Line follower robot project

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Summary*-*In the laboratory we proceed to design a line follower vehicle, which must fulfill the function of reading on a track, the device must be autonomous so that it remains stable and fulfilling parameters such as: when recognizing the black line in different sensors the car must turn on, turn off or reverse the available motors, activating them for a sharp turn or a smooth one, for the sharp one the two motors would be activated, one clockwise while the other counterclockwise, For the smooth turns will be activated the opposite to where you want to turn so that in this way is rotated on the axis of the engine you want to turn, in turn must comply with the illumination of different LEDs, being 3 the number of LEDs, one for right turns, a different one for left turns and finally a red LED to indicate that the car is at rest or backing up. The functions to be linked with the sensors,to make the connection it was necessary to make the appropriate procedure in the Karnaugh tables.

I. Introduction

Nowadays, Mobile Robotics has become a topic of great interest, with great advances due to a large number of projects that have been developed around the world. As a result, mobile robots with extensive interaction with the environment have been achieved, which has opened an immense range of applications such as sampling, analysis of the environment, gas detection, leak detection, sending audio and video signals and vice versa, etc., all remotely to avoid human risk [1]. However, these types of robots have application areas other than education. One of these application areas is industry, where they are widely used. They are also used in research and entertainment. It is for this reason, among others, that this type of robots are an interesting topic for the general public, this type of robots can be described as a mobile capable of moving in a work area on which there is a line of a different color to the floor. To detect this line the robot uses sensors. Depending on the task to be performed and the complexity of the path, more or less sensors will be used to achieve the objective. The line that is marked on the floor is the path to be followed by the robot, in figure 1 is given to note the shape of the device, now well, each of the sensors meets a reading as noted in Table 1 and in turn highlight a function in the various outputs either motors and / or Leds, these functions depend on the results obtained by performing the corresponding karnaughs of each output to give a command to the device the realization of the above maps can be highlighted from Fig.3 to Fig. 9, ensuring the excellent performance of the same.

IMAGE I
Vehicle model

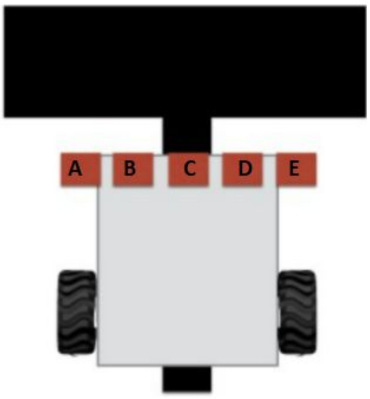


Fig. 1Proposed device

SENSORS	ESTABLISHED FUNCTION
A	Sharp left turn
B	Gentle left turn
C	Go to
D	Smooth right turn
E	Sharp right turn

Table 1. function of the sensors

II. Experimental set-up

To carry out the proposed project it was necessary to put into practice the knowledge obtained in previous courses and to complement it with the recently seen topics, so that in this way a good project could be achieved, we made use of karnaugh maps, extracting formulas, reducing functions that will serve for the operation of the car, applying programming knowledge to establish the codes that will be used, before the realization of the codes we checked the good realization of the karnaugh maps in proteus. In this way, the work team ensures a good function of the motors and leds, testing the codes that must respond to each occasion as shown in Fig. 2.

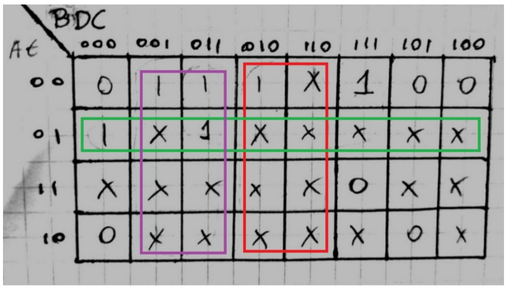
S. Ext-Iz	S.Ext-der	S.Med-Iz	S.Med-der	S.Central					Led Izq	Led Der	Led Central
A	E	B	D	C	M1 Adela	M2 Adela	M1 Rever	M2 Rever	Amarillo Izq	Amarillo Der	Rojo
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	1	1	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	1	0
0	0	0	1	1	1	0	0	0	0	1	0
0	0	1	0	0	0	1	0	0	1	0	0
0	0	1	0	1	0	1	0	0	1	0	0
0	0	1	1	0	x	x	x	x	x	x	x
0	0	1	1	1	1	1	0	0	0	0	0
0	1	0	0	0	1	0	0	1	0	1	0
0	1	0	0	1	x	x	x	x	x	x	x
0	1	0	1	0	x	x	x	x	x	x	x
0	1	0	1	1	1	0	0	1	0	1	0
0	1	1	0	0	x	x	x	x	x	x	x
0	1	1	0	1	x	x	x	x	x	x	x
0	1	1	1	0	x	x	x	x	x	x	x
0	1	1	1	1	x	x	x	x	x	x	x
1	0	0	0	0	0	1	1	0	1	0	0
1	0	0	0	1	x	x	x	x	x	x	x
1	0	0	1	0	x	x	x	x	x	x	x
1	0	0	1	1	x	x	x	x	x	x	x
1	0	1	0	0	x	x	x	x	x	x	x
1	0	1	0	1	0	1	1	0	1	0	0
1	0	1	1	0	x	x	x	x	x	x	x
1	0	1	1	1	x	x	x	x	x	x	x
1	1	0	0	0	x	x	x	x	x	x	x
1	1	0	0	1	x	x	x	x	x	x	x
1	1	0	1	0	x	x	x	x	x	x	x
1	1	0	1	1	x	x	x	x	x	x	x
1	1	1	0	0	x	x	x	x	x	x	x
1	1	1	0	1	x	x	x	x	x	x	x
1	1	1	1	0	x	x	x	x	x	x	x
1	1	1	1	1	0	0	0	0	0	0	1

Fig. 2. Table of truth

As detailed in figure 2 the coherence and logic with which the sensors are located is that, being the sensor "C" the one that will have more direct contact with the black line was located in the column that has more changes in binary "010101" and being the sensors "B" and "D" the seconds that may have more frequency were located in the following columns and with the approach of that logic is found finally the location of the remaining 2 sensors, With this in mind, we will locate in the dependent columns of each output presented (motor1, motor2, motor1R, motor2R, left yellow led, right yellow led, red led) as shown in fig. 2, Once the functions are located in each column, we proceed to make a karnaugh map dependent on each output.

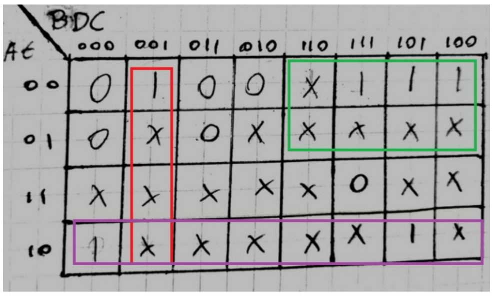
III. Results

The following are the maps made by the work team, to verify that the above-mentioned procedure was carried out correctly.



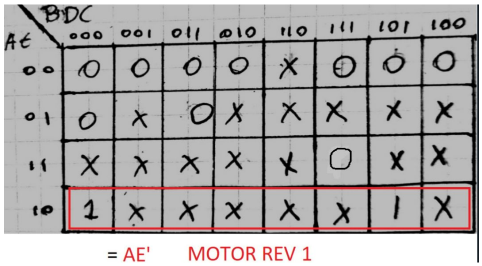
= A'E + A'D + CB' MOTOR 1

Fig. 3. karnaugh Motor 1



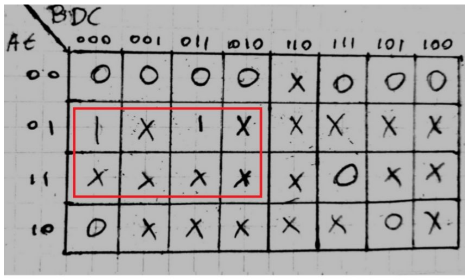
= B'D'C + A'B + AE' MOTOR 2

Fig. 4. karnaugh Motor 2



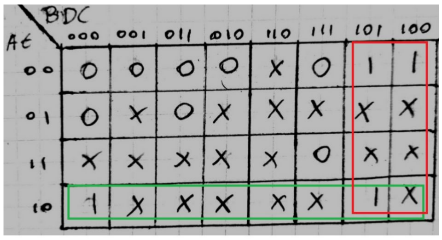
= AE' MOTOR REV 1

Fig. 5. karnaugh Motor 1 reversa



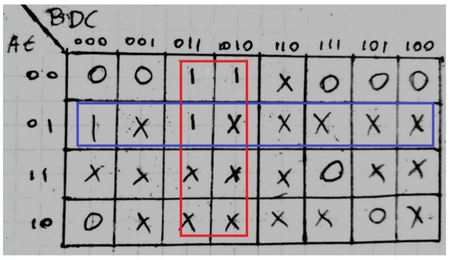
= EB' MOTOR REV 2

Fig. 6. karnaugh Motor 2 reversa



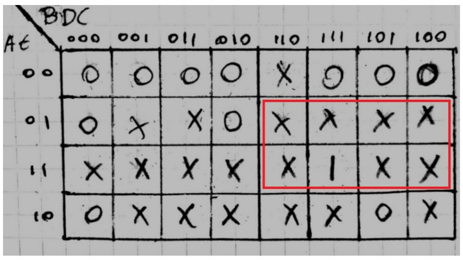
= AE' + BD' LED IZQ

Fig. 7. Led Izquierdo



= A'E + B'D LED DER

Fig. 8. Led Derecho



= EB LED ROJO

Fig. 9. Led Rojo

PROTEUS OPERATION

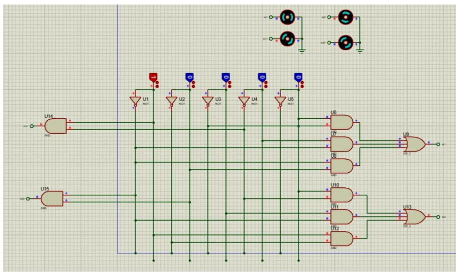


Fig. 10. Giro brusco a la izquierda

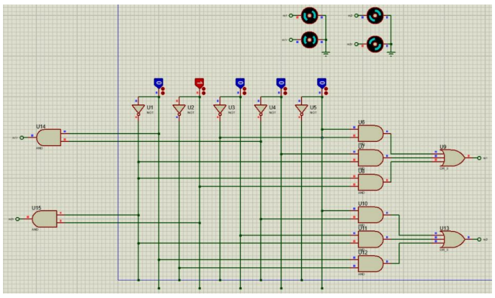


Fig. 11. Giro brusco a la derecha

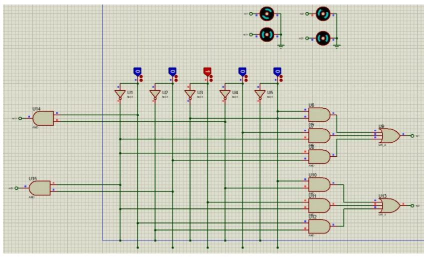


Fig. 12. Giro suave a la izquierda

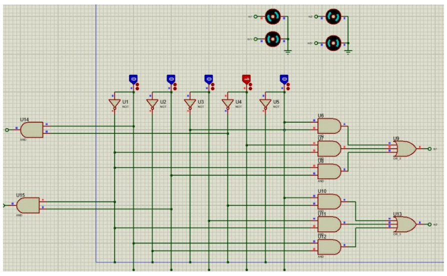


Fig. 13. Giro suave a la derecha

Map testing simulations can be found at [Proteus].

In the figures from 3 to 9 the good procedure in the realization of the different maps is demonstrated in order to obtain the best possible reduced functions and thus simplify the code to elaborate, it should also highlight the excellent location of the "1" that indicates when the output performs the role to follow or the location of the "X" which are neutral to compare "0" that serve to define when it does not work, without the good control of this map the operation that passes from the sensors to the motors or LEDs would be obsolete and affecting the subsequent steps such as programming.

Now, having made the maps, we must find a way to capture a logic for the device, the logic shows the sequence to be followed by the car, this sequence can be represented textually in a flowchart, as shown in the following images.

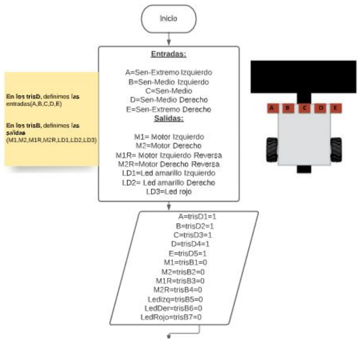


Fig. 19. The first part of the state diagram

In fig.19 we highlight the first step carried out which is In the D tris, we define the inputs (A,B,C,D,E) In the B tris, we define the outputs (M1,M2,M1R,M2R,LD1,LD2,LD3)

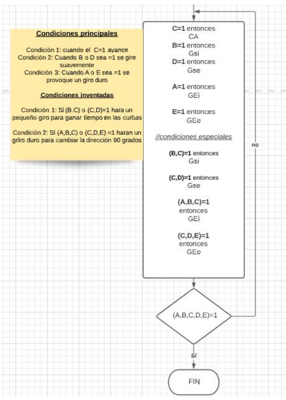


Fig. 20. The second part of the state diagram

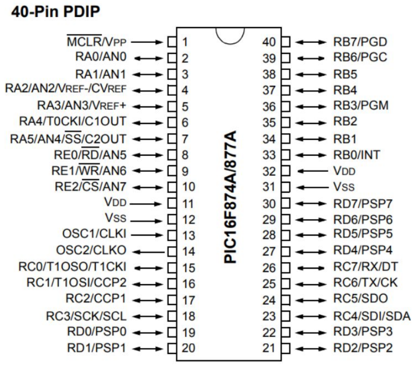
While the last figure is shown (fig.20) shows the conditions established, which were categorized into 2 groups, the first group being titled "Main conditions" which has the functions required by the guide, which are:

- Condition 1: when C=1 advance
- Condition 2: When B or D is =1, turn smoothly.
- Condition 3: When A or E is =1 a hard turn is caused.

For the second group, we analyzed possible results that the students gave as tacit in the given guide, possible functions that were not expressed textually, perhaps to test the ingenuity of the participants in the elaboration of the project; this second group of functions has given the name of "invented conditions".

- Condition 1: If (B.C) or (C,D)=1 make a small turn to gain time in the curves
- Condition 2: If (A,B,C) or (C,D,E) =1 will make a hard turn to change direction 90 degrees.

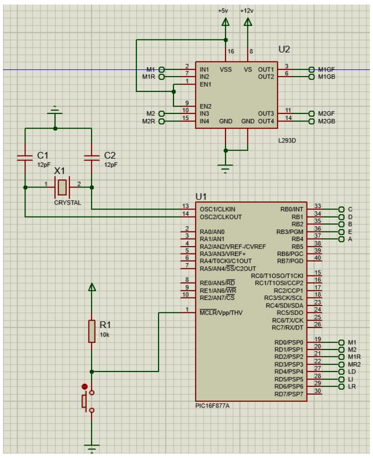
The importance of these conditions is highlighted at the moment that the programming of the code begins since it will be the one that will give a proper operation.



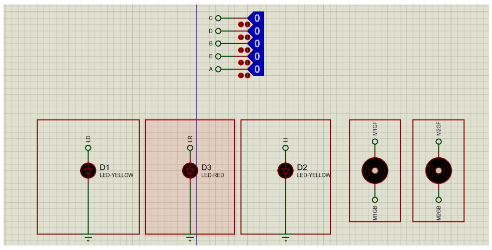
Fig,21, Pic

Finally, the simulation is performed in Proteus, and remember that for the PIC16F877A is necessary a crystal oscillator with the same frequency, in turn, two capacitors in picofarad scale, this for the correct operation of the simulation. It also has a reset PIN that must be connected to a component which will allow it to reset the microcontroller if necessary, in fig.21. all the pins of the microcontroller used are observed.

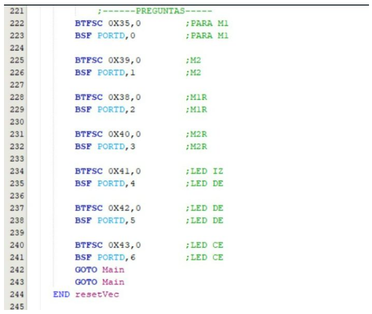
It should be noted that the four outputs corresponding to the motors are connected to the control input pins of the L293D, where according to Fig. 21, it is observed that pins 2 and 7 (INPUT 1, INPUT 2) are connected to the outputs of the microcontroller MI and MIR respectively, in that sense, the left motor is connected to pins 3 and 6 (OUTPUT 1, OUTPUT 2). As for the right motor, control input pins 10 and 15 (INPUT 3, INPUT 4) are connected to the outputs of the microcontroller MD and MDR respectively, in that sense, the right motor is connected to pins 11 and 14 (OUTPUT 3, OUTPUT 4). Keep in mind that the direction of rotation of each of the motors depends on this connection. It is recommended to check the driver datasheet to connect the necessary supply voltage and enable pins.



Fig,22, Circuit Final.



Fig,23, final circuit part 2



```
        ;------PREGUNTAS-----
    BTFSC 0X35,0        ;PARA M1
    BSF PORTD,0         ;PARA M1

    BTFSC 0X39,0        ;M2
    BSF PORTD,1         ;M2

    BTFSC 0X38,0        ;M1R
    BSF PORTD,2         ;M1R

    BTFSC 0X40,0        ;M2R
    BSF PORTD,3         ;M2R

    BTFSC 0X41,0        ;LED IZ
    BSF PORTD,4         ;LED DE

    BTFSC 0X42,0        ;LED DE
    BSF PORTD,5         ;LED DE

    BTFSC 0X43,0        ;LED CE
    BSF PORTD,6         ;LED CE
    GOTO Main
    GOTO Main
END resetVec
```

Fig,24, Code

In Fig.22 and Fig.23 the final circuit to be simulated is shown, in which the final assembly code is entered, thus verifying its operation, the simulation can be found in the Proteus folder , in Fig.24 a fragment of the final code was chosen, giving a sample of the work done, The code can be found in the Código

IV. Conclusions

- Previous knowledge of the digital area of electronics is required to complement the steps required in this laboratory.
- It was noticed that the location of the sensors responsible for keeping the carriage on the line is practically essential because if they are not where they should be, the robot does not do what is desired even if the electronics and programming are in perfect condition.
- The main objective was achieved which was the realization of the project in this case a line follower robot, thanks to the knowledge acquired in the course.

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References

[1] G. Eason, B. Noble, and I.N. Sneddon, “On certain integrals of Reyes F. et al. “Diseño, Modelado y Construcción de un Robot Móvil”, Segundo Congreso Nacional de Electrónica, Benemérita Universidad Autónoma de Puebla, pp. 1-5, Puebla, México, del 24 al 26 de Septiembre de 2002.