VISION BASED MAZE NAVIGATION USING NI-MYRIO

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ABSTRACT

A vision based robot is a new technology that use image processing technique instead of using sensor. This to increase the various of application for the robot. Vision based robot mostly used for explore, for documentation, and so on. This project used Ni-myRIO from National Instruments as platform for the image processor. The existing type of this robot using robot that transfer the data and process by computer processor. The purpose of this project is to built a pocket-size image processing robot designed to be a navigation of a maze. The idea basically came from human. Human drive a car depends on a line to make sure the car in the middle of the lane and will turn according to the line. The methodology and scope of study are performed by doing literature reviews and research on various camera, motor, NI-myRIO, and the programming of the LabVIEW. Vision based Robot will have several criteria that are efficient, organized and user-friendly, which meets human needs.

ABSTRAK

Robot berdasarkan penglihatan ini adalah antara teknologi baru yang menggunakan teknik pemprosesan imej. Ini untuk mempelbagaikan applikasi. Robot berdasarkan penglihatan ini kebiasaannya digunakan untuk meneroka, dokumentasi, dan lain-lain. Projek ini menggunakan NI-myRIO sebagai dari National Instruments sebagai platform untuk pemprosesan imej.Robot sedia ada jenis berdasarkan penglihatan ini menggunakan robot yang menghantar data ke komputer lalu diproses oleh pemproses komputer. Tujuan projek ini ialah untuk membina robot pemprosesan imej poket saiz digunakan untuk navigasi di dalam maze. Idea ini datang dari manusia. Manusia memandu kereta berpandukan kepada garisan untuk memastikan kereta berada di tengah-tengah garisan dan akan membelok berdasarkan garisan. Metodologi dan skop kajian dilakukan dengan melakukan tinjauan kesusasteraan dan penyelidikan mengenai kamera, motor, dan NI-myRIO. Robot berdasarkan penglihatan ini mempunyai beberapa kriteria seperti kecekapan yang tinggi, teratur dan mesra pengguna, yang memenuhi keperluan manusia.

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CHAPTER 1

INTRODUCTION

1.1 Background of Project

Vision-based navigation for mobile robot uses to navigate the mobile robot based on track line. The idea to develop this project is from people drive a vehicle. The line on the road is becoming their guide to follow during driving. On human body, they have their eyes to visualize the image of road line and analyze by human's brain but robot uses camera to capture image of line and analyze by computer or embedded system.

The application of this project is in autonomous or unmanned robot. The robot will move based on vision-based navigation. The vision-based navigation or called by image processing will be done by the robot and will be the guide for the robot to move.

1.2 Introduction of Project

Vision-based navigation for line following robot is the fundamental independent versatile robot. It is suitable for the individuals in learner to plan or create a dream versatile robot. In spite of the fact that it stills truly a fundamental portable robot yet the vital things that it needs to attain that the dependable, adaptable and quick reaction contrast and other versatile robot had been produced.

Vision-based navigation has been utilized as a part of unmanned or self-ruling vehicle. In this century, individuals began concentrate more points of interest to execute vision into independent vehicle. The focal points of this application are to stay away from the mischances and expand security by wiping out human misstep. In this extend, the fundamental objective is to create a portable robot which has capacity to explore focused around reference line or predefined way. Prior to this, there are numerous self-sufficient portable robots had created. Large portions of them utilized vision, infrared or ultrasonic sensors as their sensors to distinguish way. Each of sensors has its confinements and points of interest. On the off chance that we analyze among these sensors, the vision is superior to others focused around its adaptability. This is the fundamental component that numerous analysts changed infrared and ultrasonic sensors to vision sensor. Other than that, this task additionally presents the least difficult algorithm and technique to process the data particularly for image processing.

When we have utilized a dream sensor as a part of portable robot so we have to process and break down the picture that we have captured. It called as image processing. Image processing is one of the essential courses of action for line emulating versatile robot that uses a dream. It will impact the execution of this task including response, flexible, reliable and so on. Because of that, simple technique and algorithm for image processing will produce faster response but it doesn’t determine either it more reliable or not. This project presents the simplest technique and algorithm but didn’t affect the reliable and flexible.

1.3 Objective of Project

1. To develop an algorithm for vision-based navigation using LabVIEW software and NI-myRIO hardware.

2. To develop a robot for evaluating the proposed method
3. To build a stand-alone robot that can do image processing itself.

1.4 Problem Statement

In this century, there is a lot of navigation or line following mobile robots has been created. The issue is their mobile robots takes time in its decision so that it can't move quick. In other word, we called as processing time. Processing time is measured from the information has identified until produce the output. One of the reasons it takes low reaction time is their algorithm or technique excessively perplexing where it needs a period to finish it despite the fact that its more dependable.

Besides, they had confronted issue that the development of their mobile robot still unpleasant. It is happened due to their algorithm or system didn't deliver a shut yield to match with state of track where precisely take after the track. For instance the track has bended to the left yet the versatile robot turned to left ahead of schedule than it ought to be or its point not suitable with the bend of track. So it will be out from the track.

Lastly, most of the mobile robot created using computer processing unit to do an image processing. That means, the robot not a stand-alone robot and need a device or components that connect the robot and computer processing unit. So when the robot is far or the computer have problem, the robot cant be functioning.

1.5 Scope of Project

There are 3 major parts in vision-based navigation robot. First are the input, controlling unit, and lastly output. Each section has divided into subsections which are proposed to achieve their own goals. For input part, a webcam been used as a vision sensor. The purpose using vision sensor as input is acts as a detector for reference line. In this project, the reference line is the edge detection.

For controlling unit, NI-myRIO been used as a controlling unit. NI-myRIO also will be used as a device that do image processing. This part is the important part, where the software used is LabVIEW. All the coding are in virtual instrument. Lastly is the output. Motor of the robot will be the output of this project. The movement of the robot either to move forward,backward, left or right, depends on the output of controlling unit.

CHAPTER 2

LITERATURE REVIEW

2.1 Different Edge Detection Methodologies

Edge detection is a basic tool used in image processing, basically for feature detection and extraction, which aim to identify points in a digital image where brightness of image changes sharply and find discontinuities. The purpose of edge detection is significantly reducing the amount of data in an image and preserves the structural properties for further image processing. In a grey level image the edge is a local feature that, with in a neighborhood separates regions in each of which the gray level is more or less uniform with in different values on the two sides of the edge. For a noisy image it is difficult to detect edges as both edge and noise contains high frequency contents which results in blurred and distorted result.

Edge detection makes use of differential operators to detect changes in the gradients of the grey levels. It is divided into two main categories:

1. First order edge detector/Gradient based operator
2. Second order edge detector/Laplacian based operator

2.1.1 First order edge detector

$$\nabla \mathbf{f} = \begin{bmatrix} G_x \\ G_y \end{bmatrix} = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix}.$$

Figure 2.1.1.1 Equation of first order

An important quantity in edge detection is the magnitude of this vector, denoted ∇ f, Where

$$\nabla f = |\nabla \mathbf{f}| = \sqrt{G_x^2 + G_y^2}.$$

Figure 2.1.1.2 Equation of vector

Another important quantity is the direction of the gradient vector. That is,

$$\text{angle of } \nabla \mathbf{f} = \tan^{-1}\left(\frac{G_y}{G_x}\right)$$

Figure 2.1.1.3 Equation of gradient vector

Computation of the gradient of an image is based on obtaining the partial derivatives of ∂f/∂x and ∂f/∂y at every pixel location. Let the 3×3 area shown in Fig. 2.1.1.1 represent the gray levels in a neighborhood of an image. One of the simplest ways to implement a first-order partial derivative at point z5 is to use the following Roberts cross-gradient operators:

$$G_x = (z_9 - z_5)$$

Figure 2.1.1.4 Robert cross-gradient equation 1

And

$$G_y = (z_8 - z_6)$$

Figure 2.1.1.5 Robert cross-gradient equation 2

These derivatives can be implemented for an entire image by using the masks shown in Fig. 2.1.1.2 with the procedure of convolution. Another approach using masks of size 3×3 shown in Fig. 2.1.1.3 which is given by

$$G_x = (z_7 + z_8 + z_9) - (z_1 + z_2 + z_3)$$

Figure 2.1.1.6 Robert cross-gradient equation 3

And

$$G_y = (z_3 + z_6 + z_9) - (z_1 + z_4 + z_7)$$

Figure 2.1.1.7 Robert cross-gradient equation 4

a slight variation of these two equations uses a weight of 2 in the center coefficient:

$$G_x = (z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3)$$

Figure 2.1.1.8 Robert cross-gradient equation 5

$$G_y = (z_3 + z_6 + z_9) - (z_1 + z_4 + z_7)$$

Figure 2.1.1.9 Robert cross-gradient equation 6

A weight value of 2 is used to achieve some smoothing by giving more importance to the center point. Fig.2.1.1.4, called the Sobel operators, is used to implement these two equations.

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z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

Figure 2.1.1.10 A 3×3 area of an image.

0	0	0
0	–1	0
0	0	1

0	0	0
0	0	–1
0	1	0

Figure 2.1.1.11 The Roberts operators.

–1	–1	–1
0	0	0
1	1	1

–1	0	1
–1	0	1
–1	0	1

Figure 2.1.1.12 The Prewitt operators.

–1	–2	–1
0	0	0
1	2	1

–1	0	1
–2	0	2
–1	0	1

Figure 2.1.1.13 The Sobel operators.

2.1.2 Second order edge detector

The Laplacian of a 2-D function f (x, y) is a second-order derivative defined as

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

Figure 2.1.2.1 Second order derivative

There are two digital approximations to the Laplacian for a 3×3 region:

$$\nabla^2 f = 4z_5 - (z_2 + z_4 + z_6 + z_8)$$

Figure 2.1.2.2 Equation for 3 x 3 region 1st

$$\nabla^2 f = 8z_5 - (z_1 + z_2 + z_3 + z_4 + z_6 + z_7 + z_8 + z_9)$$

Figure 2.1.2.3 Equation for 3 x 3 region 2nd

where the z's are defined in Fig. 2.1. Masks for implementing these two equations are shown in Fig. 2.1.2.4

0	–1	0
–1	4	–1
0	–1	0

(a)

–1	–1	–1
–1	8	–1
–1	–1	–1

(b)

Fig. 2.1.2.4 Two kind of 3×3 Laplacian mask.