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SIMULATION OF THE TRAJECTORY OF A MOBILE ROBOT IN FLOWCODE

Urgency of the research. *Simulation is used to simulate the real movement of the robot, to test the software and capabilities of the robot before assembling it. It makes it possible to change and improve the program code during the testing process in order to implement it in practice at the end. A simulation is a free testing platform without additional financial costs.*

Target setting. *Simulate the movement of a robot using Flowcode, without composing a real robot when it is unavailable.*

Actual scientific researches and issues analysis. *Currently, research focuses on similar issues, as there are currently limitations through which design and testing takes place remotely outside the workshops.*

Uninvestigated parts of general matters defining. *The current solution of using the Flowcode program allows the implementation of programming, modelling, and simulation of work in one program.*

The research objective. *The purpose of the article is to give an idea of how to do a robot motion simulation to test the functionality of program code without using physical robot.*

The statement of basic materials. *For realization the robot simulation, need to have computer with basic configuration and a licensed version of Flowcode software installed.*

Conclusions. *The published article presents the idea of programming and simulating the movement of a mobile robot using Flowcode software, which will help reduce financial costs and time before creating a real robot. Testing the functionality of the program code and the possibility of remote operation without a physical object.*

Keywords: *simulation; mobile robot; Flowcode.*
Fig.: 12. References: 3.

Introduction. Flowcode is a Microsoft Windows-based development environment commercially manufactured by Matrix TSL for programming embedded devices based on PIC, AVR (including Arduino), and ARM technologies using graphical programming styles (such as flowcharts) and mandatory programming styles (via C and Pseudocode). It is currently in the eighth revision.

Flowcode is designed to simplify complex functions such as Bluetooth, mobile phones, communication, USB communication, etc. Using pre-developed libraries of dedicated component functions. This is accomplished by dragging virtual representations of the hardware to the visual panel, providing access to associated libraries. Flowcode is therefore ideal for speeding up software development time, allowing those with little programming experience to get started and help with projects. This is suitable for formal teaching of microprocessor programming principles.

Also it allows the user to develop and display their program using four different visual modes. These are the flowchart display, the block display (block-inspired graphical programming paradigm), the C code display, and the Pseudocode display [1].

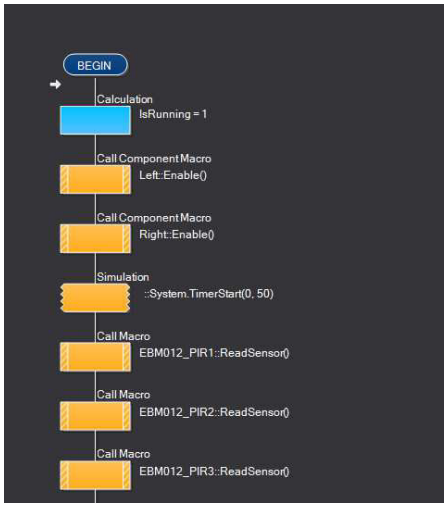

Fig. 1. Initialization

Pogram code. First, we will create functional blocks responsible for the initialization of sensors, motors and the rest of the simulation of the robot's motion process. This part of the program runs only once because it is before the main part of the program. Here, the robot's speed, inputs and outputs are set, and the simulation is controlled. Figure 1 shows what initializations take place.

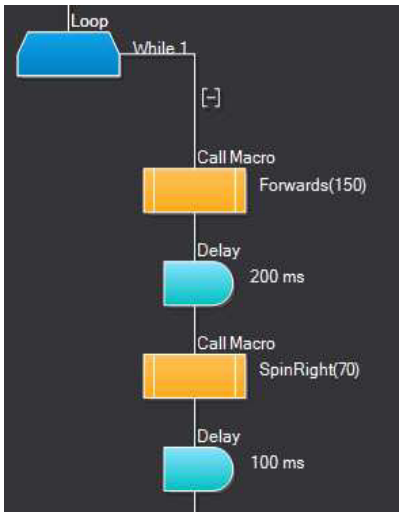

Fig. 2. Main program 1 [3]

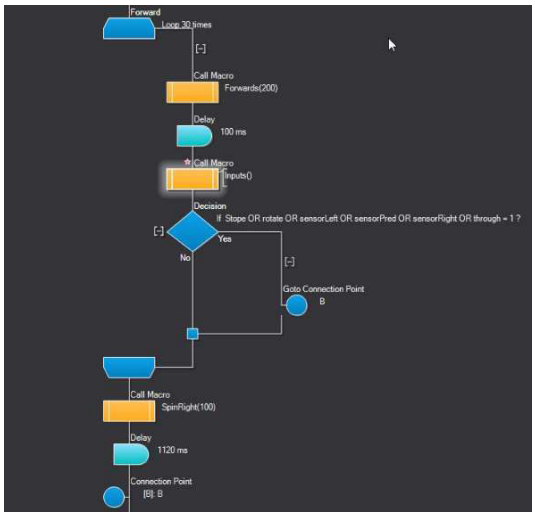

Fig. 3. Main program 2 [3]

"Main" is mainly a macro in the program for controlling a mobile robot, which contains many individual parts and the use of other macros. The principle of robot control consists of a main path, which the robot repeats the movement of which is carried out by sending PWM signals to individual motors. Using of three IR sensors, the input signals are processed and, as a result, change the movements of the robot, so that it does not collide with obstacles and can bypass them. It also includes software for using various buttons and switches, containing special functions of the robot. The initialization of the simulation is at the beginning, and the simulation macros are used throughout the control. The robot should move autonomously but has also the opportunity to communicate with an operator who can change its movement.

This program may contain many additional functions that vary from the needs of the developer and the capabilities of the robot. In particular, these are blocks that are responsible for certain additional keys, additional actions when receiving signals from sensors, which can also be added and configured in addition to the main part of the program.

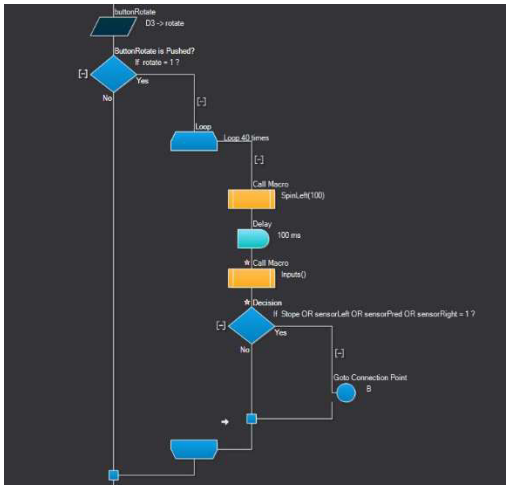

Fig. 4. Additional program of random changes of direction

The main part of the robot motion simulation consists of the following parts:

- Ev_Timer
- Movement macros.

The first and most important is responsible for the functionality of the simulation and its reproduction in the simulation field, the subsequent ones are responsible for the speed of movement of specific parts of the robot and the reproduction of this movement on the simulation field.

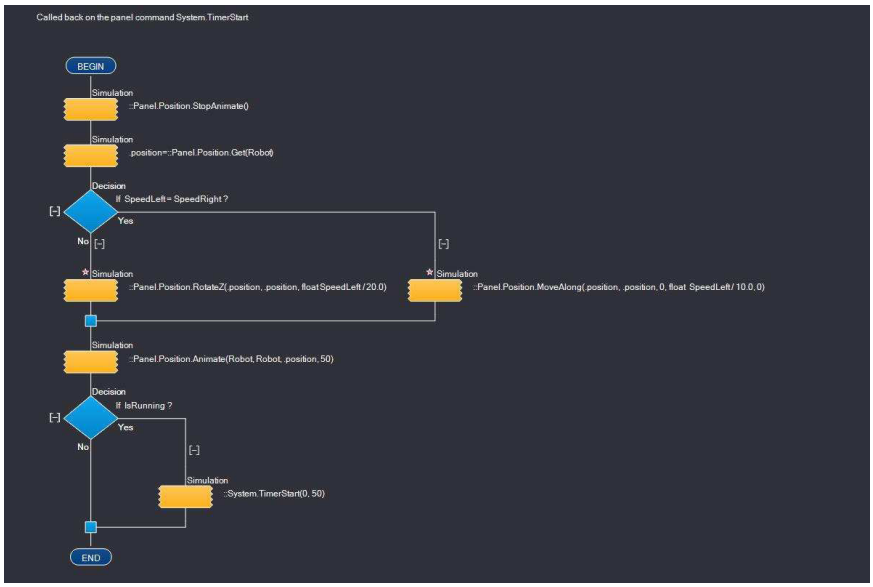

Fig. 5. Ev_Timer [2]

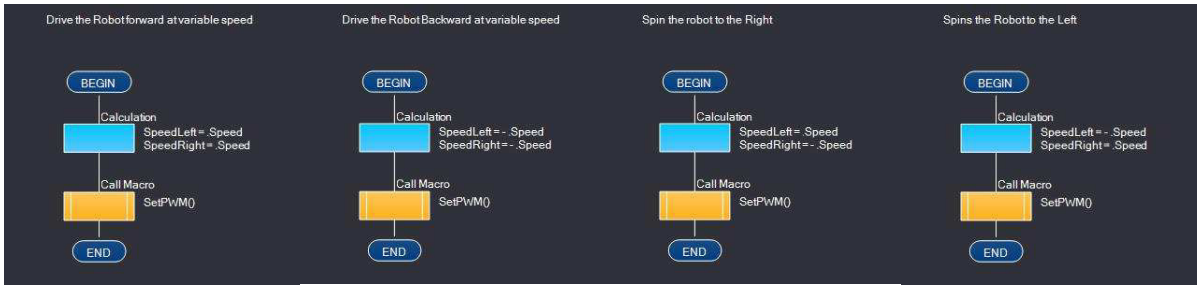

Fig. 6. Movement macros

3D Model. To visualize the movement of a mobile robot, a prototype was created in the form of a 3D model with all its parts in real size. This was done using the same Flowcode program in the Creative tab. The 3D model could also be created in other programs designed specifically for modeling, but to save time and test the performance of all functions of the robot movement program, the built-in capabilities of Flowcode were enough.

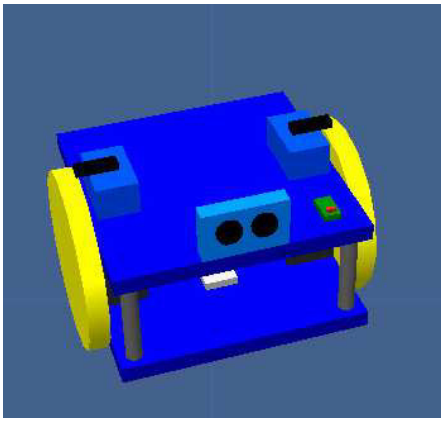

Fig. 7. 3D model 1

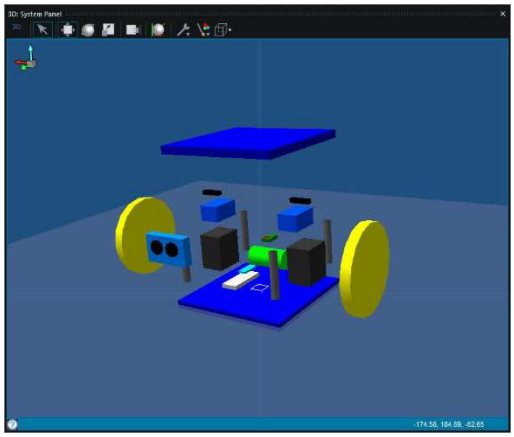

Fig. 8. 3D model 2

Dashboard Panel contains 3x IR sensors for simulation of obstacle detection, green On / Off switch, red button of special robot rotation function, switch for robot forward control, 2x PWM graphs and 2 LED diodes for monitoring incoming signals from motors. Here, when the simulation is switched on, we control all changes of input parameters and we can monitor the output signals, can see at Figure 9.

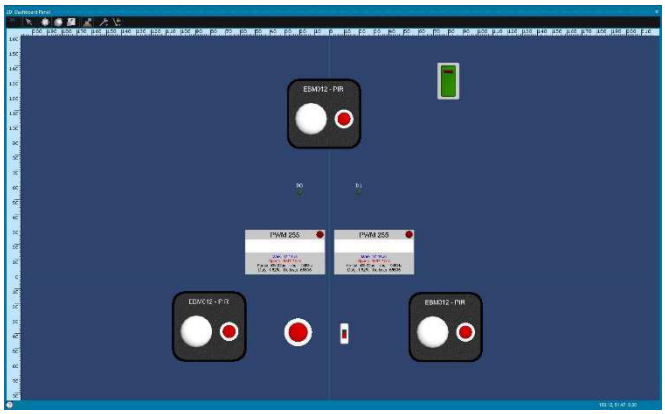

Fig. 9. Dashboard Panel

To start the simulation, we need to run the program, open the simulation field. Using the Dashboard panel, we manage all changes and simulate real obstacles to testing the functionality of the conceived solution. Figures 10, 11 and 12 show the simulation results and robot movement.

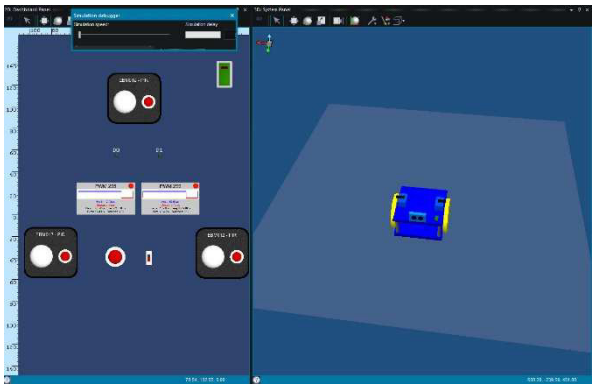

Fig. 10. Simulation results 1

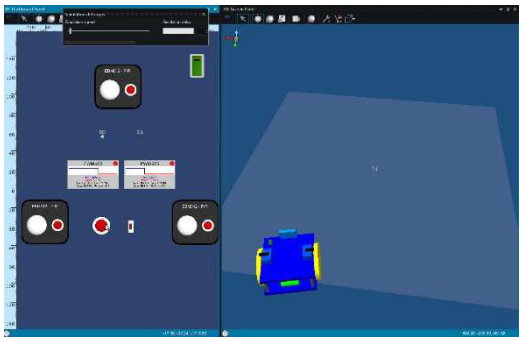

Fig. 11. Simulation results 2

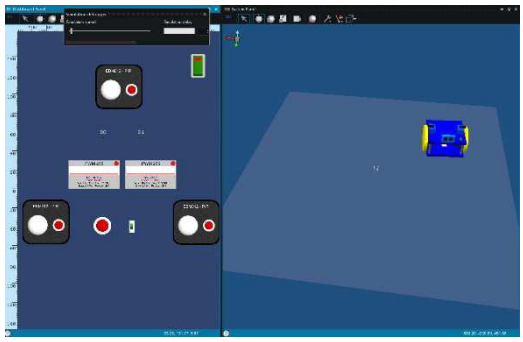

Fig. 12. Simulation results 3

Conclusions. Using the Flowcode program helps to properly invest time and resources in such a way that it would be economical, comfortable, and quick to create a simulation of the movement of a mobile robot without creating a real prototype. The robot model can be created considering the real dimensions in the program itself, the code can be programmed and tested.

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МОДЕЛЮВАННЯ ТРАЄКТОРІЇ МОБІЛЬНОГО РОБОТА НА ПЛАТФОРМІ LOWCODE

Актуальність теми дослідження. *Симуляція використовується для імітації реального руху робота, для перевірки програмного забезпечення та можливостей робота перед його збіркою. Це дає можливість змінювати і покращувати програмний код в процесі тестування, щоб в кінці реалізувати його на практиці. Симуляція – це безкоштовна платформа для тестування без додаткових фінансових витрат.*

Постановка проблеми. *Змоделювати рух робота за допомогою Flowcode, не створюючи справжнього робота.*

Аналіз останніх досліджень і публікацій. *Нині дослідження зосереджені на аналогічних проблемах, оскільки зараз існують обмеження, через які проектування і тестування проводяться віддалено, поза майстернями.*

Виділення недосліджених частин загальної проблеми. *Поточне рішення з використанням програми Flowcode дозволяє реалізувати програмування, моделювання і симуляцію роботи в одній програмі.*

Постановка завдання. *Мета статті - дати уявлення про те, як виконати симуляцію руху робота для перевірки функціональності програмного коду без використання фізичного робота.*

Виклад основного матеріалу. *Для реалізації симуляції робота необхідний комп'ютер із базовою конфігурацією і встановленою ліцензійною версією програмного забезпечення Flowcode.*

Висновки відповідно до статті. *В опублікованій статті представлена ідея програмування і моделювання руху мобільного робота з використанням програмного забезпечення Flowcode, що допоможе скоротити фінансові витрати і час для створення справжнього робота. Перевірено працездатність програмного коду та можливість віддаленої роботи без фізичного об'єкта.*

Ключові слова: *моделювання; мобільний робот; Flowcode.*

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