

Optimized Methodology for the Design of Intelligent Robot

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ABSTRACT: A robot is an intelligent mobile robot which senses the black line on white surface or white line on black surface. It uses simple differential drive mechanism, which is controlled by the microcontroller.

In this paper we are focusing on fabricating an advance line following robot using differential drive mechanism using a two wheel configuration. The robot can drive in different arena with various advance forms of line structures like curves, right angle turns, intersection and several other difficult tracks in the arena faced in our daily life.

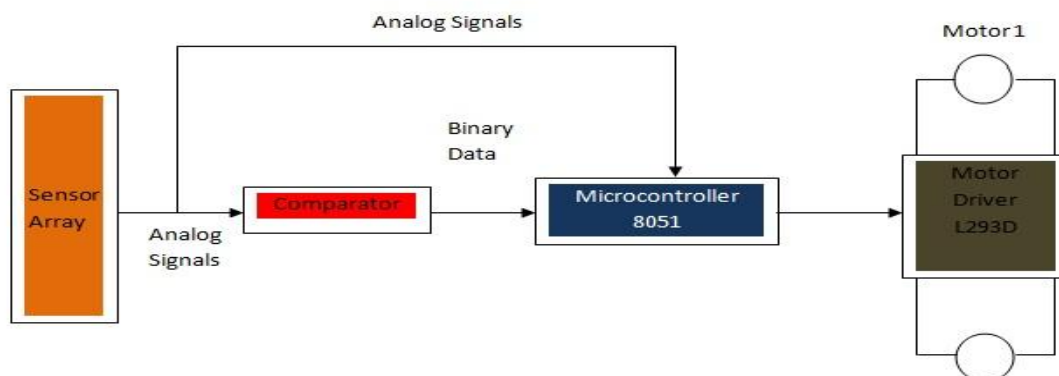
Follower robot is a mobile machine that can follow a path. The path can be a visible black line on a white surface (reverse). In order to lead a robot Trackback use the PIC18F458 from Microchip (40 pins).

The robot uses 4 IR LEDs (Tx) and 4 IR sensors (Rx) with distance between the two sensors is 25mm. The first Rx receives an analog signal that depends on the intensity of light reflected by the black line of emitted beam by the TX. These signals are sent to the MCP comparator which creates digital signals (0 or 1) that are sent to Microcontroller PIC.

I. INTRODUCTION

Line follower is a machine that can follow a path. The path can be visible like a black line on a white surface (or vice-versa). It is practically used in Automated cars running on roads with embedded magnets; guidance system for industrial robots moving on shop floor etc.[1] The drawbacks of using a personal computer were soon clear . It's difficult to control speed of motors. As cable length increases signal strength decreases and latency increases. A long multi core cable for parallel data transfer is expensive.[2-3] The robot is not portable if we use a desktop PC. The obvious next step was to build an onboard control circuit; the options – a hardwired logic circuit or microcontroller. It basically mapped input from four sensors to four outputs for the motor driver according to a truth table.[4]

II. BLOCK DIAGRAM





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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. 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.[5-6]

L4 L3 L2 L1 R1 R2 R3 R4
LEFT Center Right

Sensor Array:-

Starting from the center, the sensors on the left are named L1, L2, L3, L4 and those on the right are named R1, R2, R3, R4. Let us assume that when a sensor is on the line it reads 0 and when it is off the line it reads 1.

The uC decides the next move according to the algorithm given below which tries to position the robot such that L1 and R1 both read 0 and the rest read 1.

L4 L3 L2 L1 R1 R2 R3 R4
1 1 1 0 0 1 1 1

Algorithm:

1. L= leftmost sensor which reads 0; R= rightmost sensor which reads 0.

If no sensor on Left (or Right) is 0 then L (or R) equals 0;

Ex:

L4	L3	L2	L1	R1	R2	R3	R4
1	0	0	0	1	1	1	1

Left Center Right
Here L=3 R=0

L4	L3	L2	L1	R1	R2	R3	R4
1	1	0	0	0	0	0	0

Left Center Right
Here L=2 R=4

Left Center Right

Here L=3 R=0

Left Center Right

Here L=2 R=4

2. If all sensors read 1 go to step 3,

else,

If L>R Move Left

If L<R Move Right

If L=R Move Forward

Goto step 4

3. Move Clockwise if line was last seen on Right

Move Counter Clockwise if line was last seen on Left

Repeat step 3 till line is found.

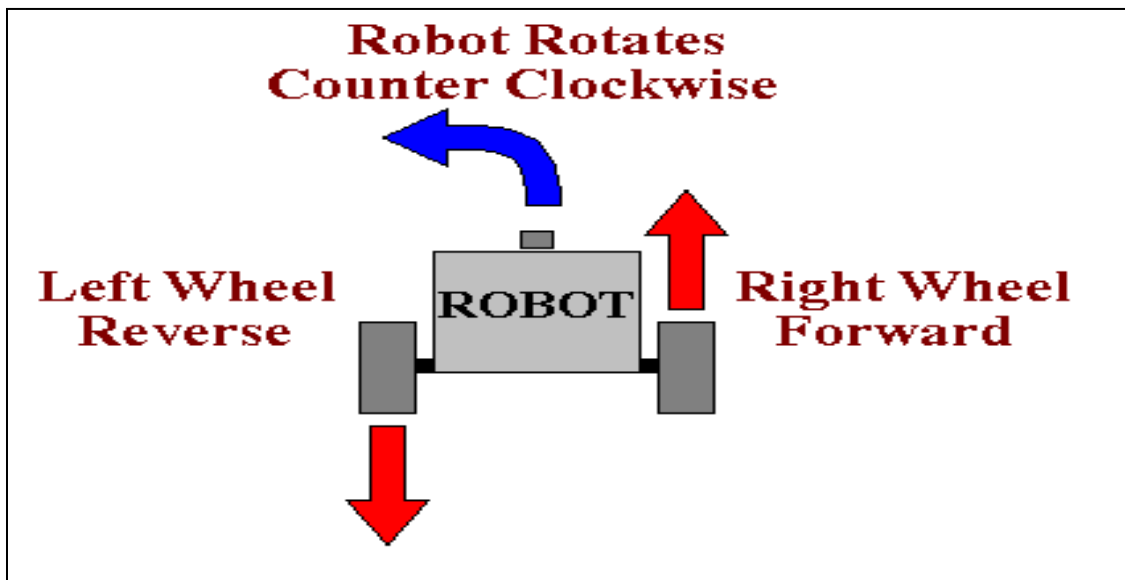
4. Goto step 1.

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III. MECHANISM: DIFFERENTIAL DRIVE MECHANISM



Differential drive is a method of controlling a robot with only two motorized wheels. What makes this algorithm important for a robot builder is that it is also the simplest control method for a robot. [7]

The term 'differential' means that robot turning speed is determined by the speed difference between both wheels, each on either side of your robot. For example: keep the left wheel still, and rotate the right wheel forward, and the robot will turn left. As long as both wheels go at the same speed, the robot does not turn - only going forward or reverse.

When two motors are connected to wheels in one line, opposite to each other (Just like a pair of wheels connected to a single shaft) the speed with which each motor rotates determines the direction of motion. When both the wheels rotate at the same speed the difference between the motors is Zero. This makes the robot move forward in a straight line. The robot can move in reverse direction if the direction of rotation of both the motors are reversed. This will again be in a straight line if the speed difference is zero. [8]

Now changing the speed of any one motor will result in movement in a direction away from the straight line. For example, reducing the speed of the right motor will result in a speed difference and hence change in direction. The resultant force is such that the robot turns right. This direction change can be controlled to required angle by further reducing the speed of the motor. Slower is the right motor, sharper is the turn to right. This is exactly the same for Left turn.

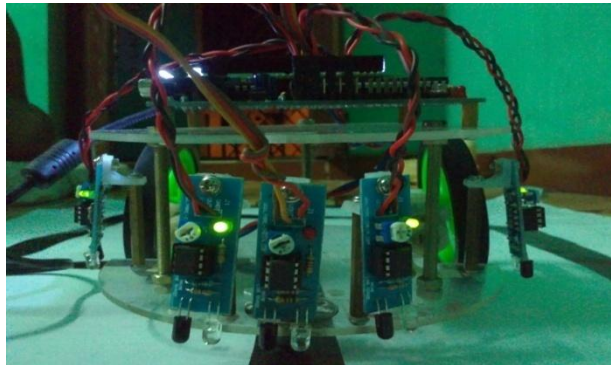
As a conclusion, Slower right motor, sharper right turn. Slower left motor Sharper left turn. Below are some scenarios which explains working of differential drive mechanism. M1 and M2 are motors which drive wheels on left and right respectively.

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IV. HARDWARE PICTURES



FRONT VIEW



SIDE VIEW



OPERATING BOARD

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ASSEMBLY

V. CONCLUSION

From the construction of the prototype, we can arrive at several conclusion for the final prototype:
The Line Sensor should follow the presented design using the sensor. The Chassis should follow the presented design except for allowing for other modification.
The speed controller should follow the presented the electrical design using transistor.
The electrical design should be tuned so as to be suitable on a board.
All circuit should be produced on board.
The proposed algorithms are accepted and functional, but they lack some adaptation to the environment.

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