
User Manual

for

Lunar Rover Mapping Robot

Version 1.0

Group: UG12



THE UNIVERSITY
of ADELAIDE

Contents

List of Figures	ii
1 Overview	1
1.1 Introduction	1
1.2 System Requirement	1
1.3 Definitions, Acronyms, and Abbreviations	1
2 Robot EV3	2
2.1 EV3 Brick	2
2.2 Color Sensor	2
2.3 Gyroscopic Sensor	2
2.4 Large Motors	3
2.5 Medium Motor	3
3 GUI	4
3.1 Connection screen	4
3.2 Main Screen	5
3.2.1 Control Panel	5
3.2.2 Switch Panel	7
3.2.3 Map Panel	7
4 Building Connection	10
4.1 Cable	10
4.2 Bluetooth	10
4.3 WiFi	10
4.4 Frequent Problems On Connection	10
5 Manual Control	11
5.1 Switch to Manual control	11
5.2 Associated Key	11
6 Autonomous	12
6.1 Switch to Autonomous	12
6.2 Setting up destination	12
7 Map Display	13
7.1 Display of Map Feature	13
7.2 Create the No Go Zones	13
7.3 Discard the Creations	14
7.4 XML Import	14
7.5 XML Export	14
Index	15

Revision History

Version	Date	Reason for changes
1.0	28/10/2017	Final version

List of Figures

1	Ev3 Brick	2
2	Color Sensor	2
3	Gyro Sensor	3
4	Large Motor	3
5	Medium Motor	3
6	Connection Screen	4
7	Main Screen	5
8	Moving Control	5
9	Color Sensor Move Control	6
10	Emergency Stop	6
11	Autonomous and Manual Switch	7
12	Reset and Start New	7
13	Map Display	8
14	Map Editing buttons	8
15	Zoom In/Zoom Out	8
16	Save Map	9
17	Close Button	9
18	Robot Control Panel	11
19	Destination icon shown on the map display region	12
20	Destination confirm	12
21	Example of Map Display	13
22	Example of No Go Zone creation	14

1 Overview

1.1 Introduction

This document is a user guide for use of Lunar Rover Mapping Project and provide guidance on both the robot and server side. The document also provide necessary information for user to deal with some frequent problem that may occur during the operation.

1.2 System Requirement

Before we get started, the following describe the necessary requirements to run the application.

Computer requirements

- WiFi
- Bluetooth
- At least 500MB of RAM
- At least 200MB of HDD
- Java 7

Robot Requirement

- Robot EV3 Brick
- EV3 Ultrasonic sensor
- EV3 Gyro sensor
- Color Sensor
- EV3 Motors
- USB WiFi adapter

1.3 Definitions, Acronyms, and Abbreviations

- CPU: Central Processing Unit
- GPU: Graphics Processing Unit
- GUI: Graphical User Interface
- HDD: Hard Disk Drive
- RAM: Random Access Memory
- UI: User Interface

2 Robot EV3

2.1 EV3 Brick

The EV3 Brick (Figure 1) is the control center and power station for the robot. All sensors and motors must be connected to the EV3 brick before starting the application. To start the brick, hold the center button for 2 to 3 sec and "leJOS EV3" will be displayed on the brick screen. The booting normally needs around 110 sec.



Figure 1: Ev3 Brick

2.2 Color Sensor

The color sensor (Figure 2) recognizes the different colors and measures light intensity. The application requires the color sensor to be connected to port 1 of the brick. Otherwise, the application will fail to set up the color sensor.



Figure 2: Color Sensor

2.3 Gyroscopic Sensor

The EV3 Gyro Sensor (Figure 3) measures the robot's rotational motion. The application requires the Gyro Sensor to be connected to port 4 of the brick. Otherwise, the application will fail to set up the Gyro Sensor.



Figure 3: Gyro Sensor

2.4 Large Motors

Large Motors (Figure 4) controls the movement of the robot. The application requires the left motor to be connected to port D and the right motor connected to port A. Otherwise, the application will fail to set up the motors.

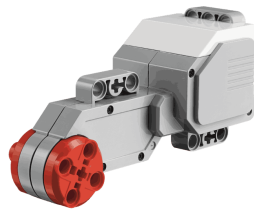


Figure 4: Large Motor

2.5 Medium Motor

In this application, the Medium Motor (Figure 5) control the movement of color sensor. The application requires it to be connected to port C. Otherwise, the application will fail to set up the Medium Motor.



Figure 5: Medium Motor

3 GUI

On the server side, the Lunar Rover Mapping Project includes a GUI that provides a window to allow the user to interact with the application. The GUI has two screens: a connection screen, and a main screen. The connection screen will pop out at the launch of application. The main screen will only displayed after the connection is successfully built.

3.1 Connection screen

The connection screen (Figure 6) is comprised of two sections. The message window displays the setting up information for each sensor and motor. The selection panel is used for selecting the connection method.

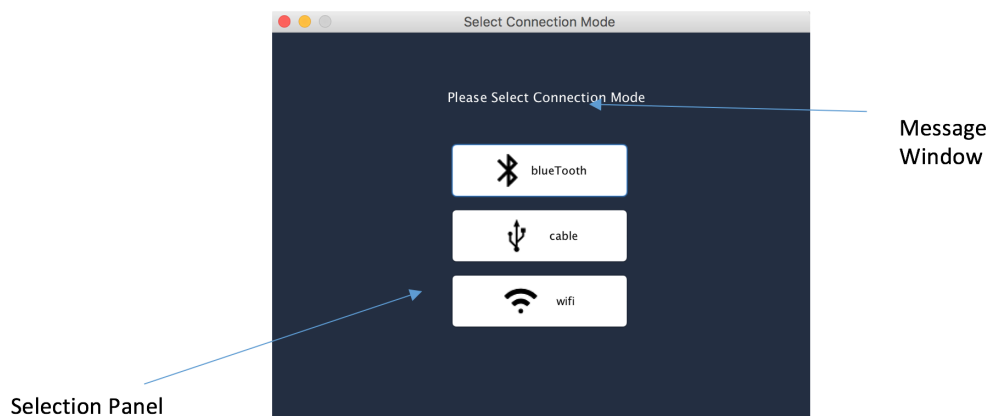


Figure 6: Connection Screen

- "Bluetooth" button should be selected when the connection is via Bluetooth. The robot will have the IP address 10.0.1.1.
- "Cable" button should be selected when the connection is via a USB cable. The robot will have the IP address 10.0.1.1.
- "WiFi" button should be selected when the connection is via WiFi. The robot will be assigned an IP address and it is displayed on the brick screen. It will pop up a prompt to ask the user to enter the IP address.

3.2 Main Screen

The layout of the main screen (Figure 7) is comprised of the following sections: the control panel, switch panel, and map display region. The control panel provides buttons that allow the user to manually control the movement of the robot. The switch panel provides buttons to switch between the manual and autonomous mode of the robot, and clear the map creations e.g. destinations. The map display region renders the map structure and presents a graphical representation of the map to user.

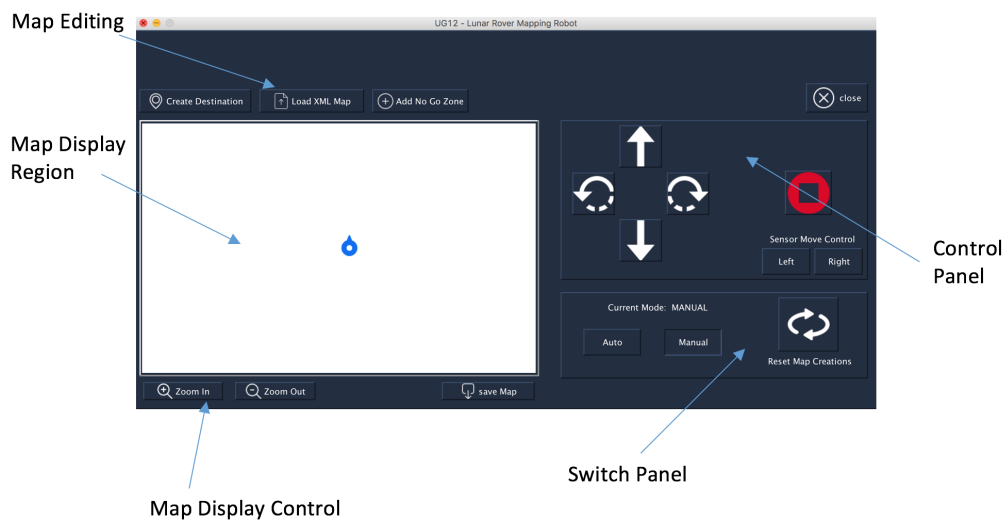


Figure 7: Main Screen

3.2.1 Control Panel

3.2.1.1 Robot movement control

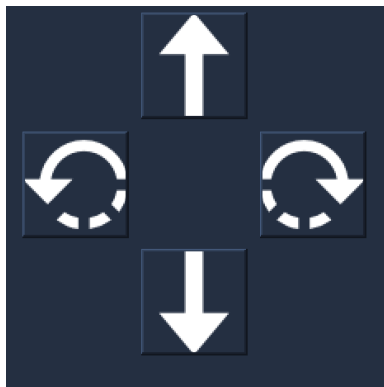


Figure 8: Moving Control

The movement controls (Figure 8) are as follows:

- The button with the up arrow will send a forward command when the user clicks on it or presses the up arrow key on the keyboard.
- The button with the down arrow will send a backward command when user clicks on it or presses the down arrow key on the keyboard.
- The button with the left rotate arrow will send a left rotate command when the user clicks on it or presses the left arrow key on the keyboard.
- The button with the right rotate arrow will send a right rotate command when user clicks on it or presses the right arrow key on the keyboard.

3.2.1.2 Color Sensor movement

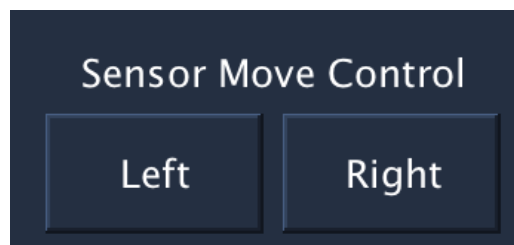


Figure 9: Color Sensor Move Control

The color sensor movement controls (Figure 9) are as follows:

- The left button will send a left move command to move the color sensor when the user clicks on it.
- The right button will send a right move command to move the color sensor when the user clicks on it.

3.2.1.3 Emergency Stop



Figure 10: Emergency Stop

- The Emergency Stop button (Figure 10) will send an emergency stop command to the robot to stop the robot from movement immediately.

3.2.2 Switch Panel

3.2.2.1 Autonomous and Manual Switch

Autonomous and Manual Switch (Figure 11) (R01 Manual Control and R02 Autonomous Control)

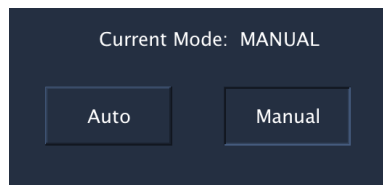


Figure 11: Autonomous and Manual Switch

- When the manual button is selected, the robot will switch to the manual mode which allows the user to manually control the robot and enable the sending of robot movement commands.
- When Auto button is selected, the robot will switch to the autonomous mode which enables self path finding of the robot and disables the sending of robot movement commands.
- The current mode can be viewed on the status window.

3.2.2.2 Reset and Start New



Figure 12: Reset and Start New

- When the robot has reached the destination, the Reset and Start New button (Figure 12) allows the User to reset the figures of map.

3.2.3 Map Panel

3.2.3.1 Map display region

- This region (Figure 13) will display the map visualization by rendering the map data. It displays the robot position and map features. It also allows the user to modify the map by marking no go zones or creating destinations.

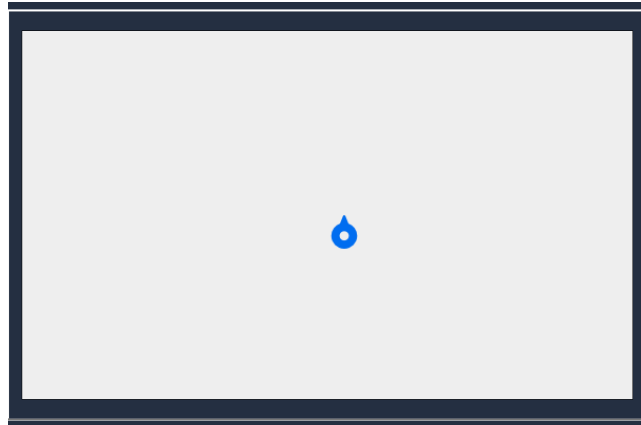


Figure 13: Map Display

3.2.3.2 Map Editing Buttons



Figure 14: Map Editing buttons

- The map editing buttons (Figure 14) are placed above the map display region. They have the functionalities to allow the user to modify the map.
- When the "Create Destination" button is clicked, it allows the user to create a destination by clicking a specific point on map. The text on this button will become "Confirm", and the user needs to click on it to confirm the destination.
- When the "Load XML map" button is clicked, it allows the user to load the data of DTD.xml into the map structure. The DTD.xml will also be rendered and displayed to the user at the same time.
- When the "Add No Go Zone" button is clicked, it allows the user to mark the NGZs on the map. This is done by using the mouse to drag a shape on the map display region. The text on this button will become "Confirm", and the user needs to click on it to confirm the NGZ.

3.2.3.3 Zoom In/Out



Figure 15: Zoom In/Zoom Out

- One click on the "Zoom In" button (Figure 15) will enlarge the components displayed in the map by 10%.
- One click on the "Zoom Out" button (Figure 15) will narrow the components displayed in the map by 10%.
- When the map is zoomed in, user can click on the map to move the camera.

3.2.3.4 Save Map



Figure 16: Save Map

- "Save Map" Button (Figure 16) allows user to save the data of current map. All features of the map will be rendered into XML format.

3.2.3.5 Close button

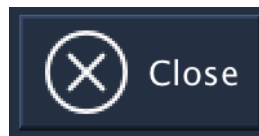


Figure 17: Close Button

- When the user clicks the "Close" button (Figure 17), it will send command to close all the motor and sensor ports and then exit the program.

4 Building Connection

4.1 Cable

This is the simplest way to connect the robot. User needs to plug the USB cable on the robot USB port and the computer. The user can then launch the application and select "Cable" on connection screen. Upon successful connection, the main screen will pop up.

4.2 Bluetooth

To connect the robot via Bluetooth, user needs to firstly turn on the Bluetooth on the computer then enter the Bluetooth setting on the EV3 brick. The brick should show your device name after searching. Then the user should confirm the device and there will be a pin shown on the brick screen. After entering this pin on the computer, the robot should connect to the computer. Then the user shall click Bluetooth on the connection screen. Upon successful connection, the main screen will pop up.

4.3 WiFi

To connect the robot via WiFi, user needs to make sure the robot and the computer are connected to the same network via WiFi. There will be an assigned IP address displayed on brick. Then user shall click WiFi on the connection screen and enter the IP address displayed on the brick. Upon successful connection, the main screen will pop up.

4.4 Frequent Problems On Connection

In case the main screen didn't pop up and it stays on connection screen, It means the connection is not built. There are following ways to resolve this problem:

1. Try another connection method.
2. Check the message shown on the connection screen and make sure sensors and motors are correctly connected to the ports.
3. Enter brick setting, reset and try again.

5 Manual Control

5.1 Switch to Manual control

Manual control is the default mode at the launch of the application. Under this mode, User can control the robot manually. The buttons associated with manual control will be enabled. The user can click the buttons to control the movement of the robot in the control panel. Holding the button will make robot movement continuously.

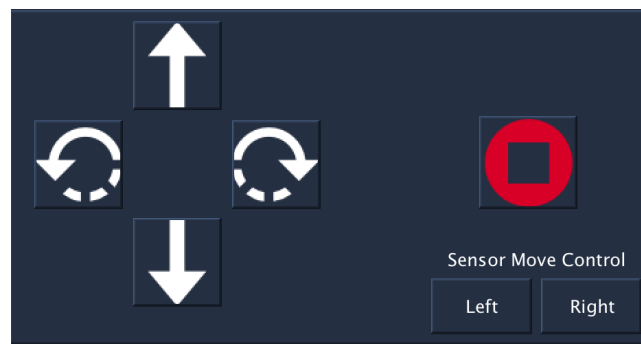


Figure 18: Robot Control Panel

5.2 Associated Key

- Moving forward - Up Arrow Key
- Moving Backward - Down Arrow Key
- Turn Clockwise - Right Arrow Key
- Turn Anti Clockwise - Left Arrow Key
- Emergency Stop - Space

NOTE : The manual control buttons except Emergency stop will be disabled in Autonomous mode.

6 Autonomous

6.1 Switch to Autonomous

The user can switch to Autonomous mode by clicking the "Auto" button in the switch panel. In this mode, the manual control buttons, except Emergency stop, will be disabled. The user can select a position on map display region by clicking to create a destination. If the path between the destination and the robot position is not blocked, the robot will automatically move to this destination through a shortest path.

6.2 Setting up destination

To set up a destination, the user needs to click the "Create Destination" button and select the destination (shown in Figure 19) on the Map display region. After the first click on "create destination", the text of this button will be changed to "confirm" (shown on the Figure 20). User can click this button to confirm the destination position and then the robot will be moving to this position if the path is not blocked.



Figure 19: Destination icon shown on the map display region is not blocked

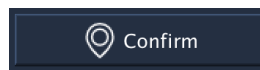


Figure 20: Destination confirm

7 Map Display

7.1 Display of Map Feature

The map is updated regularly and the GUI displays the map in real time. When the robot detects the feature on the map, it will be shown on the map with the associated color:

- Border = Blue
- Radiation = Green
- Tracks = Purple
- Craters = Black

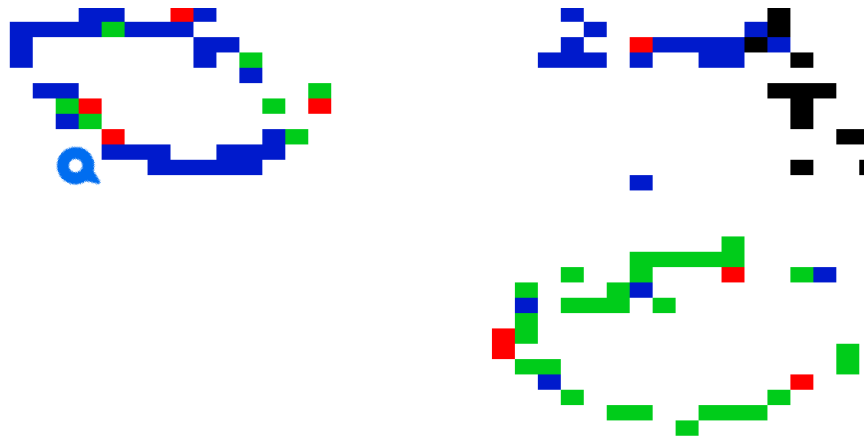


Figure 21: Example of Map Display

7.2 Create the No Go Zones

The user can create No Go zones by clicking the "Add No Go zone". It allows the user to drag a rectangular shape on the map and designate this region to be a No Go zone in the map structure. The user can add more than one No Go zones on the map.

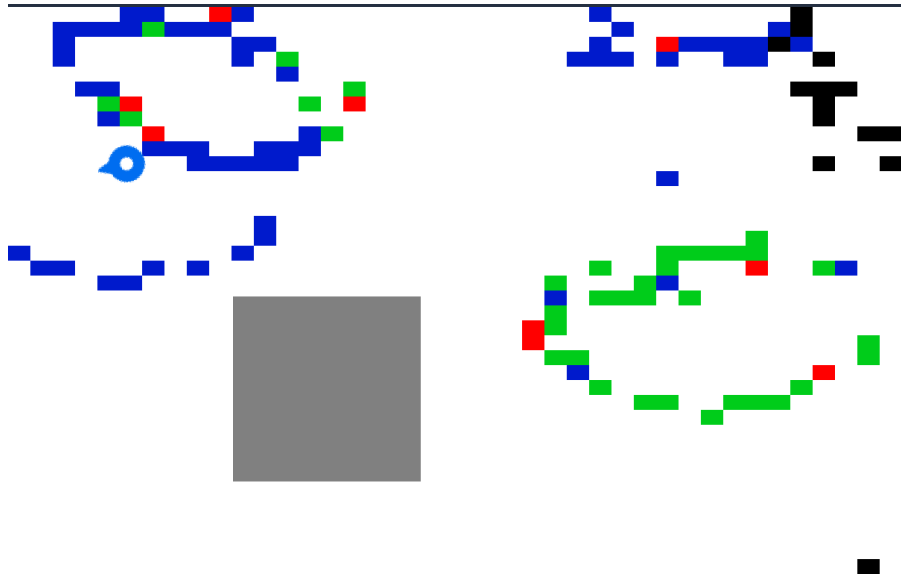


Figure 22: Example of No Go Zone creation

7.3 Discard the Creations

The user can also disregard the creations on the map including Destination and No Go zones by clicking the "reset" button on the switch panel (refer to Section 3.2.2.2).

7.4 XML Import

User can import the XML into map structure by clicking "import XML file" on map editing section (refer to Section 3.2.3.2).

7.5 XML Export

User can export the XML into map structure by clicking "save the map" on map display control section (refer to Section 3.2.3.4).

Index

A

Arrow keys - Control Panel, 6
Arrow Keys - Manual Control, 11
Autonomous Mode Control, 12
Autonomous Mode Switching Button, 7

B

Bluetooth Connection Information, 4
Bluetooth Connection Instructions, 10

C

Cable Connection Information, 4
Cable Connection instructions, 10
Close program, 9
Color Sensor, 2
Color Sensor Movement, 6
Computer Requirements, 1
Connection Problems, 10
Connection Screen, 4
Control Panel, 5

D

Destination Create Button, 8
Destination Creation, 12

E

Edit map, 8
Emergency Stop, 6
EV3 Brick Setup, 2
Export XML Button, 9

G

Gyroscopic Sensor, 2

L

Large Motors, 3

M

Main screen, 5
Manual Mode Control, 11

Manual Mode Switching Button, 7
Map - Remove features, 14
Map colors, 13
Map Display, 13
Map Display Panel, 7
Map editing buttons, 8
Map Panel, 7
Medium Motor, 3
Movement control, 5

N

No Go Zone Button, 8
No Go Zone Creation, 13

R

Reset map, 7
Robot Requirement, 1

S

Save Map, 9
Switch Panel, 7

W

WiFi Connection Information, 4
WiFi Connection Instructions, 10

X

XML Export, 14
XML Import, 14
XML Map Load Button, 8

Z

Zoom In, 8
Zoom Out, 9