Line Follower Robot

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Abstract. Line follower robot is a robot that is capable to move in a line based environment. They might follow a line painted in the surface such as floor and most of them operated as "keep the line in the center sensor" algorithm. This project was selected to line with current technology that prefers automatic product to be controlled by motor and microcontroller. This system was created from the combination of software and hardware. The basic operations of the line following is to capture line position with IR sensors mounted in front of the robot. This robot is used Assembler Language to program the AT89S51 IC and burned with ISP **(**In-System Programming) Programmer Software that can be reprogramed without removing it from the circuit. The robot uses ULN2803 IC as a Motor Driver, 7805 IC (Voltage Regulator) and L293D (DC motor driver).

Introduction

Robots are been fascinating and used in various fields such as development research, medicine, and defense and even in film industry [1]. In industry, many robots are used to lessen the work burden. This is due to the global competition and the tendency to reduce production cost and increase efficiency creates new applications for robots that stationary robots can't perform. These new applications require the robots to move and perform certain activities at the same time. The availability and low cost of faster processors, better programming, and the use of new hardware allow robot designers to build more accurate, faster, and even safer robots[2]. Line Follower is a robot used to follow path. The path can be visible for black lines on white surface (vice-versa) depend on programming or it can be visible for a magnetic field. The use of this robot is to make the shift of goods become easier in terms of performing distance operations. The robot's movement depends on the application program by a programmer. Practical applications of a line follower robot are an automated cars running on roads with embedded magnets, or guidance system for industrial robots to move in shop or factory [1, 2].

Objective

This project was carried out in order to develop a robot that can meet the specifications to compete with other line follower robot. Produced robot must be able to follow the black line provided.

Literature Review

Peter Hiscocks, Devin Ostrom and Jim Koch Robot [3]. The line sensors will be CdS (Cadmium Sulphide) photocells as shown in Figure 1. The CdS cell decreases resistance in the presence of light. The area under the photocell is illuminated with a high-intensity LED and 'viewed' with a photocell. Then the resistance of the cell increases whenever it is over a black line. This change in resistance is translated into an electrical that reverses one of the motors, which redirects the robot back over the line.

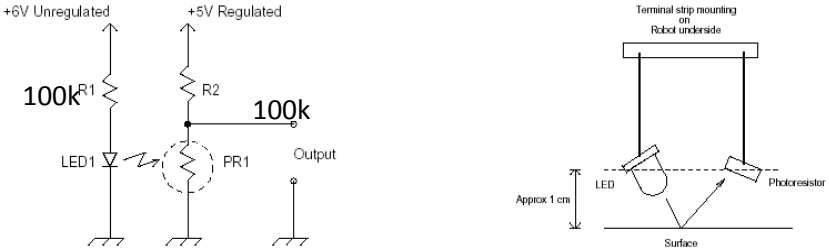


Figure 1: Photodetector Circuit

The robot also consist the Steering Circuit as shown on figure 2. The circuit consists of two main sub-sections: the basic speed control circuit is U2A and U2B, the line detector and motor control is U2C, U2D and U1A through U1D.

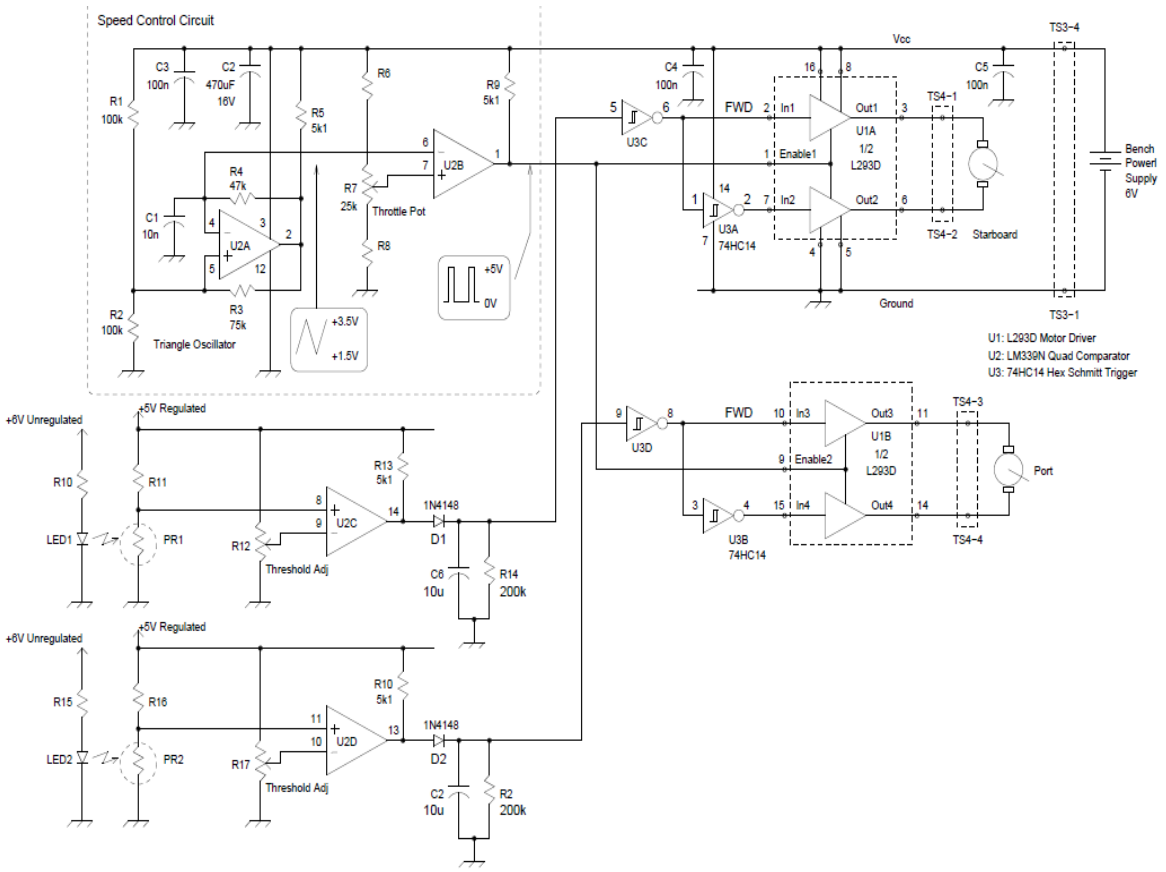


Figure 2: Line-Follower Circuit

For Line Detection, the robot power wiring is shown in figure 3, in addition to the line sensor photo resistor discussed earlier, there are a comparator U2C and a diode-RC network. The

purpose of the comparator is to generate a high (+5V) or low (0V) signal depending on whether the line sensor signals is above or below a threshold voltage.

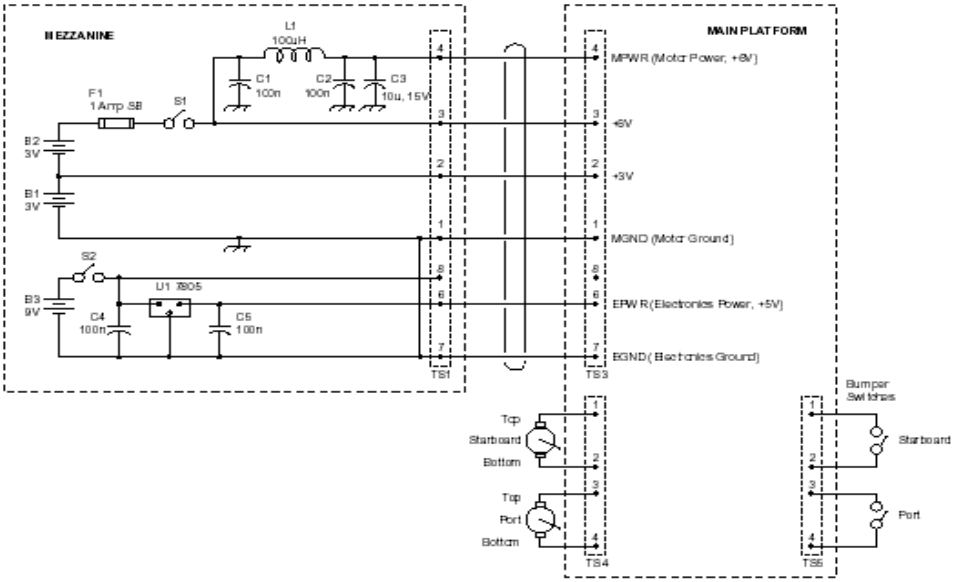


Figure 3: Power Wiring

Parallax Line Follower Module Robot [4]. The IR LED is activated by making the associated BASIC Stamp output pin low (see Figure 4 for connections). The active-low configuration is used because the BASIC Stamp can sink more current per pin than it can source. When the LED is active, reflected IR light from the course surface will strike of the IR detector transistor, affecting the current flow through it. More reflected IR causes greater current to flow through the transistor.

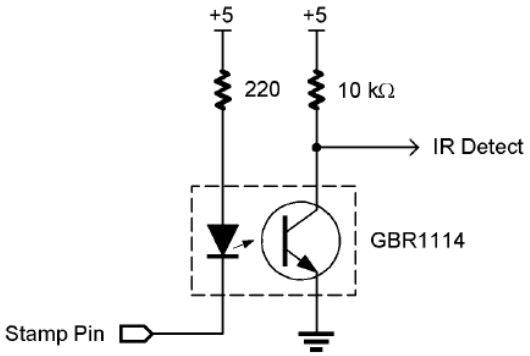


Figure 4: IR emitter/detector

This circuit forms a voltage divider with the output dependant on current flow through the transistor. The greater the IR reflection from the course surface, the greater the current flow through the transistor. This causes the voltage at the output to go lower because it "looks" like a smaller resistance. When there is little or no reflection, the current flow through the transistor is reduced making it look like a very large resistance in the circuit, causing the output voltage to increase. The second portion of the Line Follower circuit is the threshold comparator (see Figure 5).

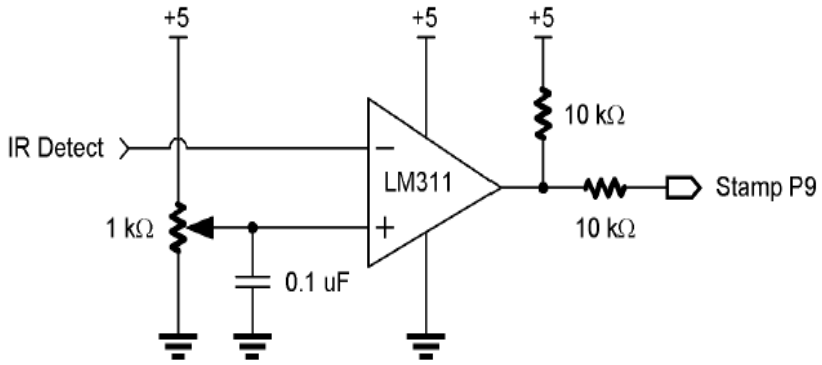


Figure 5: Threshold Comparator Circuit

The comparator output will be high (1) or low (0), depending on which of the two input pins has the higher voltage. If the minus input (voltage from IR detector) is higher than the plus input, the comparator output will go low. If the plus input (threshold pot) is higher than the minus input, then the comparator output will go high. The purpose of the threshold potentiometer is to allow you to adjust for course reflectivity and ambient lighting conditions.

Priyank Patil Line Following Robot [5]. The robot uses IR sensors to sense the line; an array of 8 IR LEDs (Tx) and sensors (Rx), facing the ground has been used in this setup as shown on Figure 6. The output of the sensors is an analog signal which depends on the amount of light reflected back, this analog signal is given to the comparator to produce 0s and 1s which are then fed to the microcontroller.

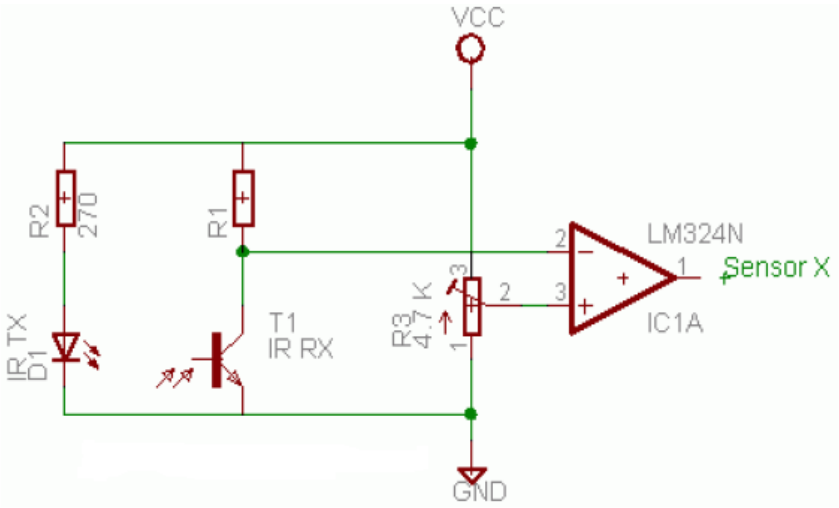


Figure 6: Schematic of Single Sensor

Implementation

Based on the literature review done, the writer comes out with a solution by using the Atmel technology produced by Intel. The circuit diagram as shown on Figure 7 shows the motors connection and the microcontrollers used and the power wiring for the robot.

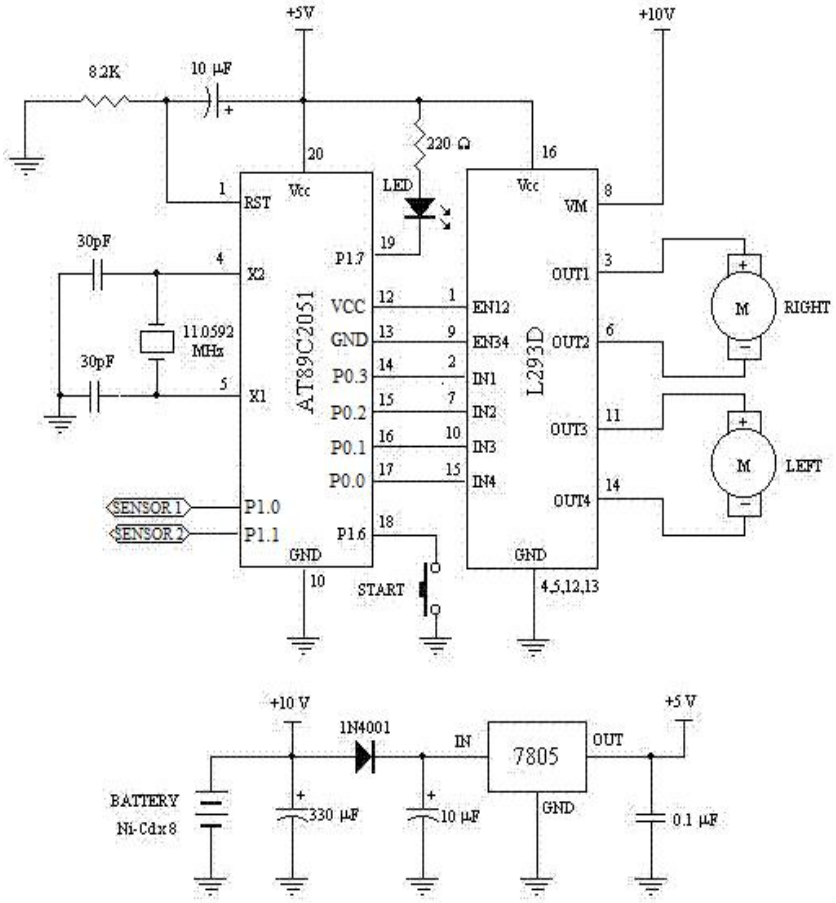


Figure 7: The Circuit of Line Follower Robot.

The sensors work as input to the microcontroller. LED circuit will generate the output by using LEDs. The output from each program that has been 'writing' into the Microcontroller chip can be seen here. LED Board will connect with Controller Board using Port 1 (P1). The LED circuit that we have done is in command cathode. When the HIGH input (1) was given, the LEDs will turn ON and vice versa. The circuit of Sensor and the installation is shown in Figure 8 and Figure 9.

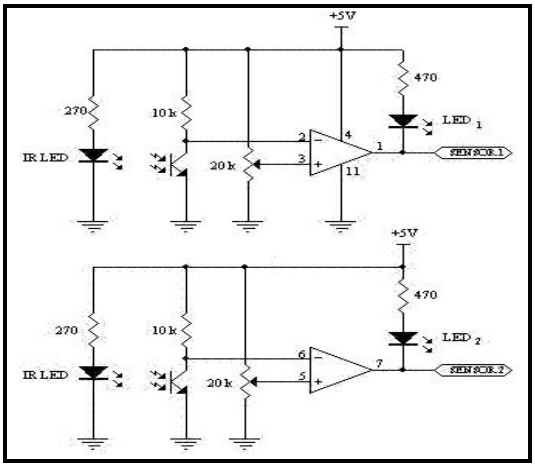


Figure 8: Sensor Circuit

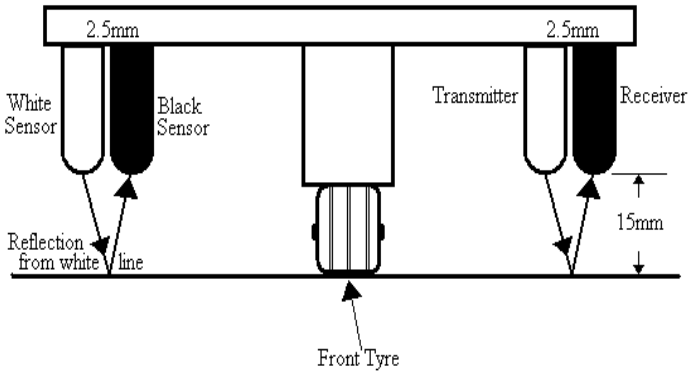


Figure 9: Installation of Sensor Detector

The sensor consists of just two components. The first is an Infra-Red (IR) transmitter (usually an LED), while the second is an Infra-Red receiver (usually a transistor). IR is transmitted out of the sensor unit. If the IR is reflected back, it is picked up by the IR receiver transistor. IR is basically heat (the heat from the sun is predominantly in the IR part of the spectrum), because black absorbs heat. If black absorbs heat, then it also absorbs IR. And this is the principle. While the sensor is over a black line, no IR is reflected back to the receiver. If the sensor strays away from the line, then IR is reflected back. This is why the robot 'follows a black line'. For best results the black line is placed on a white background, which will give the extreme two cases - white reflects IR. (As shown in Figure 10) [8, 9].

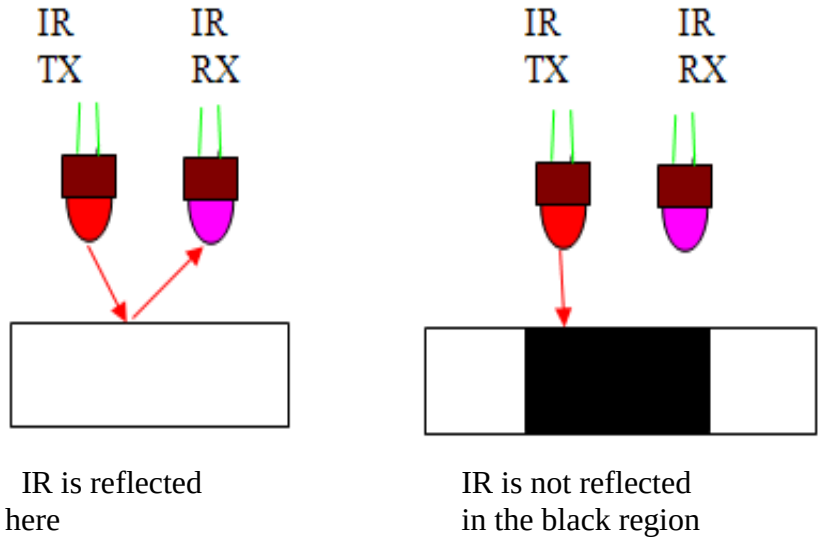


Figure 10: IR Sensor.

For DC motor driver, L293D is a dual H-Bridge motor driver is used so that two DC motors which can be controlled in both clockwise and counter clockwise direction. L293D has output current of 600Ma and peak output current of 1.2A per channel. Moreover for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D the best choice for DC motor driver [11].

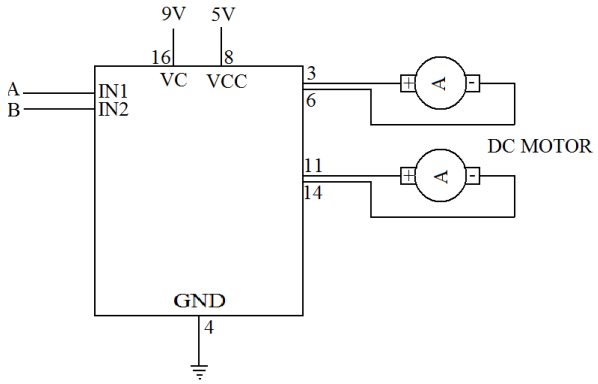
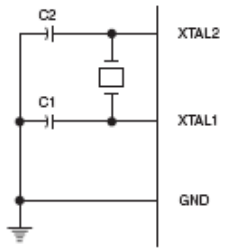


Figure 11: A Simple Schematic for Interfacing a Dc Motor Using L293d

By referring to Figure 11 and the movement of the robot will be done with D.C motor, three pin are needed for interfacing a DC motor (A, B, Enable). For the output to be enabling completely then connect Enable to VCC and only 2 pins needed from controller to make the motor work.

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier that can be configured for use as an on-chip oscillator, as shown in Figure 12. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven, as shown in Figure 13 [12]. There are no requirements on the duty cycle of the external clock signal, since the input to the internal clock-in circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.



Note: C1, C2 = 30 pF ± 10 pF for Crystals
= 40 pF ± 10 pF for Ceramic Resonators

Figure 12: Oscillator Connection.

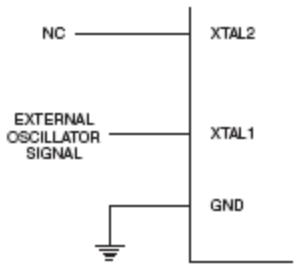


Figure 13: External Clock Drive Configuration

Conclusion

This project is designed and demonstrated to recognize, understand and modify the actual performance and the movements of the robot following and finding the path by getting information from IR sensors connected to microcontroller. A computer program is implemented in Assembler Language. This innovation has many advantages like flexibility, reliability and it is inexpensive. This project has been tested successfully indoors. For future work, IR coding can be implemented to identify different location so the line follower robot will be intelligent to detect whether it has reached the desired location.

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