

# Redesigning of Robot Tank

Conestoga College Institute Of Technology And Advanced Learning

Kinjal Badhiwala, Parth Patel, Yashasvi Bhatt

badhiwala.kinjal@gmail.com, yashasvibhatt1995@gmail.com, parthpatel.20795@gmail.com

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## Abstract

*This project is designed to control the Robot Tank using wireless keyboard and monitor the live video streaming to the desktop or mobile. To extend it we can also capture photos using camera. This project allows us to use our knowledge in embedded system by controlling dc and servo motor in one project. We are interfacing DC motor, Servo motor and Camera with Raspberry Pi for Controlling and live video streaming of Robot. This gives an opportunity to interact with Raspberry Pi wirelessly and learn more about Python programming language.*

## I. Introduction

The main aim of this project to solve the following hardware and software integration tasks.

Convert the previous PCB design from Altium PCB design software to more open-source like Ki-Cad PCB design software.

Solve the Power issue when attempting to drive robot in straight line it will resulting as jerky behaviour.

Reduce the PCB size and make it smaller as much as possible. Minimize the cost of board when send it for manufacturing. Make it under the \$40 per PCB.

For smooth controlling of Robot Tank improve the software integration with components. Reposition the Raspberry Pi on new PCB so the camera mount doesn't bend the cable while operating.

## II. Proposed solution

To establish the PCB designing in open source problem we will design in Ki-Cad PCB design. So, it is an open source software so in future if there is an update in design anyone can use this software and redesign the PCB as they want.

For solving the power issue, we will take the total current reading of the all components used in the design and calculate the voltage reading. In addition, we calculate the DC and servo operating voltage and check the existing power issue.

Reduce the PCB size we will use the Surface mount components and modules to use less amount of surface area.

After designing the PCB, we have planned to focus on the software part for programming for smooth controlling.

# Redesigning the Robot Tank

## III. Key components

### i. Raspberry Pi 3 model-B



Figure 1: Raspberry Pi

Raspberry Pi is a single-board computer with wireless LAN and Bluetooth Connectivity.

It is a minicomputer in which It have an OS based on Linux. We can use just simply connect it wirelessly with the TV or Monitor and control the on the computer.

Raspberry Pi 3 Model B is a earliest model of the third-generation Raspberry PI. It has a Quad Core 1.2GHz Broadcom 64bit CPU, 1 GB RAM, BCM43438 wireless LAN and Bluetooth low Energy on the board. In addition, it also has a 40-pin extended GPIO pins, 4 USB ports, 4 pole stereo output and composite video por, HDMI port, CSI camera port for connecting a Raspberry Pi Camera.

### ii. Robot Tank Chasis



Figure 2: Robot Tank Chasis

This is economy 2WD German Tiger Tank Robot chasis. The Product Model number is SN900. The Weight of the Tank is 244g and the size of the robot is as following parameter: Length \* Width \* Height = 21cm \* 12cm \* 4cm. The Total Load capacity of the Robot Tank is 1kg.

Motor parameters:

Motor Model: 130 toy motor

Reference Voltage: 2 – 8 V

Reference Current: 0.35 – 0.5 A

No-Load Test:

3V	0.34 A	198 RPM
6V	0.37 A	390 RPM
8V	0.5 A	553 RPM

NO Load Tank Speed:

3V	0.18 m/s
6V	0.34 m/s
8V	0.49 m/s

### iii. L298N H-Bridge Dual Driver module

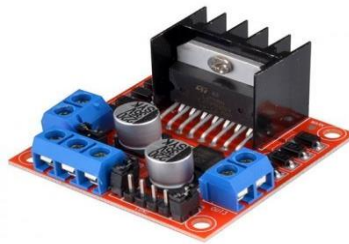


Figure 3: L298N H-Bridge Dual Driver

This dual bidirectional motor driver is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit. The circuit will allow you to easily and independently control two motors of up to 2A each in both directions. It is ideal for robotic applications and well suited for connection to a microcontroller requiring just a couple of control lines per motor. It can also be interfaced with simple manual switches, TTL logic gates, relays, etc. This board equipped with power LED indicators, on-board +5V regulator and protection diodes.

### iv. Raspberry Pi Camera Module 1080p



Figure 4: Soil Humidity Sensor

## Redesigning the Robot Tank

Raspberry Pi Camera board version 2 is high quality 8-megapixel Sony IMX219 image sensor custom designed add-on part for Raspberry Pi. It is capable of 3280\*2464-pixel static images, also support the 1080p30, 720p60 and 640\*480p90 video.

All software is supported within the latest version of Raspbian Operating System.

This camera is mostly used in following applications: CCTV security camera, Motion detection and time lapse photography. This camera is compatible with all Models of Raspberry Pi 1,2 and 3.

### v. Pan and Tilt Servo Camera Anti-Vibration Camera Mount



Figure 5: Servo Camera Mount

The Tower-Pro SG90 9g Mini Servo is 180° rotation servo. It is a Digital Servo Motor which receives and processes PWM signal faster and better. It equips sophisticated internal circuitry that provides good torque, holding power, and faster updates in response to external forces.

### vi. Onn portable Battery power bank, 6700mAh



Figure 6: HC-06 Bluetooth Module

This unit have a Lithium Ion battery. It is features an input of DC 5V/2A and output of DC 5V/2.4A. its quick glance at the LED screen will let you know your power bank charging percentage, so you will be up and running on time. This is Equipped with a versatile USB port to charge your smartphone, tablet or Other USB charged devices.

It also has rated DC output of 5V/2.4A. Leverages the power of a rechargeable lithium ION battery.

## II. Methodology

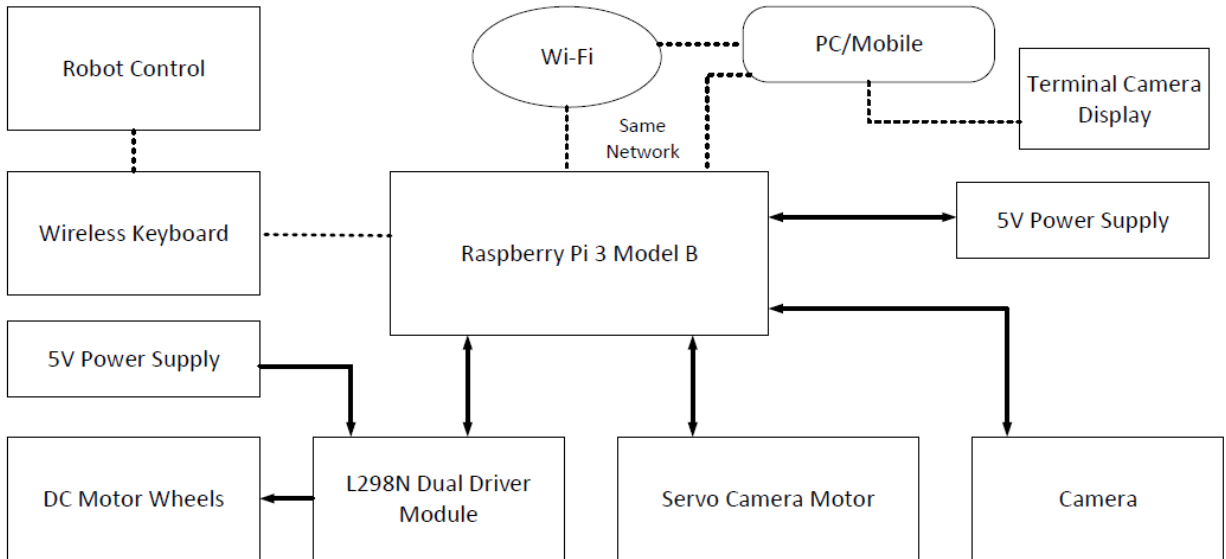
### i. Block Diagram Working

The figure 7 shows the Working block diagram

Wi-Fi need to connect with the both Robot (Raspberry Pi) and PC or Mobile from which need to control. Control of robot will be displayed in the terminal of PC. Raspberry Pi needed 5V to operate so there is one power bank which is connected to Raspberry PI 3 Model B. Camera take the input from the Raspberry PI and display the output to the terminal of PC or mobile. Servo Camera motor needed 5V power source so the power and PWM input is given from Raspberry PI.

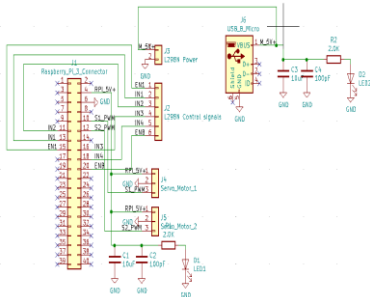
L298N dual driver module needs 5V to 9V power supply which is provided from another power source. L298N Dual driver module is used to control the DC motor of the Robot tank which is connected to the Chassis of tank. L298N module needs the Enable and Signals which is provided from the Raspberry PI as input of the L298N module. This module will control the DC motor Speed and direction. To control the Robot we have to connect the wireless keyboard to the PC.

## Redesigning the Robot Tank

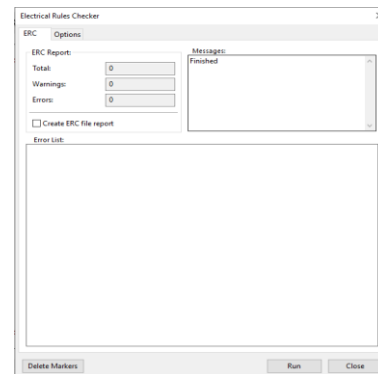


**Figure 7:** Working block diagram

i. In the first stage, circuit diagram was created in the Ki-Cad PCB design software and generate PCB files which is send to a PCB development for preparing circuit board. The following is the figures showing the board dimensions window and error checker window and both the layouts of the final Circuit:



**Figure 8:** Setting used to test the soil humidity

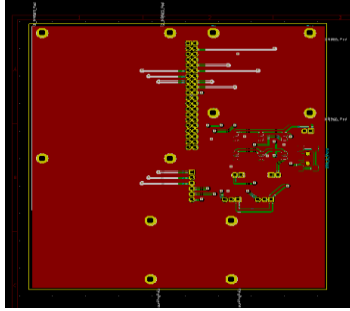


**Figure 9:** DRC Error Checking Screen on the Ki-Cad designing Software

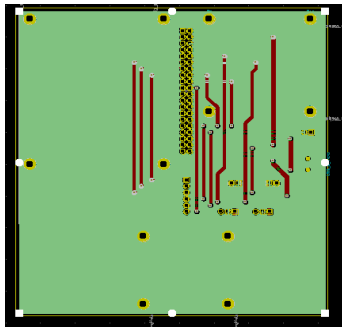
ii. After creating the circuit diagram, DRC Control error was checked in the Ki-Cad designing software.

iii. After checking the electrical rules, the next stage was PCB Layout. So, PCB layout was created in the Ki-Cad PCB layout page. The two-layer PCB design format was used for the PCB.

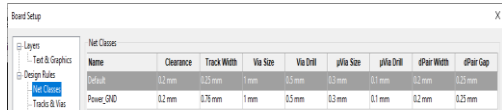
## Redesigning the Robot Tank



**Figure 10:** Top Layer Layout of the PCB in Ki-Cad PCB Design

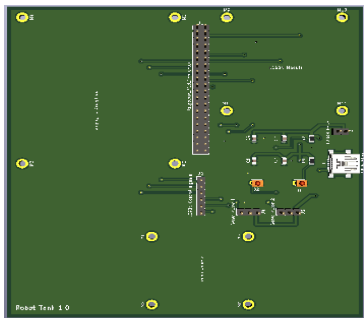


**Figure 11:** Bottom Layer Layout of the PCB in Ki-Cad PCB Design



**Figure 12:** The board dimensions as the Design Rules

iv. After designing PCB layout in Ki-Cad software the next process was about checking the 3D view in the software to check all the component if it is overlap to another component or not. At the end the 3-d view of whole PCB was checked before sanded to manufacturing.



**Figure 13:** 3D Top view of the Robot Tank Circuit

v. The last step is to create the Gerber files and Drill files for manufacturing the PCB. So simply we have gone through the simple steps by creating the Gerber files and Drill files.

vi. After creating the Gerber file and Drill file the PCB was send for manufacturing. After research and the permission from the sponsor the PCB was send for manufacturing in **JLPCB** company which is in Hong Kong.

vii. Meanwhile Raspberry Pi can connect wirelessly, and the steps are as follow:

- Connect PC and Raspberry Pi to the same network of Wi-Fi.
- Open putty.
- Enter the IP address of Raspberry Pi to it and enable SSH.
- Raspberry Pi Login Details:  
 IP address: 193.168.43.75  
 PI username: pi  
 PI password: Get automation
- After entering details in putty enter the following code:  
 sudo Raspi-config – Interfacing selection  
 Enable VMNC viewer
- Open VNC viewer and enter the Raspberry Pi login details.
- Now the Raspberry Pi will connect the PC wirelessly.

viii. Keyboard controlling keys for program

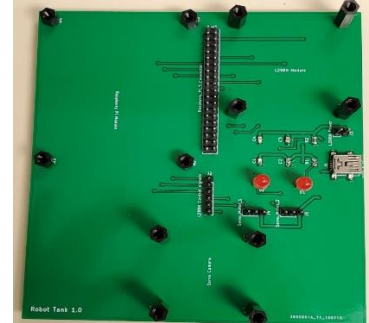
Keyboard Keys	Function
I	Upper Servo Left
O	Upper Servo Middle
P	Upper Servo Right
J	Lower Servo Left
K	Lower Servo Middle
L	Lower Servo Right

**Table 1:** Keys and its functions For Servo Motors

# Redesigning the Robot Tank

Keyboard Keys	Function
Q	Forward
W	Reverse
E	Left
R	Right
S	Stop

**Table 2:** Keys and its functions For DC Motors



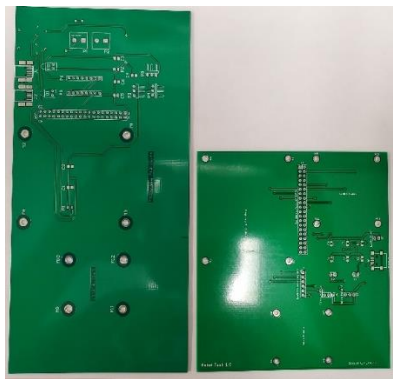
**Figure 14:** low level hardware working

After checking and doing the test plan of the PCB the Raspberry Pi was connected with the PCB that was created earlier. The following is the final output of our PCB without any error.

## IV. Results

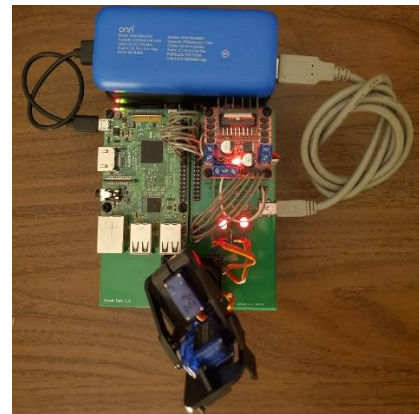
After creating the Gerber and drill file the process of checking the PCB files online for any error in designing like short circuit and any silk screen overlapping. An account on freedfm.com website was created which is powered by Advanced circuit.

PCB Manufacturing Company: jlcpcb  
Location of manufacturing company: Hong Kong  
So, PCB was manufactured in 5 days after we have ordered it. The old PCB dimensions was 203 mm \* 101 mm and the new upgraded PCB dimensions are 114 mm \* 123 mm. The following is the comparison of the old PCB to the new PCB.



**Figure 13:** old PCB vs New PCB

After the PCB was arrived, the process of PCB mounting and soldering was started immediately. The following is the low-level integration of hardware.



**Figure 15:** Working Prototype

## V. Acknowledgment

We would like to express our special thanks of gratitude to our Mentor (So-Ra Chung) as well as our project Sponsor (Robert Elder) who gave us the golden opportunity to do this wonderful project on the Robot (Robot Tank), who helped us a lot in finalizing this project within the limited time frame. We are thankful to them and our college who provided us a platform where we can show-up our skills.

# Redesigning the Robot Tank

## VI. Conclusion

Overall from this capstone, Team feels that the project is pretty successful although we had faced a few problems. The error in the voltage and the functioning of motors is very stressful. The problem solution we found later was due to the connection and the program. Another issue is with the design, in which we have to redesign the whole PCB and make it less complicate for connection. That we did by using KiCad software.

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