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Topics
Robotics, Students, Educational institutions, Curriculum

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Issues On Using Modern Platforms In The Process Of Assembling Sumorobots In Robotics Curriculums.

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Abstract: This article presents the possibilities and advantages of using different platforms for making sumo robots in the field of robotics, and gives practical instructions for assembling and coding sumo robots. Sumorobots is designed for kids, helping high school students and electronics enthusiasts learn to program and build their own interactive robots. Here are 5 robotics platforms to help easing the difficult task of choosing a robotics kit and platform.

INTRODUCTION

Nowadays extra curriculums are organized at school for children to learn the secrets of robotics. Many modern parents are trying to inspire their child learn the basics of computers and programming from a young age. Learning robotics from early school years develops a child's creativity. If a child is interested in technology, it is necessary to involve him in the robotics curriculums. Robotics helps to strengthen the student's knowledge of physics in practice, immediately sees the result of the created program, demonstrates engineering qualities and gives an opportunity to create his/her own project. Later, sports robotics will help children to choose careers in these directions. A foundation will be created for participation in international robotics competitions. [1]

Every year in our country, in order to meaningfully organize the free time of pupils, to form their skills for modern information and communication technologies, to expand their worldview, to introduce new techniques in the field of robotics, to develop friendly relations between children. in order to further develop the implementation of their abilities, "Robo-sumo robot battle" festival-competition is being held under the slogan "5 initiatives - information technologies". Robo-sumo is a sport where two robots try to knock each other out of the ring. The robots used in this competition are called sumobots. The place where robots fight is called TATAMI. During the competition, all sumo robots will be quarantined and then the competition will begin. Basically, the width of robots should be 20x20x20 centimeters and their weight should not exceed 1 kg. Apart from that, contests will be organized using sumo robots of various forms. Robot sumo or pepe sumo is a sport in which two robots try to push each other out of a circle (similar to the sport of sumo). The robots used in this competition are called sumorobots.

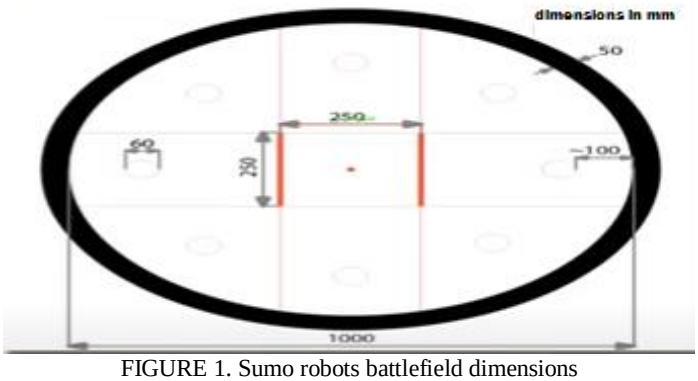


FIGURE 1. Sumo robots battlefield dimensions

The main difficulty in designing a sumo robot is that the robot can find its opponent, which is usually done using infrared or ultrasonic sensors, and the main principle of their operation is to move the opponent out of the totami area. The robot should also not normally leave the arena with an edge sensor. The most common "weapon" used in boxing competitions is a blade placed on the front of the robot, usually at an angle of about 45 degrees to its back. This knife has an adjustable height for different tactics. Sumo robots are divided into classes; they fight in progressively smaller arenas:

Heavyweights. Standard in the national robotics competition. The robots can weigh up to 125 pounds (56.8 kg) and fit into a 2-foot (61 cm) cube.

Easy. Standard in the national robotics competition too. The robots can weigh up to 50 pounds (22.7 kg) and fit into a 2-foot (61 cm) cube.

Standard-class robots (sometimes called megasumos) can weigh up to 1 kg and fit into a 20 cm x 20 cm box of any height.

Mini sumo. Weight up to 500 g, 10 cm by 10 cm, any height.

Microsumo. A weight of up to 100 g should correspond to a 5 cm cube.

Nano sumo. It should fit into a 2.5 cm cube.

Pico sumo. It should fit into a 1.25 cm cube.

Femto sumo. It should fit into a 1 cm cube. Also, in the assessment of the competition, Line Follower - in this competition, the robot follows a black line on a white background. The winner is the first to reach the designated finish line. Freestyle - in this category, participants will have to demonstrate the technological advantages and convenience of their robot.

MAIN PART

Now it is necessary to choose a robotics platform to control the robot. To help ease the difficult task of choosing an entry-level robotics kit, here are 5 of the most widely used robotics platforms in the world with different advantages. They are followings:

BBC Micro: bit is a single board computer developed by the BBC Corporation in collaboration with major technology companies, communities and educational organizations to provide children with a fun way to learn programming and encourage technical creativity. Fully developed with PC programming. The BBC project included free distribution of microbits to all British schoolchildren in the 7th year (11-12 years old). In addition, the Micro:bit is useful for classes in schools and robotics curriculums. On the Microbit.org website, one can find a ready-made 14-week curriculum for children aged 11-14. The kit includes 2 programmable buttons, 25 LEDs, 20 GPIOs and 3 connectors. The board has a thermometer, accelerometer, magnetometer and a Bluetooth module for connecting to a phone. One can implement dozens of projects using this kit. The kit is programmed in the Make Code cloud development environment at microbit.org. Beginners can program with Scratch blocks, plus JavaScript and Python.

Makeblock is a robotic platform for implementing a STEM approach in schools and "curriculums". Makeblock is a STEM education solutions company. The product line includes several mobile robots, laser engraver and XY plotter assembly kits, and even a modular drone. Makeblock kits are designed for audiences of different ages, starting from 6 years old. mTiny, Codey Rocky and Neuron constructors are suitable for exploring the world of robotics. Mobile robot kits have touch connectors familiar to Lego Mindstorms learners. Equipped with an Arduino-like controller. They are suitable both for independent study and for robotics curriculums. A ready-made tutorial is available at makeblock.com. Depending on your project, you can choose a package. The kits can be programmed using the Arduino IDE in Scratch or C++ at makeblock.com.

Arduino IDE is an integrated development environment for Windows, MacOS and Linux, developed in C and C++ languages, designed to create and upload programs to Arduino-compatible boards, as well as to boards from other manufacturers. A decade and a half ago, it took a lot of work to turn off an LED from a microcontroller. It was necessary to read several books, get the necessary devices in the form of a crystal oscillator, resistors, capacitors and a programmer, connect everything correctly and turn the chip on and off by connecting the wires together.Arduino microcontrollers is famous for many projects based on Arduino. You can start with simpler projects and gradually increase the complexity. The Arduino website has a Project Hub section that contains thousands of projects from around the world. You can program your Arduino in C++ using the desktop or web version of the Arduino IDE. It is also possible to use ScratchX or S4A through Scratch and Python through pyFirmata.

Raspberry Pi

Raspberry Pi is a miniature and self-contained single board computer. Raspberry Pi is a complete single board computer that can run Raspbian, Ubuntu Core, Windows 10 IoT Core and more. There are many ways to program on the Raspberry Pi platform. If you connect a monitor, keyboard and mouse and run a graphical interface, you will have a complete personal computer. Can be programmed in Python, C, C++, Java, Html5 and other languages.

Now let's look at assembling a robo-sumo using Lego mindstroms NXT.

The educational version of the LEGO Mindstorms NXT 2.0 set includes:

- 1 programmable block
- 3 motors

- 5 sensors
- 2 sensor transmitters
- 1 light sensor
- 1 ultrasonic distance sensor
- 1 microphone

NXT sensors, motors and cables are compatible with EV3, so both NXT and EV3 kits can be combined.

Below are the features of the NXT programmable box:

• Processor - Atmel 32-bit ARM 48 MHz, 256 KB RAM, 64 KB RAM

• Coprocessor - Atmel 8-bit AVR 8 MHz, 4 KB RAM, 512 bytes RAM

• 4 input ports for sensors. Both analog and digital sensors are supported. Baud rate: 9600 bps (I2C)

• 3 output ports for motors

• Monochrome LCD display, 100 * 64 pixels

• Connectivity - USB 2.0, Bluetooth

Programming environment

NXT comes with LabViewbased graphics development environment, NXT-G. Supported operating systems are Windows and Mac. The NXT development environment is very simple and intended for children with no special knowledge of computer science and no familiarity with programming.

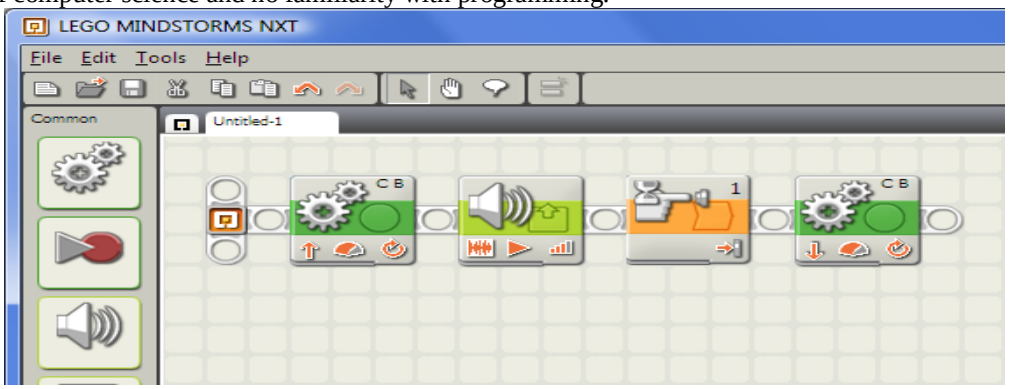


FIGURE 2. Block-based coding in the Lego Mindstroms NXT window.

In the NXT-G environment, each command given to the robot is represented as a graphical block. An example of a command for a motor is to turn the motor on for 3 seconds or to turn the motor on for 4 turns. The command for the sensor depends on the sensor type. For example, the command for the light sensor can be - tell the lighting of the room, and for the distance sensor - tell how far it is to the obstacle. By compiling a sequence of such blocks, you can create a program.

RESEARCH RESULTS

Using these platforms, schoolchildren can design and build sumo robots in robotics curriculums. Let us look at the assembly and coding of standard sumorobots using the Lego mindstroms NXT microcontroller and the Arduino platform. We study the effectiveness of choosing platforms through the necessary equipment and the results of the sumo robot in the competition.

We assemble sumo robots using the Arduino board and write the program code.

The necessary devices to make a robo-sumo robot are followings:

arduino board, 2 DC motors, 2 DC bus-bars, 50*50 fomix, l298n driver, Ultrasonic sensor, wires, 1 BUTTON, 2 x 18650 batteries or 9V batteries, Arduino Ide software

FIGURE 3. Details needed to make a sumo robot.

Let's explain each of the above details:

1 - Arduino Uno

It is the main board that controls all the parts and unites it.

2 - DC Motor

Helps to maneuver the robot and move around the competition ring.

4 - L298N Dual H Bridge for Arduino

This is a small panel that provides constant voltage for the motors, as well as support for the Arduino plate with good control of movement and voltage.

5 - Ultrasonic sensor

An ultrasonic sensor is used to locate an opponent robot and is usually placed on top of the robot.

6 - IR TCRT5000

7 - Battery 9v

It supports the main board (Arduino) with a significant voltage.

8 - 4 * 1.5 AA batteries + Battery holder

With this important voltage, two motors (DC Motor) must be separated to support and give full power to the wheel.

9 - Jumper wires

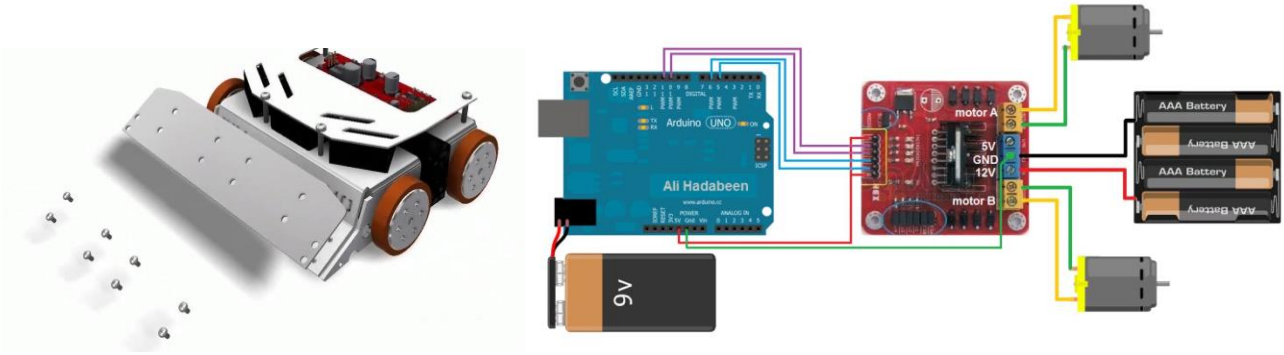
Wires are needed to connect the necessary things to the board.

We use Arduino Uno, we need a 2-channel motor driver to control the high power motors and an expansion board to connect all the sensors. You can build your own expansion board and connect all the pins to the Arduino with jumpers. Here you have to connect all the electronics on one board.

The 4-wheel robo-sumo is definitely stronger in pushing the opponent robot and it has more traction because the wheel's contact surface is doubled compared to the 2-wheel drive. However, the mobility of a 4-wheeled robot is not as flexible as a 2-wheeled robot. This means that turning and reducing its dexterity is more of a struggle, and we must not forget that adding additional motors and wheels affects the robot's weight. In this project we will create a 4 wheeler using 4 x DC motors with 380RPM and 1.4kgfsm torque.

We don't have many options to buy a good wheel for Sumo Robot. The best wheel we recommend is the silicon wheel by JSumo, but it's a bit pricey. Instead, you can simply put it on the wheel of a toy car and try to change it to increase the friction.

One thing to consider when choosing a wheel is a permanent engine wheel setup. Make sure the wheel you choose has the correct bore size for the engine output shaft. Let's look at the design part of the robot. We need to start working on the robot first from the design part, then the necessary components will be connected. But you can customize the design of the sumorobot, it is recommended that it looks like the picture below.



a) b)

FIGURE 4. a)- View of the finished sumo robot. b)- Collect the code block

Now that we have connected them, we need to upload the program to the arduino:

We load the program of the robot.

#define ena 5

#define enb 6 // bu sumorobotni dastur kodi

#define in1 7

#define in2 8

```
#define in3 9
#define in4 10
unsigned char carspeed=255;
#include <Ultrasonic.h>
Ultrasonic ultrasonic(A0, A1);
int distance;
void setup()
{&amp;amp;nbsp;
 Serial.begin(9600); // we give the speed for the monitor port
 delay(5000);
pinMode(in1,OUTPUT);&amp;amp;nbsp;&amp;amp;nbsp;&amp;amp;nbsp;//&amp;amp;nbsp;L298n
pinMode(in2,OUTPUT);&amp;amp;nbsp;&amp;amp;nbsp;&amp;amp;nbsp;//&amp;amp;nbsp;L298n
pinMode(ena,OUTPUT);&amp;amp;nbsp;&amp;amp;nbsp;&amp;amp;nbsp;//&amp;amp;nbsp;L298n
pinMode(in3,OUTPUT);&amp;amp;nbsp;&amp;amp;nbsp;&amp;amp;nbsp;//&amp;amp;nbsp;L298n
pinMode(in4,OUTPUT);&amp;amp;nbsp;&amp;amp;nbsp;&amp;amp;nbsp;//&amp;amp;nbsp;L298n
pinMode(enb,OUTPUT);&amp;amp;nbsp;&amp;amp;nbsp;&amp;amp;nbsp;//&amp;amp;nbsp;L298n
}
void loop()
{
 // we pass the parameters for the robot eye
 distance = ultrasonic.read();
 Serial.print("Distance in CM: ");
 Serial.println(distance);
 delay(10);
if (distance <43){
digitalWrite(ena,carspeed);
digitalWrite(enb,carspeed);
digitalWrite(in1,carspeed );
digitalWrite(in2,carspeed);
digitalWrite(in4,0);
Serial.println("forward");
}
if (distance >43){
analogWrite(ena,235);
analogWrite(enb,235);
digitalWrite(in1,0);
Serial.println("Rotate");
}
 }
```

Now let's look at assembling a robo-sumo using Lego mindstroms NXT.
In Lego mindstroms NXT Education, the program code is written as follows.

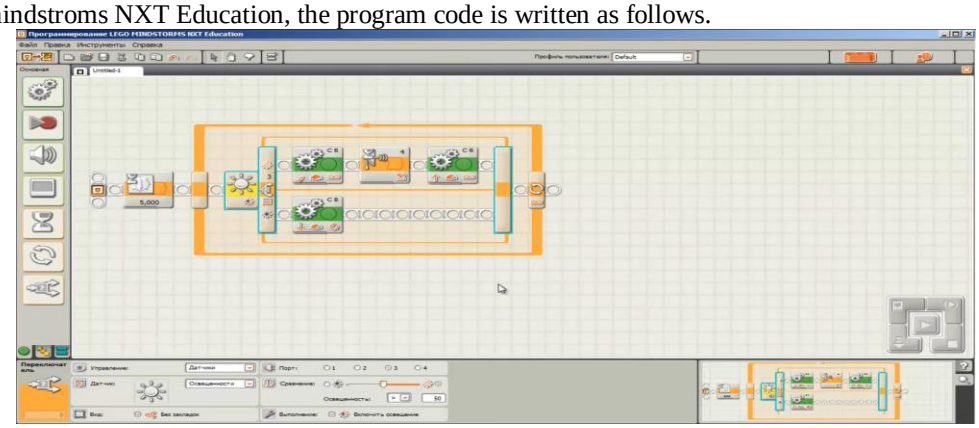


FIGURE 5.The program code in Lego mindstroms NXT Education

TABLE 1. The process of assembling a sumo robot using Lego mindstroms NXT parts

In the analysis of the results of the pedagogical test-experiment, the results of the participation of the sumo robots developed by the students in the competition and the compliance of the sumo robot with the specified requirements were analyzed using the mathematical-statistical method according to the criteria of the sumo robot competition in the experimental and control groups.

The efficiency of the competition result of the sumo robot developed by the pupils at the end of the experimental work

TABLE 2. The process of assembling a sumo robot using Lego mindstroms NXT parts

Groups	Number of pupils	Result in competition			
		Excellent	Good	Satisfactory	Unsatisfactory
On educational program					
Arduino Uno	10	7	1	1	1
Legomindstroms NXT	8	4	2	1	3

By specifying the learning indicators and the number of students in the experimental group by X(i) n(i) and the control group Y(j) m(j)respectively, we have the following statistically grouped variation series, as well as

We mark an excellent level with 4 points, a good level with 3 points, a satisfactory level with 2 points, and an unsatisfactory level with 1 point. This pupil-developed project will be assessed as follows:

Competition indicators in the group working with the Arduino board:

$$\begin{cases} X_i & 4, \quad 3, \quad 2, \quad 1 \\ n_i & 7, \quad 1, \quad 1, \quad 1 \end{cases} \qquad (n=10)$$

Competition indicators in the group working with the Lego Mindstroms NXT board:

$$\begin{cases} Y_j & 4, \quad 3, \quad 2, \quad 1 \\ m_j & 4, \quad 2, \quad 1, \quad 3 \end{cases} \qquad (m=8)$$

The diagram corresponding to these indicators is following:

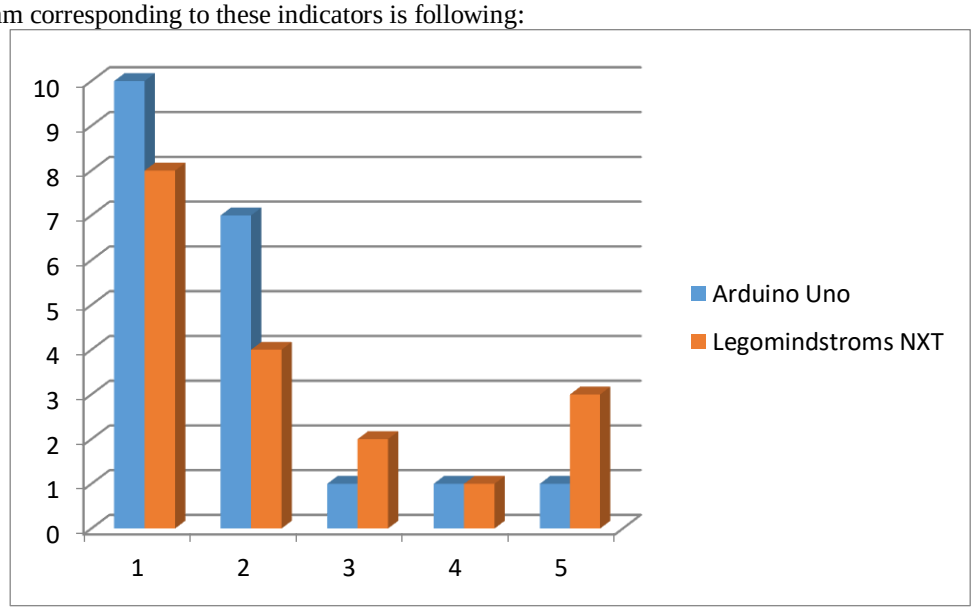


Diagram 1. Results of Arduino and Lego Mindstroms robots

CONCLUSION

Today in the global labor market, the demand for engineers-specialists in the technological direction has increased more than ever. Extensive work is being done in our country to create a generation of personnel that meets the requirements of the technological age. Among these actions, I believe that it is necessary and important to pay attention to one issue, that is, we need to expand the scope of robotics curriculums to schoolchildren and help them actively participate in international robotics competitions and achieve high results. Because the robotics course occupies a leading place in the modern educational programs of developed countries. In an era of increasing coverage of technologies controlled by artificial intelligence, learning robotics has become a crucial necessity. Different robot sets can be used in these robotics curriculums depending on the age group. When assembling sumo robots through LegoMindstroms NXT and Arduino kits, we need to pay attention to teaching the Arduino board and C++ programming language in circles, considering that more Arduino-based robots will give effective results.

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