

Hardware report for Lego Robot Game ALL Project

Components

The EV3 brick makes use of a micro USB port, enabling it to be connected to a computer, and sync code created in the Mindstorms software. This has a speed of 480 Mbit/s. It uses USB 2.0 to communicate with a computer, as well as USB 1.1 for connecting to other EV3 bricks (daisy chaining) (Xander Soldaat 2013). The brick communicates to a large and a medium motor, with 160 - 170 RPM and 240- 250 RPM respectively (Xander Soldaat 2013).

Processing

The main brick makes use of a 300MHz ARM9 processor. The robot operates on a Linux-based operating system (Laurens Valk 2013). This gives us the processing power to run the code for our game.

Memory

The brick also contains an Micro SD-Card Reader, that can handle up to 32GB, along with 16MB of flash memory, and 64MB of RAM (Xander Soldaat 2013). This quantity of memory has allowed us to store programs on the brick itself, and use variables within the program, which are stored in the bricks memory.

Sensors

Infrared

The robot makes use of the infra-red sensor, an optical sensor, a touch sensor, motors and the core EV3 brick. The infrared sensor can read signals at a proximity between 50cm and 70cm away. It also supports 4 signal channels to avoid signal confusion. (The LEGO Group 2015). We were able to use this to detect obstacles throughout the maze, and detect the positions of the deposit boxes at the end of the game.

Optical Sensor

The optical sensor can distinguish 7 different colours, as well as a lack of a colour, giving the programmer many options. (Xander Soldaat 2013). We used the sensor multiple times throughout the game, for line following purposes, the

maze-solving algorithm, to signal when to begin the mini-game, finishing the maze and deciding whether or not the deposit location is correct for the placing of the object to finish the game. We found that a limitation of the sensor was that it sometimes had difficulty registering certain colours, in particular green, yellow and white, with which it often registered as a different colour.

Touch Sensor

We used the touch sensor for a very simple purpose, which was starting the game. The program would be halted at the start until the player activates the touch sensor, indicating that the robot should begin.

References

- Xander Soldaat 2013 *Comparing the NXT and EV3 Bricks* [online] available from <http://botbench.com/blog/2013/01/08/comparing-the-nxt-and-ev3-bricks> [8 January 2013]
- Laurens Valk 2013 *LEGO MINDSTORMS EV3 - A new Generation!* [online] available from <http://robotsquare.com/2013/01/07/lego-mindstorms-ev3-new-generation> [7 January 2013]
- The LEGO Group 2015 *EV3 Infrared Sensor* [online] available from <https://shop.education.lego.com/legoed/en-US/catalog/product.jsp?productId=45509&ProductLine=LEGO-MINDSTORMS-Education-EV3> [2015]

Bluetooth

The EV3 brick uses Bluetooth version 2.1+EDR (Xander Soldaat 2013), allowing the data transfer to occur at 24Mbit/s, proving to be 2 - 3 times faster than the previous version of Bluetooth (Maragret Rouse 2010). The Bluetooth support meant that we were capable of connecting an Android-powered mobile device to the brick, and send data, using the 'EV3 Mailbox Remote' application. Within our game, we have taken advantage of the Bluetooth capabilities twice. The first was to receive an answer from a phone (to a mathematical question put to the player). Then the robot can delegate a bonus accordingly. The second use is for the user to send a message the robot to inform which layout they have decided to use at the end of the maze.

- Maragret Rouse 2010 *Bluetooth 2.0+EDR* [online] available from <http://whatis.techtarget.com/definition/Bluetooth-20EDR> [2010]