

Line Follower Robot with PID Control

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Abstract— The Line Follower Robot Using PID Control with Register Level project was done using the STM32F103C8 coded microcontroller, at the Register Level and coded in C language. The purpose of the robot is to follow a very dark line drawn on a light background. The drawn path has sharp turns of 90 degrees, circular parts, and sudden turns of 30 or 45 degrees in different directions. In this way, it has become specific what kind of algorithms the sensor should have while reading. The second main aim of the project is for the robot to complete the drawn path (Figure 13) as soon as possible. The better the implementation of the PID Controller, the more stable the robot will be. This will ensure that the path is completed in a shorter time. Many tests and observations were made for P, I and D values, and the optimum values were reached by analyzing the robot's movements. In addition, it is possible to say that robots with different structures will have different P, I, D values due to the effect of the robot's hardware design on its weight. Since 4S BMS Li-Io Battery Pack is used in our project, it is possible to say that it is twice as heavy as its counterparts. For this reason, it has been observed that its stability decreases as it accelerates. Additionally, an extra feature has been added for the coding part. By considering the working principle of the sensors when they are not reading lines, the engines stop on normal ground and when they start reading lines, they continue reading the road quickly again. As a result, a robot has been developed that is stable in sharp turns, can stop in the absence of a line, and continues reading the road as soon as it detects the line.

Keywords— Line Follower Robot with PID Control, STM32F103C8 Microcontroller, C Programming Language, Infrared Sensor, Path Following, Stability, Li-Io Battery, RPM, QTR-SRC Infrared Line Tracking Sensor, ST-LINK/V2, L298N Motor Driver, Voltage Regulator, Mini Adjustable 3A Step-Down Voltage Regulator LM2596, Sensor Distance, ST-Link V2, Li-ion Battery, BMS, PWM, Duty Cycle, Keil uVision5.

I. INTRODUCTION

The aim of this designed project is to create a suitable control algorithm for the robotic vehicle to complete the predetermined track in as little time as possible. In this project, an infrared sensor was used for the line-following robot to follow the line on the specified track, and the movement of the robot was adjusted according to this sensor. Another purpose is to shut down the line-following robot to save power after 6 seconds when it cannot find a line. When the vehicle is placed on the road again, it will automatically activate and follow the road. A map algorithm has been developed for the designed PID-controlled line-following robot to detect and follow the specified path. It is aimed to complete the track in a stable state by minimizing the oscillation of the black line path created by debugging the errors of the data collected with the line tracking sensor with the PID control system and without leaving the track. The control method with a proportional-integral-derivative controller control loop is called PID control. PID control constantly and regularly calculates the error value and tries to return the system to the input value.



Figure 1: Line Follower Robot

II. BUILDING LINE FOLLOWER ROBOT

A. Mechanical Components

The line-following robot vehicle used and developed in the project can be seen. Two 6V DC motors with 250 RPM were used as motors in the project. Motors have 6-7V DC input voltage and 9V to the motor in the project. The fact that the motors are affordable and can reach high RPM values in a short time with high input voltage was effective in choosing these motors. Controlling the motors has an important place in following the drawn line and responding correctly to debugging the sensor. Motors have been added to the interior of the line following robot for an aesthetic appearance. Two wheels are fixed to the skeleton system so that they can rotate without skidding, and each is connected to its own engine. The wheels were chosen to reduce slipping so that the vehicle remains stable on the ground and does not skid during turns. The electronic and mechanical components are fixed to two pieces of plastic frame parts. While designing the vehicle, the QTR-SRC infrared line tracking sensor was desired to be close to the ground, so it was positioned with wide wooden tongue sticks. As a result of the experiments, the mechanical components were combined in the skeletal system and the design was completed (Figure 1).

B. Electronic Components

1) *Microcontroller (STM32F103C8):* Microcontroller is the name given to integrated circuits that combine a microprocessor, memory and I/O pins within the integrated circuit. It is generally used in embedded systems. It is low cost and low power consumption. ARM-based STM32F103C8T6 microcontroller development board, also known as Blue Pill, was used in the project. With microcontroller, the sensor data

Very Fast Line Follower Robot With Pid Control

Judd E. Hollander



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Industrial Networks and Intelligent Systems Nguyen-Son Vo, Hoai-An Tran, 2023-10-30 This book constitutes the refereed proceedings of the 9th EAI International Conference on Industrial Networks and Intelligent Systems INISCOM 2023 held in Ho Chi Minh City Vietnam during August 2-3 2023. The 23 full papers were selected from 55 submissions and are organized thematically in tracks on telecommunications systems and networks, information processing and data analysis, industrial networks and intelligent systems, security and privacy. *Intelligent Technologies: Design and Applications for Society* Vladimir Robles-Bykbaev, Josefa Mula, Gilberto Reynoso-Meza, 2023-01-31 This book is oriented towards applications and perspectives on future developments connected to intelligent technologies. Specifying topics connected to industry, mobility, telecommunications, biomechanics, among others. The innovative character of the text allows relating technical experiences and advances that seek to improve the implication of new technologies at local, national and regional levels, demonstrating the advances towards the different fields of knowledge in the area of engineering. The potential readers of this work would be master and doctorate students, professors, researchers in the field of new technologies and companies connected to the development of engineering. The texts serve to illustrate new procedures, new cases and new techniques for the optimization of systems that optimize social progress. **Proceedings of the National Conference on Advanced Manufacturing & Robotics, January 10-11, 2004** S. N. Shome, Jhankar Basu, G. P. Sinha, 2004 Contributed papers presented at the conference held at Central Mechanical Engineering Research Institute Durgapur. **Proceedings of SAI Intelligent Systems Conference (IntelliSys) 2016** Yaxin Bi, Supriya Kapoor, Rahul Bhatia, 2017-08-22 These proceedings of the SAI Intelligent Systems Conference 2016 IntelliSys 2016 offer a remarkable collection of papers on a wide range of topics in intelligent systems and their applications to the real world. Authors hailing from 56 countries on 5 continents submitted 404 papers to the conference attesting to the global importance of the conference's themes. After being reviewed, 222 papers were accepted for presentation and 168 were ultimately selected for these proceedings. Each has been reviewed on the basis of its originality, novelty and rigorousness. The papers not only present state-of-the-art methods and valuable experience from researchers in the related research areas, they also outline the field's future development. Learning LEGO MINDSTORMS EV3 Gary Garber, 2015-01-27 This book is for the hobbyists, builders and programmers who want to build and control their very own robots beyond the capabilities provided with the LEGO EV3 kit. You will need the LEGO MINDSTORMS EV3 kit for this book. The book is compatible with both the Home Edition and the Educational Edition of the kit. You should already have a rudimentary knowledge of general programming concepts and will need to have gone through the basic introductory material provided by the official LEGO EV3 tutorials. *Artificial Intelligence and Soft Computing, Part II* Leszek Rutkowski, Rafał Scherer, Ryszard Tadeusiewicz, Lotfi A. Zadeh, Jacek M. Zurada, 2010-06 This volume constitutes the proceedings of the 10th International Conference on Artificial Intelligence and Soft Computing ICAISC 2010.

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International Symposium on Intelligent Control ,1996 Intelligent and Fuzzy Techniques in Big Data Analytics and Decision Making Cengiz Kahraman, Selcuk Cebi, Sezi Cevik Onar, Basar Oztaysi, A. Cagri Tolga, Irem Ucal

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The International Journal, Advanced Manufacturing Technology, 1985 *Robot Control 1988 (SYROCO'88)* U. Rembold, 1989-05-18 Containing 88 papers the emphasis of this volume is on the control of advanced robots These robots may be self contained or part of a system The applications of such robots vary from manufacturing assembly and material handling to space work and rescue operations Topics presented at the Symposium included sensors and robot vision systems as well as the planning and control of robot actions Main topics covered include the design of control systems and their implementation advanced sensors and multisensor systems explicit robot programming implicit task orientated robot

programming interaction between programming and control systems simulation as a programming aid AI techniques for advanced robot systems and autonomous robots **Proceedings of the IECON...International Conference on Industrial Electronics, Control, and Instrumentation** ,1997 *Intelligent Control* American Society of Mechanical Engineers. Winter Annual Meeting,1987 **Information, Intelligence and Systems** ,1996 *Proceedings of the IECON '97: Emerging technologies, factory automation, robotics, vision, and sensors* ,1997 **Computer & Control Abstracts** ,1996 *Sensor Fusion and Decentralized Control in Robotic Systems II* G. T. McKee,Paul S. Schenker,1999 This work presents a series of papers examining various aspects of sensor fusion and decentralized control in robotic systems **Robotics Abstracts** ,1990 Robot Control (SYROCO '85) L. Basañez,Gabriel A. Ferraté,George N. Saridis,1986

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