Design and Implementation of a Mobile Robot for the Transport of Objects Inside an Industrial Warehouse

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SUBJECT: ANALYSIS AND DESIGN OF DIGITAL CIRCUITS

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SUMMARY

This project involves the implementation of a prototype mobile robot that is intended for use in logistic distribution of goods in stores and industrial warehouses. With the implementation of new technologies, and the current trend of the industry, constant improvement and mutual competition both in quality, production, implementation of new systems as saving space and optimal shipment of goods has been watching developments in industries and commercial chains. This paper proposes a solution to this problem.

INTRODUCTION

The means of transport and merchandize distribution in an industrial warehouse or commercial chain were slow and uncertain, with the technological advances the man has developed appliances that to their convenience improved the daily life and the execution of the works, one of these inputs are mobile robots, used in this particular case to maximize efficiency and effectiveness by optimizing the transport and distribution of loads in industrial warehouses.

The use of machineries is for increasing the capacity of production of the individual, causing that the product arrives optimally to the place where it is required. Figure (1).

Figure (1). Shuttle machines.

Currently, industries and commercial chains have problems with transportation of materials and goods, few are the factories that made deep studies on the daily transportation of their goods and materials to reach their destination efficiently and effectively.

Arises the idea of optimizing commuting making industries, factories and commercial chains, as much to transfer to the warehouses like also moving within it, in order that those goods and materials arrive without deterioration and higher quality to their destination, besides saving time and costs. The implementation of the project aims to propose a solution to this problem, which affects the industry daily.

The report consists of an overview and presentation of a problem happening in industries and factories and then describes the solution to be given to this problem. Good results were obtained with the implementation of mobile robot that was made, those results are detailed below. General and specific objectives arise finally issued conclusions from the results, the process followed and the methodology used are issued.

PRESENTATION OF THE PROBLEM

In the last decades the great Commercial Chains and of Storage as product of the substantial increase in the cost of the land and the necessity of optimization in the handlings of merchandize and operations has been seen in the necessity to look for new solutions for the daily unfolding of their activities

These investors when seeking for the services of a professional engineer would have conveyed their concerns about the use of space, efficiency and optimization in the distribution of goods.

Now with the advancement of technology and the use of machinery supplied with automatic and electronic equipment, we have a way to achieve a high degree of efficiency in the transportation of materials and goods. Figure (2).

Figure (2). Automatic and electronic machinery.

OBJECTIVES

General purpose

• The main objective of this project is to develop 01 prototype mobile robot, which moves along a line that delimited its path, from a starting point to an end point, indicated on the track.

Specific objectives

• Design and to implement the control circuit and the power circuit of the robot

.• Design and implement the necessary logic to the prototype robot to perform the desired work.

• Check the functionality of the proposed prototype, using a 2m x 1m track with a track circuit.

DESCRIPTION OF THE SOLUTION

Faced with this problem of the industries and factories, the idea of creating a prototype mobile robot for optimal distribution of goods in warehouses and commercial centers.

Then the process that has to make the prototype throughout their journey, in this case a flow chart described was used. Figure (3).

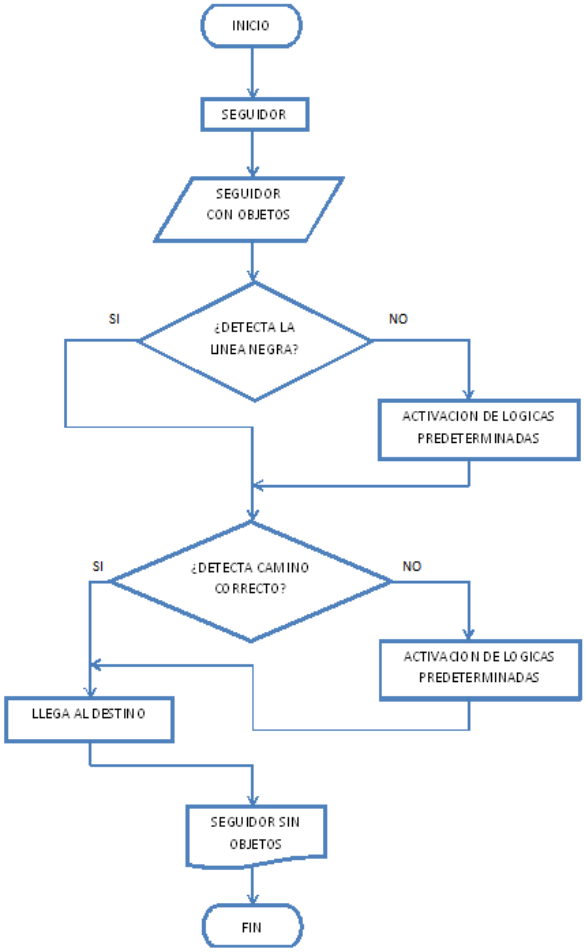

Figure (3). Flowchart prototype.

To implement this prototype, first chassis with wheels, seen in Figure (4) was designed. 02 DC motors one for each wheel is placed. Then the track is printed in order to make the logic as essay tests. Figure (5).

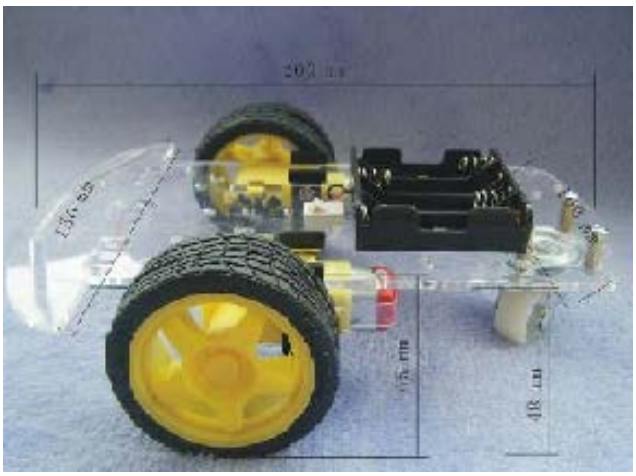

Figure (4). Initial design of the prototype.

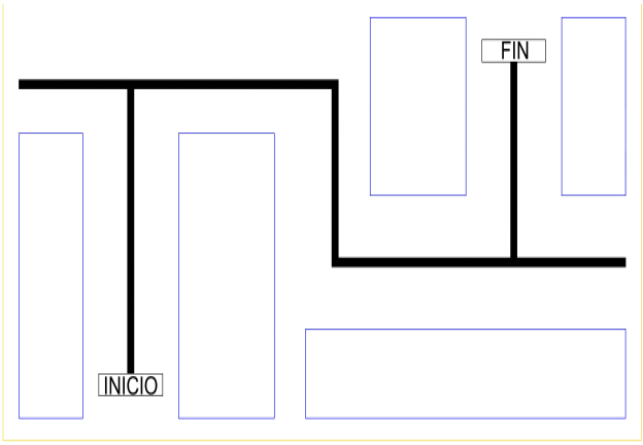

Figure (5). Graph of the test track.

The mobile robot is based on the use of TTL technology, such as logic gates and integrated sensors. With these tools the logic circuit to be implemented in the breadboard is designed, finally was made different tests on the track with the complete mobile robot. Figure (6).

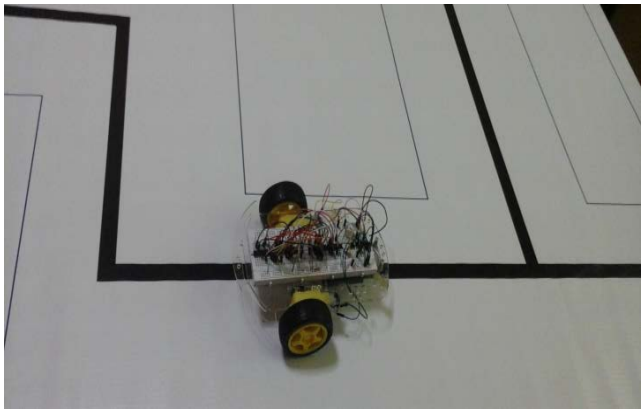

Figura (6). Pruebas de ensayo

An example of circuit used to control electric motors are shown in the following chart. Figure (7).

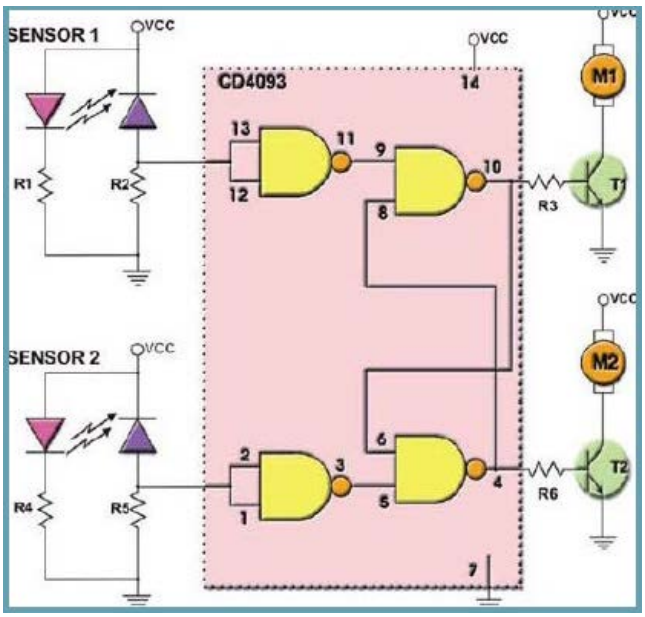

Figure (7). Graphic circuit

As for the design of logic functions used (Boolean equations) to said path shown with their respective truth box. Figure 8).

Equation to the right engine, according to the sensor readings.

$$MI = \overline{s_2} * s_4 + \overline{s_1} * s_3 + \overline{s_4} * s_3$$

Equation for the left engine, based on the sensor readings.

$$MD = \overline{s_4} * s_2 + \overline{s_1} * s_3 * s_2 + s_4 * s_1 * \overline{s_3}$$

$$S_n = Reading\ of\ sensors\ in\ digital\ form.$$

	S1	S2	S3	S4	MI	MD	STATE
1	0	0	0	0			
2	0	0	0	1	1	-1	RIGHT
3	0	0	1	0	1	-1	RIGHT
4	0	0	1	1	1	-1	RIGHT
5	0	1	0	0	-1	1	LEFT
6	0	1	0	1			
7	0	1	1	0	1	1	IT ADVANCES
8	0	1	1	1	1	1	IT ADVANCES
9	1	0	0	0	-1	1	LEFT
10	1	0	0	1	1	-1	RIGHT
11	1	0	1	0	1	-1	RIGHT
12	1	0	1	1	1	-1	RIGHT
13	1	1	0	0	-1	1	LEFT
14	1	1	0	1			
15	1	1	1	0	1	1	IT ADVANCES
16	1	1	1	1			

Figure (8). Chart logic engines.

Since in a warehouse of an industry, moving materials efficiently and effectively is needed, the mobile robot has to do a certain route and dispensed at the right place. An efficient transfer on our test track was obtained, in Figure (9) can be observed the movement of the mobile robot on the test track.

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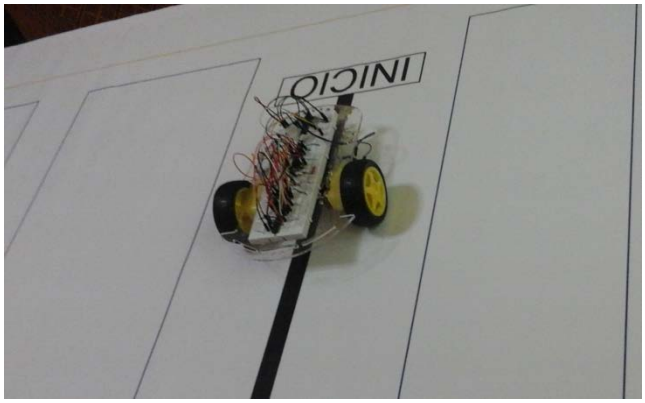

Figure (9). Movement of the mobile robot.

RESULTS

The respective analysis was done to the assay tests, getting test results that meet the initial expectations.

The mobile robot successfully performed its trajectory given by black lines, moved from the starting point to the end point. Figure (10).

Figure (10). Mobile robot nearing the end point.

With regard to monitoring of the black lines with a white background, the mobile robot moved efficiently and effectively, not out of its path, starting from the start point and optimally coming to an end in a certain point on the test track. Figure (11)

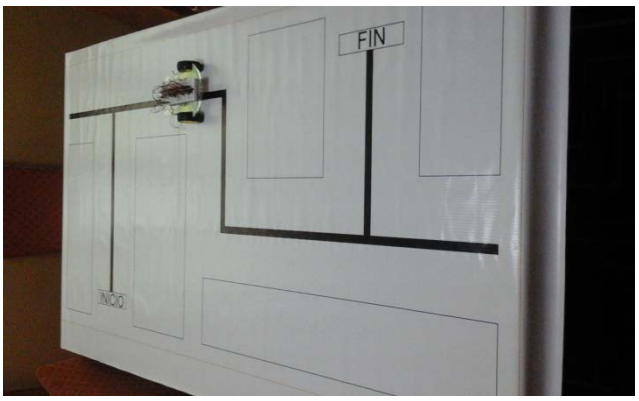

Figure (11). The prototype following the route correctly.

In the design of the necessary logic to perform its route; the prototype used very few materials of TTL technology, sensors and other materials, resulting in optimal results within costs. Figure (12).

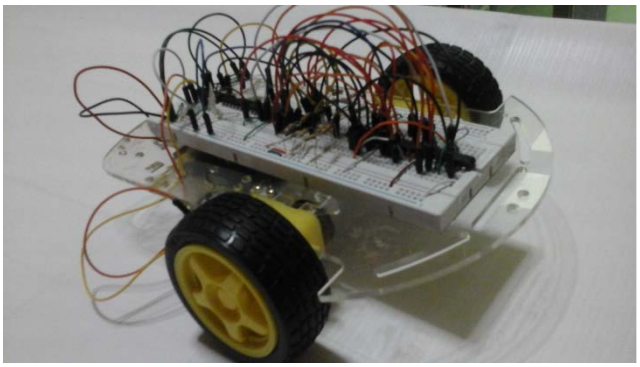

Figure (12). The prototype with TTL technology.

Good results for the implementation of the control circuit for the engines were obtained; they performed their respective work for the prototype made its path efficiently. Figure (13).

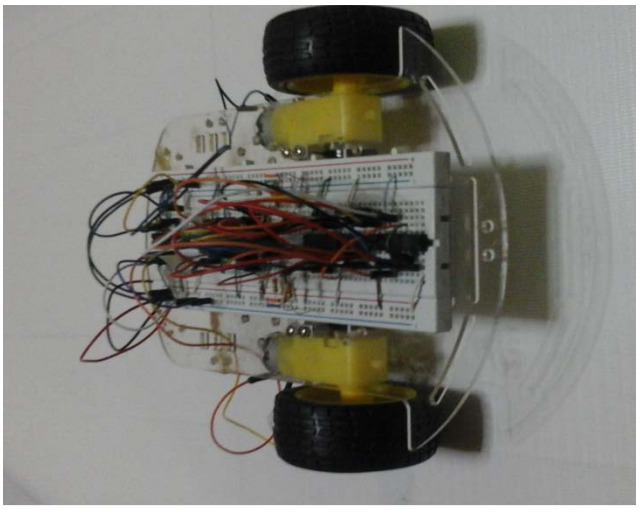

Figure (13). Mobile robot with optimal motor control.

The following describes in detail the materials used and their respective costs, showing the total cost in soles. Figure (14)

NAME	AMOUNT	PRICE C/U	TOTAL
CNY 70	4	3	12
L293D	1	7	7
CD40106	2	1.6	3.2
SOLAR PADDLE	1	8.5	8.5
74LS04	1	1	1
74LS08	2	1	2
74LS32	1	1	1
PLANE	1	20	20
CABLES			7
RESISTANCE			3
SCALE MODEL	1	30	30
BREADBOARD	1	10	10
		TOTAL	104.7

Figure (14). Table of quantity and price for the total project

CONCLUSIONS

1. The main objective was achieved, which was the culmination of the project in this case a mobile robot line follower, thanks to the knowledge acquired in the subject and collaboration of friends and colleagues.

2. The design adopted for mounting the mobile robot was the most successful since the location of the sensors are provided and the tires which must be in perfect hub for the robot to perform in the best way in the tasks assigned.

3. The development of the line follower was very important to apply all the knowledge acquired during our process of education.

4. The mobile robot is a tool that encourages creativity and development of the knowledge acquired by the engineer during the process of education.

5. The result of this project meets initial expectations, follow the black line with white background is efficient and mobile robot moves from the starting point to the end point indicated on the test track.

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