User Manual

Obstacle Robots For Swarm Robots Platform

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ISSUED BY

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1.1. Process Overview

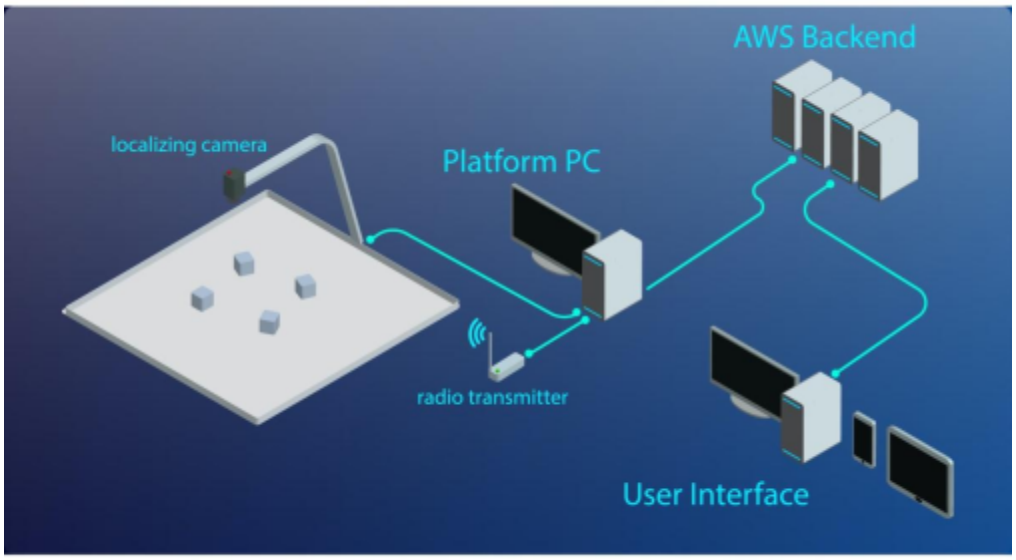


Figure 1

The system uses an overhead camera to localize the robots and the video feed is sent to the platform PC where all the algorithms are running and calculating the required parameters and the relevant data to the robots are sent using radio transmission and the other required data is sent to the server backend.

1.2. The System

The system contains a radio transmitter module, camera module, and robots. You should have to have an arena for the given dimensions. If your arena dimensions are higher than the given dimensions you have to purchase a separate HD overhead camera module. You have to have a computer (not included with the product) with an internet connection.

2. Features

- Algorithms are capable of handling about 100 robots.
- Self homing feature when the battery levels are too low.
- Battery level monitoring feature with GUI.
- Hardware and software emergency stop buttons.
- User-friendly 3D web interface.
- User-friendly operator GUI.
- Compact robot designing.
- Highly accurate positioning of robots.
- Colour changing capability of robots.
- Automatic error detections of robots.

3. Quick Startup

This section explains the quicker way to set up the system to use

1. **Setting up the overhead camera**

   Overhead camera should be fixed about 2m from the top surface of the arena. Then the USB cable should connect to the platform PC. (Camera calibration have to be done after step 2)

2. **Installing and setting up the operator GUI**
   a. First, you have to install and set up **python3** and **pip3** in your system.
   b. Then you have to clone this repository.
   https://github.com/cepdnaclk/e16-3yp-obstacle-bots-for-swarm-robots.git
   c. Then change the directory to, **/Platform_PC_Software/MainCode/**

   ```
   cd /Platform_PC_Software/MainCode/
   ```

   d. Next open a terminal in that directory and enter the following command

   ```
   pip3 install -r req.txt
   ```

3. **Installing and setting up the radio transmitter module**
   a. You have to plugin the provided radio transmitter module to a USB port on the Computer
   b. You have to identify the COM port for the usb device

4. **Starting the Operator GUI for the first time**
   a. You will be prompted to enter the **Swarm Name, Swarm ID, and the COM Port** for the radio transmitter module.
   b. Now you can see the Operator GUI for the First time.

5. **Adjusting the camera position**
   a. You have to adjust the camera position in such a way that the whole camera feed fits to the camera view.

b. Next place a bot inside the arena (Don't turn on the robot yet). Observe the camera feed and verify the AR marker has been identified. (If identified, you can see a green square around the marker)

6. **Turning on the robot**
    a. Now you can turn on the robot.
    b. Then click the start button on the Operator GUI.
    c. Then the robot should turn to a 90-degree angle and the status light should turn into cyan colour.
    d. Now click on the home button in the control panel.
    e. Then the robot should be moved into the home position.

(Note:- If you have any issues please refer to the troubleshooting section)

4. Device Installation

4.1. Power Requirements

- You have to install two 18650 Li-ion batteries on a robot. You have to charge each and every battery for at least 3 hours.
- A 24v power supply should be connected to the status lamp.

4.2. Network Configuration

- Platform PCs should always be connected to the internet. (No other specific configuration needed)

4.3. Configuring Camera Setup

- The camera should be fixed, about 2m from the top surface of the arena.
- Then adjust the camera view by looking at the camera image in the Operator GUI (the whole arena should be visible through the camera view)
- Then you have to place a robot inside the camera view (Without turning on the robot)
- Make sure the robot is identified by the Operator GUI by drawing a green square around the AR marker.

(Note:- If the markers are not detecting. Please refer to the camera troubleshooting section)

4.4. Radio Transmitter Installation

- The radio transmitter should be plugged into a USB port
- You should find the COM port for the transmitter
- You will be prompted to ask the COM port of the radio transmitter when opening the Operator GUI.

4.5. Emergency Stop and Status Lamp Installation

- The status lamp should be fixed on the arena
- Emergency stop should be fixed near to the operator
- Both of them should be connected to the radio transmitter module.
- Given 24V power supply should be connected to the status lamp.

5. Operator GUI

5.1. Overview

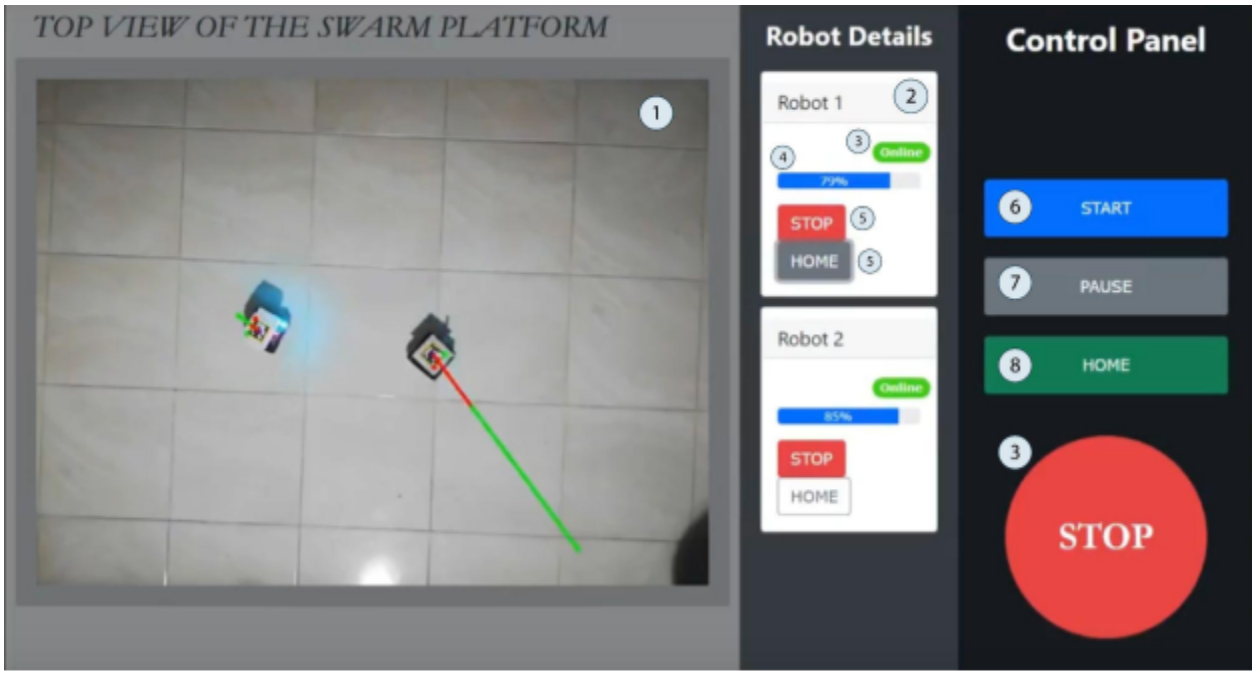


Figure 2

1 - Live view	5 - Individual Stop	9 - All Home Button
2 - Robot details	6 - Individual Home	10 - All Stop Button
3 - Robot live status	7 - Start button	
4 - Battery percentage	8 - Pause button	

5.2. Indicators

The operator can check the battery status of the robots using the [4] battery status progress bar. Also, use the [3] status indicator to check the online/offline status of the robots.

5.3. Controlling

- **Adding a new robot**

The system will auto-detect a robot once you are adding a new robot to the system.

- **Homing a robot**
  Press button 5 of individual robots to move the individual robot to the home position.
- **Software emergency stop**
  Press the emergency stop button (button no. 3) to stop all the robots in an emergency.
- **Starting and pausing a sequence**
  Press button 6 and 7 to start and pause the robots.

6. Web Interface

6.1. Overview

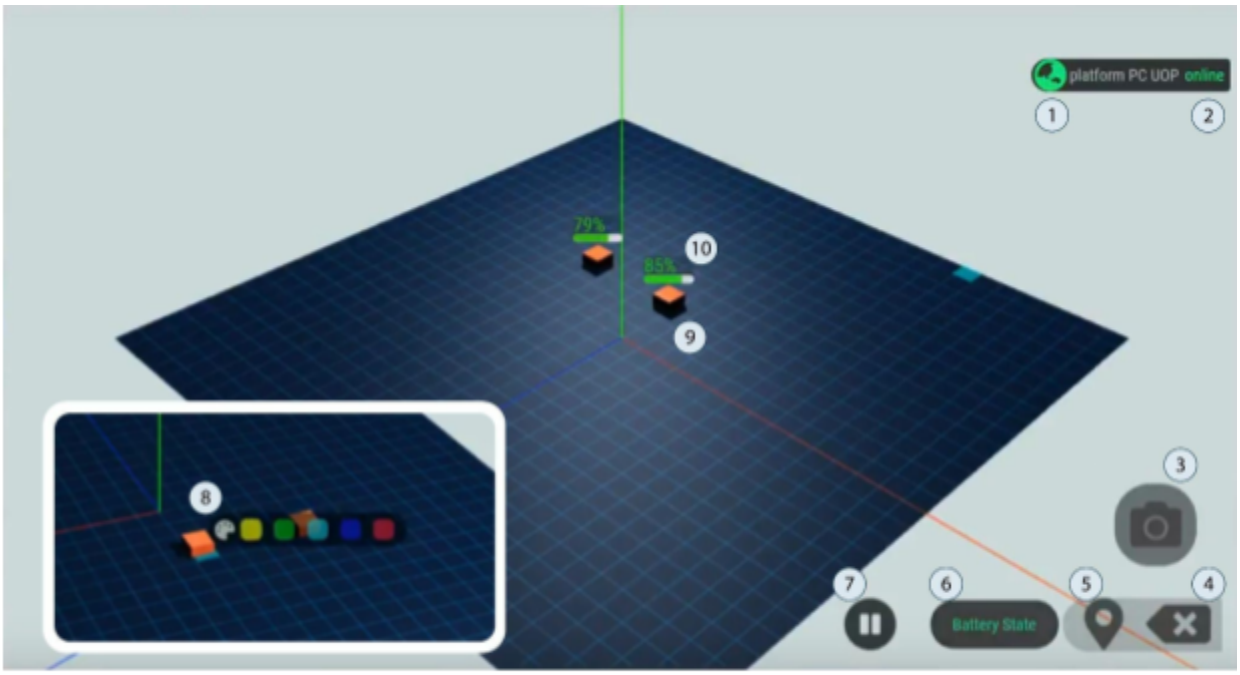
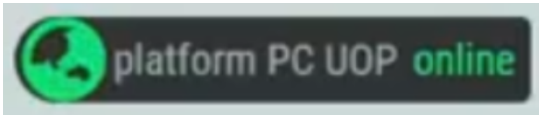


Figure 3

1 - Server name	5 - Destination setter	9 - Robot
2 - Server status	6 - Battery status	10 - Battery level
3 - Camera controller	7 - Pause button	
4 - Destination clear	8 - Robot colour picker	

6.2. Indicators

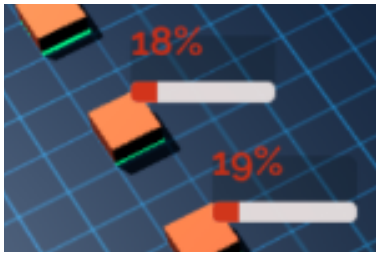
- Server Status



The status of the server can be seen in this tag. The globe will be animated if

the server is online. Also, you can see the platform name in this tag.

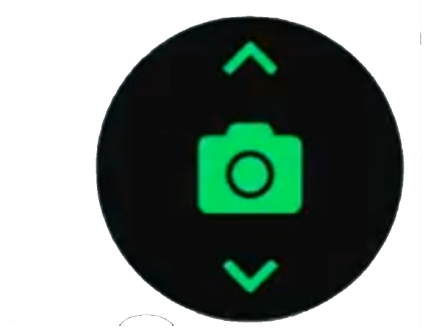
- **Robot Battery status**



The battery status of the robot can be activated through the battery status button.

6.3. Controlling

6.3.1. Change the camera view



This is the controller for the camera view. The upper arrow has the control to align the camera view to the top view. And the middle camera logo is the button for isometric camera angle(camera home).

6.3.2. Setting a destination

To set the destinations you have to first toggle into destination set mode by clicking this button. Then you can set the destinations up to the count of robots by clicking on the arena. After deciding the destination positions you can release this button to transmit the destination data to the platform PC.

6.3.3. Removing a destination

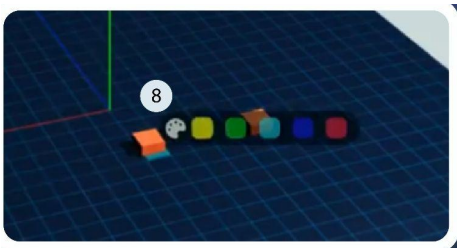
To remove a single destination, click the destination button to go to the destination set mode. Then click on the destination you need to remove. Then the indication of the destination will go away.

6.3.4. Remove all destinations.

 Click on this button to remove all destinations.

6.3.5. Change the color

To change the color, hover over the color pallet to get the color selecting option.choose a color you want .



7. Robot

7.1. Overview

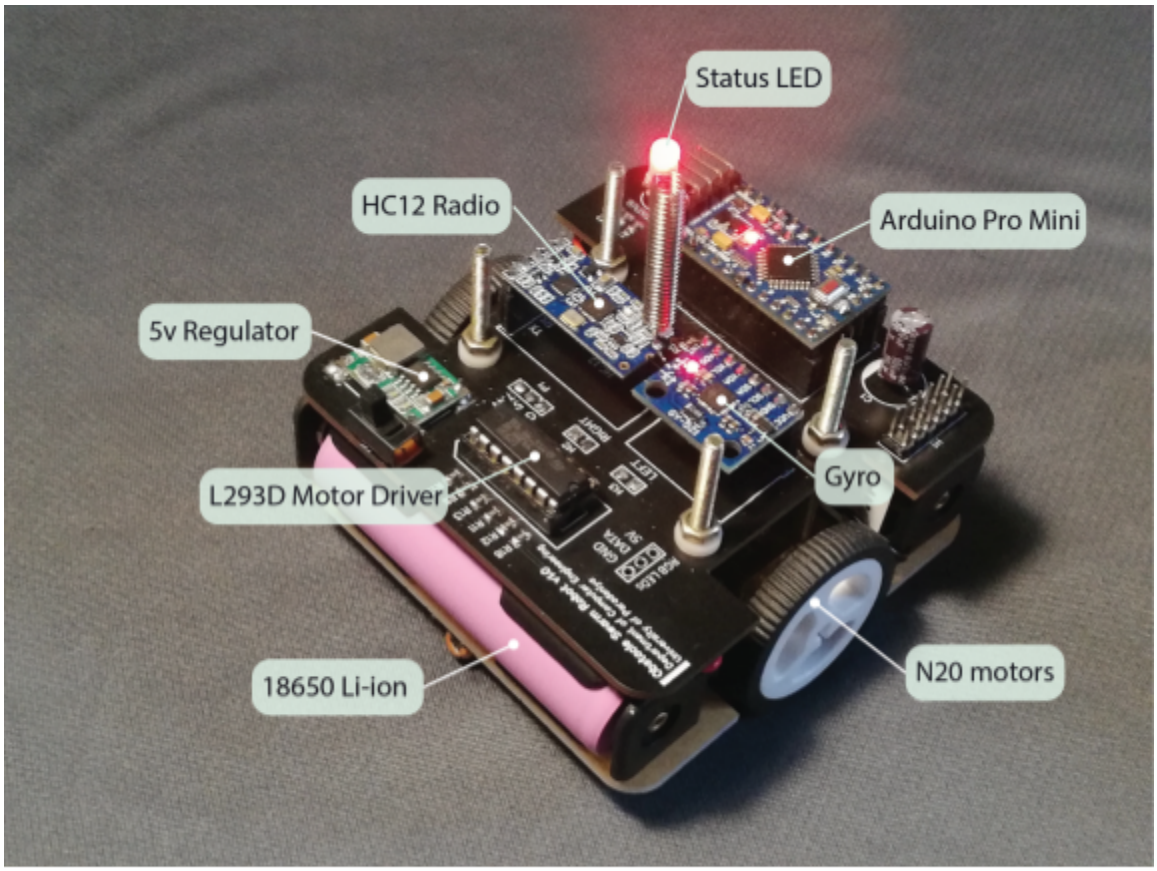


Figure 4

- **Arduino pro mini**
  - Arduino 328p 16mhz microcontroller is used as the computer of this robot
- **HC12 Radio module**
  - The radio communication is done with a 433Mhz HC-12 module. This is the transceiver that has the capability of 2-way communication with the platform PC.
- **Gyroscope**
  - MPU 6050 is the gyroscope module used in this robot.

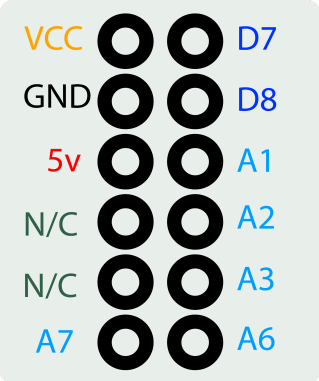
- **5v Regulator.**
    - Switch Mode 5v voltage regulator.

- **Motor driver**
    - L293D is the motor driver IC used in this robot. Since this is the D version internal circuitry is safe from the flyback voltages.

- **Batteries**
    - This robot is powered with 2s 18650 2000mah Li-ion battery.

- **Motors**
    - This robot has two N20 100rpm 6v motors with 30mmx7mm wheels.
- **Status LED**
    - **Red blinking -** robot successfully received a data packet.
    - **Blue blinking -** robot successfully received a data packet that belong to the specific robot.
    - **Green** - robot is in the turning PID loop.
    - **Light Blue** - Robot at the destination.

- **Extension port**
    - For the further development the unused pins of the arduino are extended via male 6x2 header the pin description is as follows.



8. Troubleshooting

8.1. Camera position troubleshooting

Problem	Solution
Camera view detecting only part of the arena	• *Move the camera upwards until you can see the whole arena* • *Center the camera module in the Arena*
Camera not detecting	• *Unplug the USB cable and plug it again*
Camera feed interruption (or lagging)	• *Check for the CPU usage of the system. If the CPU usage is above 80%, kill unwanted processes.*

8.2. AR marker detection troubleshooting

Problem	Solution
AR Markers not detecting	• *Adjust the lighting conditions* • *Move the camera closer to the Arena*

8.3. Local communication troubleshooting

Problem	Solution
If the blue LED on the transmitter not blinking rapidly	• *Unplug the radio transmitter and plug it again* • *Check whether the COM port is correct*
Robots red light not blinking	• *Check whether the Robot ids are correct in the Operator GUI* • *Reset the Robot*

	● *Reduce the distance between the radio transmitter and the Arena* ● *Check the radio transmitter module is firmly attached to the PCB*

8.4. Robot troubleshooting

Problem	Solution
Not turning ON	● *Check whether the batteries are charged* ● *Check the batteries are installed in the correct way*
One or both wheels not turning	● *Check the pugs connected to the motors are firmly attached to the PCB* ● *Check the wheels are firmly attached to the motor* ● *Check the battery level.*
Robot is oscillating	● *Run the robot calibration programme*