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Line Tracking Robotic Vehicle

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Abstract: ***In recent years a great deal of time and effort have been spent on developing systems to enable an autonomous robot to follow a marked path using a vision system.The Line Tracking Vehicle is an embedded machine that can detect and follow the line drawn on the floor. Generally, the path is predefined and can be either visible like a black line on a white surface with a high contrasted color or it can be invisible like a magnetic field. It is an integrated design from the knowledge of Mechanical, Electrical and Computer engineering. This paper presents a 9W LDR sensor based Line Tracking Vehicle design and fabrication procedure which always directs along the black mark on the white surface. This low cost fundamental electronic component based line sensing robot can carry a reasonable load withoutgetting off the line.***

Keywords: IR Sensors;Arduino;Motor Driver

1. Introduction

A line tracking vehicle is basically a robot designed to follow a 'line' or path already predetermined by user. This line or path may be as simple as a physical white line on floor or as complex path marking schemes e.g. embedded lines, magnetic markers and laser guide markers. In order to detect these specific markers or 'lines', various sensing schemes can be employed. These schemes may vary from simple low cost sensing circuit to expansive vision systems. The choice of this schemes would be dependent upon sensing accuracy and flexibility required. From industrial point of view, line tracking vehicle has been implemented in semi to fully autonomous plants. In this environment, these robots functions as materials carrier to deliver products from one manufacturing place to another where rail, conveyer and gantry solutions are not possible. Apart from line following capabilities, these robots should have capability to navigate junctions and decide on which junction to turn and which junction to ignore. To add on to complexity of the problems sensor positioning also plays a role in optimizing the robots performance for tasks mentioned earlier. Line Tracking Vehicle with pick- and- placement capabilities are commonly used in manufacturing plants. They move on a specified path to pick the components m specified locations and place them on desired locations. Basically, a line-following robot is a self-operating robot that detects and follows a line drawn on the floor. The path to be taken is indicated by a white line on a black surface. So all in all it can be said that, Line Tracking Vehicle is a machine which follows a line, either a black line or white line.Basically there are two types of line follower robots: one is black line follower which follows black line and second is white line follower which follows white line. Line follower actually senses the line and run over it.

2. Design

This is a very simple model which follows a line- either a black or white line. According to that the robot will take turn or will simply follow a line. However this is a very efficient model, it is not designed to work at business level. But with help of some business strategies and proper planning gap of business management and technical requirements can be reduced.

Hardware

- ARDUINO UNO
- L293D Motor Driver
- IR Module
- Voltage Regulator(IC 7805)
- Toy Car Chassis
- Motor (12V)
- Power Supply

Software

- ARDUINO IDE
- PROTEUS

3. Proposed System

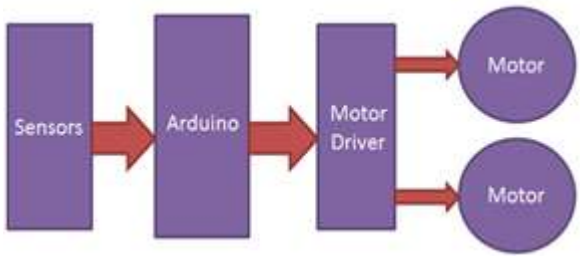

Figure 1: Block Diagram

IR sensors sense the reflected light according to the sensed light by IR sensor Arduino decides direction of motors. If left sensor sense black line then the line follower will move left.S imilarly if right sensor sense black line then the line follower will move right.If both sensor sense black line then line follower will stop.

The Whole Line tracking robotic vehicle is divided into three sections: Sensor section, Control Section, Driver Section.

1) Sensor section

This section contains IR diodes, potentiometer, Comparator (Op-Amp) and LED's. Potentiometer is used for setting reference voltage at comparator's one terminal and IR sensors are used to sense the line and provide a change in voltage at comparator's second terminal. Then comparator compares both voltages and generates a digital signal at output. Here two IR sensors are used.

Figure 2: Flex Sensors

2) Control Section

Arduinoused for controlling whole the process of line follower robot. The outputs of comparators are connected to digital pin number 2 and 3 of Arduino. Arduino read these signals and send commands to driver circuit to drive line tracker.

3) Driver Section

Driver section consists motor driver and two DC motors. Motor driver is used for driving motors because Arduino does not supply enough voltage and current to motor. So we add a motor driver circuit to get enough voltage and current for motor. Arduino sends commands to this motor driver and then it drive motors.The 4 input pins for this L293d, pin 2,7 on the left and pin 15, 10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1. In simple you need to provide Logic 0 or 1 across the input pins for rotating the motor.

Input		Output				Movement of Robot
Left Sensor	Right Sensor	Left Motor		Right Motor		
LS	RS	LM1	LM2	RM1	RM2	
0	0	0	0	0	0	Stop
0	1	1	0	0	0	Turn Right
1	0	0	0	1	0	Turn Left
1	1	1	0	1	0	Forward

Figure 3: Movement of Vehicle according to sensor

4. Working

Circuit Diagram:

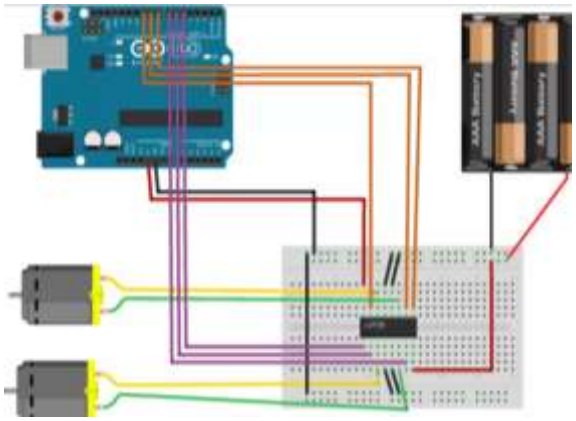

Figure 4: Circuit Representation

Concept of working of line tracking robotic vehicle is related to light. We use here the behavior of light at black and white surface. When light fall on a white surface it is almost full reflected and in case of black surface light is completely absorbed.

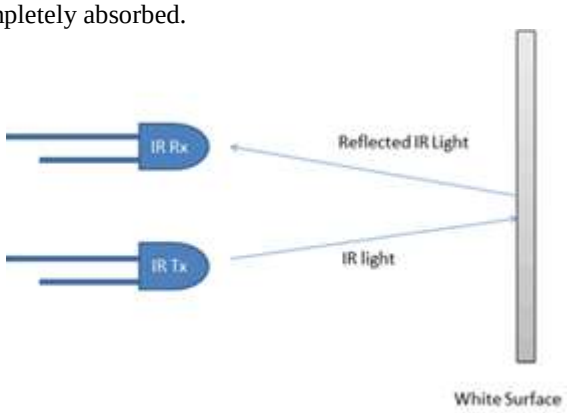

Figure 5: Reflection from White surface

In this line tracking robotic vehicleIR Transmitters and IR receivers also called photo diodes are used. They are used for sending and receiving light. IR transmits infrared lights. When infrared rays falls on white surface, it's reflected back and catched by photodiodes which generates some voltage changes. When IR light falls on a black surface, light is absorb by the black surface and no rays are reflected back, thus photo diode does not receive any light or rays.

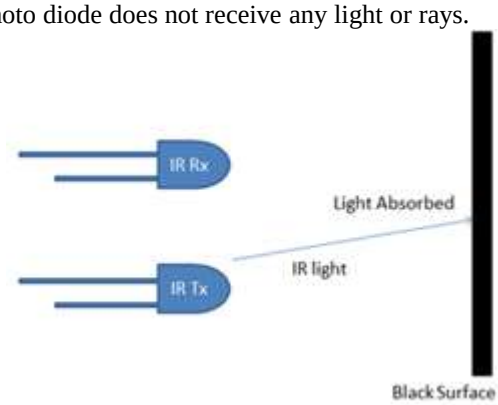

Figure 6: Light absorption on black surface.

Here in this vehicle when sensor senses white surface then Arduino gets 1 as input and when senses black line Arduino gets 0 as input.

Here in this Project two IR sensor modules namely left sensor and right sensor are used. When both left and right sensor senses white then robot move forward. If left sensor comes on black line then robot turn left side. If right sensor sense black line then robot turn right side until both sensor comes at white surface. When white surface comes robot starts moving on forward again. If both sensors comes on black line, robot stops.L293D IC is used to change the directions of the motors separately.The coding of the robotic vehicle is done using Arduino IDE software.If else and for loop logic conditions are applied while programming for the line following robotic vehicle and the response of the Arduino is also quite quick.The whole circuitry consumes about 9V at max.

5. Results

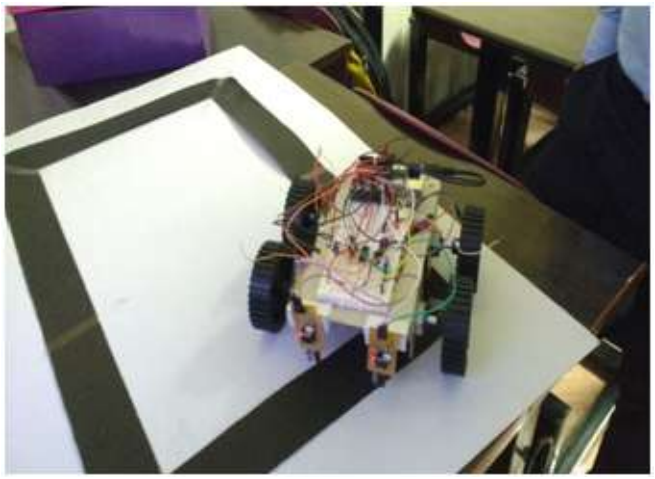

Figure 5: Output

6. Future Scope

- Line tracking robotic vehicle can be used in the medical store to pick up the medicine from a particular drawer for this one has to just add some robotic-arm to it.
- Can be further extended for color detection operations or lane detection on highways.
- It can be used in shopping malls for carrying different types of products.
- It can be developed so that it can be used in hospitals where patients are needed to take medicines every regular interval of time so one can take what they want.
- Further development of this vehicle can be made,so that it can be used in defence industries for carrying the hazardous materials like radioactive materials and poisonous gas cylinder.
- Digital camera can be attached to the vehicle for real time monitoring of the traffic.

7. Conclusion

The objective of line tracking robotic vehicle is to follow a line on its given path which is obtained for which it uses IR sensors which detects the line and sends the information to L293 motor driver IC and then H-bridge which controls the working of the wheel. Arduinouno controls the other operations.The line tracking robotic vehicle was finally completed. A lot of effort was put into the design, implementation and days of toil in front of the computer, writing and debugging the code. The robot was finally running with a few glitches here and there which were sorted in the later revisions of the firmware. The line tracking robot still has a few shortcomings but achieves most of the objectives. A lot of knowledge on micro-controllers, a deeper & clearer view of the architecture, ports & all other functional blocks was achieved. Also had a peek look at all simple functional parts of the project like the crystal oscillator, logic gates and the works.

So in short, a line tracking robotic vehicle requires a line and it follows that line .On adding IR sensor, it overcome its limitation. The specifications of line tracking robotic vehicle are It have lots of different path to go to its destination.It can choose where to go after giving proper instruction at starting. This robotic vehicle uses cheap parts like IR sensor, a low voltage motor, a chassis (structure of robot),which makes this robot a cost effective product.

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