**Report**

**On**

**PID Line Follower Robot**

***As part of PBL on***

**Signal Analysis and Processing(20EE502)**

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**Contents**

[Chapter 1 Introduction 3](#_Toc21509911)

[1.1 Introduction 3](#_Toc21509912)

[1.2 Problem Definition 3](#_Toc21509913)

[Chapter 2 Project Description 4](#_Toc21509914)

[2.1 Objectives 4](#_Toc21509917)

[Chapter 3 Project Implementation 5](#_Toc21509918)

[3.1 Design Parameters 5](#_Toc21509921)

[3.2 Tools Used 5](#_Toc21509922)

[3.3 Project Implementation 5](#_Toc21509923)

[Chapter 4 Results and Discussion 6](#_Toc21509924)

[4.1 Results: 6](#_Toc21509926)

[4.2 Discussion 6](#_Toc21509927)

[References 7](#_Toc21509928)

# Chapter 1 Introduction

## Introduction

A robot is a reprogrammable, multifunction, manipulator designed for moving materials, tools, parts etc. Autonomous robots are the robots that can perform desired tasks in any environment without continuous human guidance. Line Following is one of the fundamental characteristics in robotics. A Line Follower Robot is an autonomous robot which can follow either a black or white line that is drawn on the surface consisting of a contrasting color. PID control of line follower is a method consisting of Proportional, Integral & Derivative functions to improve the movement of the robot. The robot uses different types of sensors to identify the line. The robot is driven by DC Motors to control the movement of the wheels. The Atmega Microcontroller will be used to perform and implement PID algorithms to control the speed of the motors steering the robot to travel along the line smoothly. This project aims to implement the PID algorithm and control the movement of the robot by proper tuning of the control parameters and thus achieve better performance. This project has various applications in the field of Medicine, Automation and Space Application.

## Problem Definition

Line following robots are one of the most simplistic types of robots that performs a simple task: tracking a black or a white line on a white, respectively on a black surface. In a competition of this type, the added challenge is that the robots must compete against time, and the fastest wins the competition. Thus, it is a problem of control and accuracy, especially at narrow curves, but also a problem of speed. Classical line follower robot is very slow response to the error and will easily go off the track. The corrections are very abrupt in nature and is very unsmooth. To overcome this problem, we implemented this project. In this project we were able to greatly enhance the accuracy and smoothness of the changes that is required to correct the error.

The main features of this system are:

* The increased accuracy due to the PID control.
* Error caused by external disturbances are corrected.

Advantages:

* The amount of overshoot was also reduced.
* Response of the system was better as compared to that of a simple open loop controller.
* It has a stable design.
* It is more versatile.

# Chapter 2 Project Description

## 2.1 Objectives

The main objective of this project is:

* To design an autonomous robot to follow the black line and increase the accuracy of the tracking the line
* To study and observe the working of sensors, motors, PID controller etc.
* To implement the PID algorithm to test and tune the PID control to gain better accuracy and speed
* To design a line follower robot with PID controller and compare it with other line follower.

# Chapter 3 Project Implementation

## 3.1 Design Parameters

* Microcontroller – Arduino pro mini of 5V 16Mhz is used.
* Motor Drver – LM 298D of 2 channel motor driver. Operating voltage of 5-35V with peak current of 2A is used.
* Sensor – QTR sensor is used to sense the black or white line.
* Motor – N20 micro metal gear motor with 9.96:1 metal gear box.
* Battery – Lithium Polymer Battery of 2cell, 850 mAh.

## 3.2 Tools Used

* Zero PCB board
* Arduino Pro Mini
* LM 298
* N20 motors
* Push button
* Resistors
* Wheels
* Jumper wires
* Castor wheel
* LIPO battery (7.4V)

## 3.3 Project Implementation

Robot can be applied in military to reducing the number of casualties which occur during military actions has already been prioritized. The military also uses robots for locating and destroying mines on land and in water, spying on enemies and entering enemy bases for gathering information.

People are interested in places full of danger like outer space or under seas. They cannot go themselves there, so they use robots which are used for exploration. The robots can carry cameras and other instruments through which they can collect information and send back for processing to their human operators. The continuous development of autonomous robots increases our ability to explore universe.

# Chapter 4 Results and Discussion

## 4.1 Results:

The robot was successfully able to follow the line for Kp equal to 0.45 and Kd equal to 0.3. However, the output was taken under a certain lighting condition and a similar response might not be obtained for a different ambient lighting condition. The sensors used would need to be calibrated to produce the perfect output.

## Discussion

In the project, we studied the design of a line following bot and the implementation of PID controller. The parameters of the controller were designed using the manual tuning method. Due to limitations in the hardware (Motor and Sensors), perfect control was not obtained. However, the response of the system was better as compared to that of a simple open loop controller. The amount of overshoot was also reduced using the above-mentioned techniques.

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