Unmanned Six-Wheels Bogie Rover with Robotic Arm for Surveillance and Fixing Objects

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Abstract: Wheeled mobile robots' utilization is increased rapidly and in dangerous situation such as planetary surface exploration. This paper provides a manner to construct a mobile controlled six-wheels Rover with robotic arm and camera which can stream video over internet. This project is controlled by blynk custom designed mobile application. With robotic arm can collect samples from the affected area.

Keywords: Arduino Uno, Node MCU, ESP32, Servo Motors, Motor Driver, rocker-bogie rover, robotic arm, Arduino,Bylnk Cloud.

1. Introduction

A rover designed to move on the solid surface and these devices were developed since 1960.Planetary exploration rovers have various sorts along with wheeled, legged and tracked, etc[1-4]. Wheeled portable component have phenomenal highlights, such as it can penetrate even in burrow and easy control.Wheeled structure planetary rovers have 4-wheel, 6-wheel, 8-wheel, and many others. Among those rovers, the 6-wheeled mobile rover with rocker bogie mechanism has good adaptability and climbing obstacle function. This paper affords a manner wherein Surveillance may be performed in remote areas and Robotic Arm helps to transport /dismantle objects. This rover with a robotic arm can be controlled using smart phone over internet. A camera module which will be helpful for surveillance. The streaming done by the camera module can be monitored.

2. Methodology

A. System Architecture

The main purpose of this project is to carry small object /collect samples with robotic arm with the aid of IOT, the more accurate andsmart way for doing these things with EPS32 cam. It will stream the video to remote location. Fig. 1 shows the system Architecture.

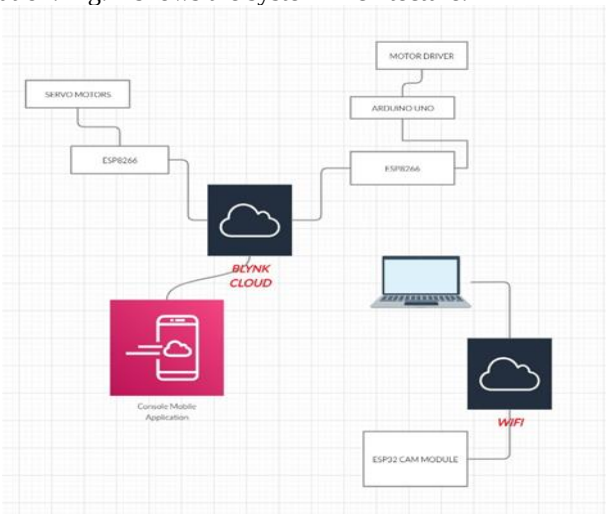


Fig 1 : system Architecture

The following are the components:

- Arduino Uno
- Node MCU
- ESP32
- SERVO MOTORS
- MOTOR DRIVER
- BYLNK CLOUD

B. Circuit Connection

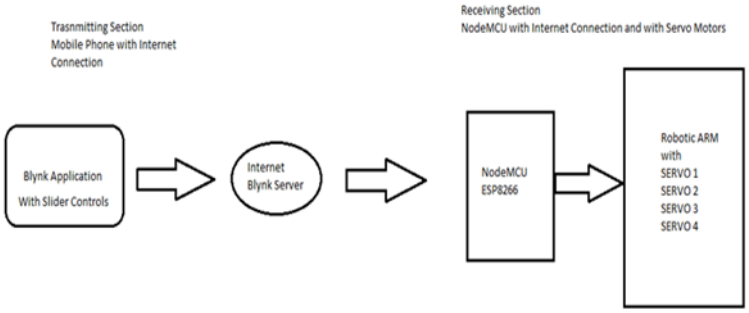


Fig 2: Circuit Connection

This project controls the robotic arms with 4- servo motors with mobile application.The NodeMCU has built in ESP8266 Module, with this we can connect with internet. Subsequent using the custom configured Blynk application we can control4-servo motors connect to Node MCU

WHY ARDUINO?

Arduino has been utilized in a huge number of activities and hobbyist.The Arduino is ready for productivity, yet can be used by the professional users. Arduino IDE can be installed in different operating systems like windows, Mac, and Linux. Widely used byteachers and studentsto construct lowcost gadgets, robotics, physics, chemistry and robotics.Designers construct prototypes for instructiveness, experiments are conducted by many musicians and artists formusical instruments. Arduino plays a vital role in building new things. An admirer respect to the age can start doing the project by following step-by-step instructions or share sketches to community of arduino over internet.

WORKIG WITH ARDUINO

Arduino can receive inputs from the sensors and may have an effect on its surroundings by controlling lighting, cars, and different actuators. The microcontrollerboard is programmed the use of the Arduino IDE. The projects which are built using Arduino board can be stand-alone or they can communicate with software program.The board contains fourteen digit IO pins (6are PWM outputs), six analog pins, a power jack, USB connection and a reset button.

Fig 3: Ardunio diagram

ESP32 CAM MODULE

Integrating ESP32-CAM with Arduino Video Streaming and Face Recognition can be done.The ESP32-CAM is a small camera module with the ESP32-S chip that costs low. Besides the OV2640 cam, and several GPIOsto connect peripherals, it also functions a microSD card slot that may be beneficial to store images curious about the cam or to save documents to serve to clients [11,12].

Fig 4:ESP32 Camera module

Introducing the ESP32-CAM

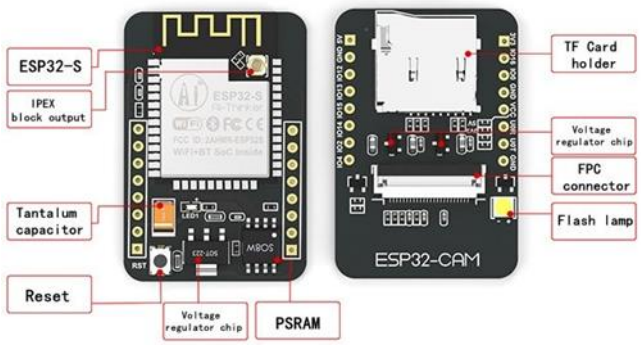


Fig 5: ESP 32 Cam module parts

The ESP32-CAM requires FTDI, as it doesn't come with a USB connector, additionalFTDI is required for programmer to upload code through the U0R and U0T pins.

FTDI MODULE

Future Technology Devices International(FTDI) is a serial UART IC device for serial communication. This handles all protocol to communicate to UART serial data. We can program exactly the same when the "client" labelled header connected to arduino. TTL serial interface to Use doesn't require additional installation of software and setting ahead of use. It's a simple plug and play device

Fig 6: FTDI Module

ESP32-CAM PINOUT

The below figure shows thepinout (AI-Thinker module). ESP32 Cam Pinout

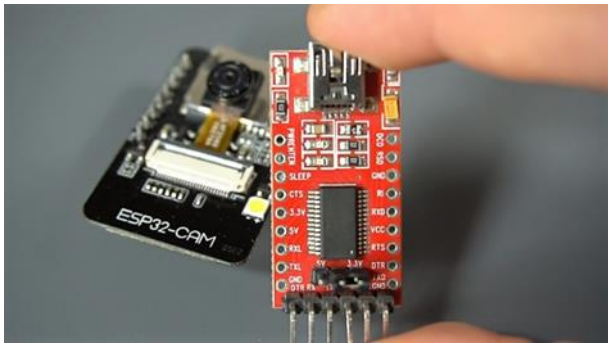


Fig 7: Pinout

It contains 3 Ground pins and 2 power pins: 3.3V or 5V.GPIO 1 and GPIO 3 are the serial pins. These pins help us to flash the code to board.Additionally, GPIO 0 also plays avital role, since it determines whether the ESP32 is in flashing mode or not. Connecting GPIO 0 with GND ESP23 turns into flashing mode. The following pins are internally connected to the microSD card reader:

- CLK => GPIO 14
- CMD=> GPIO 15
- Data 0=> GPIO 0
- Data 1 => GPIO 4
- Data 2=> GPIO 2
- Data 3 => GPIO 13

VIDEO STREAMING SERVER

Upon above connection, the next step is to construct a video streaming web server with the ESP32-CAM this allows us to access local network.

1. Install the ESP32-CAM
2. CameraWebServer

In Arduino IDE, select "File" and choose "Examples" and then "ESP32" and "Camera" and open the "Camera WebServer example".

Fig 8: Adding of ESP32 Board

Before flashing the code, enter private network credentials:

const char* ssid = "REPLACE_WITH_YOUR_SSID";

const char* password = "REPLACE_WITH_YOUR_PASSWORD";

Useappropriate camera module. In this case, we used the “AI-THINKER” Model.Now, the code is ready to flash in ESP32-CAM. Connect the “ESP32-CAM”to PC using an FTDI programmer. Follow the next schematic diagram:

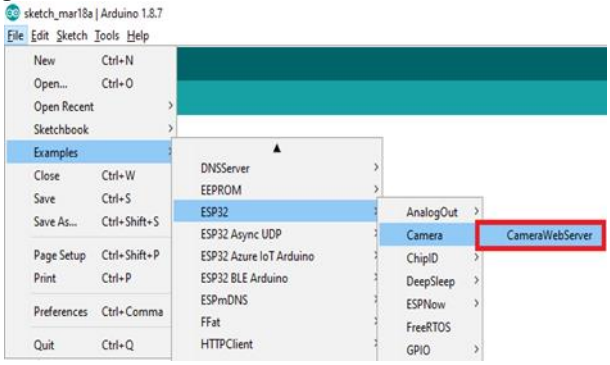


Fig 9: Connecting ESP32 CAM to FTDI Module

Many FTDI module consists of a jumper that allows us to select either 3.3V or 5V. To select 5V place the jumper at right position.After flashing the code, select the Serial Monitor baud rate to 115200. Press the Reset button on ESP32-CAM board. The ESP32 IP address have to be displayed in serialmonitor.

ROBOTIC ARM USING NODEMCU

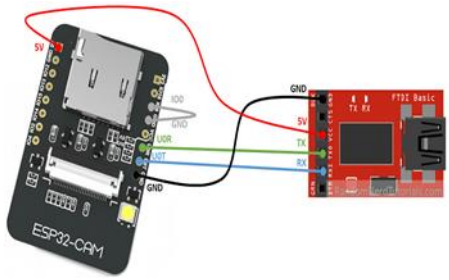
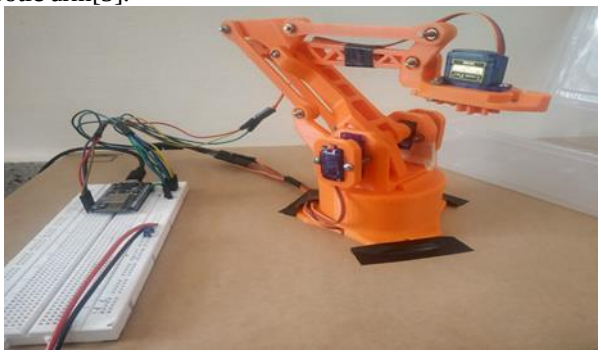


Fig 10: Robotic Arm connected with NodeMCU

The robotic arm can be controlled from any mobile application called Blynk, which is available in android and iOS stores.

The 3D printed robotic arm used in this project,if it is not available, you can use any Robotic Arm or build a crude one using cardboards [13,14,15]. After assembling 3D printed Robotic with four Towerpro SG90Servo Motors looks like this. It is connected with the help of nuts and bolts to put together the complete connected robotic arm[5].



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CIRCUIT DIAGRAM

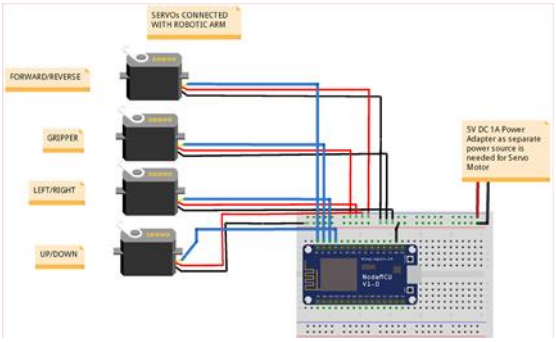


Fig 12: Circuit diagram of Robotic Arm servo motors connected to NodeMCU

Total of 4 servo motor are needed to function with robotic arm, these motors do not consume huge power they are being driven by the 5V dc supply from 1A adapter. Once the connections are done set-up looks like below.

NodeMCU	SERVO MOTOR	POWER ADAPTER
D0	Servo 1	-
D1	Servo 2	-
D2	Servo 3	-
D3	Servo 4	-
GND	GND Pin	GND
-	+5V Pin	+5V

3.Working With Blynk & Nodemcu Library For Arduino IDE

Working with Robotic Arm is simple and easy to function. Use Blynk library from Arduino IDE.

1. Manage Blynk library with Ctrl+Shift_i

2.Next download NodeMCU library

To program with NodeMCUinArduinoIDE "File" then "Perferences" and "Settings".

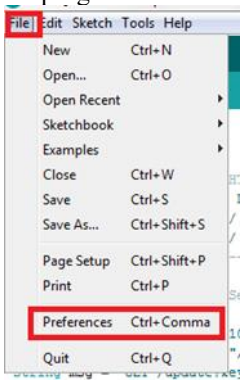


Fig 13: Setting up preferences of ESP8266 Board

Enter "http://arduino.esp8266.com/stable/package_esp8266com_index.json" into "Additional Board Manager URL" field and select "Ok".

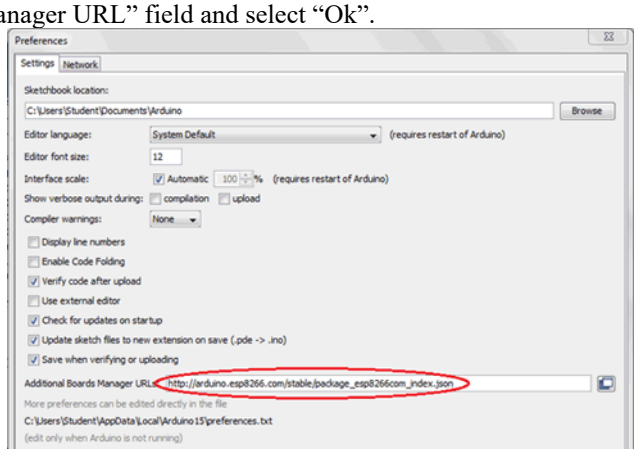


Fig 14: Adding URL of the board

Select“tools”then“board” and ”boards manager”.

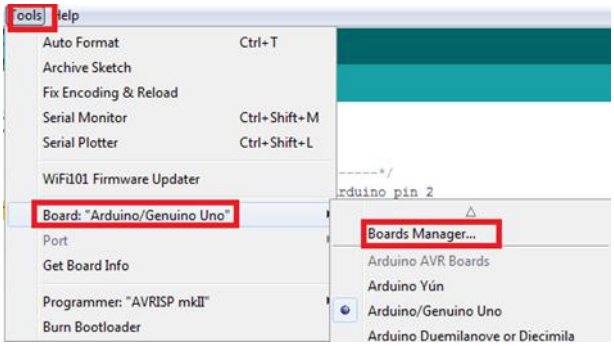


Fig 15: Selecting the Board

In “Boards Manager”prompt, search for “esp” in the search box, listed below we can find “esp8266”. Choose the latest board version and then install.

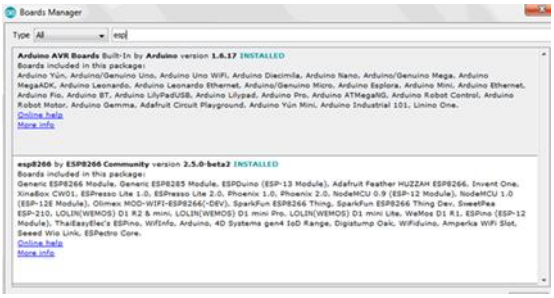


Fig 16: Installation of the Board

After successful installation, choose “tools” and then “Board” and select “NodeMCU 1.0”Now NodeMCU with arduino IDEis the ready to program.

3.2.4 ESP8266 WIFI MODULE OR NODE MCU

The ESP8266 WiFi Module is integrated with TCP/IP protocol stack and contains microcontroller access to privateWiFi network.

Fig 17: ESP8266 WIFI Module

Flashing blynk example inNodeMCU

To do so go to “File” select“Examples”and then choose “Blynk” select “Boards_WiFi” and “NodeMCU”

Insert“auth token” from “Blynk app” and private“WiFi credentials” in sketch:

```
charauth[] = "BlynkAuthToken";
 // private WiFi credentials.
 // set private password.
charssid[] = "private SSID_Name";
char pass[ ] = "private password";
```

Select NodeMCU 1.0 from Board menu located in Tools. Verify your code before flashing by choosing Verify button for compiled. Select the board port and upload speed as 115200. Once compilation is done flash the code on to the board.Use mobile app and try to on the light on the board LED (pin D4). Even after installing driver, if you port is not visible. Unplug and plug the NodeMCU Board.

SERVO MOTOR

Fig 18: Servo Motor

A servo motor is a device that may push or rotate an object with nice precision. If you wish to rotate an object at some specific angles or distance, then you utilize a servo motor. The position of a servo motor is determined by electrical pulse and is placed beside the motor [10].

CONTROLLING SERVO MOTOR

Most of the motorscome with 3-wires out. Out of three wires, 2-wires are used for power supply (positive and negative) and another one is used for sending signal to the node MCU.

A control wires, which are called as PWM (Pulse width Modulation) is used by the control wire of servo motor. Servo motor can rotate 90 degrees from both the direction from its initial position.

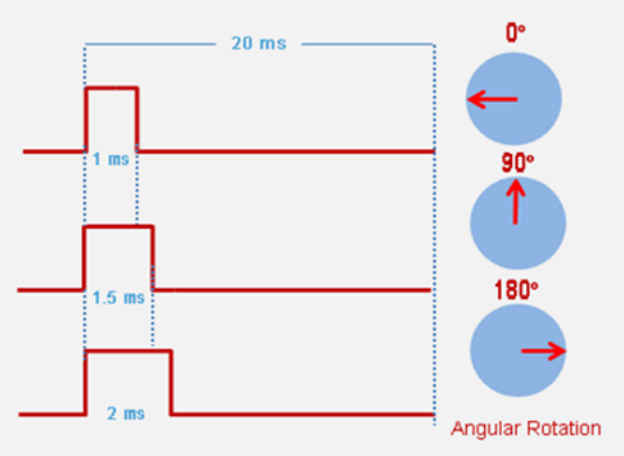


Fig 19: Rotation of Servo motor

Depending on the manufacture these servo motors can rotate up to degree 210. This rotation is controlled with proper electric pulse of the pulse with modulation control pin.These motors check pulse for every 20 milliseconds. Rotation of servo motor 0 degree can be done with giving pulse of 1 ms (1 millisecond) width, rotation of 90 degrees can reach with width of 1.5ms and can achieve 180 degrees by supplying width of 2ms [6].

DC MOTOR

An electric motor that uses DC power is known as DC Motor. It works on the principle of electromagnetism. It converts electrical energy to mechanical energy. It rotates with respect to its initial position. Field winding in the DC Motor provides the magnetic flux and armature acts as the conductor.

ADVANTAGES

- Good acceleration and deceleration control
- Excellent speed control
- Ready to use
- Low cost drive design

MOTOR DRIVER

Motors can't drive directly it require some kind of drivers to control the speed and direction. This device acts as interface between motor and microcontroller. With the help of the L298D chip eases the process of controlling the motor using microcontroller.An H-Bridge allows you to control the motor move forward and backword. It is controlled by Pulse Width Modulation (PWM). A jumper pin enable to drive 5v output and power supply less or equal to 12v. it should note be placed when power supply is above 12v[6-7].

Fig 20: Motor Driver

PINS

Motor Drive	**Other circuit**
Out_1	Motor A lead out
Out_2	Motor A lead out
Input voltage	Depends on the power supply and jumper
GND	Ground

Input/output voltage	Act as output when Jumper is enabled, else act as input
EnA	PWM signal for Motor A
In_1	Enable Motor A
In_2	Enable Motor A
In_3	Enable Motor B
In_4	Enable Motor B
EnB	PWM signal for Motor B
Out_3	Motor B lead out
Out_4	Motor B lead out

L298 Motor driver

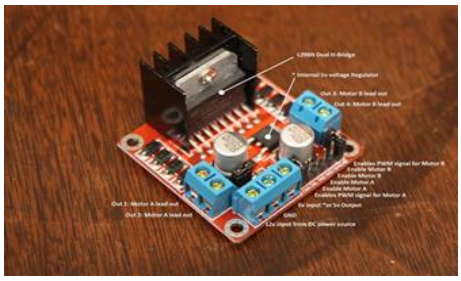


Fig 21: L298 Motor driver

PIN DIAGRAM

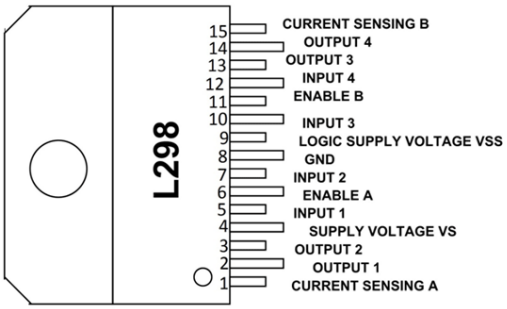
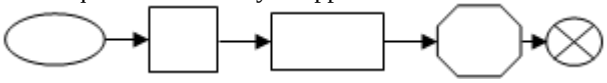


Fig 22: Pin Diagram of L298

Bogie rover

Here we choose a six-wheel bogie rover made up of plastic.For this rover it consists of six dc motors connected to a microcontroller with L298 motor driver. The motor driver acts as a bridge between the motors and establishes connection between them. The movement of the rover will be controlled using our smart phone via blynk app. To control the rover we create an interface to move it in four directions i.e., forward,backward, left,right. The interface here we designed is similar to joystick[7,8,9].

The sequence in how blynk app communicates with our rover will be as follows:



Blynk ---- node mcu---- Arduino---- Motordiver-------Motors(rover)

Blynk NodeMcu Arduino UNO Motordriver Rover

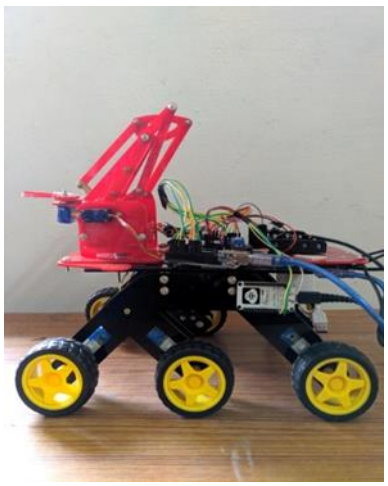


Fig 23: Bogie rover

Results

Joystick and sliders used for controlling rover and robotic arm.

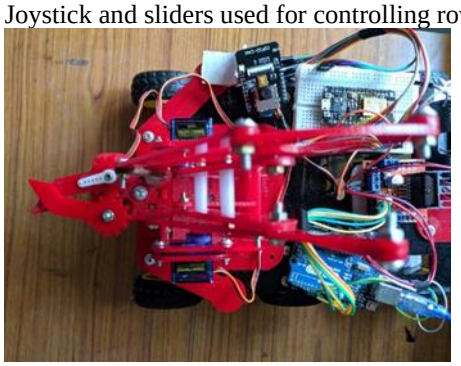
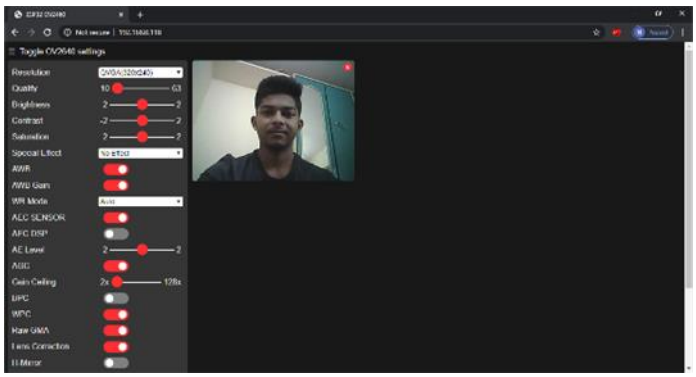


Fig 24: Robotic Arm claw when opened

Fig 25: Robotic Arm claw when closed

Fig 26: Interface for operating rover and Robotic Arm



MONITORING THROUGH ESP32 CAM MODULE

Fig 27: Monitoring through ESp32 CAM module

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