MARS LITE

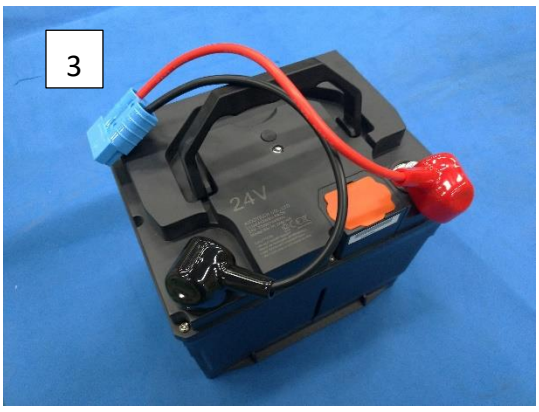
Quick Start Guide

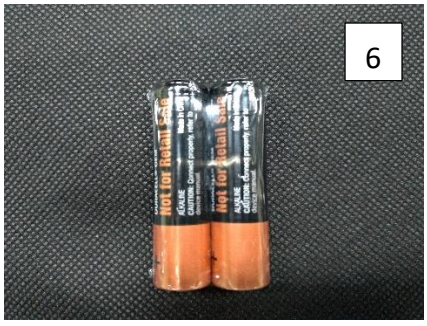
Version 1.0

I. Preface

A. *Box Contents*

1) Mars Lite Robot x1
2) Mars Lite Joystick x1
3) Robot battery x1
4) Power cable for charger x1
5) Battery charger x1
6) AA batteries for Joystick x2





II. Index

III. Safety

A. *Warnings*

1. Mobile platform teleoperation

When tele-operating the mobile platform the following warnings will be given to the user through joystick vibrations:

***Single vibration*:** When an obstacle is detected in the vicinity within a range of approximately 1.4 meters. After this warning is given, the mobile platform will disable fast mode. To enable fast mode again the mobile platform should not detect obstacles nearby.

***Constant vibration with intervals of one second*:** When an obstacle is detected within a close range; approximately 0.8 meters. The mobile platform will stop immediately. In this scenario the only way to move the platform is to change to *emergency mode* (section V.C.2), and distance the unit from the surrounding obstacles.

2. Robot arm warnings section

These are caused by attempting to perform robot arm movements that are disallowed:

Singularity Point alert: Whenever the robot is close to a singularity point the joystick will start vibrating.

3. Power Supply

***Normal* (15% ~ 100%):** The LCD display has white background and shows 5 parameters (Battery percentage, Temperature, Voltage, Current, Time to empty).

***Low* (5% ~ 15%):** Orange background with the same parameters, as well as a "battery low" message that will be displayed at the lower row of the LCD.

***Critical* (3% ~ 5%):** Red background with the same parameters, as well as a "battery critical" message that will be displayed at the lower row of the LCD.

4. Other states of battery LCD display

Cyan Background LCD: Shooting down.

Blue Background LCD: Mars Lite has been successfully powered off.

B. *Robot arm LED states*

Red Blinking: Recovery state. Not ready to use.

Red-Green Blinking: Robot in error state. Re-initialization of the robot arm is needed. To restart robot arm, please read troubleshooting section.

Green Blinking: The robot arm is in free mode. Please read the Joystick Buttons and Axes section to learn how to use free mode.

Green Constant: The robot arm is in jog mode (task-space or joint-space)

Blue Constant: Trajectory mode.

Cyan Blinking: The arm is locked. Release arm emergency stop in order to use the arm. This color will just happen once, when you unlock the arm for the first time after starting up.

C. Intended Use

This unit is designed to carry objects of no more than 1kg. It's intended to operate in smooth floor surfaces. This platform offers a wide range of sensors that are intended to be used for development purposes and applications. The unit can be tele-operated with the provided joystick.

D. Emergency Buttons

The platform has two emergency stop buttons:

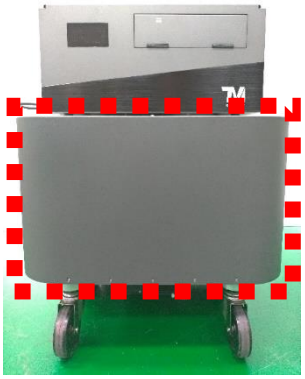
1. *Mobile platform emergency button*: Is located on the left side control panel of the mobile platform. When pressed, it will cause an immediate stop of the mobile platform motors if they are running.
2. *Robot Arm emergency button*: Is located on the control panel of the robot arm controller box. When pressed, the robot arm will stop its motion and enter recovery mode.

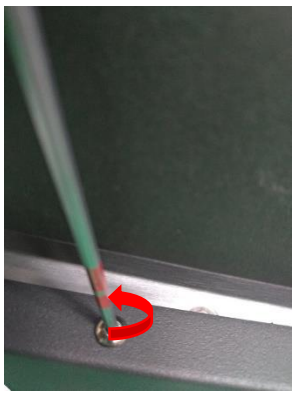
IV. Hardware Installation Manual

A. *Battery Replacement*

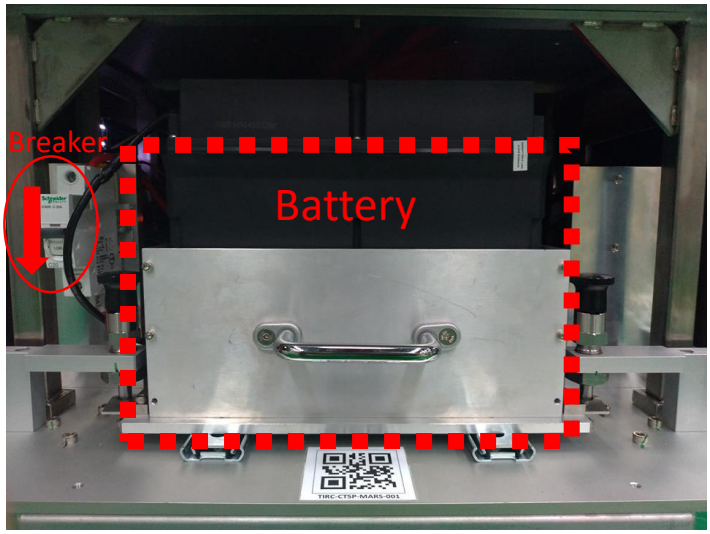
Step 1. Make sure Mars Lite robot has been powered off. To verify the power is off inspect the mobile platform control panel does not have any light on, as shown in the figure below.

Step 2. Remove the mobile platform's cover back. Remove all screws that attach this part of the cover to the structure. You don't need to remove the whole cover, just the back part.

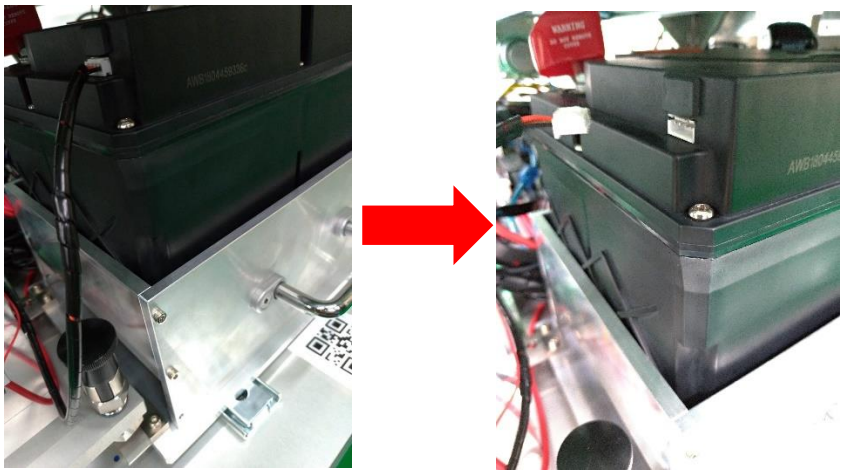




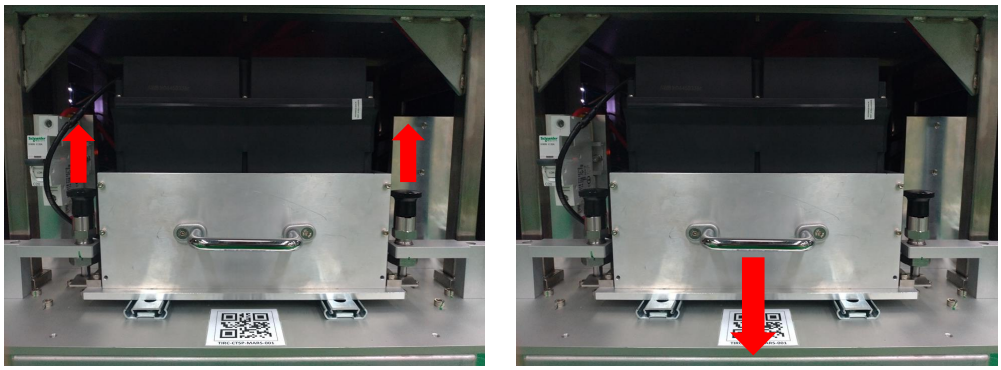
Step 3. Pull the breaker down.



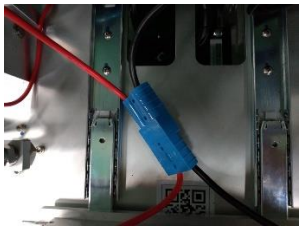
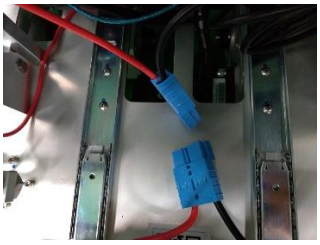
Step 4. Disconnect the small cable on the left side of the battery.



Step 5. Pull up the small locks located on each side of the battery and pull the battery cabinet using its handle.



Step 6. Pluck the cable that is located behind the battery.

Step 7. Remove the empty battery and replace with a recharged battery.

Step 8. Reconnect cable at the back of the battery to the recharged battery.

Step 9. Push the cabinet back inside.

Step 10. Connect cable at the side to the recharged battery.

Step 11. Pull up the electric breaker.

Step 12. Close the case.

V. Tele-operation of device

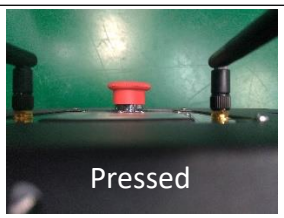
A. *Initialization*

To initialize the Mars Lite there are two control panels that must be used

Mobile platform control panel

Step 1. Press button 1 in order to turn on the mobile platform. The contour will have a green glowing light when on.

Step 2. Mobile platform button (button 2): Whenever is pressed wheels' motors will be turned off. Release mobile platform tele-operation.

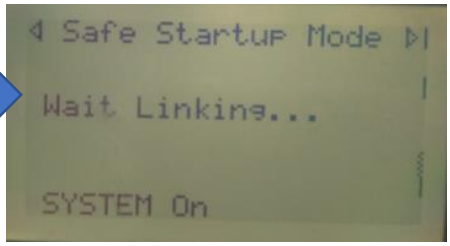


Robotic arm control panel

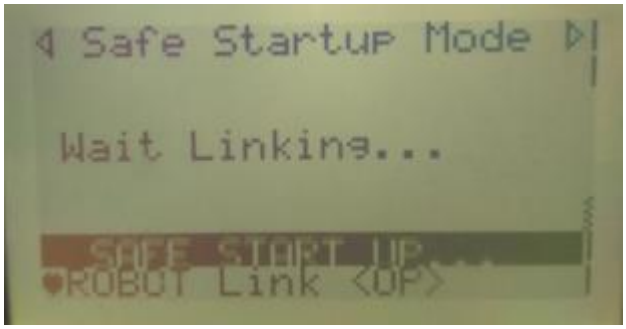
Step 3. Make sure robot arm emergency stop button (4) is pressed before turning the control box on. Press button 3 until a beep is heard. This sound indicates the robot controller is turning on. The arm will be powered but is still not ready to be used.

Note:
The ✖ symbol represents that the button has no function.

During initialization you should see the following screens on the small display on the back of the robot arm control box.



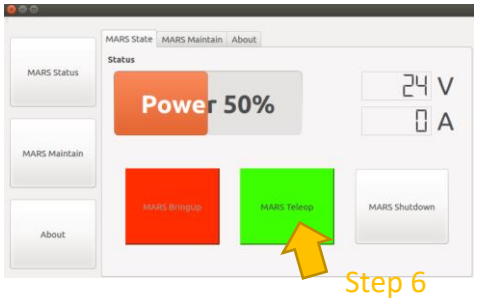
After step 3 this screen will be displayed, wait until the text SAFE START UP is displayed.



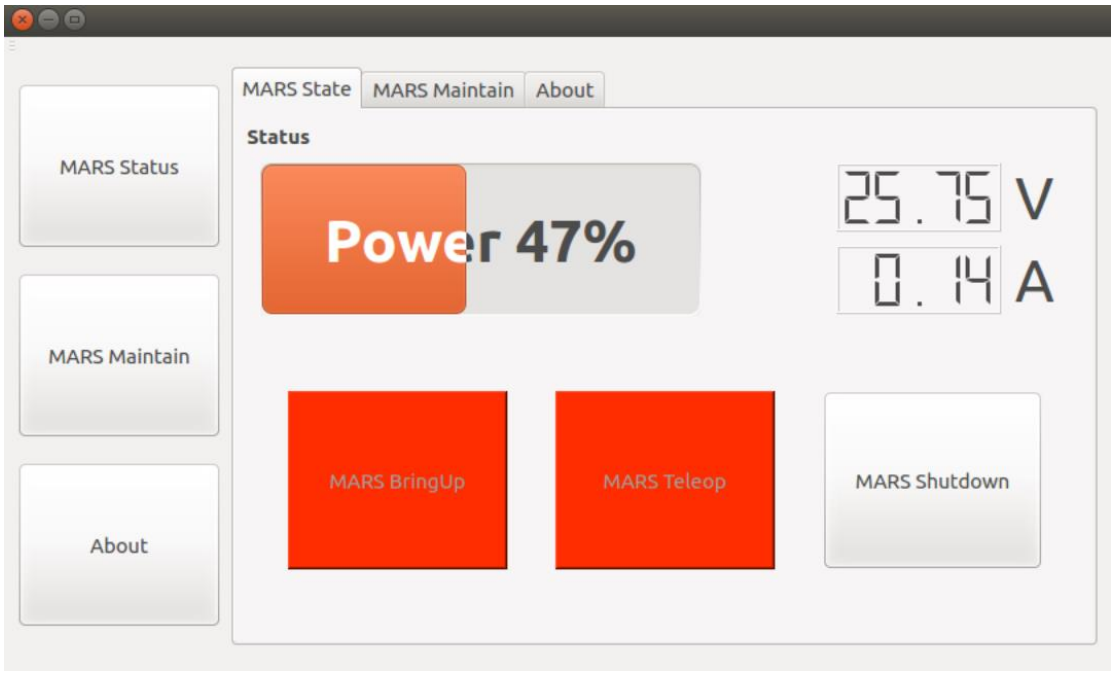
Step 4. This is the SAFE START screen. At this point you can release the emergency robot to start the robot arm.

This is the final screen that will be displayed. Now the robot is fully functional and ready to use.

Step 5. Go to the control interface and click the "MARS BringUp" button. It will turn red as shown in the next picture. This will start the drivers for each component of Mars Lite.



Step 6. Click "MARS Teleop" button. This will start the tele-operation mode. The mobile platform will start in Normal Mode and the robot arm in Free Mode.



At this point the Mars Lite is ready to be tele-operated using the joystick. To turn the joystick on press button 1 as shown in section Joystick Controls. Wait until the joystick vibrates and the button 1 light stops blinking. This indicates Mars Lite is ready to be tele-operated. For more information about tele-operation modes please follow the instructions in the next sections.

To deactivate the Mars Lite joystick tele-operation, double click “MARS Shutdown” button. The “MARS Bringup” and “MARS Teleop” buttons will return to their original state. Steps 5 and 4 will be undone.

B. Mars Lite Modes

1. Robot Arm Modes

Task-Space jog: Jog the robot arm using task-space velocities.

Joint-Space jog: Jog the robot arm using joint-space velocities.

Trajectory mode: Execute trajectories preconfigured and written in the file “mars_lite_teleop/config/joy_buttons_trajectories.yaml”.

2. Mobile Platform Modes

Normal Mode**:** Tele-operation is allowed with low speed motion (0.2 m/s). Collision-protection is on.

Fast Mode**:** Tele-operation is allowed and the platform’s speed is increased to 0.5 m/s. Collision-protection is on

Stop Mode**:** Complete stop of motion. Automatically triggered when objects are in a close range from the front sensor. Motion is not allowed unless *emergency mode*

is activated.

***Emergency Mode*:** Allows to tele-operate the mobile platform with slow speed (no fast mode allowed). Collision-protection is off.

C. Joystick Controls

1. Mobile Platform Controls

Button 1: Turn joystick on
Analog Left and Button 3: Control mobile platform rotation on its own axis, long press 3 to enter emergency mode
Button 12: Accelerate forward (while pressed)
Button 13: Keep pressed to enter Fast Mode.
Button 14: Reverse

2. Robot Arm Controls

2.1 Trajectory Mode

Hold button 11 to enter trajectory mode. In this mode the robot arm LED will light ***Constant Blue***. In trajectory mode the buttons: button 4, button 5, button 6 and button 7 will execute preset trajectories when pressed.
If button 11 is released while executing a trajectory, the trajectory will be canceled. Use this feature to stop the robot arm in case of an unsafe situation, e.g. risk of collision.

2.2 Jog Mode

Hold button 13 to enter jog mode. In this mode the robot arm LED will light ***Constant Green***. In jog mode, the following controls are available:

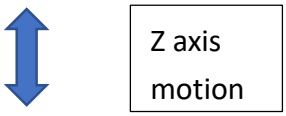
2.2.1 Task Space Jog Mode

Button 1: Turn joystick on.

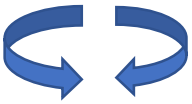
Analog Right and Button 2:

Long press button 2 to change task-space reference frame with respect to joint 1 current orientation. A short vibration indicates the reference frame has been updated.

Button 4:
Button 5:



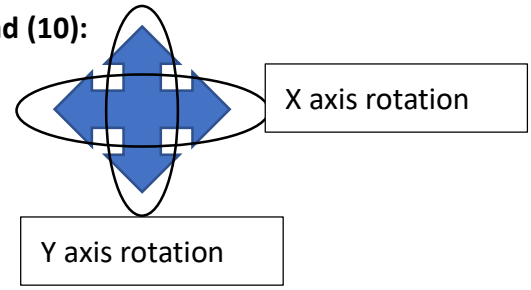
Buttons 6 and 7: rotation on Z axis



Button 8: Long press to change between Task-Space and Joint-Space mode. A short vibration indicates the mode has been changed.

Button 9: Open and close gripper

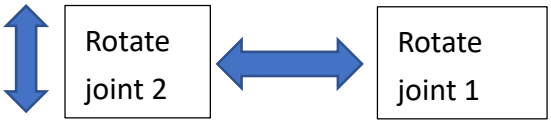
D-pad (10):



2.2.2 Joint-Space Jog Mode

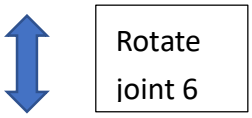
Button 1: Turn joystick on.

Button 2:



Long press button 2 to change joint-space reference frame with respect to joint 1 current orientation. A short vibration indicates the reference frame has been updated.

Button 4:
Button 5:

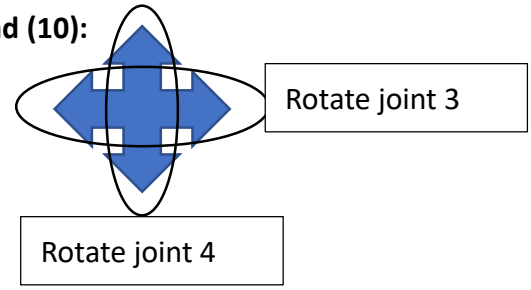


Button 6 and 7: rotate joint 5

Button 8: Long press to change between Task-Space and Joint-Space mode. A short vibration indicates the mode has been changed.

Button 9: Open and close gripper

D-pad (10):

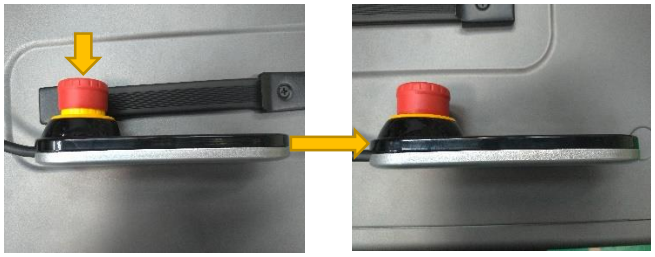


2.3 **Robot Arm Free Mode**

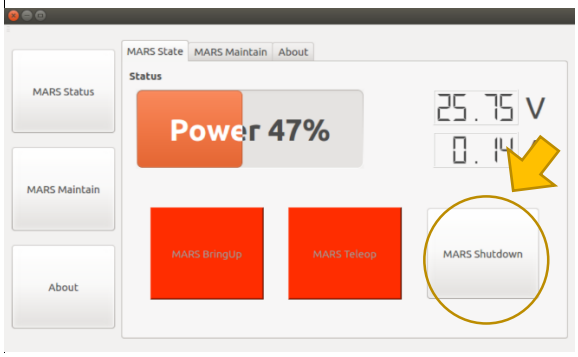
When arm LED is green blinking the arm is in free mode. The “free” button on the right side of the camera can be pressed to move the arm around by dragging it manually.

D. Shutdown

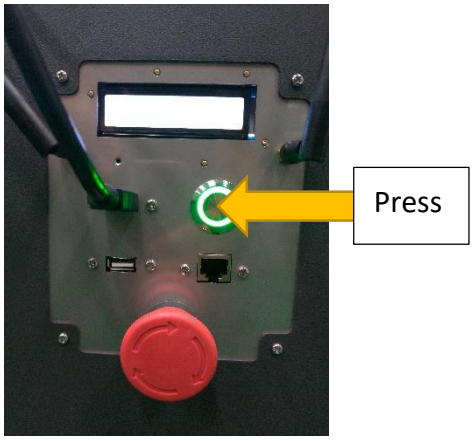
Step 1. Press the robot arm emergency stop button



Step 2. Turn computer off. Triple click "MARS shutdown" in order to shutdown.



Step 3. Turn off Mars Lite



E. Troubleshooting

Robot Arm

Remove from Error State: If Mars Lite is moving through irregular surfaces or the arm is jogged and stopped immediately, the error state might be triggered (robot arm blinks red-green). The arm cannot be used in this state. To recover from error state, press and then release the robotic arm emergency stop button.

Robot motion safety: When operating the arm in jog/task or trajectory mode. Hold pressed the corresponding button to complete the task. If you release the button the robot arm motion will stop. If the robot is in any danger of collision can release the corresponding buttons and stop the motion of the unit.

Failed Connection attempt:
Make sure that you already turned on the robotic arm. Then try to connect again.

Mobile Platform

Unable to bring-up mobile platform: Check that platform emergency stop button is released, otherwise, you'll have to start over the initialization process.

VI. Mars Lite Features

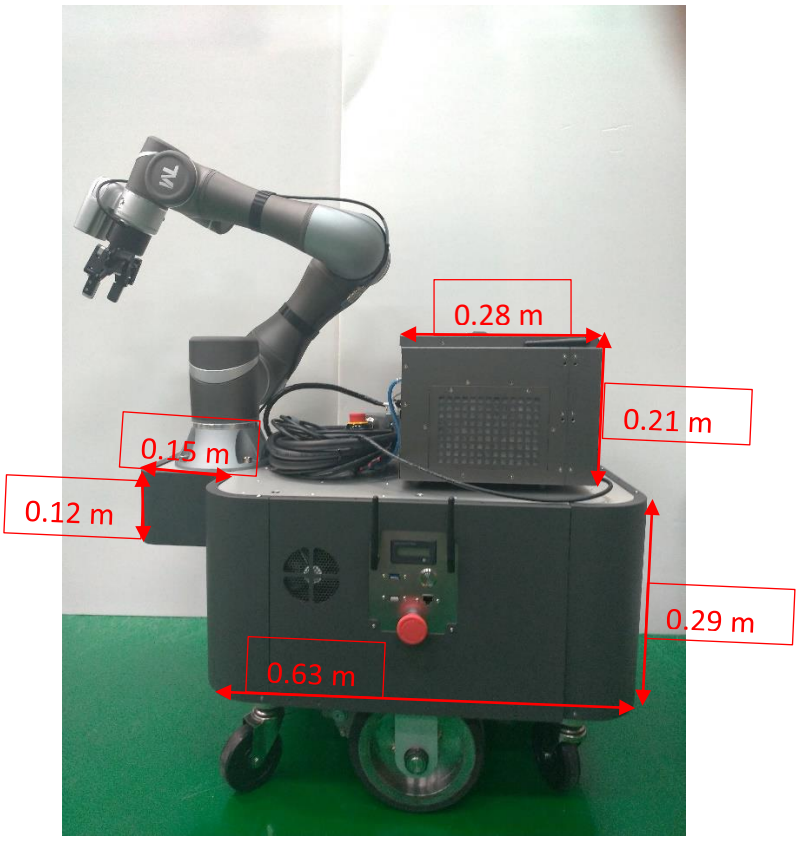
The platform unit counts with a wide variety of components, between them:

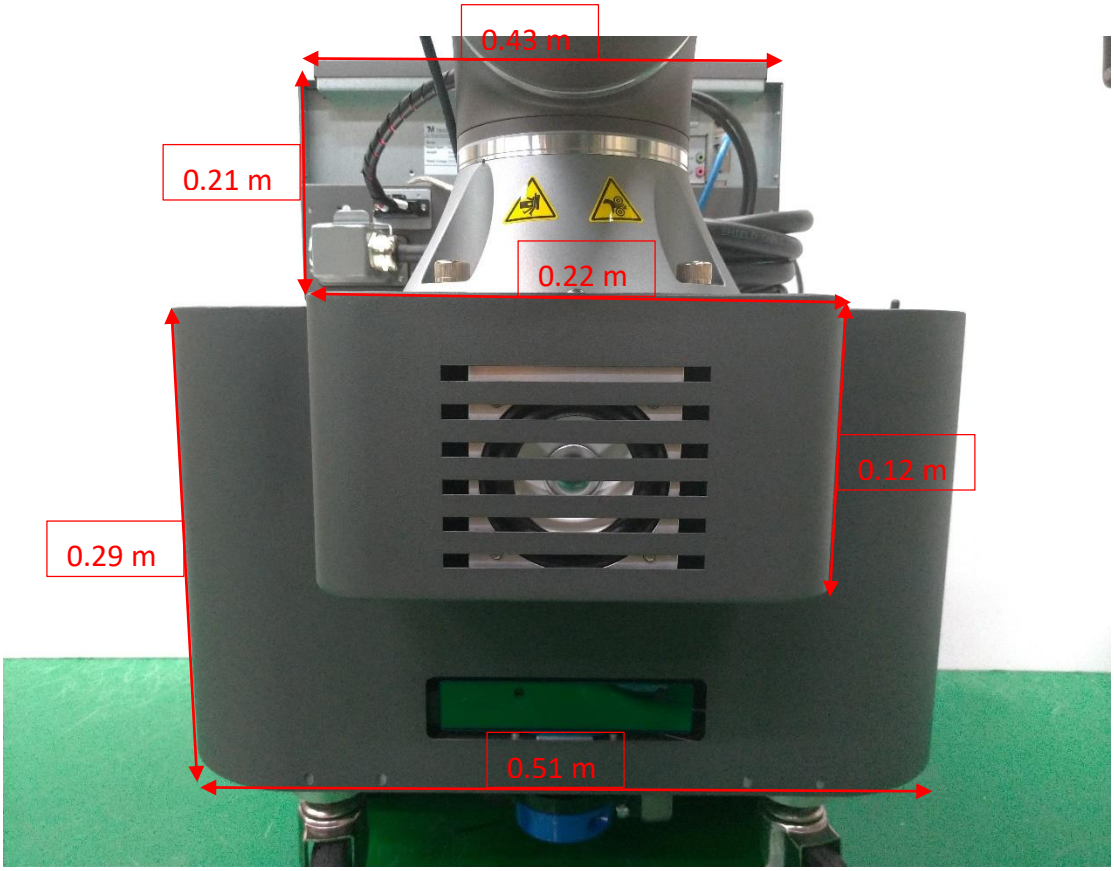
- Mobile platform powered by Trumman motors
- TechMan TM700 robot arm. ROS driver with functions for joint trajectory execution and joint speed commands
- Robot arm hand mounted camera
- X4 Lidar
- Sparkfun 9DoF IMU
- Intel Real Sense color and depth cameras
- TFT 7 inch display
- Microphone
- Speakers
- Wifi/Bluetooth connection

VII. Technical Specifications

Weight	116 kg
Normal Mode Speed	0.2 m/s
Normal Mode Angular Speed	0.16 rad/s
Fast Mode Speed	0.5 m/s
Fast Mode Angular Speed	0.4 rad/s
Emergency Mode Speed	0.1 m/s
Emergency Mode Angular Speed	0.08 rad/s
Max. Payload	1 kg
Height (home)	1.3 m
Arm radius	0.045 m

Mars Lite Home





Robot Arm