EDUCATIONAL APPLICATION WITH EDUCATIONAL ROBOT WITH LEGO TYPE COMPONENTS, ULTRASONIC AND COLOR SENSORS THAT SOLVES THE RUBIK'S CUBE

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ABSTRACT: In this paper we present how we can use a programmable lego robot, the advantages that students can obtain if they use a construction like this and highlight the program involves the use of sensors works.

KEYWORDS: Robot, Arduino, Programing Robot, Assembly Robot.

1. Introduction

In training robot programming skills, it is important to work with models that can solve many general situations and that are programmable. One such example is the LEGO MINDSTORMS EV3 robot (see [1]). It can be programmed in several languages, for example in Python (see [2]).

The advantages of using lego robot for a highschool stundet are:

- understanding the notions of elementary applied mechanics;
- understanding how can programming different servomotors and sensors in Python, C++ or Scratch;
- the development of algorithmic knowledge in the movement problems of a robot.

The advantages of using lego robot for a university stundet are:

- understanding the operation of a gear much better;
- understanding the use of the Arduino board;
- can simulate various processes on a model much less expensive financially than an expensive robot (for example Kuka robot).

2. Kit components

1. Brick

It contains the Arduino board. It has 8 ports (A,B,C,D- for motors; 1,2,3,4- for sensors). It can be connected via Bluetooth or Wi-fi. It works with batteries or is charged with a special charger.

Fig. 1. Brick

2. Two servomotors

The large EV3 servo motor is a powerful motor that uses tacho feedback for precise control to a degree of precision. By using the built-in rotation sensor, the smart motor can be made to align with other motors on the robot so that it can travel in a straight line at the same speed. It can also be used to give an accurate reading for experiments. The design of the motor housing makes it easy to assemble the gear trains. (Figure 1 and Figure 2)

- Tacho feedback to a degree of accuracy
- 160-170 RPM • Torque of 20 N.cm (approx. 30 oz / in)
- Locking torque of 40 N.cm (approx. 60 oz / in)

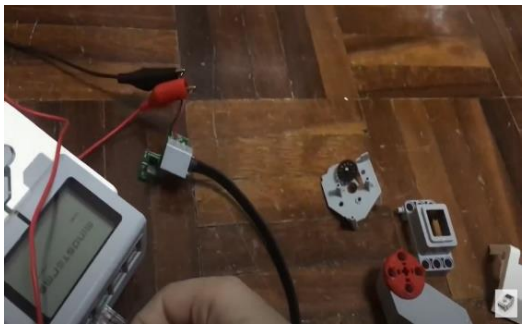

Fig. 2. Arduino servo motor

Fig. 3. Servo motor

3. A touch sensor

The EV3 Touch analog sensor is a simple but exceptionally accurate tool that detects when the front button is pressed or released and is capable of counting single and multiple presses. Students can build start/stop control systems, create maze-solving robots, and discover the use of technology in devices such as digital musical instruments, computer keyboards, and kitchen appliances.

- Hole of the transverse axis on the knob

Fig. 4. Touch sensor

4. Digital color sensor

The EV3 digital color sensor distinguishes between eight different colors. It also serves as a light sensor by detecting light intensities. Students can build color-sorting and line-following robots, experience the reflection of different colored light, and gain experience with a technology that is widely used in industries such as recycling, agriculture, and packaging.

- Measures reflect red light and ambient light from dark to very bright sunlight
- Capable of detecting eight colors. Can differentiate between color or black and white or between blue, green, yellow, red, white and brown
- 1 kHz sampling rate

Fig. 5. Color sensor

5. Medium servo motor

The medium device "EV3 Servo Motor" is great for lighter load, higher speed applications and when faster response time and a smaller profile are required in the robot design. The device uses mileage for precise control, having a built-in rotation sensor. Mileage to a certain degree of accuracy.

- 240-250 rpm.
- Operating torque of 8 N / cm (approx. 11 oz / in.).
- Stabilizing torque of 12 N / cm (approx. 17 oz / in.).

Fig. 6. Medium servo motor

6. Gyro sensor

The "EV3 Gyro" digital sensor measures the robot's rotational motion and orientation changes. Students can measure angles, create balancing robots, and explore the technology that powers a variety of real-world tools like Segways, navigation systems, and game controllers.

- "Angle" mode measures angles with an accuracy of +/- 3 degrees.
- "Gyro" mode has a maximum power of 440 degrees / second.
- The frequency rate is 1 kHz. • Auto-ID is built into the "EV3" software.

Fig. 7. Gyro sensor

7. Ultrasonic sensor

The "EV3" digital ultrasonic sensor generates sound waves, which read echoes to detect and measure the distance to objects. It can also send out single sound waves to work as a sonar or listen to a sound wave that triggers the start of a program. For example, students could design a traffic monitoring system and measure distances between vehicles. There is the opportunity to discover how technology is used in everyday items such as automatic doors, cars and manufacturing systems. It measures distances between 1 and 250 cm (one to 100 inches).

- Accuracy to +/- 1 cm (+/- 0.394 inches).
- Front lighting is steady while emitting and blinks while listening.
- The value "True" is returned if another ultrasonic sound is recognized.
- Auto-ID is built into the EV3 software.

Fig. 8. Ultrasonic senzor

3. Explanations on the action of the robot

The algorithm implemented in the robot solves the rubik's cube.

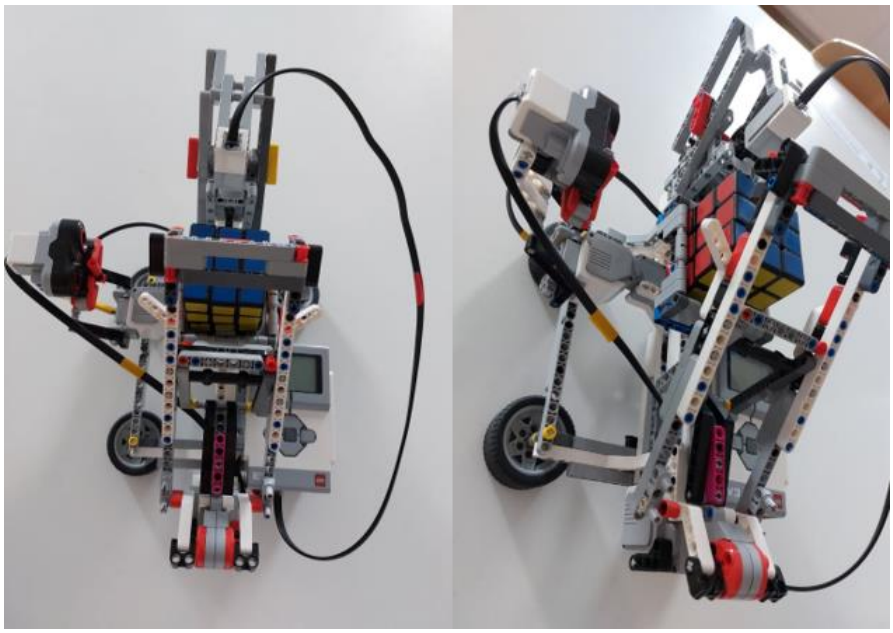

Fig. 10. LEGO robot

MindCub3r is a robot that can be built from a single LEGO MINDSTORMS EV3 home set to solve the well-known Rubik's Cube puzzle (see [3], [4]).

This robot uses a color sensor that reads the faces of the Rubik's cube, an ultra sensor that detects the cube placed on the turntable, two motors and a brick.

The first stage is to scan all the faces with a color sensor (it stores the position of each color on the faces in 3 x 3 matrix), then the cube positioning arms hold the cube and the rotating table at the base rotates, so the robot starts to solve rubik's cube.

The legs of the robot are made of wheels, which have a large diameter for good stability, without any vibrations in the structure.

4. Technical data about the program

The robot is based on the program of two sensors that transmit movement and color, but also two motors that are activated according to the code that is based on the order of actions.

The robot ultrasonically detects the cube as being placed on the rotary table at a certain distance, then the color sensor scans the surfaces and determines their colors and order (3x3 matrix is used). The colors are registered with a certain code but it must be a suitable brightness so that the wrong registration of colors does not occur.

After scanning each face, the robot has a moment of 3-4 s to think, after which it starts to grasp the cube with the robotic arm and twist the cube with the help of the rotary table. The duration of completing the Rubik's cube is counted. The program is made of 2 subprograms that call on each other, based on functions and calculated by mathematical algorithms transposed into blocks that establish steps for solving the rubik's cube.

5. Conclusions

The use of programmable LEGO robots represents a much cheaper way of simulation for many situations. The presented robot solves the rubik's cube. This mockup represents an alternative solution to highlight a classical algorithm that receives part of the input data from sensors and that trains sensors and motors.

6. References

[1] https://en.wikipedia.org/wiki/Lego_Mindstorms_EV3.

[2] https://education.lego.com/en-us/product-resources/mindstorms-ev3/teacher-resources/python-for-ev3.

[3] http://mindcuber.com/index.html.

[4] http://mindcuber.com/mindcub3r/mindcub3r.html.