Xiaosen CHEN

Alexandre EANG

Alexandre MENSAH

Théophile THOMAS

Zhipeng ZENG

TECHNOBOTS

User manuel

Summary

I. Introduction

1. Purpose of the manual

The purpose of this manual is to provide a comprehensive instructional resource for those participating in the Search and Rescue Robotics Competition. Through detailed step-by-step instructions and clear explanations, this manual will help users understand how to go from basic component identification to complex task programming, thus ensuring that every participant will be able to effectively manipulate the robot through a range of challenges, including exploring uncharted areas, identifying targets, and executing rescue missions. In addition, the manual will also contain troubleshooting and maintenance guidelines to help users maintain optimal performance of the robot during competitions. Our goal is that every user will be able to use these guides to not only succeed in search and rescue, but also to develop their STEM skills as they learn.

2. Overview of the Search and Rescue Robot

The Search and Rescue Robot is a versatile and powerful tool that can be used in a variety of situations. It has several features that make it well-suited for search and rescue applications, including:

- **Autonomous navigation:** The robot can autonomously explore the area and search for the target without the need for manual control. This makes it ideal for use in dangerous or hazardous environments where it may not be safe for humans to operate. The robot can follow different patterns to explore the area.

- **Target detection:** The robot has sensors that allow it to detect the target and emit a beep sound when it is found. This makes it easy to keep track of the robot's progress and identify the target once it has been found.

- **Target movement:** The robot has grippers that can be used to move the target over a short distance. This allows the robot to complete the search and rescue mission.

II. Robot Review

1. Components

Search and rescue robotic systems are composed of several key components, including color sensors, gyro sensors, ultrasonic sensors, touch sensors, and motors. These components work together to enable the robot to sense and interact in a variety of environments. To work, all the components are connected to a terminal (or Lego brick).

Figure 1: Lego brick

Figure 2: Pixy camera

Figure 3: Gyro sensor

Figure 4: Color sensor

Figure 5: Ultrasonic sensor

Figure 6: Large motor

2. Functions

Robots utilize these sensors to perform a variety of functions.

Color Sensors: Used to detect various colors to assist the robot in navigating on different colored paths, as well as identifying task objectives.

Gyro Sensor: monitors the robot's direction and angular velocity to ensure stability and accuracy of the travel path.

Ultrasonic Sensor: detects the distance of objects around the robot by transmitting and receiving ultrasonic waves for obstacle avoidance and distance measurement.

Touch Sensor: Can sense being touched or pressed, used to initiate certain operations or as an emergency stop trigger.

Motors: control the movement of the robot and manipulate the arm or other moving parts used to perform complex actions such as navigation, grasping, and handling of objects.

Here is a diagram of the different functions that we have implemented in our robot:

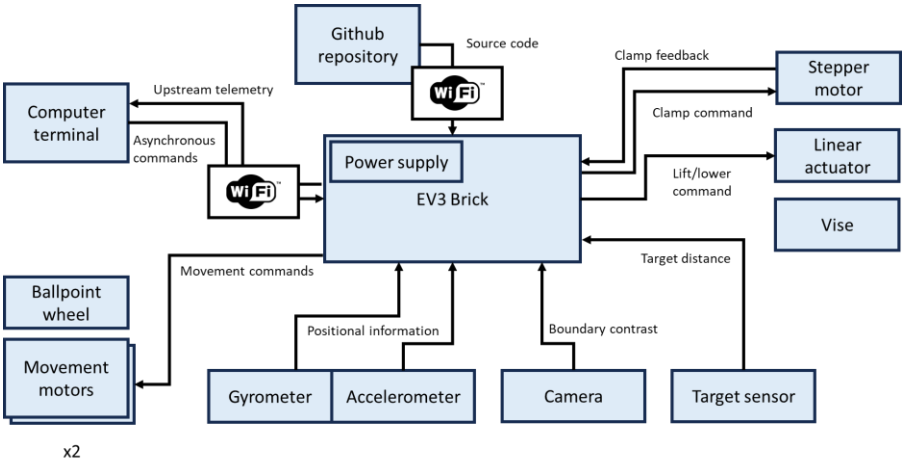

Figure 6: Function diagram of the robot

3. Technical Specification

For technical specifications, the following are the technical specifications for each sensor, motor, and a pixy camera:

Pixy camera: camera that is compatible with the Lego Mindstorm EV3 brick. It is used to detect an object.

Color sensor: can recognize seven colors under specific lighting conditions with fast response time. (The sensor uses a scale from 0 (very dark) to 100 (very bright).)

Gyroscope Sensor: Capable of accurately measuring the rotation and tilt angle of the robot.

Ultrasonic sensor: When using centimeters, the sensor can measure between 3 and 250 centimeters (with an accuracy of +/-1 cm).

Touch sensor: Robots can be programmed to use data provided by touch sensors by reaching out and responding when something is touched (pressed)

Motor: The motor runs at 160-170 rpm (round per minute) and has a rotational torque of 20 Ncm (Newton centimeter) and a stalling torque of 40 Ncm (slower, but more powerful). The engine supports auto-detection.

Here is a diagram of our robot's structure:

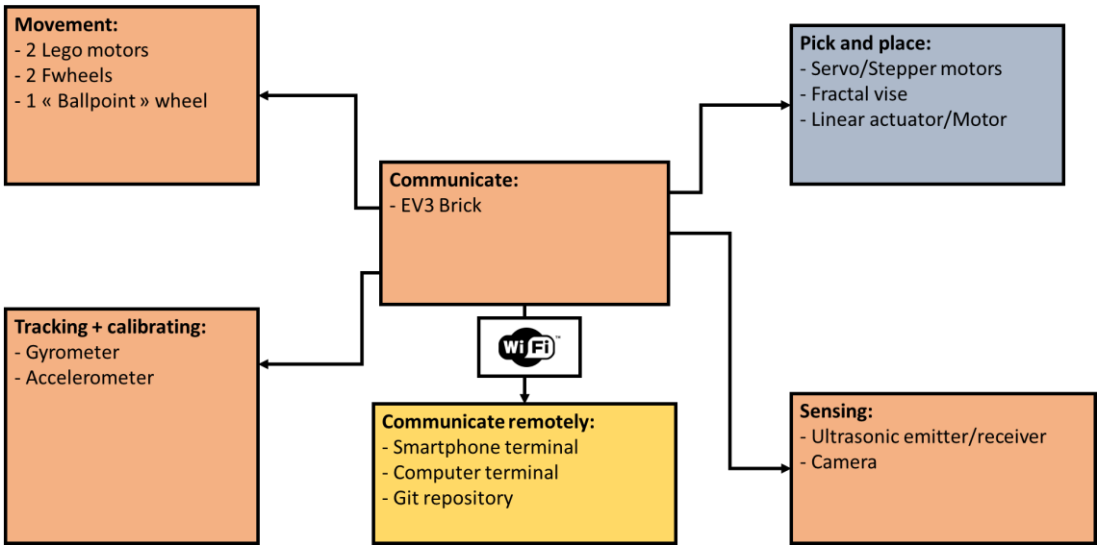

Figure 7: Structure diagram of the robot

III. Software Guide

1. Software Installation

The workflow described on this site is based on **Microsoft Visual Studio Code**. This is a free, open source, multi-platform code editor that runs on Windows, Mac OS, and Linux. Extensions for VS Code allow programs written in VS Code to be downloaded to the EV3 and run there, all with the press of a key.

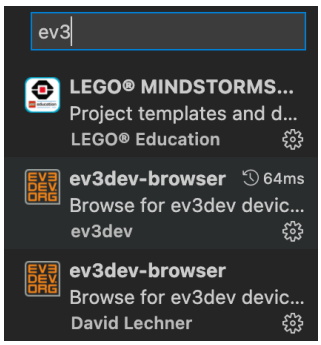

Figure 8: Lego Mindstorm software

2. Interface overview

(1). Resource Manager - We can manage and operate .py files.

(2). Extensions - We need to download the relevant extension files to connect EV3.

(3). EV3 Device Browser - It allows us to view files on the EV3.

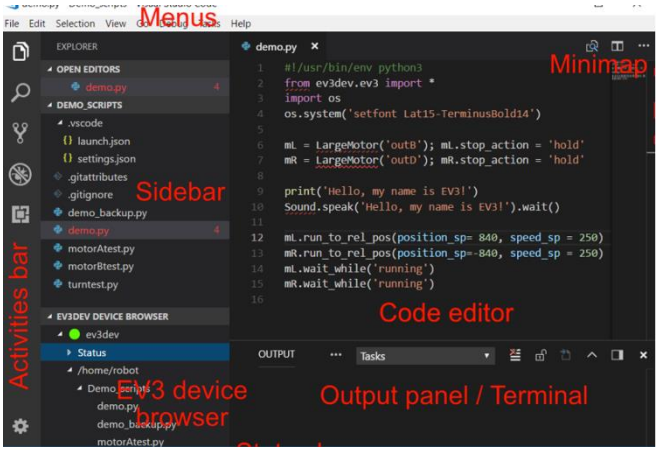

Figure 9: Vs code terminal structure of the project

3. Debugging and testing

Before starting, we need to connect EV3 to the computer. When you see the EV3 Device Browser showing a green sign, it indicates a successful connection. Thanks to the EV3 extension installed, we have access to the EV3 Device Browser, which allows us to view files on the EV3 and run selected files. We can write code in the code editor and click to upload it to the EV3 machine after saving.

IV. Safety Guidelines and Maintenance

Here is some safety information that you should know about our robot before using it:

- Do not allow children to operate the robot unsupervised.
- Keep the robot away from water and other liquids.
- Do not drop the robot or expose it to excessive force.
- Do not use the robot in areas with flammable materials or electrical hazards.

Warranty

This product is warranted against defects in materials and workmanship for a period of one year from the date of purchase. For warranty service, please contact the manufacturer.

Contact Information

Manufacturer: Technobots

Address: 75 Rue de Tocqueville, 75017 Paris

Phone number: 3615

Email address: sav@technobots.com