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# Methods of automation and management of physical agents

**Abstract.** In this work programming of physical agents using the designer of Lego was carried out. The main opportunities with the description of components of the the creating robot designer were lit. The robot finding the road was experimentally created and the effective algorithm of its programming is chosen. Methods of training in bases of programming of robots using the above-named designers are shown to students. The RobotC environment as means of programming with examples of works of automation and management of physical agents in real time was used. Functionality of this environment the very wide. Environment gives the chance to program physical robots by a traditional method. The student seized effective algorithms of control of the robot finding the road and also enhanced skills on search of methods of modulation, optimum control of agents. As a result of work the student showed also other capabilities to solve complex engineering challenges.
**Key words:**Physical agent, Lego Mindstorms, light sensor, servomotor, RobotC, microcontroller.

## Introduction

If to pay attention to development of high technologies, there is enough opinions that the future behind robots and systems of artificial intelligence. Even now in our everyday life robots everywhere nearby. For example: computers, payment terminals, ATM, automatic machines for water sale, etc.

In order that technologies didn't stop in development we consider very important young IT-specialists in a to creating robot subject[1].

One of necessary technical means in this direction are the creating robot designers. From them we can allocate Lego designers [2].

The very first creation of robots based on Lego of designers belongs to Massachusetts Institute of Technology (MIT). The first robots of a series (RCX) were made in 1998. Now available the upgraded Mindstorms robots.

Designers of Lego Mindstorms consist of numerous mechanical components, sensors, motors and managing microcontrollers[3].

## Main part

For the confirmation told we create the robot finding the road using the Designer of Lego Mindstorms.

For implementation of this system the student faces various obstacles of subjects of mechanics, modeling, electronics (in small amount), programming. Their successful overcoming improves skills of the student, tempers his experience[4].

The robot finding the road in our work shall pass across the black line, drow on white paper. For implementation of it we use a standard set – 2 servomotors, 1 sensor of light and the microcontroller.

Verbally we characterize work of algorithm of the robot so: by means of motors the robot begins movement, at the expense of sensors of light finds the road and on the road continues movement.

Servomotors are responsible for movements of the robot. Working capacity of motors depends on the influencing factors. Values of capacity in the

range of 100-100. Capacity is signals PWM (pulse-width modulation) from the blog NXT[5].

The microcontroller - intelligently programming blog of the robot. Its technical characteristics are lower:

- 32-bit ARM7 256kbayt FLASH microprocessor, 64 Kb of RAM
- USB port (speed of transfer of 12 Mbps)
- 4 ports of connection (for sensors). IEC 61158 Type 4/EN50 170
- 3 ports for connection of servomotors
- 100x64 pixel display

As the environment of programming we use the C-shaped RobotC [6] environment. This environment allows to program agents by a traditional method (text). This environments works in two modes – basic and expanded. That is it is convenient both for unexperienced users and for professionals[7]. Except the NXT platform supports such hardware providing as TETRIX, Cortex, RCX, PIC, VEX PIC, Arduino Diecimila. The software has environment, similar to Visual Studio, and includes the powerful interactive debugger capable to function in real time, thereby significantly reducing time of debugging of a code [8].

**Figure 1** – Main elements of the robot. Servomotor and managing elements

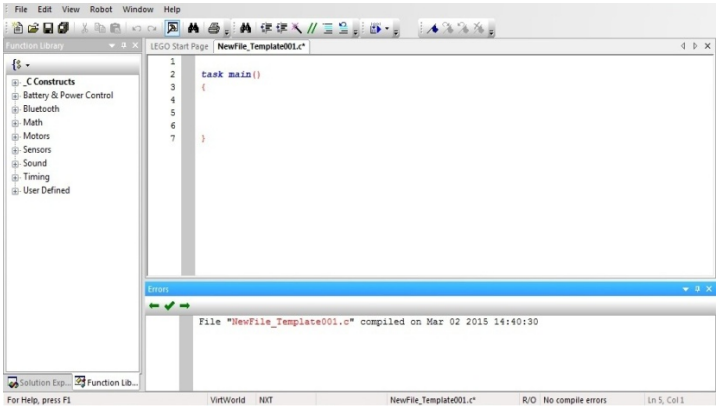


**Figure 2 –** Robot C interface

In work the leading role is played by light sensor. It works in two modes: active and passive.

In the active mode the sensor radiates infrared beams, at the expense of a repeated beam measures illumination level. And in the passive mode gives information on intensity of light in environment [9].

The sensor of light shows values in the range from 0 to 100.

*//Initialization of the sensor of light is performed:*
***#pragma config (Sensor, S3, lightSensor, sensorLightActive)***

so here connection of a sensor, number of port, the name of a sensor, the sensor of an operating mode are determined.

Determination of color robot:

*//when preserving **true** value the cycle continues to work*
***while (true) { }***

*//we read out indications from sensors*
*//when indications of a sensor are more than 45*
***if (Sensorvalue[lightSensor] < 45)***

```
//motors turn
      motor [motorB] = 60;
      motor [motorC] = 20;

//or on the contrary
      else
     motor [motorB] = 20;
      motor [motorC] = 60;
```

This code makes the following movement


**Figure 3 –** Employment light sensor

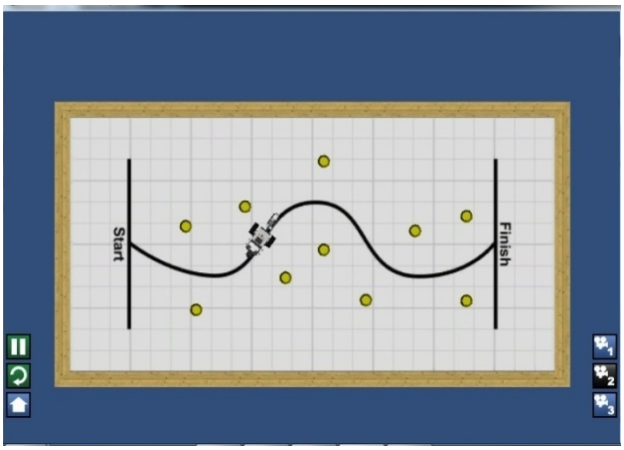


**Figure 4 –** Line tracing robot

Indications of the motor are synchronized as 60-20, 20-60. They help the robot not to go beyond the line in case of turn [10]. The following team synchronization can be executed automatically:

```
nSyncedMotors = synchBC;
nSyncedTurnRatio = +60;
motor [B/C] = 25;
```

## Conclusion

Following the results of work the robot passed along the set route. The optimum algorithm of movement of motors, synchronizing work is chosen. The student mastered conducting work with the virtual Robot C environment, increased the experience and knowledge. We are sure that training of students in bases of programming of designers of Lego develops their creative and professional capabilities.

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