.

Wide control range, anyone in the world can view and control the rover, and all of the materials used are open source, controlling is simple, and storage capacity may be increased. One can increase the control range. To overcome the drawbacks in existing system we have proposed a methodology which includes

- Live streaming is made possible.
- Captures video and sends back to the user
- User will be able to download and view the captured visuals in PC or smartphone.
- It detects and sends the environmental conditions, presence of poisonous and dangerous gases.
- It follows the commands of the user and the movement is controlled through smartphone.

#### 4.1.1 Advantages of proposed methodology

- control range is very wide
- control range can be extended
- person can see and control the rover from anywhere in the mine
- easy to control
- all contents used are open source

#### 4.1.2 Block Diagram of proposed methodology

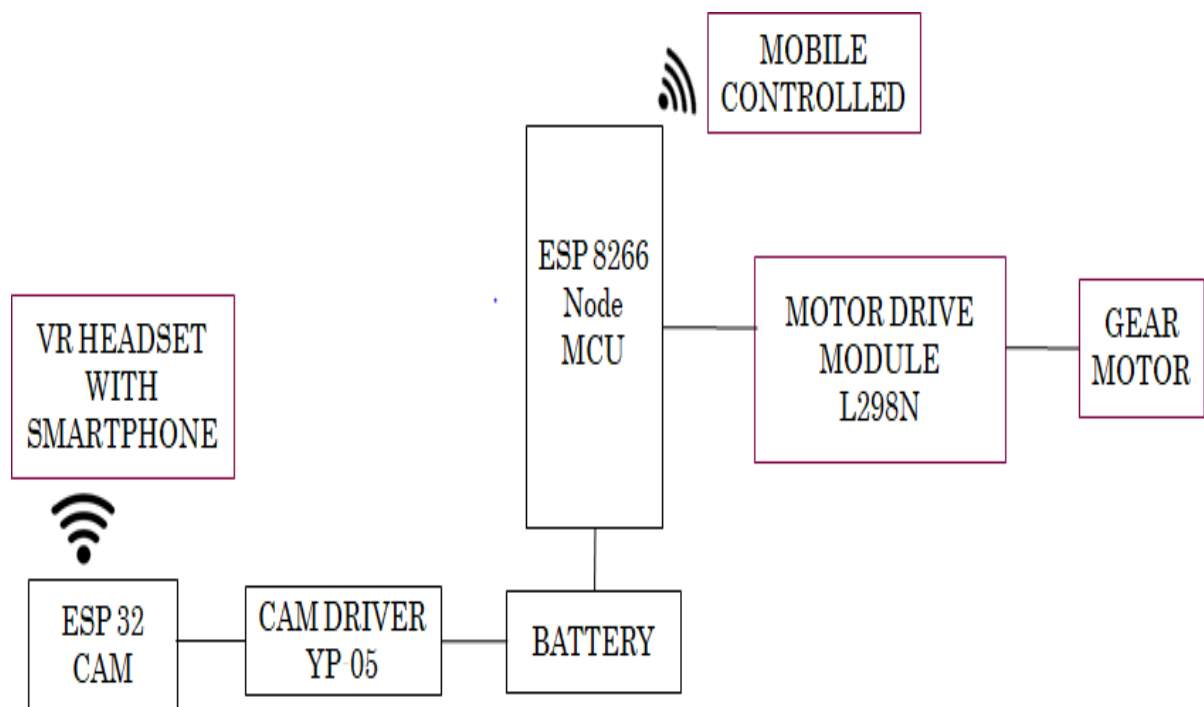


Fig 4.1:Block diagram of virtual telepresence robot for mine inspection

Safety is one of the main aspects related to industries specially the mining industry. In the underground coal mines, human safety is the most important thing which needs to look. Atelepresence robot will be sent to the mines, there it will capture the environment and will send the captured

visuals back to the user and videostreaming and live streaming will be made so that the user can view through VR headset and analyse those condition. The rover will be able to rotate 360 degrees and will be able to cover the surrounding visuals of the environment. Also the movement of the rover can be controlled through smartphone.

The system is designed using the hardware components and software programming. The following are the required hardware components.

#### **4.2 HARDWARE REQUIRED:**

- Rover chasis
- Gear motor(4 pieces)
- Rover wheels(4 pieces)
- Screws, nuts and bolts
- Motor drive module(L298N)
- ESP8266 Node MCU
- ESP 32 Cam
- Cam diver
- Li-ionic cell 3.7 V (3 pieces)
- Battery Holder
- VR Headset
- Connecting wires

#### **4.2.1 Rover chasis**



Fig 4.2: rover chasis

It is used for building the body. It assembles motors, wheels. It basically acts as a base and it is the main part and acts as a body.

#### **4.2.2 Gear motor**



Fig 4.3: gear motor

A gear motor is a mechanical system consisting of an electric motor and a gearbox containing a series of gears. The function of the gearbox coupled to the motor is to reduce its speed and increase its torque to do a given job at a given speed.

Depending on the number and type of gears, different combinations of output RPM and torque can be achieved. With fewer gears, the result is higher RPM and lower torque and vice versa. It can be mounted in any position. The gear motor structure regulates whether the gear motor is suitable for light, medium or heavy loads and short or long operating periods. Depending on the internal gear structure and the reduction stages, the gear motor varies the speed on the output shaft. The reduction ratio is the ratio between the input speed and the output speed; therefore, it is one of the most important characteristic values of the gearbox. The power and load capacity of a gearbox depends on the maximum torque it is capable of transmitting and it is measured in the physical unit Newton meter [Nm].

It gives power to the wheels. It is used for motion that is movement from one place to another. Electrical energy is converted into the mechanical energy. Basically used for power transmission.

#### **4.2.3 Screws, nuts and bolts**



Fig 4.4: screws, nuts and bolts

A nut is a component that fits over the end of a bolt and helps it hold objects in place. A bolt is a non-tapered fastener that uses a washer and nut to hold objects together. A screw is a tapered fastener that mates with an existing thread or creates its own thread in a material as it turns.

**Screw:** The two primary functions of a screw are to hold things together or to lift objects. The threading around the shaft in a screw makes it an efficient tool to hold things together. The threads grip the surrounding material like teeth, resulting in a secure hold.

When two or more solid objects require joining, screws are often used. They offer an easy and effective solution for joining multiple solid objects. While all screws have helical threading around a shaft, though, they aren't necessarily the same.

**Nuts and bolts:** They are important elements of machines that are used to attach two different parts together without causing any type of damage. They are the smallest tools and come with numerous benefits. If we don't use these tools, then mechanical construction would be difficult. They come in a small size, but they have the power to hold the whole machine together. A nut is a small metallic piece of metal with a spiral cut groove that runs around a hole in its centre while a bolt is a metallic piece with a round stem as its body and threaded into one end. Bolts have different length sizes while nuts have a standard size.

#### **4.2.4 Motor drive module(L298N)**

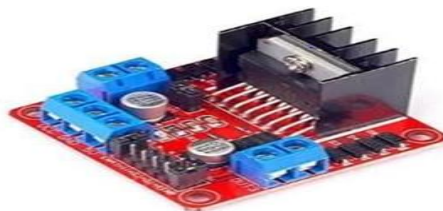


Fig 4.5: motor drive module(L298N)

L298N module is a high voltage, high current dual full-bridge motor driver module for controlling DC motor and stepper motor. It can control both the speed and rotation direction of two DC motors. This module consists of an L298 dual-channel H-Bridge motor driver IC. This module uses two techniques for the control speed and rotation direction of the DC motors. These are PWM – For controlling the speed and H-Bridge for controlling rotation direction.

#### 4.2.5 H-Bridge Techniques

L298N motor driver module uses the H-Bridge technique to control the direction of rotation of a DC motor. In this technique, H-Bridge controlled DC motor rotating direction by changing the polarity of its input voltage.

An H-Bridge circuit contains four switching elements, like transistors (BJT or MOSFET), with the motor at the center forming an H-like configuration. Input IN1, IN2, IN3, and IN4 pins actually control the switches of the H-Bridge circuit inside L298N IC.

We can change the direction of the current flow by activating two particular switches at the same time, this way we can change the rotation direction of the motor.

##### Case 1

When S1, S2, S3, and S4 all switches are open then no current goes to the Motor terminals. So, in this condition, the motor is stopped (not working).

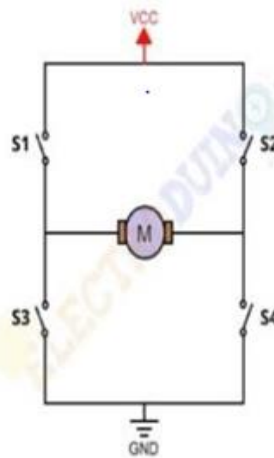


Fig 4.6: motor driver module(L298N) H-Bridge case 1

##### Case 2

When the switch S1 and S4 are closed, then the motor left terminal is getting a positive (+) voltage and the motor right terminal is getting a negative(-) voltage. So, in this condition motor start rotating in a particular direction (clockwise).

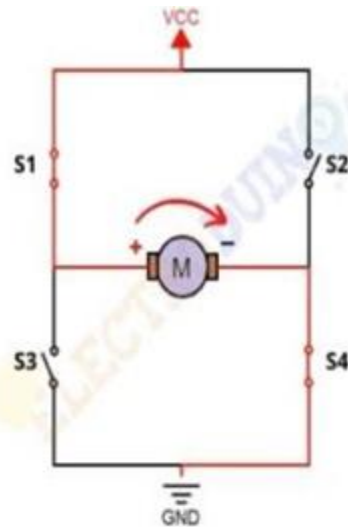


Fig 4.7: motor driver module(L298N) H-Bridge case 2

### Case 3

When S2 and S3 switches are closed, then the right motor terminal is getting a positive (+) voltage and the left motor terminal is getting a negative (-) voltage. So, in this condition motor start rotating in a particular direction(anticlockwise).

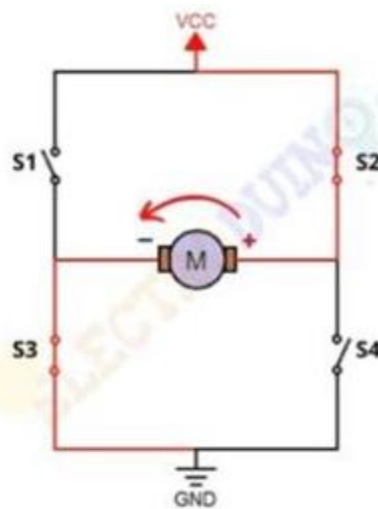


Fig 4.8: driver module(L298N) H-Bridge case 3

#### 4.2.6 ESP8266 Node MCU



Fig 4.9: ESP8266 Node MCU

The NodeMCU (Node MicroController Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the “computer” on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users

need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications.

On December 30, 2013, ESPRESSIF systems began production of the ESP8266. NodeMCU started on 13 Oct 2014, when Hong committed the first file of nodemcu-firmware to GitHub. Two months later, the project expanded to include an open-hardware platform when developer Huang R committed the gerber file of an ESP8266 board, named devkit v0.9. Later that month, Tuan PM ported MQTT client library from Contiki to the ESP8266 SoC platform, and committed to NodeMCU project, then NodeMCU was able to support the MQTT IoT protocol, using Lua to access the MQTT broker. Another important update was made on 30 Jan 2015, when Devsaurus ported the u8glib to the NodeMCU project, enabling NodeMCU to easily drive LCD, Screen, OLED, even VGA displays.

In the summer of 2015 the original creators abandoned the firmware project and a group of independent contributors took over. By the summer of 2016 the NodeMCU included more than 40 different modules.

As Arduino.cc began developing new MCU boards based on non-AVR processors like the ARM/SAM MCU used in the Arduino Due, they needed to modify the ARDUINO IDE so it would be relatively easy to change the IDE to support alternate toolchains to allow Arduino C/C++ to be compiled for these new processors. They did this with the introduction of the Board Manager and the SAM Core. A "core" is the collection of software components required by the Board Manager and the Arduino IDE to compile an Arduino C/C++ source file for the target MCU's machine language. Some ESP8266 enthusiasts developed an Arduino core for the ESP8266 WiFi SoC, popularly called the "ESP8266 Core for the Arduino IDE". This has become a leading software

development platform for the various ESP8266-based modules and development boards, including NodeMCUs.

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module.

Power pins:

- There are four power pins. VIN pin and three 3.3V pins.
- VIN can be used to directly supply the NodeMCU/ESP8266 and its peripherals. Power delivered on VIN is regulated through the onboard regulator on the NodeMCU module – you can also supply 5V regulated to the VIN pin
- 3.3V pins are the output of the onboard voltage regulator and can be used to supply power to external components.

**GND:** They are the ground pins of NodeMCU/ESP8266.

The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds. The prototyping hardware typically used is a circuit board functioning as a dual in line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications.

**I2C Pins:** These are used to connect I2C sensors and peripherals. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

**GPIO Pins:** NodeMCU/ESP8266 has 17 GPIO pins which can be assigned to functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

**ADC channel:** The NodeMCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

**UART Pins:** NodeMCU/ESP8266 has 2 UART interfaces (UART0 and UART1) which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing log.

**SPI Pins:** NodeMCU/ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:

- timing modes of the SPI format transfer
- Up to 80 MHz and the divided clocks of 80 MHz
- Up to 64-Byte FIFO

**SDIO Pins:** NodeMCU/ESP8266 features Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz. SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

**PWM Pins:** The board has 4 channels of Pulse Width Modulation (PWM). The PWM

output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000  $\mu$ s to 10000  $\mu$ s (100 Hz and 1 kHz).

**CONTROL Pins:** These are used to control the NodeMCU/ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

- **EN:** The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.
- **RST:** RST pin is used to reset the ESP8266 chip.
- **WAKE:** Wake pin is used to wake the chip from deep-sleep.

#### 4.2.7 ESP32 CAM



Fig 4.10: ESP32 CAM

The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot.

The ESP32-CAM can be widely used in intelligent IOT applications such as wireless video monitoring, WiFi image upload, QR identification, and so on.

ESP32-CAM can be widely used in various IoT applications. It is suitable for home smart devices, industrial wireless control, wireless monitoring, QR wireless identification, wireless positioning system signals and other IoT applications. It is an ideal solution for IoT applications.

#### **4.2.7.1 Features**

- Onboard ESP32-S module, supports WiFi + Bluetooth
- OV2640 camera with flash
- Onboard TF card slot, supports up to 4G TF card for data storage
- Supports WiFi video monitoring and WiFi image upload
- Supports multi sleep modes, deep sleep current as low as 6mA
- Control interface is accessible via pinheader, easy to be integrated and embedded into user products.
- Comes with ESP32-CAM-MB Micro USB to serial port adapter, adapts CH340 chip, for connecting ESP32-CAN to the PC, no additional converter required.

#### **4.2.7.2 Specifications**

WIFI module: ESP-32S

- Processor: ESP32-D0WD-V3
- Built-in Flash: 32Mbit
- RAM: Internal 512KB + External 4M PSRAM
- Antenna: Onboard PCB antenna
- WiFi protocol: IEEE 802.11 b/g/n/e/i
- Bluetooth: Bluetooth 4.2 BR/EDR and BLE
- WIFI mode: Station / SoftAP / SoftAP+Station
- Security: WPA/WPA2/WPA2-Enterprise/WPS
- Output image format: JPEG (OV2640 support only), BMP, GRAYSCALE

- Supported TF card: up to 4G
- Peripheral interface: UART/SPI/I2C/PWM
- IO port: 9
- UART baudrate rate: default 115200bps
- Power supply: 5V
- Transmitting power:

802.11b: 17 ±2dBm(@11Mbps)

802.11g: 14 ±2dBm(@54Mbps)

802.11n: 13 ±2dBm(@HT20,MCS7)

- Storage environment: -40 °C ~ 90 °C, <90%RH
- Dimensions: 40.5mm x 27mm x 4.5mm

#### **4.2.7.3 Applications**

The ESP32-CAM suit for IOT applications such as:

- Smart home devices image upload
- Wireless monitoring
- Intelligent agriculture
- QR wireless identification
- facial recognition
- Built-in Flash: 32Mbit
- RAM: Internal 512KB + External 4M PSRAM
- Antenna: Onboard PCB antenna
- Bluetooth: Bluetooth 4.2 BR/EDR and BLE

#### **4.2.8 Cam driver YP-05**

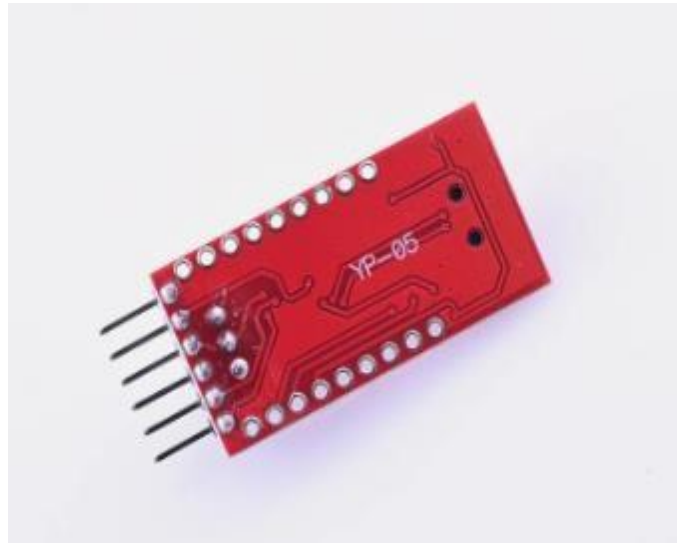


Fig 4.11: cam driver YP-05

A Webcam Driver is a program which allows communication between your webcam (in-built or external camera on your computer) and your PC.

Webcam Drivers should be updated in order to keep the devices running well.

- We cannot connect ESP32 cam to laptop or PC because it does not have any port.
- So we are using YP-05 module which works as an intermediate between ESP32 and laptop.

#### **4.2.9 Li-ionic cell 3.7 V (3 pieces)**



Fig 4.12: Li-ionic cell 3.7V

It is a type of rechargeable battery which uses reversible reduction of lithium ions to store energy.

The anode of a conventional lithium ion cell is typically graphite made from carbon. The cathode is typically metal oxide and electrolyte is typically a lithium salt in an organic solvent.

#### **4.2.10 Battery Holder**



Fig 4.13: Battery Holder

The primary function of a battery holder is to keep cells fixed in place safely and securely while conveying power from the batteries to the device in question. Basically in this battery holder we use rechargeable batteries which use reversible reduction. External connections on battery holders are most often made by contacts either with pins, surface mount feet, soldered lugs or via a set of wire leads. So we have used this battery holder in our project for keeping the cells fixed in place securely.

#### 4.2.11 VR Glass



Fig 4.14: VR glass

Virtual reality glasses or goggles are a type of eyewear which functions as a display device. They enable the wearer to view a series of computer generated images which they can then interact with. They take the form of one or two display screens which are worn in front of the face and project graphical images, often accompanied by sound and video. The viewer sees two separate images, one in each eye which the brain combines to form a three dimensional image. They show an illusion in of depth which is a characteristic feature of virtual environments.

A virtual reality headset (or VR headset) is a head-mounted device that provides virtual reality for the wearer. VR headsets are widely used with VR video games but they are also used in other applications, including simulators and trainers. VR headsets typically include a stereoscopic display (providing separate images for each eye), stereo sound, and sensors like accelerometers and gyroscopes for tracking the pose of the user's head to match the orientation of the virtual camera with the user's eye positions in the real world. Some VR headsets also have eye-tracking sensors and gaming controllers. The VR glasses use a technology called head-tracking, which changes the field of vision as a person turns their head. The technology may not be perfect, as there is latency if the head moves too fast. Still, it does offer an immersive experience.

Virtual reality glasses or goggles are a type of eyewear which functions as a display device. They enable the wearer to view a series of computer generated images which they can then interact with. A virtual reality headset, sometimes known as a VR

headset, is a head-mounted gadget that immerses the user in virtual reality. Although VR video games are the most common application for VR headsets, they are also employed in simulators and training programmes. In order to align the virtual camera's orientation with the user's eye locations in the real world, VR headsets often contain a stereoscopic display (giving separate images for each eye), stereo sound, and sensors like accelerometers and gyroscopes for tracking the user's head attitude.

Some VR headsets additionally include game controllers and eye-tracking sensors. The head-tracking technology used by the VR glasses alters the user's field of vision when they turn their head. The technology might not be flawless because if the head moves too quickly, there will be delay. Yet, it does provide a fully immersive experience. Goggles or glasses for virtual reality are an example of eyewear that also serves as a display. The user can interact with a series of computer-generated pictures while wearing them.

#### **4.2.12 Connecting wires**



Fig 4.15: Connecting wires

Wires are used to bear mechanical loads often in the form of wire rope. In electricity and telecommunication signals, a "wire" can refer to an electrical cable, which can contain a "solid core" of a single wire or separate strands in stranded or braided forms. Usually cylindrical in geometry, wire can also be made in square, hexagonal, flattened rectangular, or other cross-sections, either for decorative purposes, or for the technical purposes such as the high-efficiency voice coils in loudspeakers. Edge-wound coil springs, such as the slinky toy, are made of special flattened wire.

A wire is a flexible strand of metal. Wire is commonly formed by drawing the metal through a hole in a die or draw plate. Wire gauges come in various standard sizes, as expressed in terms of a gauge number or cross-section area.

Wire rope is a common kind of wire used to support mechanical stresses. A "wire" can refer to an electrical cable in the context of electricity and telecommunication signals. This type of cable may have a "solid core" made up of a single wire or multiple strands woven together in stranded or braided forms. Usually cylindrical in geometry, wire can also be made in square, hexagonal, flattened rectangular, or other cross-sections, either for decorative purposes, or for technical purposes such as high-efficiency voice coils in loudspeakers. Edge-wound coil springs, such as the slinky toy, are made of special flattened wire.

Wire is often reduced to the desired diameter and properties by repeated drawing through progressively smaller dies, or traditionally holes in draw plates. After a number of passes the wire may be annealed to facilitate more drawing or, if it is a finished product, to maximise ductility and conductivity.

Connecting wires allows an electrical current to travel from one point on a circuit to another, because electricity needs a medium through which to move. Most wires in computers and electronic components are made of copper or aluminum. Copper is cheap and electrically conductive. Silver has higher conductivity but is far more expensive. In a basic circuit, the wire comes from one terminal of a power source, such as a battery. It then connects to a switch that determines whether the circuit is open or closed. The wire then connects to the device that is drawing power, allowing it to draw electricity and perform its task. Finally, the wire connects the load back to the opposite terminal of the power source. Before a current can travel through the wire, the circuit has to be closed; in other words, there cannot be any breaks in the path. Electricity cannot easily travel through air, and if it does there is a risk of stray current leaking into the surroundings and causing damage or failing to power the appliance. Wire has many uses. It forms the raw material of many important manufacturers, such as the wire netting industry and also engineered springs, wire cloth making and wire rope spinning, in which it occupies a place analogous to a textile fibre. Wire-cloth of all degrees of strength and fineness of mesh is used for sifting and screening machinery, for draining paper pulp, for window screens, and for many other purposes. Vast

quantities of aluminium, copper, nickel and steel wire are employed for telephone and data cables, and as conductors in electric power transmission and heating. It is in no less demand for fencing, and much is consumed in the construction of suspension bridges, and cages, etc. In the manufacture of stringed musical instruments and scientific instruments, wire is again largely used. Carbon and stainless spring steel wire have significant applications in engineered springs for critical automotive or industrial manufactured parts/components.

In the form of wire rope, wires are frequently utilised to support mechanical loads. In the context of electricity and telecommunications signals, the term "wire" can refer to an electrical cable that may have a "solid core" made up of a single wire or multiple strands woven together in stranded or braided forms. While having a typically cylindrical shape, wire can also be produced in square, hexagonal, flattened rectangular, or other cross-sections for aesthetic or technical reasons, such as high-efficiency voice coils for loudspeakers. Special flattened wire is used to create edge-wound coil springs, like those found in slinky toys.

Wires are used to bear mechanical loads often in the form of wire rope. In electricity and telecommunication signals, a "wire" can refer to an electrical cable, which can contain a "solid core" of a single wire or separate strands in stranded or braided forms. Usually cylindrical in geometry, wire can also be made in square, hexagonal, flattened rectangular, or other cross-sections, either for the decorative purposes, or for technical purposes such as like the high-efficiency voice coils in the loudspeakers. Edge-wound coil springs, such as the slinky toy, are made of special flattened wire.

This type of cable may have a "solid core" made up of a single wire or multiple strands woven together in stranded or braided forms. Usually cylindrical in geometry, wire can also be made in square, hexagonal, flattened rectangular, or other cross-sections, either for decorative purposes, or for technical purposes such as high-efficiency voice coils in loudspeakers. It forms the raw material of many important manufacturers, such as the wire netting industry and also engineered springs, wire cloth making and wire rope spinning, in which it occupies a place analogous to a textile fibre.

## 4.3 SOFTWARE REQUIRED

- Arduino IDE
- ThingSpeak IOT platform

### 4.3.1 *Arduino IDE*

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port.

The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

The Arduino Integrated Development Environment - or Arduino Software (IDE) – is used for writing the code.

Arduino program can be divided in three main parts:

- Structure
- Values (variables and constants)
- Functions

Arduino is an open-source platform that uses a programming language based on C++, which makes it easy to use for beginners and professionals. The message area gives feedback while saving and exporting and also displays errors. In their essence, they are text files written in Arduino language. To save and upload them to your Arduino board, you will need to use the .ino extension.

There are three main parts that make up the Arduino programming language. First of all, you have functions that allow you to control your board. Using functions, you can analyze characters, perform mathematical operations, and perform various other tasks e.g., `digitalRead()` and `digitalWrite()` lets you read or write a value to a certain pin.

There are two functions that every sketch written in Arduino language contains. Those are `setUp()` and `loop()`. A sketch always starts with `setUp()`, which executes once after you power-up or reset your board. After you create it, you use `loop()` to loop the program repeatedly until you power-off or reset the board.

Next, we have the Arduino values that represent constants and variables. Most of the data types (array, bool, char, float, etc.) are similar to those of C++. You can perform type conversion as well. The last part of the Arduino language is called structure. It contains small code elements, such as operators.

As for the syntax, it is not unlike that of C++. The first similarity you might notice is the use of curly braces to wrap your code blocks. If you miss a closing curly brace after using the opening one, the system will throw an error. Thankfully, the Arduino IDE will highlight the closing brace if you click on the opening one, so its a rather simple thing to check. Just like C++, Arduino also requires ending your statements with semicolons. Missing one causes an error to fire.

One more clear similarity is the way you enter comments. There are two ways to do this in Arduino language, based on whether you need a single-line or a block comment. If you only need to comment out one line, start it with two forward slashes. To include a specific library in your sketch, use the `#include` statement and name the library you need to use.

#### **4.3.2 ThingSpeak IOT Platform**

ThingSpeak is IoT Cloud platform where you can send sensor data to the cloud. You can also analyze and visualize your data with MATLAB or other software, including making your own applications.

The ThingSpeak service is operated by MathWorks. In order to sign up for ThingSpeak, you must create a new MathWorks Account or log in to your existing MathWorks Account.

ThingSpeak is free for small non-commercial projects.

ThingSpeak includes a Web Service (REST API) that lets you collect and store sensor data in the cloud and develop Internet of Things applications. It works with Arduino, Raspberry Pi and MATLAB (premade libraries and APIs exists) But it should work with all kind of Programming Languages, since it uses a REST API and HTTP.

## CHAPTER 5

### IMPLEMENTATION ANALYSIS

#### 5.1 WORKING

- Connect ESP32 Cam with YP-05 chip and then we will connect it to the system and program it.
- We will set device name and password to which it has to be connected.
- After that we will upload the code using Arduino IDE software.
- For transmitting we use Rx and Tx and for power we are using Vcc and ground.

#### 5.2 IMPLEMENTATION

We have implemented additional features in our project such as live streaming that means the user will be able to see the live things happening in mines, gas detection which means the rover will detect the poisonous gases in the environment and alert the users and streaming videos in VR mode in the sense that the downloaded videos can be viewed in VR so that it gives the users a feeling that they are actually present the mines, and also the rover will be capturing the visuals and the captured visuals will be sent to telegram.

##### 5.2.1 Rover movement

- The signals which we are giving though NodeMCU app will be received by the motor driver wirelessly.
- Then the motor will send them to the gear motors. Then based on the instruction given it will moved back,front, left, right, 360 degrees.

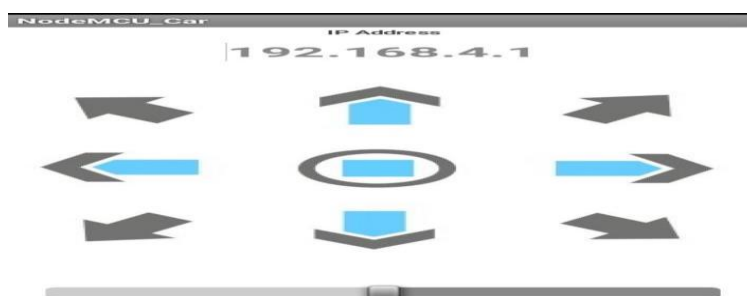


Fig 5.1: NodeMCU\_Car for controlling rover

### 5.2.2 Live Streaming

- Connect ESP32 cam with YP-05 chip and then connect it to the system and program it.
- We will set the name and password of the device which has to get connected.
- After that we will upload the code using Arduino IDE software.
- For transmitting we use Rx and Tx and for power we use Vcc and ground.
- We cannot connect ESP32 to laptop or PC because it doesnot have any port.
- So we are using YP-05 module which works as an intermediate between ESP32 and laptop.
- The reset wire is connected to the ground in ESP32 cam for coding purpose.
- So while uploading the source code we have to ensure wi-fi is present and to which it has toconnected.
- So for that we give wi-fi name and password in the code.
- Once the code is uploaded remove the reset wire connected to the ground.
- Then open the serial monitor in the Arduino IDE , then click the reset button in the ESP then wecan get the IP address like this <http://192.168.208.163/>.
- Then copy the IP and paste in which the device password is given in the code.
- Paste it in the chrome then we will get Live streaming.

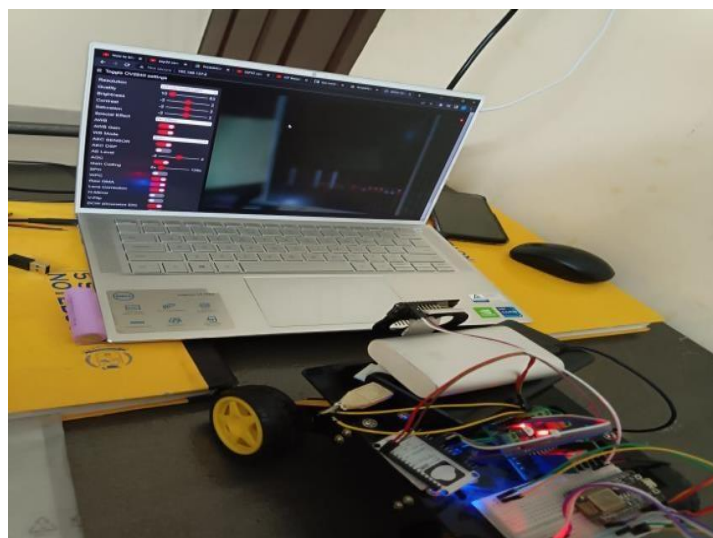


Fig 5.2: Live streaming can be viewed in either pc or mobile phone

### 5.2.3 Gas Detection Working

- The NodeMCU and MQ-07 sensor are connected.
- In our project we are determining carbon monoxide using MQ-07 sensor.
- Open the browser and login to ThingSpeak iot platform and create a channel and get an API (Application Programming Interface) key copy.
- Open Arduino IDE software and enter into the code.
- Now paste the API key in the code and also enter the wi-fi name and password in the code.
- Finally upload the code in Node MCU.
- After uploading the code in Node MCU, the Node MCU automatically connects to the wi-fi and sends the report to ThingSpeak iot platform.

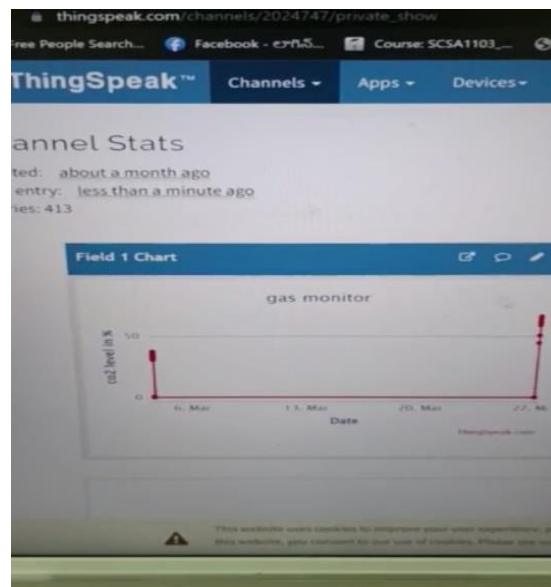


Fig 5.3: report of carbon monoxide on ThingSpeak iot platform

### 5.2.4 Streaming the video in VR mode

- To stream the video in VR first we have to download the video from ESP32cam that means the video which was previously recorded from the rover using ESP32cam.

- After downloading send it to the mobile and then we will convert the normal MP4 to VR video .
- Then we will stream it in mobile and place it in VR box.
- Hence we will get the output.

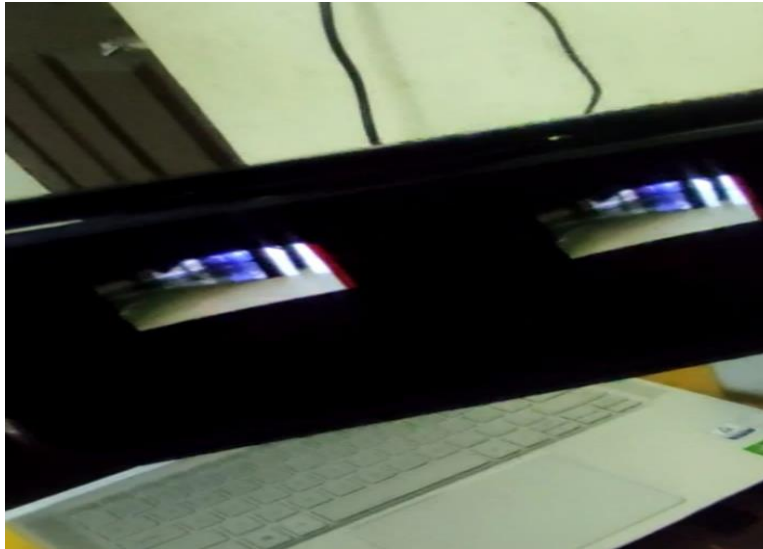


Fig 5.4: Playing the downloaded video in VR mode

### **5.2.5 Sending captured visuals to Telegram**

- The rover will be capturing the visuals and the captured visuals will be sent to telegram.
- The esp32 is connected as per the circuit diagram.
- We need to create telegram API to paste in the code.
- So we are going to telegram and open botfather create a new bot.
- Then we get the telegram api.
- Copy the api and paste it in the code.
- Write the wifi name and password in the code and upload it in the esp32 camera.

- Then open telegram open upavlatemp and then type /start when ever you need photo text /photo in the chat then in the bottom we automatically get photo.

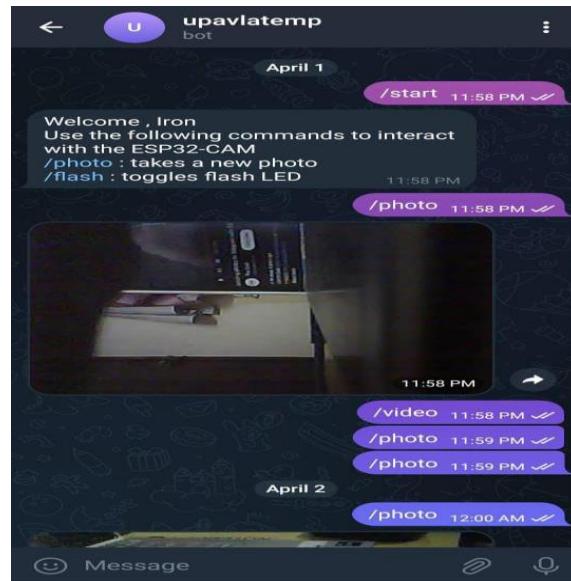


Fig 5.5: Downloading the captured visuals in the telegram

## CHAPTER 6

### RESULTS AND DISCUSSION

This chapter discusses the results and observations from the evaluation tests as well as other factors that influenced the project. The biggest challenge when assembling the robot was to supply power to all electrical components of the robot. There was already an existing power supply to the stepping motors and the video cameras that is ESP32 Cam , however this solution needed to be reworked with the addition of a ESP8266 NODEMCU and also battery provides less power so we have used powerbank so that the power lasts for a longer period of time.

However ,We successfully demonstrated that the telepresence robot gives us with the live streaming in the direction of our request after putting the hardware together, installing, and running the programme.

#### Final Prototype

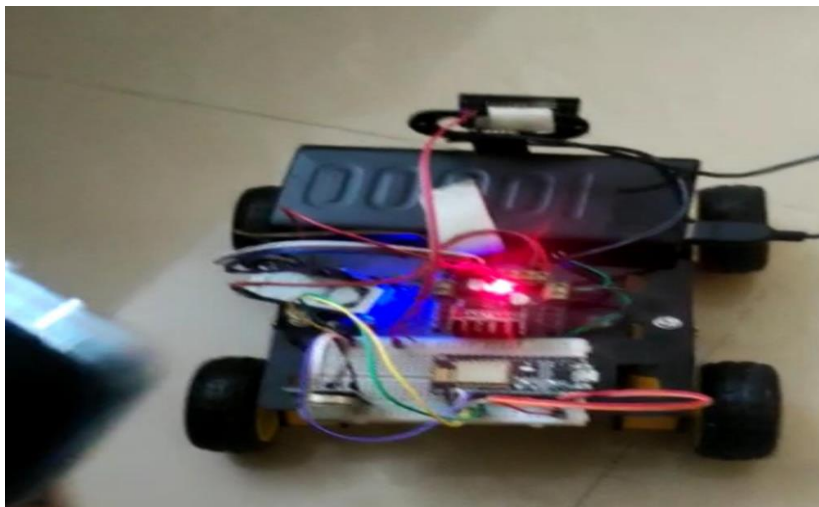


Fig 6.1: rover with components assembled

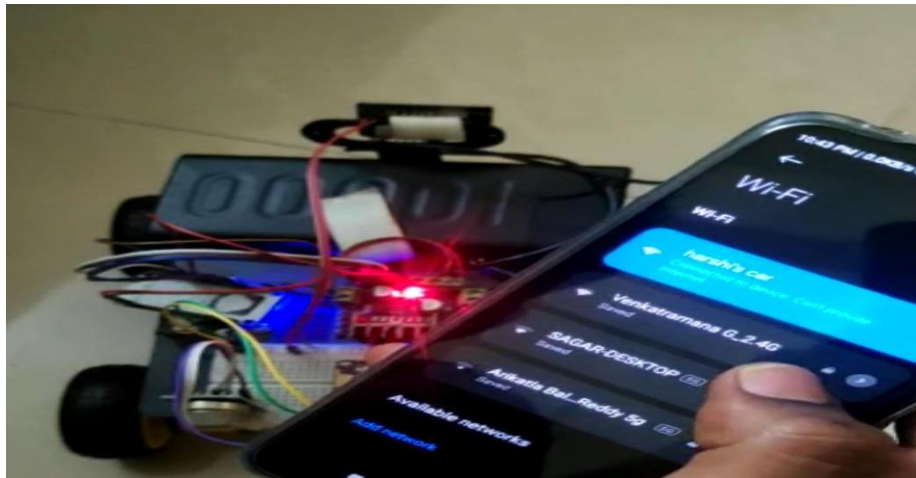


Fig 6.2: getting connected to Wi-Fi

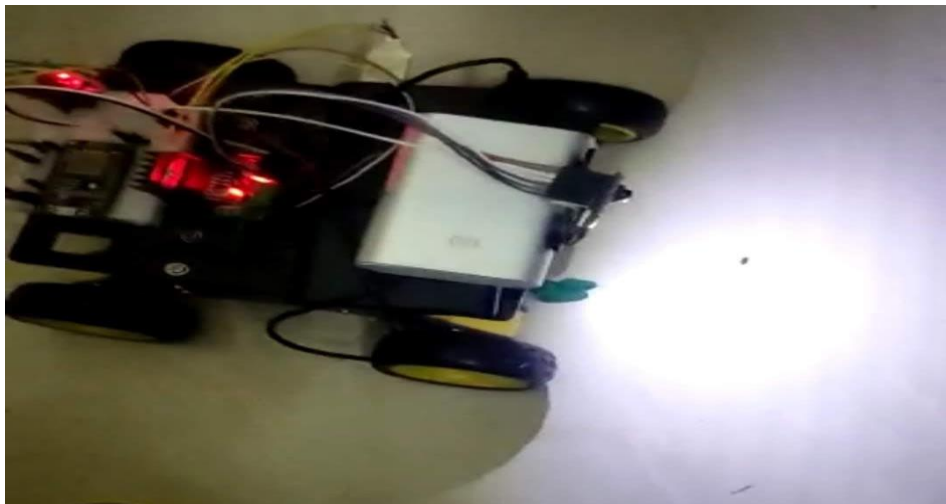


Fig 6.3: rover with torch to view dark environments

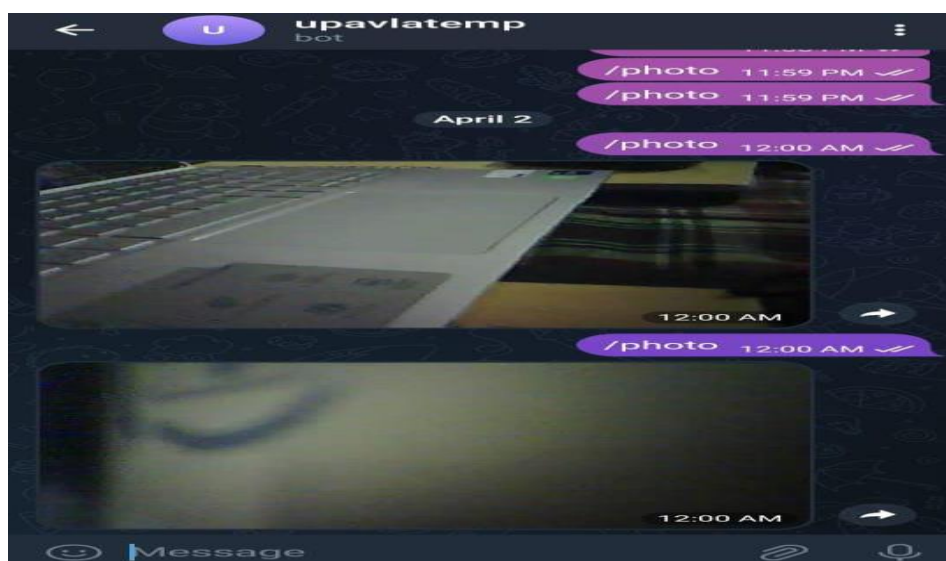


Fig 6.4: Downloading visuals captured by rover in telegram

## **CHAPTER 7**

### **CONCLUSION**

#### ***7.1 Conclusion***

After creating our own version of Virtual Telepresence Robot, we realized that this robot can enable its users to remotely interact with and observe the people & their surrounding without being physically present there themselves.

- Enable its users to remotely interact with and observe people
- Able to provide live visuals of the surroundings.
- Able to detect gases and sends the environment conditions back to the user.
- Without being physically present users can experience the environment and in this way it ensures safety in the mines.

#### ***7.2 Applications***

- Appropriate for live streaming
- To communicate information to the issue
- Used in mining, toxic environments, and bomb disposal, delivers the user films and environmental data that are captured.

#### ***7.3 Future scope***

Future work will focus on

- Increasing motor control precision and the reality of sharing robot views via 360-degree cameras.
- To completely integrate environmental, machine, and human information.

- To increase the effectiveness of rescue efforts and offer a fresh method for robot rescue work.
- Control range can be increased.

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