Digital Logic Circuits Lab PROJECT

Obstacle Avoiding Robot

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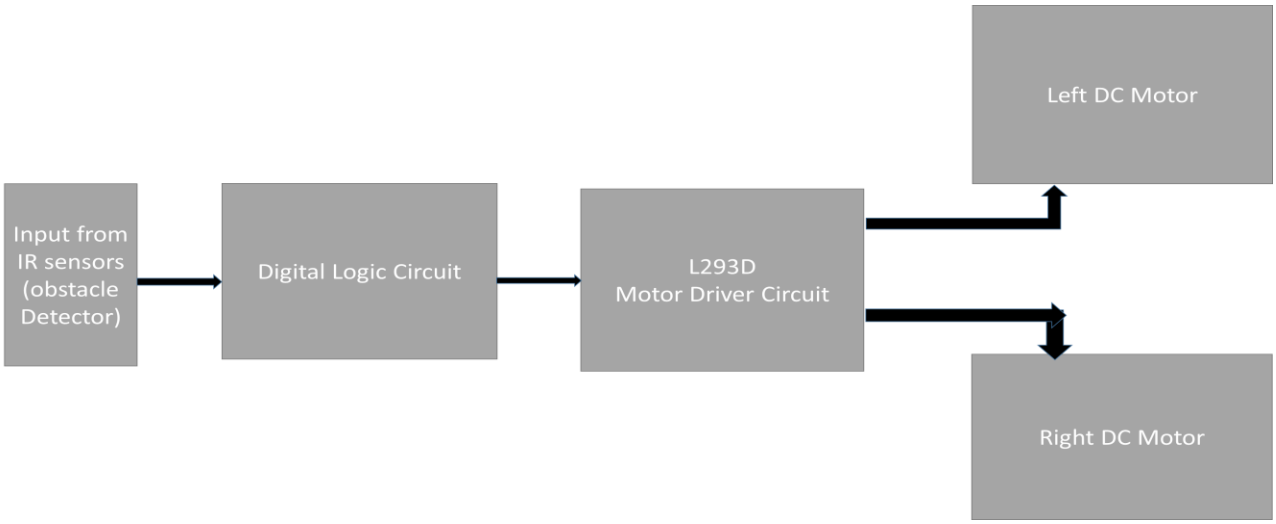
Problem Statement

Robotic automation is the very essence of our future. This technology is a major area of research for many scholars around the world and for good reason. It serves to improve the life of millions around the world, allowing us to explore the horizons previously believed to be impossible. As aspiring engineers, we believe it is our duty to indulge in activities that help the general populous and with that in mind we opted for this project, the obstacle avoiding robot. This project serves to be the basic prototype for self-operating robots since obstacle avoidance is imperative for basic robot functionality. Although the object could be achieved rather easily using a micro-controller we opted for a different approach using a comparatively simple logic circuit thus reducing cost of production and increasing ease of maintenance.

Proposed Solution

Obstacle avoidance is widely researched and applied in the world, and it is highly probable that most robots in the future will have some form of obstacle avoidance functionality. We approached this project keeping a few pointers in mind. First and foremost, we believed that since this project would serve as a basic prototype for numerous specialized complex robot it must be efficient in usage of resources and simple in application. With that in mind we designed a logic circuit using only four 74-series ICs. For obstacle sensing we used digital IR sensor modules Since these components are cheap and readily available it made our project more approachable. Another objective of ours was to keep the circuit board as compact and simple as possible. This was achieved after the circuit went through several iterations. Working within the bounds of a 15 by 10 centimeter board we built a PCB using only the bottom copper layer while ensuring that the use of jumper cables was kept to a minimum.

BLOCK DIAGRAM

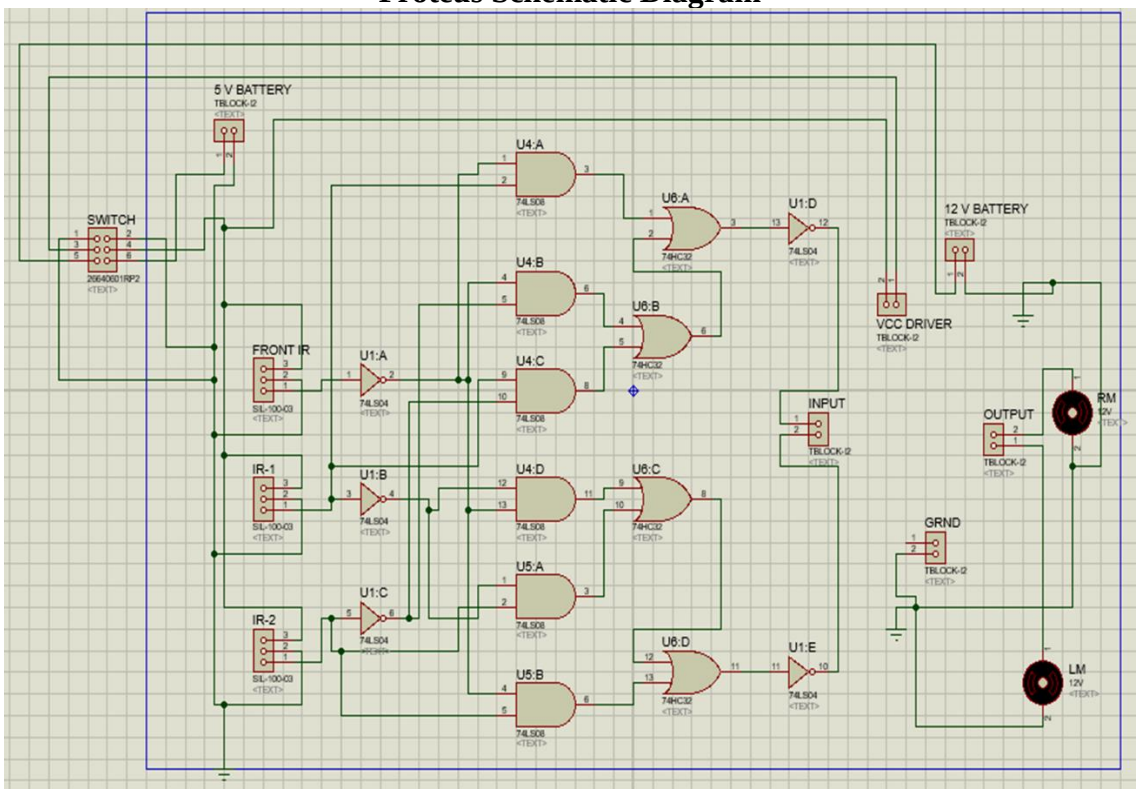


METHODOLOGY

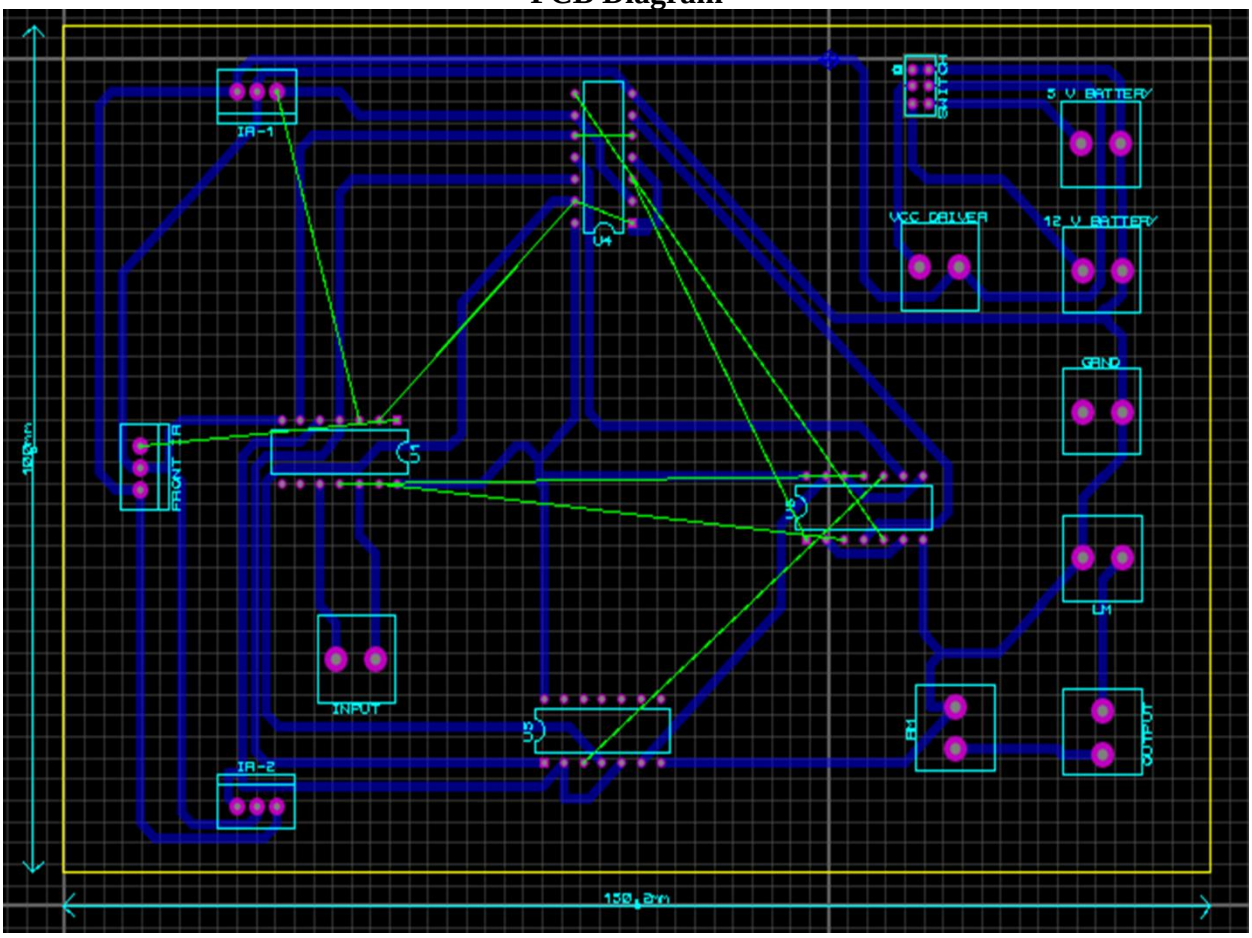
The digital IR modules give a binary output depending on whether or not an obstacle is detected. This binary data is then transferred to the digital logic circuit which we devised using, K-maps and the corresponding desired motor output. In order for the Digital logic circuit output to correspond to the binary logic of IR sensors we use K-maps to devise how many basic gates AND, OR and NOT will be used and in what orientation. This desired output of the logic circuit is used by the motor driver to control the two motors (left and right motors). This motor driver can operate on a range of voltage up to 12V depending on the required speed of the motors. Movement of robot in left, right or forward direction is dependent on the output of logic circuit. Output from IC's manipulate the motor driver which drives the motor corroborating to IR sensor detection of obstacle.

Project Outcomes

Proteus Schematic Diagram



PCB Diagram



Societal Relevance

With some further alteration and advancement this robot can be use as household service robot with application such as vacuum and mop robot.
It can also be modified for scientific exploration and emergency rescue since it can access places inaccessible or dangerous for humans.
It can even deliver as an industrial robot performing the lackluster jobs such as transporting raw materials, industrial components etc. The same basic principle applies to transporting heavy industrial objects.

DETAIL OF COMPONENTS

Sr. No.	Description	Specification	Quantity
1	Digital IR sensor	IR sensor module	3
2	Inverter(Not) gate	74LS04	1
3	2 input AND gate	74LS08	2
4	2 input OR gate	74LS32	1
5	Motor driver(h-bridge)	L293D	1
6	DC motor	Direct current motor	2

Future Work

The project can be improved using ultrasonic sensor instead of IR sensors since these have a short range while ultrasonic sensor can detect obstacles up to 6m. Furthermore, IR sensor are rendered useless in dark while ultrasonic sensors are operational under these circumstances. Another area of improvement could be the use of a more complex "brain" for the robot. Our robot comes to halt when detecting an obstacle at the front side only. It cannot decide in which direction (left or right) to move as this requires a decision making algorithm, and so this domain can be further improved. Use LDR so that can Robot can be used as path locator in dark places.

PROBLEMS FACED DURING COMPLETION OF PROJECT AND THE LAB AS A WHOLE

The IR sensor modules available operated on a short range. We reduced the voltage applied to the dc motors to ensure that the robot worked properly. The etching technique available only works for the bottom copper layer. As a workaround we used physical jumper cables for wiring on the component side. The minimum width for the PCB tracks was restricted to 40^{TH} forcing us to incorporate jumper cables in our project.

SUGGESTIONS FOR IMPROVEMENT IN PROJECT HARDWARE AND THE LAB AS A WHOLE

- Multilayer etching should be available so that more compact and complex circuits could be implemented.
- Lockers to store our individual equipment should be available. This will not only improve work efficiency but also save on resources since a significant amount of equipment was misplaced and much of the hard work went to waste.