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LINE TRACKING ROBOT

Ilie BORCOŞI, Luminiţa POPESCU, Daniela NEBUNU

Abstract: *This paper proposes a solution for a mobile robot project, which is simple, cheap and can be used as an educational robot as well as for industrial necessities. The mobile robot has a sensorial system, which aids to its motion lengthways one trajectory. The trajectory is in this case a black line.*

Key words: *mobile robot, sensorial system, line tracking, moving.*

1. INTRODUCTION

Lately, the use of mobile robot has extended from the academic and research domains to the industrial and commercial domains.

At present, from the mobile robots used on a large scale, the following classes can be mentioned: Nomad, Khepera and Pioneer. Moreover, a series of toy robot kits appeared.

The Nomad robot continuously tries to adapt to the environment, simulating the reactions of the human brain using artificial neuronal networks for environment perception and motion.

Khepera II robot has smaller dimensions, is modulated and is used in educational purposes.

Pioneer 3-Dx has a computer on-board which tracks the robot's motion in real-time and is used for mapping applications, telephone-operating, object recognition, location finding etc.

Today, the tendency is towards an economical solution for the development of some educational types of robot systems, which should represent an intermediary step between the simulator and the real systems.

2. ROBOT DESCRIPTION

The mobile robot on which we'll debate in the paper has to track a certain given path (black line).

It is composed of a metallic or plastic chassis, two driving wheels placed in the backside of the chassis, a wheel situated in front of the chassis, a sensorial system and the control electronic system.

The two driving wheels work independent from each other because each is driven by a step-by-step engine.

The two step-by-step engines work with a non-symmetrical or mix command.

The driving logic of the coiling is made through the software stored in PIC 16F84 microcontroller from the electronic circuit.

The sensorial system represents the "eyes" of the robot, which helps it to move. This system must detect the robot's guidance black line and is composed of three pairs of infrared sensors (three emitters and three receivers) positioned in line or in a "V", according to the thickness of the guidance line and to the deviation from the line, as shown in Fig. 1.

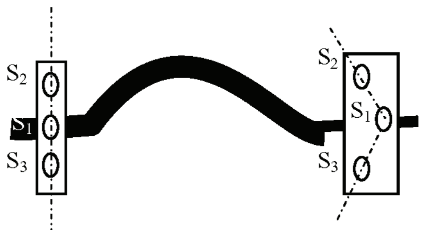

Fig. 1. The representation of the sensorial system.

For a good reception of the signal given by the emitter, the receiver and emitter are mounted under the same angle from the normal of the movement plan.

The electrical scheme of the sensor's alimentation is shown in Fig. 2.

The sensors give logical "0" when the robot isn't above the black line (when the sent signal is reflected back towards to receiver).

The electronic circuit is powered by a continuous power source at a 6 V voltage (4 batteries of 1,5 V) through a continuous voltage establisher 7805 (electrical scheme in Fig. 3).

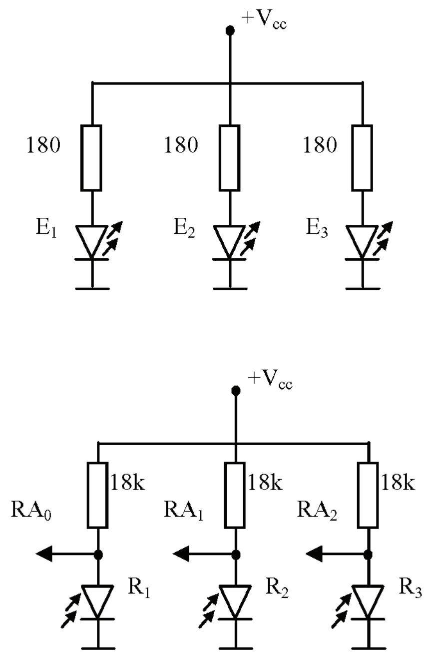

Fig. 2. The electrical scheme of the sensor's alimentation.

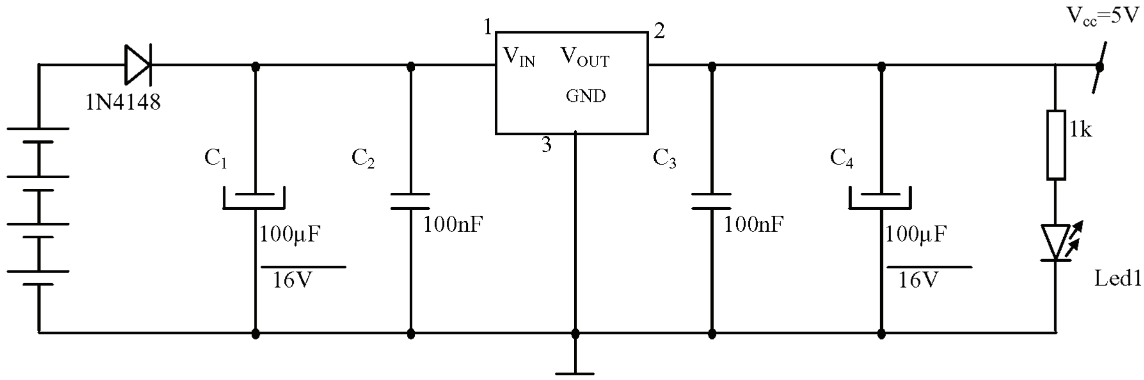

Fig. 3. The supply electronic circuit.

In the control electronic circuit (which has the scheme in Fig. 4) there can be seen several electronic the power driver (ULN 2803).

In the PIC 16F84 microcontroller is stored the program used for the robot's command, or better said, of the two step-by-step engines.

The program is written in assembly language or in the micro-Pascal language, after the logical scheme presented in Fig. 5, which is according to the sensor's symbolization in Fig. 1.

The logical scheme tries to distinguish how the mobile robot works through permanent testing of the sensors S_1, S_2, and S3.

If the sensor S_1 is logical "1" (the emitter and receiver are above the black guidance line) and the sensors S_2 and S_3 are logical "0" (not above the line, but on one side and on the other), the robot goes straight on, meaning that both step-by-step engines are commanded.

If S_1 is logical "1", S_2 is logical "0" and S_3 is logical "1", the sensors S_1 and S_3 are above the line and that means that the robot tends to move towards left and in this case, the robot receives command to swerve right in order to return to the straight on moving position, when only sensor S_1 is above the line.

The command for swerving right means that the corresponding step-by-step motor will drive the back-left wheel of the robot.

If the sensors S1 and S2 are 1 logic (the sensor S3 is 0 logic) then means the sensors S1 and S2 are above the black line. In this case the robot must receive the command for swerving left (the weal from the right side is in function and the weal from the left side is stopped).

When the logical values of S1 sensor and S2 sensor are 0 respectively 1 (only the S2 sensor is above the black line) the robot is situated on the left side of the line, in this case the robot must swerving left. This situa-

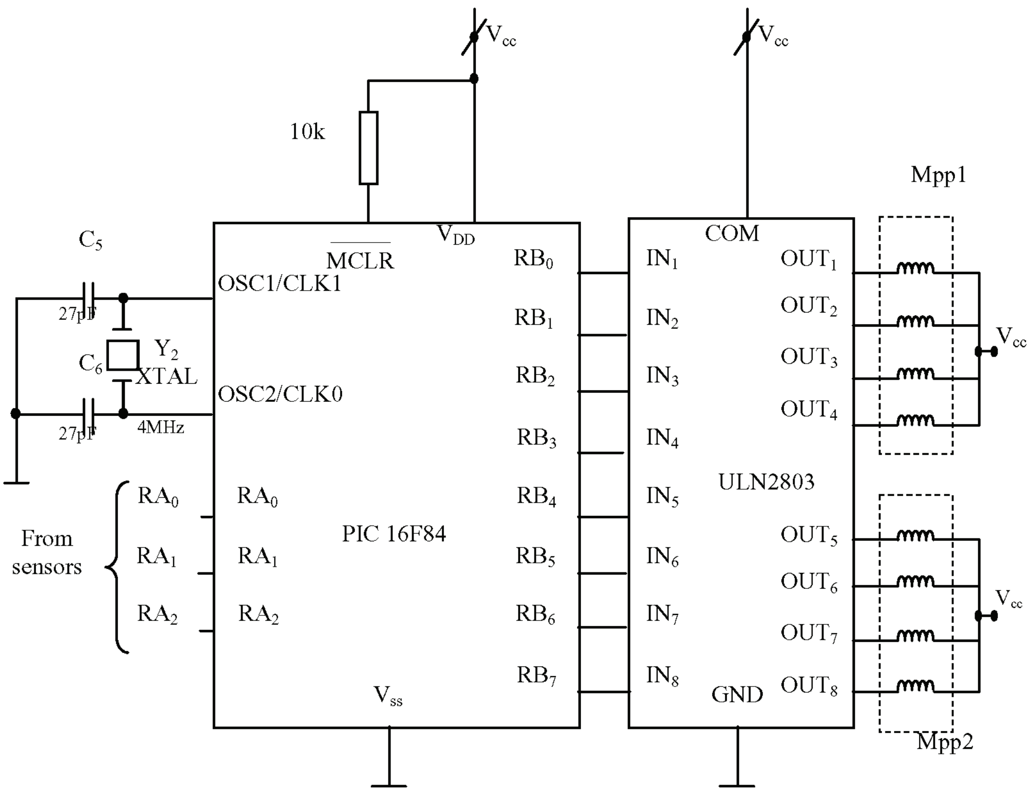

Fig. 4. The control electronic circuit.

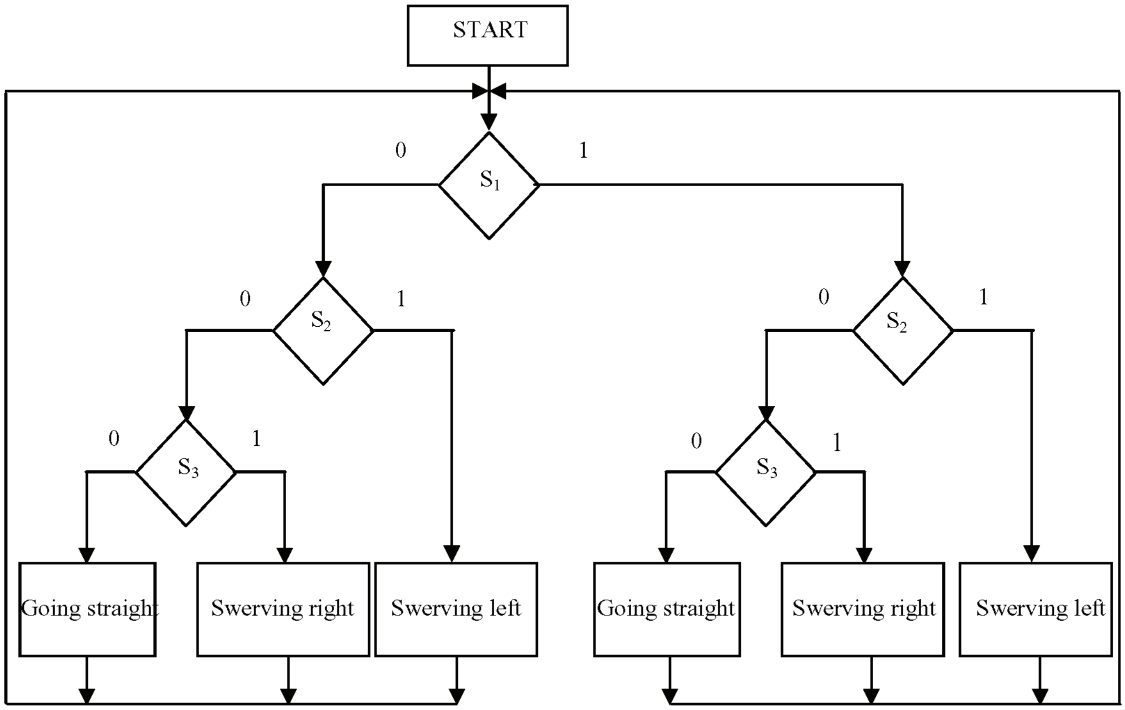

Fig. 5. The logical scheme.

tion is happening when the robot is moving too fast or the wide of the line is too little.

When the logical values of S1, S2 and S3 sensors are 0,0 respectively 1(only the S3 sensor is above the black line) the robot is situated on the right side of the line, in this case the robot must swerving right. This situation is happening when the robot is moving too fast or the wide of the line is too little.

In the logical scheme was not been included the situation when logical value of S1 sensor is 0 and logical value of S1 and S3 sensors are 1 because this situation is happening only where the distance between sensors (the distance between S1 and S2 sensors or the distance between S1 and S3 sensors) is bigger than the wide of the line. This distance between sensors must be situated above 2/3 and 3/4 of the wide of the line.

During movement, this situation can be eliminated if the distance between the sensors is smaller than the width of the guidance line. In case the sensors cannot be oriented as aligned and the requirements to be respected, they will be "V" oriented.

During the robot's movement, two limit situations can appear: one is when $S_1 = S_2 = S_3 =$ "0" and the second is when $S_1 = S_2 = S_3 =$ "1". The elimination of the first situation can be initially done by manually moving the robot towards the guidance line, so that $S_1 =$ "1" and $S_2 = S_3 =$ "0".

The tests show that the robot doesn't reach during movement the limit situations if the observations above

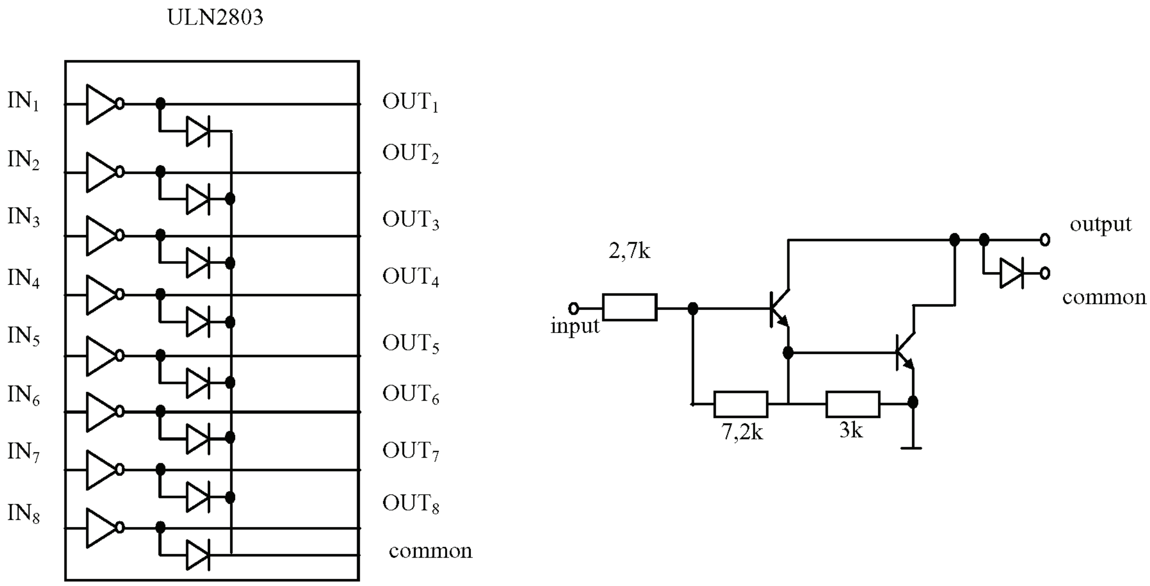

Fig. 6. The configuration of the circuit.

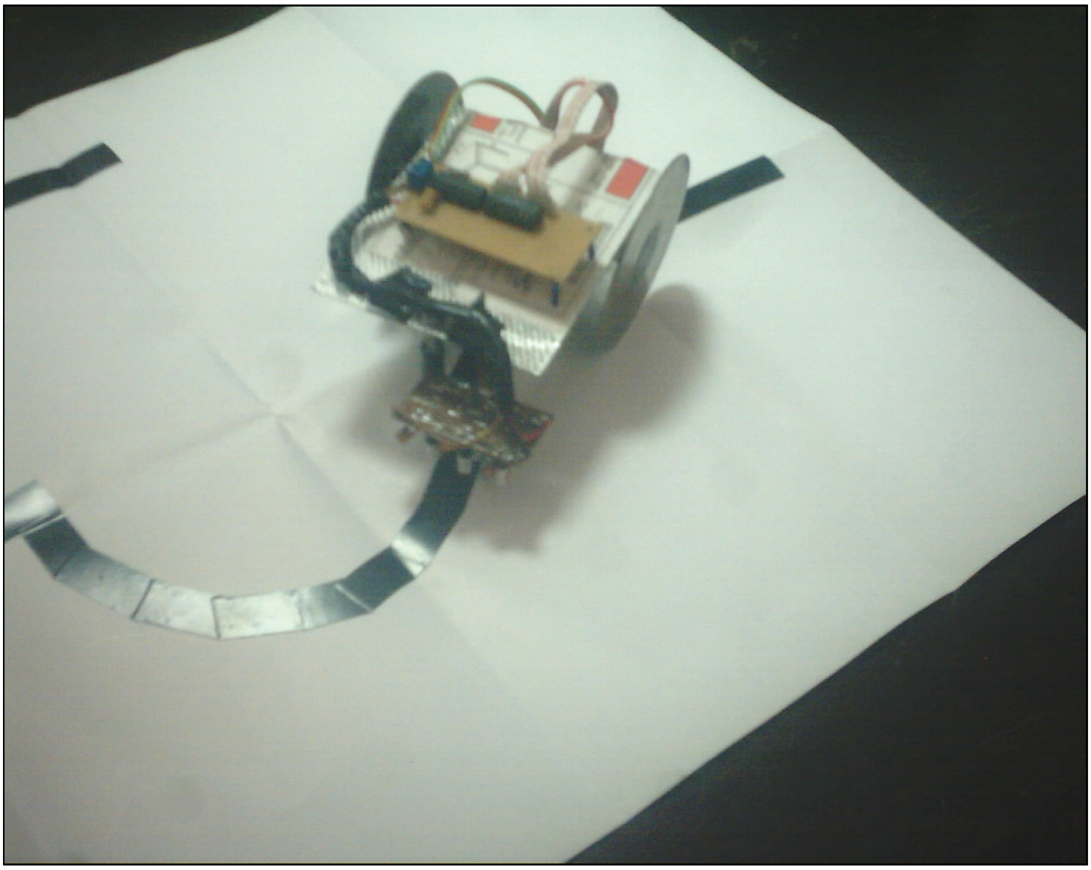

Fig. 7. The line tracking robot.

are respected. The second limit situation is very unlikely to appear in operating.

The commands for swerving right and swerving left from the logical scheme are generated when one of the sensor S2 or S3 have 1 logic value and stay activate until this sensors have 0 logic value.

The power driver circuit, ULN 2803, made especially for the interface circuits has a maximum output current of 500 mA. The circuit consists of 8 pairs of NPN transistors in Darlington configuration (Fig. 6) and is compatible with TTL and CMOS logic. The command for the driver, which has an inverter character, is directly done by the microcontroller. The circuit is made up of 8 channels on which the two engine's coiling are connected.

The robot was realized practical and is presented in the Fig. 7.

3. CONCLUSION

This mobile robot is simple and economical to be made, with a high applicability in many domains. It can be used as an educational robot, but mostly in the industrial domain, in the areas with high toxicity (where people life can be affected) for material transport. Also, it can be used in the military domain for security (with a video camera attached) of to transport materials in the limited access areas.

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Authors:

Eng. Ilie BORCOŞI, Lecturer, "Constantin Brâncuşi" University, Automation Dept., E-mail: ilie_b@utgjiu.ro

Eng. Luminiţa POPESCU, Assoc. professor, "Constantin Brâncuşi" University, Automation Dept,
E-mail: luminita@ utgjiu.ro

Eng. Dana NEBUNU, Assistant, "Constantin Brâncuşi" University, Automation Dept., E-mail: dana@utgjiu.ro