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UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DESIGN AND IMPLEMENTATION OF LINE CAMERA BASED LANE FOLLOWING INTELLIGENT VEHICLE CONTROL SYSTEM

Sesi Pengajian :

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ABSTRACT

A line scan camera based lane following robot is an autonomous robot build for the Freescalecup™ competition. The Freescale™ racing car which builds up with a line scan camera and peripheral actuators such as motors are expected to complete the racing track which provided by Freescale™. The camera will provide the KL25Z microprocessor with signal representing the line scan result, a cross section line representing the upcoming track. In order to understand the signals provide by the camera, a real-time system to monitor the input signal is made. The digitized signal will be transferred from the KL25Z microprocessor wirelessly (Wi-Fi) to the monitoring PC. The received data will then be analysed in real-time with Matlab. Apart from the signal monitoring the Freescale™ racing car also need to undergo calibrating procedure to ensure the performance of the system is at the maximum level. The overall system is modelled into a closed loop system which allows the robot to manoeuvre and complete the racing track. PD controller is added to the closed loop for error compensation and to stabilize the system

.

ABSTRAK

Robot pengikut jejak berdasarkan kamera adalah sebuah robot yang mampu bergerak secara sendiri yang dibina khas untuk pertandingan"FREESCALECUP™" yang bertaraf antarabangsa. Robot yang terdiri daripada kamera dan pelaksana sampingan dijangka mampu untuk melengkapi cabaran litar yang disediakan oleh pihak FREESCALE™. Kamera yang terdapat pada robot bertindak sebagai alat pengesan dan akan menghantar isyarat ADC yang diambil kepada mikropemproses KL25Z. untuk menambah baik analisis projek ini, maklumat yang diterima oleh mikropemproses akan dihantar secara wayarless kepada computer. Maklumat ini akan diperhati menggunakan perisian serial port. Selain itu maklumat itu juga boleh diterjemah ke dalam bentuk graf menggunakan perisian MATLB. Selain daripada pemerhatian terhadap isyarat, robot juga perlu melalui kalibrasi secara berkala untuk memastikan prestasi robot adalah pada tahap yang maksimum. Keseluruhan system adalah dimodel menggunakan system lingkaran tertutup untuk membolehkan robot itu membuat keputusan secara sendiri. Oleh yang demikian pengawal PD ditambah untuk memastiakan perkara ini tercapai. Secara keseluruhan projek ini memberi aksess kepada peserta untuk menceburi teknologi terkini dan mengaplikasikannya secara praktikal.

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APPROVAL

I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality for the award of Bachelor of Electronics Engineering (Industrial Electronics)

Signature :…….

Name :…….

Date :…….

DECLARATION

I hereby declare that this thesis entitled "DESIGN AND IMPLEMENTATION OF LINE CAMERA BASED LANE FOLLOWING INTELLIGENT VEHICLE CONTROL SYSTEM" is the result of my own research except as cited in the references.

Signature :…….

Name :MOHD HASBULLAH BIN PUTRA

Date :……

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LIST OF ABBREVIATIONS

PD	Proportional Derivative
TCP/IP	Transmission control Protocol
IR	Infra red
ASCII	American Standard Code Information Interchange
PC	Personal Computer
UART	Universal Asynchronous Reciever Transmitter
TX	Transmitter
RX	Receiver
DC	Direct Current
PWM	Pulse Width Modulation
PID	Proportional Integrad Derivative
CCD	Charged Couple Device
CMOS	Complementary metal Oxide
VGA	Video Graphic Array
ADC	Analog Digital Converter
IP	Internet Protocol
SCI	Serial Communication Interface
RPM	Rotation per Minute
3D	Three dimensional

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CHAPTER 1

INTRODUCTION

Nowadays, an autonomous technology is widely used especially in vehicle research and development. This technology is constantly emerging and has high potential commercial value in various fields. Thus from this potential Freescale™ is providing fundings to encourage students to innovate the autonomous lane following car.

1.1 Background

A line camera based lane following intelligent vehicle control system is an idea to satisfy the autonomous racing car for the Freescale™ cup. The Freescale™ cup is a global competition where student teams build, program, and race a model car around a racing track for speed without derailing from the track. This competition is believed to be a platform for the participants from around the globe to access to the latest technology and apply it by hands on.

The line camera based lane following intelligent vehicle control system is using the camera as the source of input to capture the signal of the racing track. The line scan camera is widely used in the industry due to its fast response and easy to analyse. From the camera the data will be further process by the KL25Z microcontroller. The microcontroller is then will send the appropriate output to the peripherals actuator to complete the autonomous control for the Freescale™ cup racing car. The overall system of the car will be further discussed in chapter 3.

The intelligent vehicle control system indicates that the autonomous control is having a smooth cruise along the racing track. This idea is possible with the implementation of PD control which will stabilize the closed loop system build for the Freescale™ cup racing car. Besides having an autonomous control, the Freescale™ cup racing car also can be controlled by using an Android based TCP/IP controller. This will give the access to the user to interact with the car systems.

1.2 Problem statement

The line camera based lane following intelligent vehicle control system need to be modelled in a closed loop system and the control is to be determined by the PD controller.

1.3 Objectives

1. To build a system to have better understanding on the human interaction with the freescale cup lane following car
2. To identify and minimize the physical system error for the Freescale™ cup racing car.
3. To identify and apply suitable real-time signal processing method for the freescale cup lane following car.
4. To design and implement Proportional-Differential (PD) servo controller for the freescale cup lane following car

1.4 Scopes

The scope of the project is limited to the rules and regulation stated by the organizer of the Freescale™ cup. The main focus of the project is to complete the Freescale™ racing track with the shortest time.

1.5 Overview

The reminder of this thesis includes the literature review on the existing robots and input sensors are explained in chapter 2. The methodology on how to achieve the objective stated in Section 1.3 to be achieved is explained in chapter 3. Furthermore, chapter 3 also comprise on the physical calibration of the Freescale™ racing car. In chapter 4 all the results from each objective is represented. For further understandings, the results are represented in the form of graph and tables.

CHAPTER 2
LITERATURE REVIEW

In this chapter, the review on the application is being explained in Section 2.1. Different approach of robot might use different components. The design of the line following robot is being studied in Section 2.2 by comparing the existing line following robots. In addition, the topology of a serial communication is also being explained in Section 2.3. The serial communication will allow the robots to communicate with the personal computer. In conjunction with the serial port the UART are also being reviewed in Section 2.4. In this section the method for the microcontroller to transmit the data is being emphasized. The mechanical approach in Section 2.5 and 2.6 will allow further understanding on how the mechanism works. Then in Section 2.7 the PD controller which is the most important in the Freescale™ racing car is being explained in detail. In the last part, the comparison of the sensor being used is further discussed. The discussion will let point out the advantages and disadvantages of each system

2.1 Application of Line Following Robot

Line following system has been incorporated in mobile robots so that the robots can travel according to the line autonomously. Ben, Zoran, Tim, Saeid and Philip (2011) introduced the OzTug mobile robot developed to autonomously manoeuvre large loads within a manufacturing environment. The robot is configured to follow a predefined trajectory. Figure 2.1 shows the OzTug mobile robots during initial experimentation.

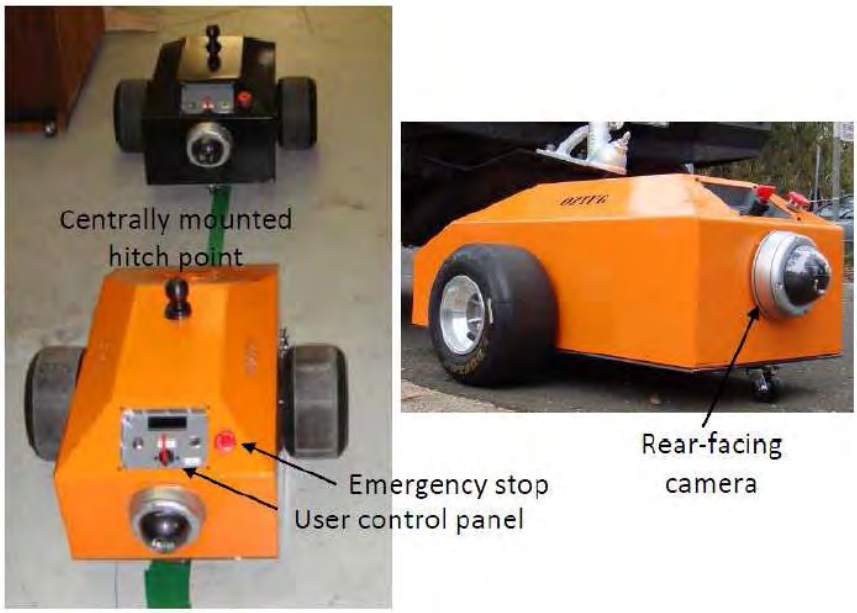

Figure 2.1: OzTUg Mobile Robot

Besides manufacturing environment, line following mobile robots also can be deployed as a commercial product. Illnur and Deniz (2009) proposed a design of a line following robot which is commonly used to carry visitor through shopping mall and entertainment fair. Figure 2.1.2 shows the prototype of the line following robot.

Figure 2.2: Prototype of line following robot proposed by Illnur and Deniz

Apart from that, Thirumurugan, Vinoth, Kartheeswaran and Vishwanathan (2010) demonstrated the application of line following robot for library inventory management system. In their design, a line following robot is designed using sensor operated motor to keep track the line path predetermined for library book shelf arrangements.

Figure 2.3: Book searching and arranging operation of the line following robot

2.2 Existing Line Following Systems

Line following capability can be achieved by a few methods; the most basic method is using the light sensor such as infrared sensor or colour sensor. Figure 2.2.1 illustrates the application and placement of infrared sensors in the design proposed by Illnur and Deniz (2009).

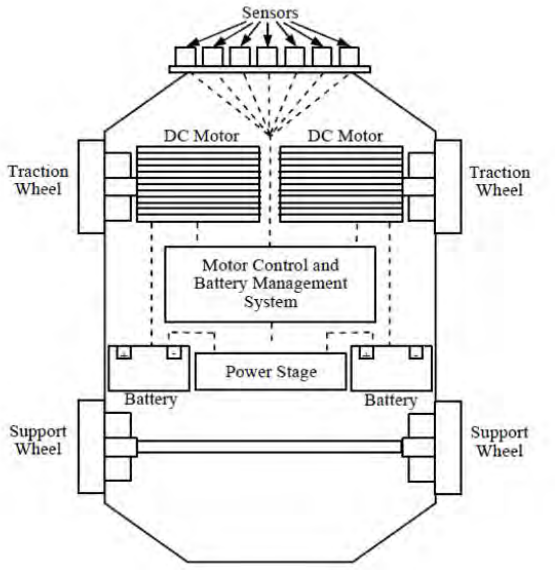

Figure 2.4: Placement of Infrared Sensors

Jean and Marc (2006) presented a webcam-based line following mobile robot equipped with a miniature Linux-based single-board computer as shown in Figure 2.2.2.

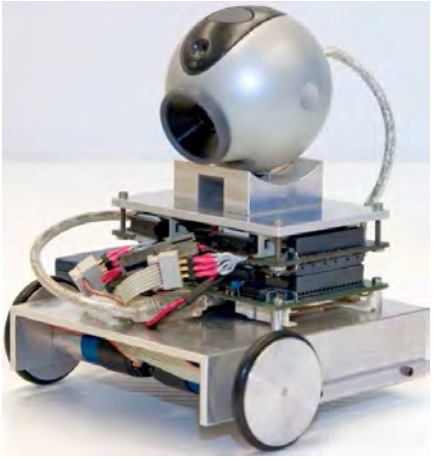

Figure 2.5: Webcam based Mobile Robot