USER MANUAL

Mobile Robot Photogrammetry

Safety Caution:

Operating the mobile robot with caution is essential to ensure a safe and successful photogrammetry process. Please consider the following safety guidelines:

1. Terrain Awareness: Avoid navigating the robot on steep edges or uneven surfaces, as it may lead to tipping or loss of balance. Stick to flat and stable areas for smoother movement.

2. Constant Supervision: Always keep the robot under close supervision, especially during manual operation. Be prepared to intervene promptly if needed.

3. Emergency Stop: Familiarize yourself with the location of the emergency stop button. Ensure it remains easily accessible at all times to halt the robot's operation in emergencies.

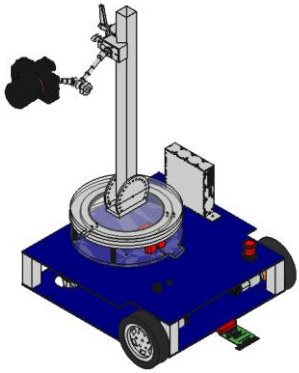
4. Keep Obstacles Clear: Before starting, clear the surrounding area of any obstacles or tripping hazards that could interfere with the robot's path.

5. Prevent Cable Tangles: Manage all cables and wires connected to the robot properly to avoid entanglement and accidental disconnections.

6. Battery Safety: Charge and handle the robot's batteries according to the manufacturer's instructions to avoid accidents or damage.

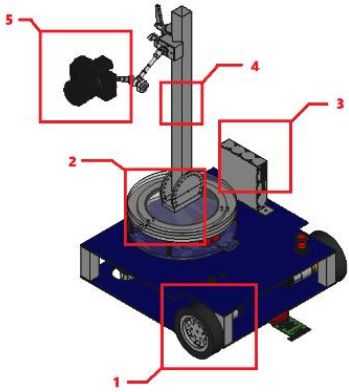
By following these safety precautions, you can ensure a secure and efficient photogrammetry process while minimizing the risk of accidents or damages. Your careful attention will contribute to a successful and rewarding experience with the mobile robot.

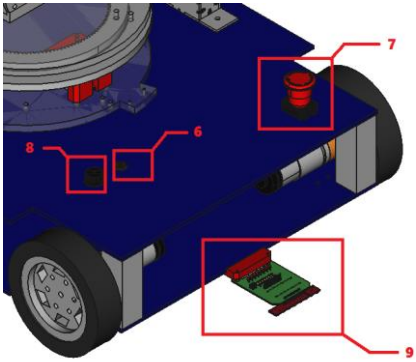
Specification:

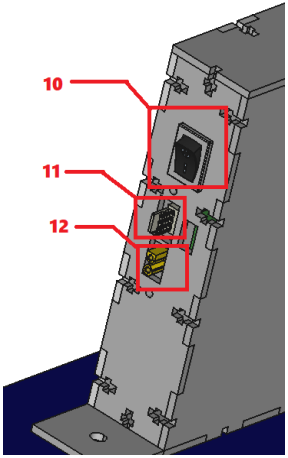


Dimensions	:	52 x 52 x 100 cm
Weight	:	20 kg
Chassis Material	:	Iron Plate 3 mm
Load Capacity	:	Up to 150 kg
Wheel Diameter	:	15 cm
Line Sensor	:	QTR-8A
Master PC	:	Raspberry Pi 3B
Robot Controller	:	STM32F407VET
Maximum Speed	:	0.18 m/s

Parts:



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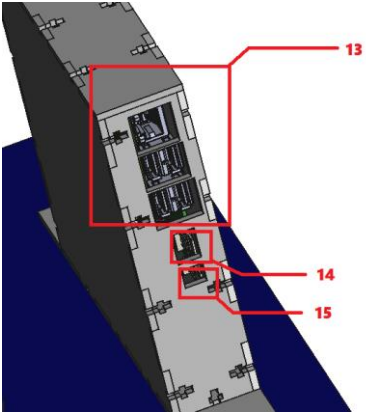
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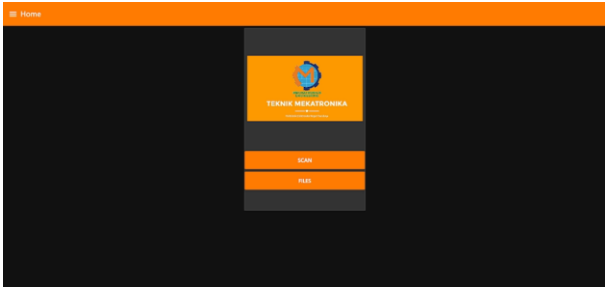
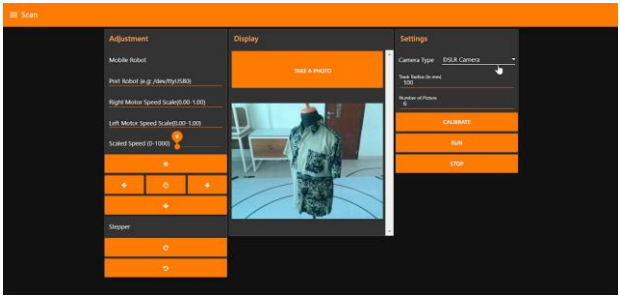
Part names:

1. Wheel
2. Turnable Base
3. Mini Computer
4. First Link
5. Camera
6. Mobile Robot Power Button
7. Emergency Button
8. Charging Port
9. Line Sensor
10. Mini Computer Power Button
11. Mini Computer Charging Port
12. External Battery Port
13. USB Ports of Mini Computer
14. Stepper Motor Port
15. Emergency Port

User Interface Navigation:

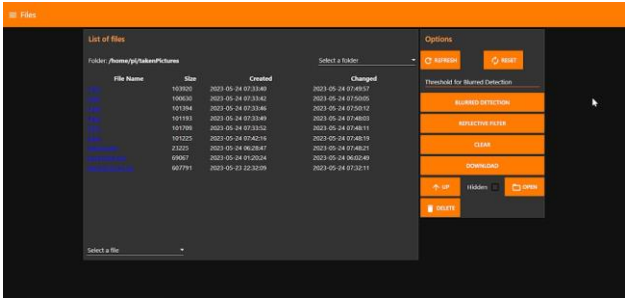


SCAN	:	Navigator to Scan page
FILES	:	Navigator to Files page



RUN	:	Start capturing
STOP	:	Terminate the running task
CALIBRATE	:	Calibrate the line sensor
Number of Picture	:	Determine the number of picture to take
Track Radius	:	Set the radius of the circular track
Camere Type	:	Set camera type

TAKE A PHOTO	:	Take a display picture
⟲	:	Turn stepper left
⟳	:	Turn stepper right
↓	:	Move robot back
←	:	Turn robot left
→	:	Turn robot right
↑	:	Move robot forward
✋	:	Stop the robot
Scaled Speed	:	Set the speed of the robot
Left Motor Speed	:	Set the speed of the left motor
Right Motor Speed	:	Set the speed of the right motor
Port Robot	:	Set the port communication of the robot



REFRESH	:	Refresh page
RESET	:	Reset directory
Threshold for Blurred Detection	:	Set the threshold
BLURRED DETECTION	:	Process blurred detection
REFLECTIVE FILTER	:	Process reflective filter
CLEAR	:	Delete last taken pictures
DOWNLOAD	:	Combine files in a zip
UP	:	To the previous directory
OPEN	:	Open a certain directory
DELETE	:	Delete a certain file

Material Preparation

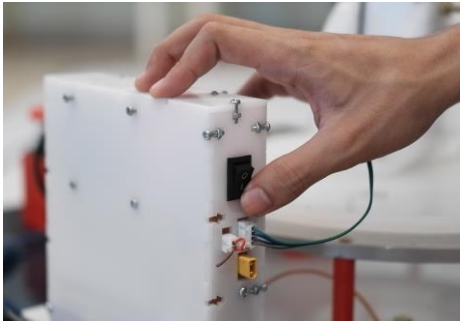
Before starting the capturing process, make sure every piece of equipment required to run this robot is ready. It includes the robot, track, pc or laptop for the user, and the object to be captured.

Open the track and then put the object in the middle of the track.

The robot needs to be exactly on the line. The robot can be moved using the UI on the user's PC. The guide for moving the robot is going to be discussed in the next section.

Robot Activation

Users can turn the robot on by simply pressing the power button of the Mini Computer on the robot.



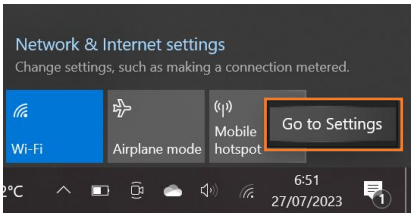
Then followed by pressing the power button on the robot.

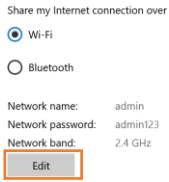
Accessing UI

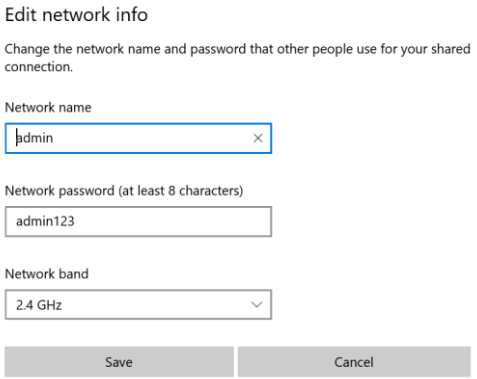
After activating the robot, the user can open the laptop or personal computer. As long as the user's computer can run a web browser and is able to make a portable hotspot, then it will be able to access and run the UI. Before accessing the UI, set a mobile hotspot with:

SSID : admin
Password : admin123

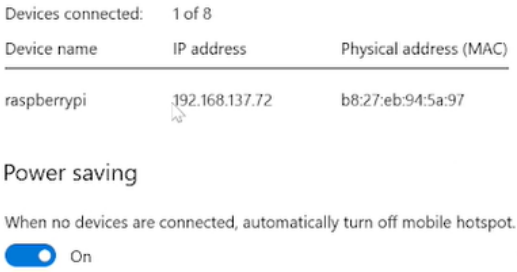
The step for Windows 10 is shown in the pictures bellow.



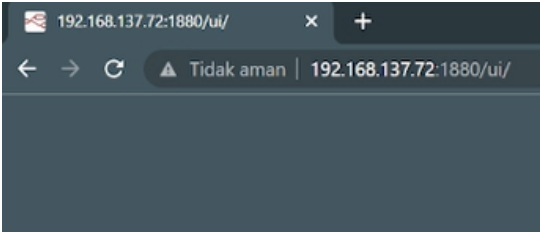




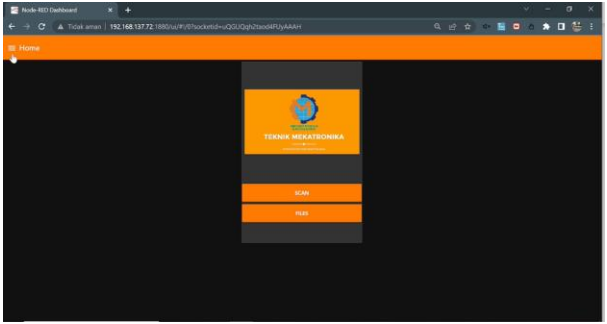
After setting the SSID and Password, activate the mobile hotspot by pressing the Mobile hotspot button. Let the Setting page open to track any device connected to the user's PC. After a while, the IP address of raspberrypi, which is the IP address of the robot, will appear on the device connected column.



Copy the IP address, then write it down on the web browser with the format ipadress:1880/ui. For example in the picture below.

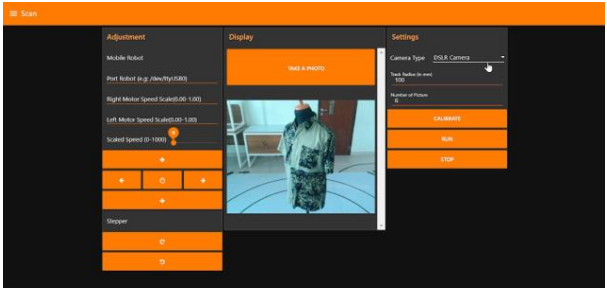


Congratulation! The UI is accessed successfully.



Parameter Setup

To set the parameters, open the Scan page by pressing the SCAN button on the UI. This page will appear like picture bellow.



By default, the port is defined as /dev/ttyUSB0. However, the user can adjust the port communication of the robot based on practical use, especially if there is more than one system communicating with the Mini Computer using UART Serial Communication.

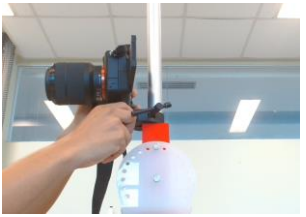
Right Motor Speed and Left Motor Speed can be adjusted to balance both motor speeds of the robot. The robot's speed as a whole is adjusted by sliding the Scaled Speed slider.

There are two options for the camera to use on this system, it could be one of DSLR or a Webcam. The user can choose one of them by changing it on Camera Type.

Running The Robot

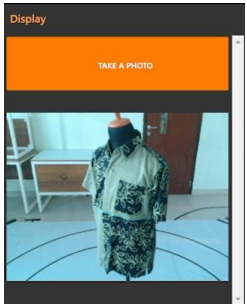
Before running the robot, make sure every part of the picture-capturing process were in the right position. The robot can be moved to the right position by pressing the arrow buttons on the Scan page, where every button function was defined in the User Interface Navigation section.

After moving the robot to the right position, the user can put the camera and adjust its angle according to the requirement. The camera can be installed using a clamp connector which can be connected to the robot's Camera Link.

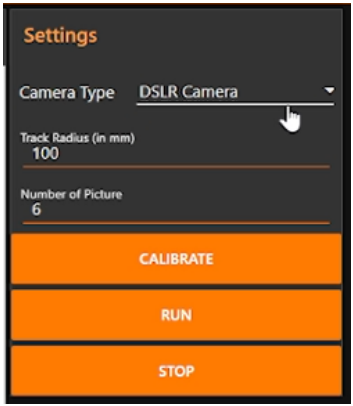


Then, users can adjust the vertical angle by opening the screws of the bracket and shifting the link up to 45 degree.

If users use a webcam, the display of how the camera captures the object and whether it's already on its right angle or not can be shown by pressing TAKE A PHOTO button in the Scan page.



After making sure that the camera captures the object's picture properly, finally, user can set parameters including the radius of the track and the number of picture that will be taken.

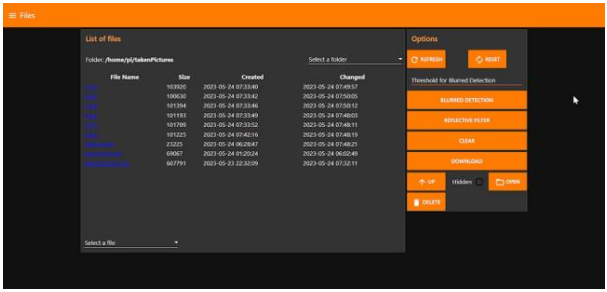


Before running the robot, calibrate the sensor by pressing the CALIBRATE button, the robot will turn left and turn right, and then stop for a while. When the calibration process succeeds, the led indicator of the sensor will show different behavior when it detects a black line and a white surface. If the sensor detected the black line, the led will be turned on, on the other hand, it will off when the white surface is detected.

Finally, users can run the system by pressing the RUN button. The robot will automatically capture pictures from different angles. To terminate the task, press the STOP button, then the robot will stop.

Post-Processing

After taking the pictures, the user can download picture files by simply clicking them in the List of Files. If the file did not appear, try to press the REFRESH button.



Users can use the blurred detection feature to delete any blurred result that will disturb the 3D reconstruction process. Another feature to use is the reflective filter, to clean the reflective surface of the taken object.

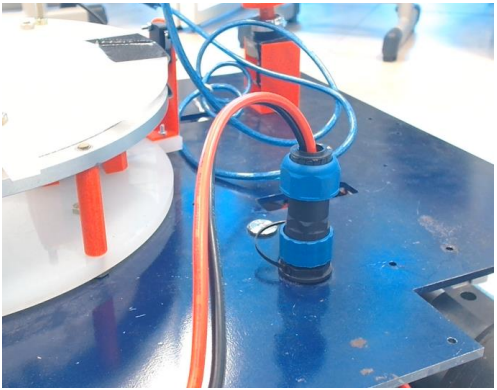
To download all files, click DOWNLOAD then click the takenpictures.zip file which contains a collection of pictures. To delete current pictures, click CLEAR.

After having a collection of pictures, the 3D reconstruction can be processed using various software, including Meshroom. It will produce a mesh model of the object that can be shown 360 degree.

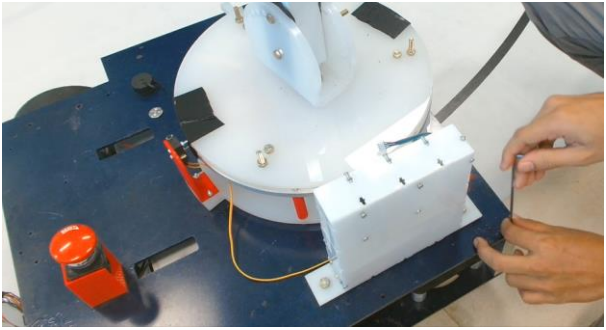
Maintenance

Always make sure that the Mini Computer's battery voltage always above 11.8 V and the robot's battery always above 26.0 V by using a battery checker.

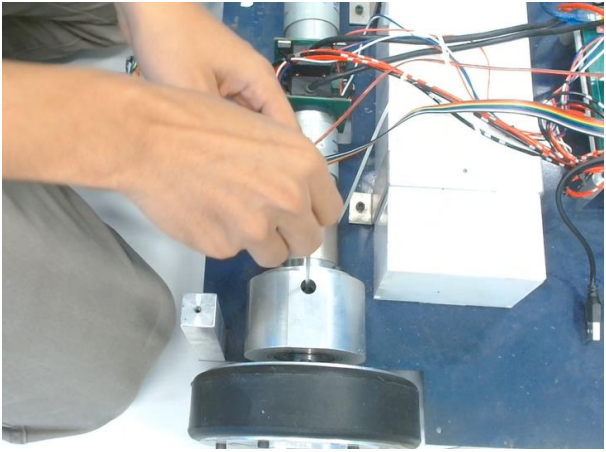
If the battery is bellow the voltage threshold, charge using the charger unit.



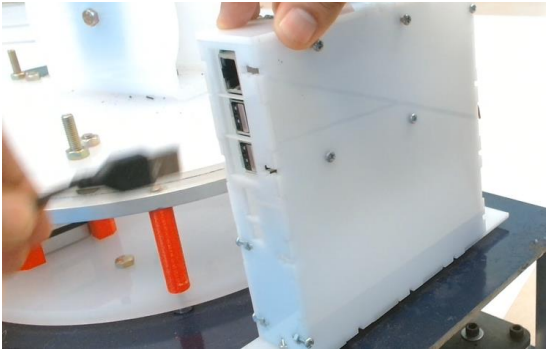
When it is required, tighten the robot's wheel mounting by opening the robot's top plate.



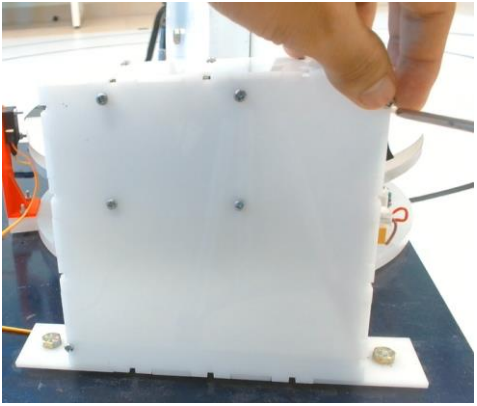
Then, tighten the wheel's mounting.



If there was a need to fix some problem with the Mini Computer, open the case by unplugging the cable first.



Then, lose the screws of the case.



Be careful when opening the case, make sure no cable damaged on the process.