Robot SRS

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Abstract: *In this article the construction of the robot is described. The robot intends for movement on a black line on the set map. Also the algorithm of movement of the robot on a line including turns, crossroads, and long curves is considered in clause.*

Keywords**:** robot, algorithm, black line, crossroad.

1. Construction of the robot

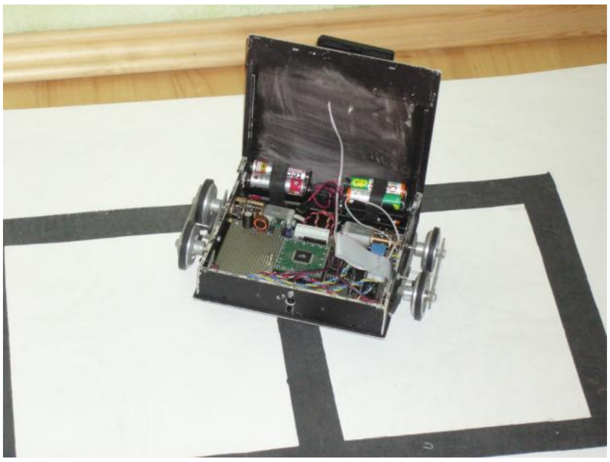

Fig.1 - Robot photo

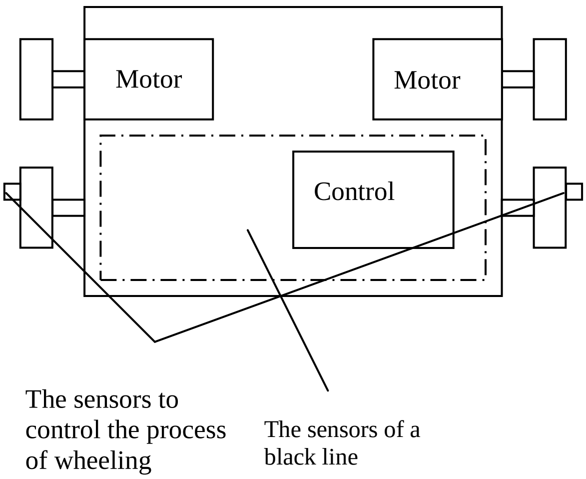

Fig.2 - The structure of robot

Robot SRS is built out of odds and ends. The body of the robot is a box for 5.2 inch discs. The back wheels are powered once and each of them is put into motion by an individual electric motor. Twelve-volt collector motors whith built-in reduction gears is used in robot. The gear-ratio of the reduction gear is 90 to 1. The motors are controlled by a driver built on chip L293D. The power supply is provided by eight feeding elements type AA. The control unit of the robot applies microcontroller ATmega128L. The main characteristics of this microcontroller are 8MHz frequency, 52 controlled pins, the power of 2.7 V – 5.5 V, 123 kB memory capacity of commands. The loading of command codes into the memory of the microcontroller is carried out by a personal computer via JTAG. On the driven wheels there are nine-position sensors to control the process of wheeling. There are twenty optocouples on the bottom of the robot to identify the black lines. Optocouples make up the 5x4 matrix. The system works using infra red light of 36 kHz frequency which protect it from the influence of the day lights. Each optocouple is connected directly with the microcontroller, which guarantees a high speed definition of the sensors. The elimination of the "contact bounce" in optocouple is carried out by programming. The exclusion of possible errors is made by the check of the latest three positions of the sensors. Only three latest positions are checked as given with two checks the movement of the robot remains stabilized. The sensors of a black line are analyzed every five mille seconds. The refresh of the matrix condition takes place within the same period. The algorithm provides the movement of the robot along the black line.

0;0	1;0	2;0	3;0	4;0
0;1	1;1	2;1	3;1	4;1
0;2	1;2	2;2	3;2	4;2
0;3	1;3	2;3	3;3	4;3

Table 1.

2. Algorithm

The algorithm provides the movement of the robot along the black line. According to the robot algorithm the black line should meet the following requirement:

1. The lines should cross only at the right angle.
2. The turnings should be at the right angle.
3. The distance between crossings shouldn't be shorter that the robot length.
4. The long curves should be marked.

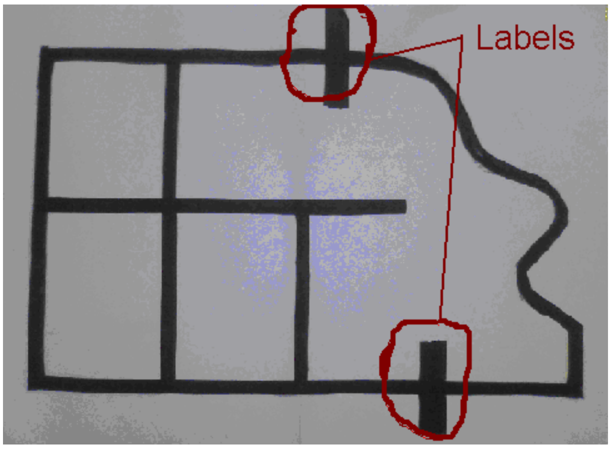

Fig.3 - Photo of black line.

The algorithm is based on consequent run of the crossroads. The idea of the algorithm is in the following. If the robot moves along the left side of the black line, it turns to the left at the nearest crossing. But if it moves along the right side of the black line, it turns to the right at nearest crossing. For driving endways on a road crossing the robot simply moves on a black line with the minimum deviations to the right/left. Such algorithm of driving of the robot can be applied to known maps. As the regularity of driving of the robot depends on a select of a direction. At a select of a nonexistent direction, for example, endways on T-figurative road crossing, driving of the robot is unpredictable.

Let's consider driving the robot along the left-handed boundary of a black line. For this purpose two sensors (2, 2) and (1, 2) are used. (Table 2).

Course:	black	white
Forward	(2, 2)	(1, 2)
Turn left 1	(1, 2) and (2, 2)	-----------------
Turn left 2	(1, 2)	(2, 2)
Turn right	-----------------	(1, 2) and (2, 2)

Table 2.

Let's consider driving the robot along the right boundary of a black line. For this purpose two sensors (2,2) and (3,2) are used.

Course:	black	white
Forward	(2,2)	(3,2)
Turn right 1	(3,2) and (2,2)	---------------
Turn right 2	(3,2)	(2,2)
Turn left	-----------------	(3,2) and (2,2)

Table 3.

Driving endways is carried out due to operation of central sensors if they black driving is carried out endways. Otherwise are parsed the right and left half of sensors, turn is carried out in that side from what side of black sensors more. For determining road crossings it was supposed to consider all chances, namely 2^20=1048576. It is practically impossible. Therefore, all road crossings has been decided to lead to one type. As a result in concept a road crossing switch on T and X figurative road crossings, and also road turns. Function has been developed, whether defining there is a robot on a road crossing. A data-in is the array describing a state of sensors of a black line. Outcome 1 - a road crossing, 0 - not a road crossing.

The given algorithm was tested on robot SRS. Operation of the robot was steady, except for cases when the equipment of the robot refused. That is a problems in power supply of the robot, a breakaway of wire, poor-quality assembly of robot. That concerns to pluses of the given algorithm that customization of algorithm is not required: the definition of coefficients. The given algorithm will work steadily even at a different velocity of rotation of sprockets, right and left-handed. The given algorithm was not tested in system MatLab. So we can approve about successfully of the algorithm only rather. In practice to check up the majority of situations it is impossible by virtue of duration of carrying out of experience (The velocity of the robot is small). Therefore compilation of a mathematical model for improving algorithm is a priority direction in the given project.

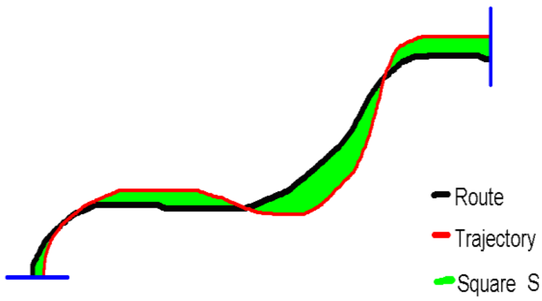

Fig.4

The given algorithm demands estimation on following parameters safety and velocity. Let's consider an arbitrary lot of a black line. The length of a lot is equal l then a metric of safety will be S/l. than metric that above safety of the robot less. The concept of safety includes also concept boundary distance. This is a maximum distance on which the robot from a black line can move away. In most cases this distance does not exceed width of the robot. In practice to estimate the safety is complicatedly enough as determining of square is complicated enough. In the theory where driving of the robot is set by coordinates, square to calculate simply enough, using an integral calculus. Following criterion of an estimation of the robot is the velocity. It is simple to estimate an average speed of driving of the robot on a black line. We shall divide the path (4.7м) into the time of driving (117s). For robot SRS the velocity of driving on a black line has made 4cm/s. At a rectilinear movement the velocity of the robot makes 5.5cm/s. A difference of velocities is only 28 %.

Further operation above project provides magnification of reliability of the equipment of the robot and development new algorithms of driving on a black line.

3. REFERENCES

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