

VR Robot

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Operation and Assembly Manual



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TABLE OF CONTENTS

ASSEMBLY	3
1. Wheels	3
2. Track	3
3. Roller	3
4. Tensioner	4
5. Robotic Arm (Braccio)	4
6. Camera Assembly	4
OPERATION	4
7.1 RUT	4
8.1.1 RUT Controls	5
7.2 VR (Oculus Quest 2)	5
7.3 Arm Control	5
7.4 Maintenance	5
7.5 Troubleshooting	5

ASSEMBLY

The RUT Base should come mostly assembled, however, some components may need to be removed during transport to reduce footprint size. This section will provide a comprehensive overview on assembling various components.

1. Wheels

The front wheels are held onto bearings via retaining rings. A snap ring plier will be needed for this piece of the assembly. To start, install a retaining ring on one end of the wheel. The two bearings can now be installed via hydraulic press. Once the second bearing passes the retaining ring groove, do not continue to press as it may cause damage to the wheels. The second retaining ring can now be installed. The front axle assembly consists of two spacers, washers, one wheel, and a nut. The assembly order is as follows: spacer 1, wheel, spacer 2, washers (to ensure contact with nut), and the nut.

The drive wheel assembly differs from the front. A general tool kit will be needed for this assembly. First, install the aluminum coupler to the wheel, ensure the 4 holes align with the holes drilled on the wheel. Install 4 bolts and corresponding nuts to secure the coupler to the wheel. Install the coupler to the shaft with the key. Install the rectangular bracket and allen bolts to properly space the wheel. Install the final bolt to secure the wheel assembly to the shaft.

2. Track

The track can be installed at this time. Ensure the tensioner is loose by backing bolts to the end of the tensioner bolts, the track should now be slipped over the front and drive wheels. The tension can now be increased and adjustments made as needed if slipping is seen.

3. Roller

The roller assembly consists of a mount, bracket, 3 bearings, 4 retaining rings, a bolt, and one nut. The smaller bearings can be installed on the lower bracket posts and the corresponding retaining rings installed. The large bearing is to be installed to the center hole along with its retaining ring. The mount will go through the center bearing and the final retaining ring can be

installed. Finally, the assembly should be aligned with the hole drilled on the RUT frame in the center of the track, with the bolt and nut to secure to RUT.

4. Tensioner

The tensioner assembly consists of two springs, two bolts, two nuts, four washers, four oil embedded bronze bushings, and the axle blocks. To disassemble the tensioner it is very straightforward and simple. All that needs to be done is to slowly loosen the nuts, being careful to make sure the spring will not go flying. Then simply pull the bolt out and all that is left is the oil embedded bronze bushing inside of the axle blocks. Assembling the components is the same process just backwards.

5. Robotic Arm (Braccio)

This component is pretty simple to assemble. The first thing that needs to be done to take it apart is to take off all the screws that are visible on the arm links. Make sure that the first parts to be taken apart are the arm links (Black links). After the links the next step is to take off the servos that are attached to them. This is to prevent the wires from being pulled when handling the links. Once all these parts are taken apart, continue with the base. Flip the base upside down and unscrew the screws that are visible. Once the base plate is off you will see four screws, take these out and be careful that the spring does not come off when performing this operation. Lastly, unscrew the two servos that are located inside the base. For more information on how to assemble or disassemble the BRACCIO arm click [here](#).

6. Camera Assembly

For removing the camera from the pole gently pull the camera straight up. Be careful that when it is off the pole the wires are not pulled all the way from inside the RUT. Disconnect the wires using the quick disconnect attachment, also make sure that the antenna is also disconnected from the camera. Unscrew the two screws located on both sides of the camera. Make sure that the camera cap is on during the entire process. Once all these operations are done and the camera is safely off the pole, locate the camera in a padded surface to prevent damage. To de-attach the antenna from the pole gently pull it up from the housing. The antenna should not be hard to remove since it is only attached with double sided tape.

OPERATION

7.1 RUT

The operation of the RUT begins when the switch at the front of the robot has been turned to the ON position. An easy way to tell if this step has been successful is by checking both power

lights on the Braccio, as well as the camera. If these lights do not illuminate see to the troubleshooting section of the manual. Once power has been successfully turned on, the next step is the integrated controller for RUT. Shown below is a figure of the controller that is being referred to:



Figure 1: RUT Controller

Once the user has located the controller, the next step is to turn it on. Down in the bottom right of the controller is a switch labeled “POWER”, flip this and you have successfully turned on your RUT controller. From here a message may illuminate on the screen of your controller prompting you to “turn all switches to their upright position”. This simply means that one or more of the switches at the top of the controller, along with the analog sticks, are not in the proper position to initialize and as such must be corrected before moving forward. If no message was displayed then move onto the next step.

7.1.1 RUT Controls

Controls for the RUT are fairly simple. When looking at the controller, after completing the tasks above, the main control is through the right analog stick. The right analog stick is responsible for the RUT’s movement. By pushing the right stick forward, the robot will move backwards. Similarly, when pushed backwards the RUT will move forward. This is due to the past teams programming of the RUT. That being said, when the stick is pushed to the right, the RUT will mimic this motion and turn to the right. The same is true for when the stick is pushed to the left, the bot will turn left. In the future if more controls are needed they can be mapped to other sticks and switches on the controller.

7.2 VR (Oculus Quest 2)

To use VR as a camera display, first download the Unity Files from Capstone Website and Unity Hub. Create a new project of AR example. Add following assets:

1. XR Interaction Toolkit
2. Uduino
3. Text Mesh Pro

Also check the preference of the project, make sure Oculus VR is enabled, switch the project environment to Android. The view should display on a screen in the scene.

After Unity setup, connect the receiver to the computer. Power the camera on the robot and tune the receiver until it displays an image.

Link Oculus VR to computer using cable or air link, noting that air link requires wifi connection and the process of switching from air link to cable connection needs wifi as well. Once the connection is done, click the play button in Unity and the program will run.

7.3 Arm Control

Follow the steps above until Uduino is installed.

For controlling part, Uduino and Uduino wifi plug in of Unity is necessary, you need to add libraries to both Unity and Arduino IDE.

To control the arm remotely, a wifi environment is necessary. The computer and ESP8266-01 module should connect to the same wifi.

Compile the corresponding Arduino codes for both ESP8266-01 and Arduino Uno. Noting that for ESP8266-01, it is required to add ESP8266 library and select board type as Generic ESP8266. Change SSID and password before compiling to ESP8266-01, after compiling, open the serial monitor to get the IP address and port number. Attach Braccio board to Arduino, connect ESP8266-01 to Arduino as following:

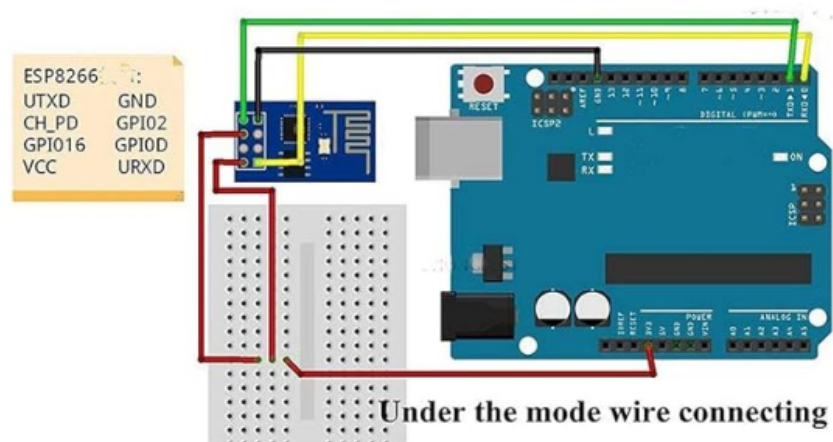


Figure 2: Wifi Module Wiring

Note that never plug power supply into 5V node, it will fry the wifi module, the voltage for wifi module is 3.3V. After hardware setup, configure Uduino.

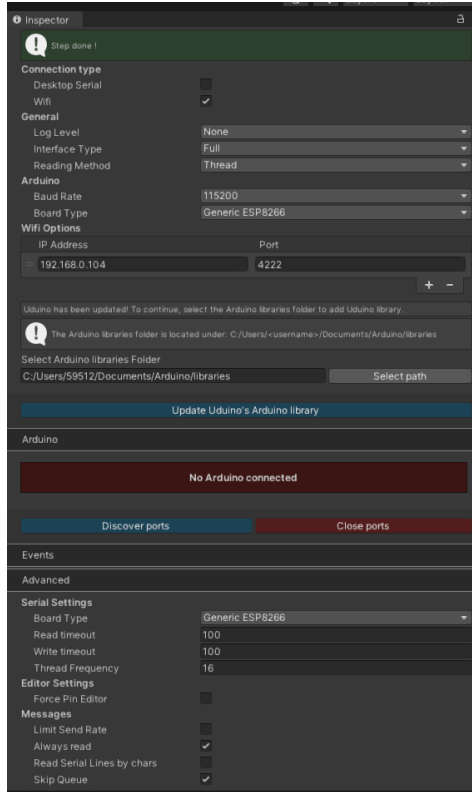


Figure 3: Uduino Configuration

Enable “wifi” only, change board type to Generic ESP8266, change IP address and Port to what you get from previous steps. Click Discover Ports to test the connection.

The arm is controlled by the position of VR Controller. The reaction is very sensitive to the control. By default, right hand controller is in use. The control is based on a virtual datum that can be reseted, click A button to reset the datum point. Press the trigger to hold gripper, this is a linear input so you can control the force.

7. 4 Maintenance

The maintenance of RUT is extremely straightforward. To start, just give RUT a onceover to check for any deformation in parts. Following that keeping the batteries of RUT, controller and VR headset charged. Tightening the nut on the tensioner to increase tension of track occasionally to ensure optimal tension. Additionally some components generate a significant amount of heat and could cause damage to the component or surrounding components, like the camera transceiver. The wiring between the Arduino and ESP8266-01 is fragile and may break if too much force is applied to that connection.

7.5 Troubleshooting

The robotic arm is losing torque under wireless input and the motor is struggling to lift up its shoulder.

The control is very sensitive to the input so it might break the components by sharp movements. For the cabled control, there is a small chance to have the arm reset and back for a short period of time.

The VR has a fixed coordination when the program starts running, be careful during the setup stage and do not rotate yourself when operating.