METR4810 – TEAM 1 INSTRUCTION MANUAL

Safety Warnings

This vehicle is not a toy and it is not suitable for children under age of six.

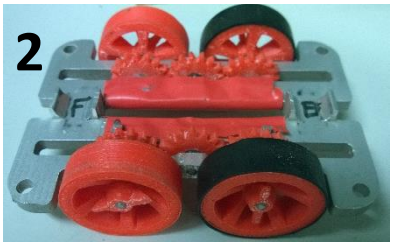
The Lithium Polymer Battery

Lithium Polymer (LiPo) batteries are ideal for small hobby projects as they are capable of delivering a large amount of current and are available in large capacities while still taking up a small amount of space. If treated incorrectly LiPos will be dangerous and potentially explode.

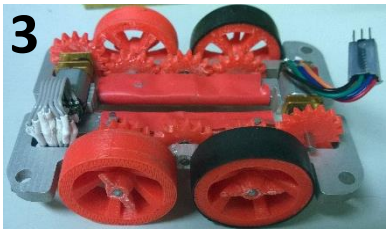
Follow the safety instructions below to ensure safe and reliable battery operation:

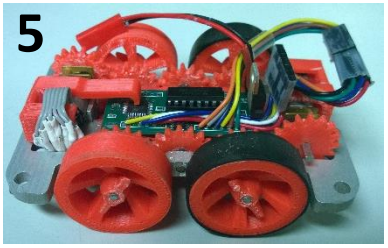
- Overcharging a LiPo battery can cause an explosive fire.
    - To avoid this always use a compatible charger, which has been designed to charge Lithium batteries.
    - Avoid charging batteries in direct sunlight or extreme heat.
    - Always monitor the battery while it is charging and remove the battery when it is charged to avoid over charging
- LiPo batteries can be over discharged, which will render the battery useless
    - Once a LiPo has been over discharged it will no longer accept a full charge and may experience problems holding it's voltage
    - These is no circuitry in the vehicle to prevent this, so it is up to the user to ensure the battery is not over discharged
    - This battery will be over discharged when the voltage drops below approximately 6V
- Do not puncture the battery
    - If the battery is punctured or damaged in anyway, immediately cease using it and dispose of it correctly
- Do not short the battery or use the battery with damaged cables
    - If the cables are damaged in anyway, quickly cover them up using an insulating material and ensure the damaged wires never touch
    - Shorted cables can cause an explosive fire and may melt the object they are shorting through.

Assembling the Car

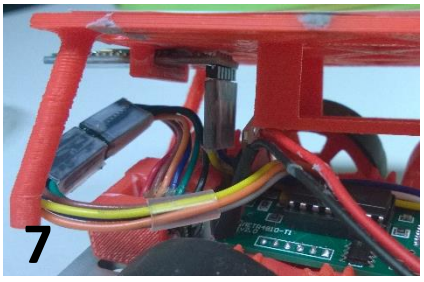


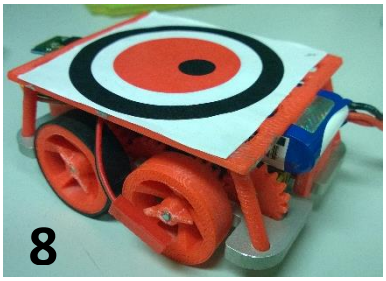
1. Thread the wheels onto the shafts until they reach the Circlips secured to the shaft
2. Thread the wing-nuts on, and tighten against the wheels
3. Place the motors in the correct orientations within their cradles, as indicated on the chassis
4. Place the PCB on the chassis, passing the underside cable through the frame and aligning the holes on the PCB with the cylindrical extrusions on the frame
5. Clip the motors in, using the smaller clip for the rear motor
6. Plug the motors in, matching blue to yellow cables
7. Orient the canopy with the Bluetooth module at the rear of the vehicle, and plug it in
8. Seat the canopy
9. Insert the battery with the battery wires pointing to the left of the car, and plug in the battery cable

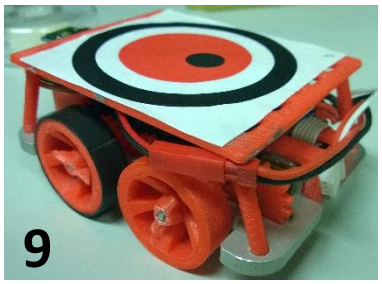




Disassembly happens in reverse.







Powering on the Car

After confirming the battery is fully charged and in a safe condition it can be connected to the car. The connector has been designed to ensure the battery cannot be connected back to front. After connecting the battery to the car the Bluetooth module will begin to flash (assuming the car was correctly assembled as discussed above). Once the module is flashing the car can be placed on a track and the control computer can connect to the car via Bluetooth. The car is now ready for automated driving.

Using the Control Software

Step 1) Camera Setup

To set up the camera, go to the Camera Setup tab. Select the number of cameras from the drop down menu. The enter the port numbers and the IP address of the RoboRealm server. Then click on the "Connect to RoboRealm" button to connect to the server. Then select a camera and find its transform using the "Get Transform" button and save the transform using the Save Transform button. To obtain transforms, click on the top left corner of a tile and click the remaining three corners in the clockwise direction. The Save

Transform button allows reloading the camera transforms using “Load Transform” button later if the application crashes due to unforeseen circumstances.

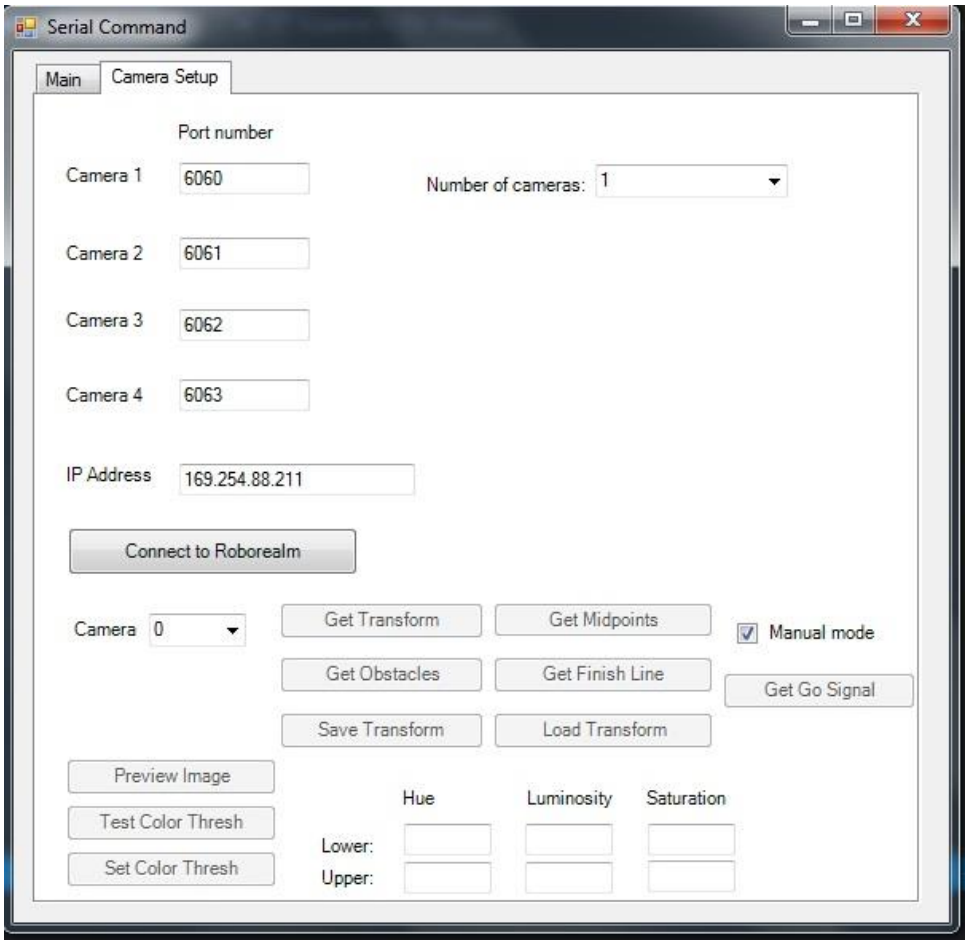
Then click on Get Midpoints. This will open a window that lets the user choose a start position for automatic track detection. To select starting points, click one point and then click the second point in the direction that car would travel. This will generate the track path automatically. In case the auto generated path is not smooth at some point, the user can use their mouse to smooth the path by clicking points and dragging the cursor along the desired segment.

If there are multiple segments of track due to partial track view, the user can press “C” and repeat the same procedure to generate each segment. Once the path is complete, press “Space” to record the auto generated path.

The same procedure is repeated for each camera to obtain the paths. Then user is ready to connect to the car and launch the car.

After paths are generated for all four cameras, the finish-line tile must be detected using Get Finish Line. Once the finish-line is detected, the go signal lights must be detected using Get Go Signal button.

Then the car is ready to be launch upon Go Signal.



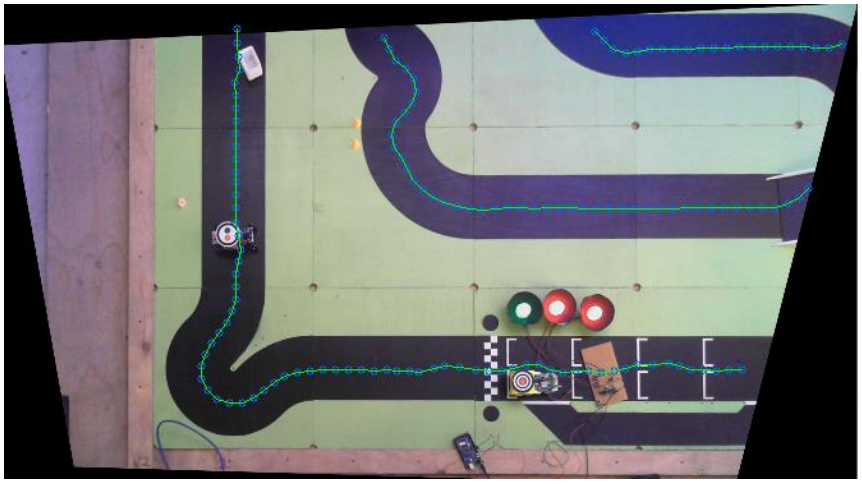


Image Preview and Adjustment

To preview the image in each camera, select the desired camera from the drop down menu and then click on Preview Image button. This will show the current view in the selected camera.

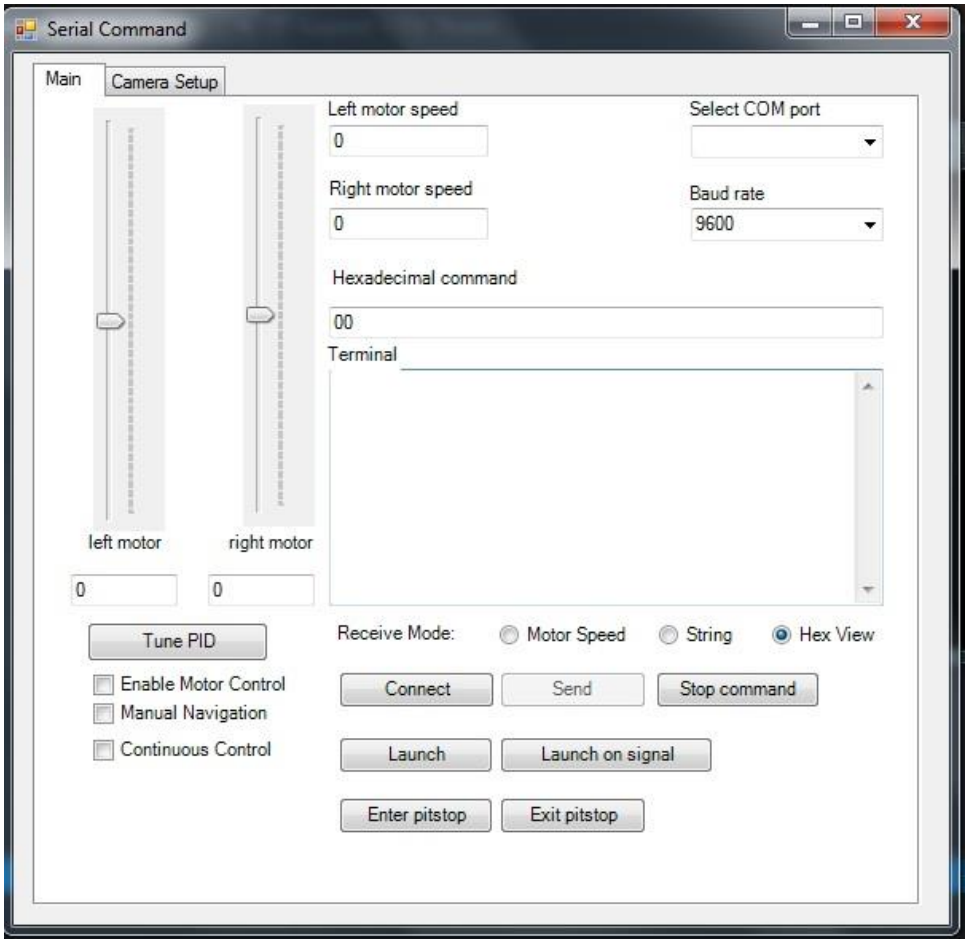
The automatic track detection relies on color thresholding. Different lighting conditions may need adjusting of the default color thresholds. To achieve this, click on Test Color Thresh button to see the current color threshold in effect. If the result is not satisfactory, you can enter desired values between 0-255 in the provided textboxes and click Set Color Thresh. To see the effect of the new color thresholds, use Test Color Thresh button.

Step 2) Launching the Race

To launch the race, first make sure the host computer is paired with the on-board Bluetooth. Once the computer and the car are paired, switch to the Main tab. Then select the COM port using the drop down menu and set the baud rate to 9600. Then click on the “Connect” button to connect to the car. The messages sent back by the car will be displayed in the terminal. To view messages as String, select String on the bottom of the Terminal. Then click Launch to start the autonomous drive around the track. To start race upon Go Signal press Launch on Signal button.

Step 3)Pit-Stop manoeuvre

After the race is launched To perform a pit stop click on the Enter pit-stop button. Once is the pit-stop is done, click on Exit pitstop to exit the pitstop.



Emergency Stop

To stop the car in case of unexpected behavior, press stop command. This stop the motors and bring the car to a halt.

Troubleshooting

The interface provides tools that allow tuning control gains (Proportional, Integral and Derivative), however the car only uses Proportional Control. To tune the Proportional gain, enter a value between 0 and 100. The default value is 10 and it is advised not to set the P gain beyond 20. The P gain settings will be reset to default with resetting the car.

The Terminal displays the messages from the race car which by default displays the motor speeds. However by reprogramming the Microcontroller, the user can add more diagnosis messages and even use the Hexadecimal text box to send binary commands.

The interface also allows the user to set motor speeds manually from the host computer and monitor the speed measurements in the Terminal. This feature allows the user to evaluate the motor response. To do that, click on Enable Motor Control and Manual Navigation checkbox, then select the motor speeds using the trackbars or the text boxes. To send command to the car press Send button.