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AUTOMATIC ROBOT LOCALIZATION

Yong Yoon Seong

Bachelor of Mechatronics Engineering
2009

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"I hereby declared that I have read through this report entitled "Automatic Robot Localization" and found that it has complied with the partial fulfillment for awarding the degree of Bachelor of Mechatronics Engineering"

Signature : .....

Supervisor's Name : En Ahmad Zaki bin Hj. Shukor

Date : 12/5/09

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AUTOMATIC ROBOT LOCALIZATION

YONG YOON SEONG

A report submitted in partial fulfillment of the requirement for the degree of Bachelor in Mechatronics

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APRIL 2009

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I declare that this report entitle "Automatic Robot Localization" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : Yong Yoon Seong

Date : 12/5/2009

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To my beloved mother and father

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ABSTRACT

This project is to design and develop automatic robot localization for the purpose of Robocon 2009. Actual robot position and projection of direction is needed to accomplish motion to destination. This project is categorized to three main parts which include electric circuit, mechanical design and algorithm. The main objective of this project is to order the automatic robot to move from an origin to destination set. After the robot arrive at the destination then it returns to origin accurately. The concept of this project is to use mouse encoder to count the number of revolutions of the encoder wheel. The program can determine whether a command to move forward some specified distance has actually resulted in the proper number of physical encoder wheel turns required for the distance and the number of revolutions of the encoder wheel will be displayed on the LCD screen. For the drive, the robot will use transwheel to perform more accurate and faster localization using x-axis and y axis.

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ABSTRAK

Projek ini adalah untuk merekabentuk dan membangunkan penentuan tempat robot automatik untuk tujuan Robocon 2009. Kedudukan robot sebenar dan arah unjuran adalah diperlukan untuk mencapai pergerakan ke destinasi. Projek ini dikategorikan kepada tiga bahagian utama iaitu litar elektrik, reka bentuk mekanikal dan algoritma. Objektif utama projek ini adalah mengarahkan robot automatik untuk bergerak dari tempat asal ke destinasi yang ditetapkan. Selepas robot sampai di destinasi maka ia akan kembali ke tempat asal dengan tepat. Konsep projek ini ialah untuk menggunakan pengekod tikus komputer untuk mengira jumlah revolusi roda pengekod. Aturcara dapat menentukan sama ada satu perintah untuk bergerak ke jarak yang ditetapkan sebenarnya menghasilkan bilangan yang sesuai pengekod fizikal pusingan-pusingan roda pengekod yang diperlukan untuk jarak tersebut dan jumlah revolusi-revolusi bagi roda pengekod akan ditunjukkan di atas LCD skrin. Untuk penggerak robot, ia akan menggunakan transwheel untuk melaksanakan dengan lebih tepat dan cepat penentuan tempat menggunakan paksi-x dan paksi-y.

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LIST OF SYMBOLS

v	-	Linear velocity
ω	-	Angular velocity
θ	-	Angle between the coordinates $X_rO_rY_r$ and XOY
α	-	Angle between the axles of the wheels
r	-	Radius of the wheel
b	-	Radius of the robot body
O	-	Origin
X	-	Horizontal axis
Y	-	Vertical axis
T	-	Period

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LIST OF ABBREVIATION

PCB	-	Printed Circuit Board
PIC	-	Programmable Intelligent Computer
USB	-	Universal Serial Bus
A/D	-	Analgoue-Digital
RF	-	Radiofrequency
LED	-	Light Emitting Diode
LCD	-	Liquid Crystal Display
IC	-	Integrated Circuit
PE	-	Polyethylene
CW	-	Clockwise
CCW	-	Counter Clockwise
CAD	-	Computer Aided Design
HEX	-	Hexadecimal
2D	-	Two-Dimensional
3D	-	Three-Dimensional

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CHAPTER I

INTRODUCTION

Automatic Localization Robot is an actual robot position and direction projection which is needed to accomplish motion to destination. Particularly, the system is useful for mobile robot navigation in industrial, service or research applications. This chapter will describe the problem statement, objectives and scopes of this project.

1.1 Problem Statement

By comparing the conventional automatic robot which is used in the previous Robocon, most of the automatic robots such as Line Following Robot could not determine the destination correctly and accurately. Since most of the line following robots is using infrared sensors, once any interruptions like sunlight or "out of line" occurs, the robot will go to the wrong destination or even keep turning around to get back to the path. Apart from that, line following automatic robot spend more time to reach its destination, because the robot needs to detect and make decision at every junction. Some line following robots had been applied at restaurants for the purpose of delivering the foods from kitchen to customer; however the place to use line following robot must have a line as its guide and the person in charge always need to ensure the line is clear for detection by Line Following Robot.

The purpose of this project is to overcome all the problems faced on the automatic robot that had been mentioned previously. Automatic Localization Robot does not need any line as its guide; because it only depends on encoder pulses to calculate the desired distance, hence unnecessary to make a specific line for the robot to move. Besides that, the interruptions such as sunlight do not affect Automatic Robot Localization because all the input is taken from encoder pulse and not from infrared sensors. After setting the destination needed according to distance of x-axis and y-axis for example x = 300 encoder

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pulse and y = 250 encoder pulse, the robot directly follows the x-axis and y-axis set (refer to Figure 1.1), this can save the time to reach the destination because detection and decision making need not be done at every line junction.

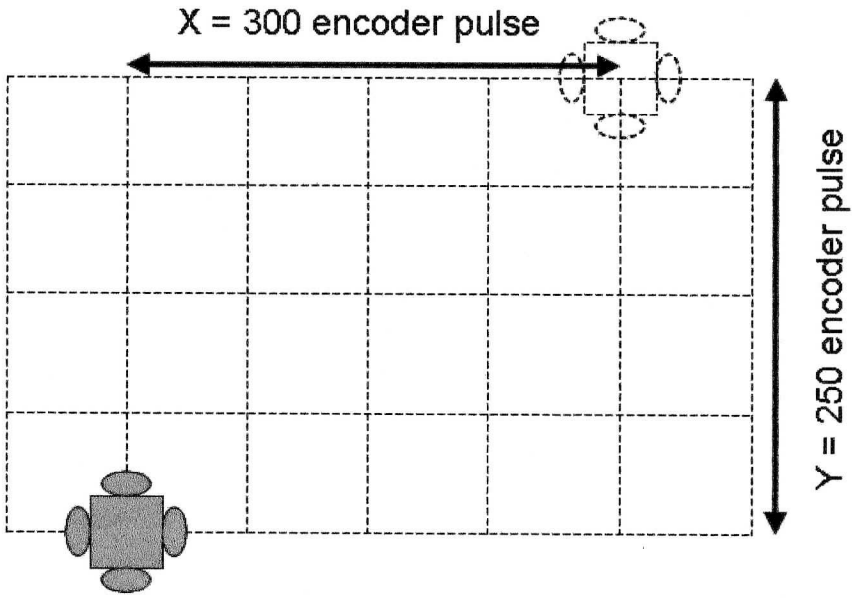

Figure 1.1: Motion of Automatic Robot Localization

1.2 Objective

The main objective of this project is to develop an Automatic Localization Robot that will be the method used for the Traveler Robot for Robocon 2009 by using PIC microcontroller as main controller of the robot and encoder signal as input of the robot. To ensure the project progresses smoothly, there are some objectives that need to be achieved:

1. To capture the signal from mouse encoder for distance calculation.
2. To do simulation by using Proteus ISIS and build circuit with the purpose of changing the analogue signal from mouse encoder to digital.
3. Design the mechanical structure of robot by using Solidworks software.
4. To program a simple Analogue-Digital converter from mouse encoder to main PIC microcontroller. Then implement another program for main PIC microcontroller to calculate numbers of mouse encoder revolution, display numbers of mouse encoder

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revolution on the LCD screen and perform the robot motion: left, right, forward or reverse according to the x-axis and y-axis positions.

5. To perform simulation in Proteus ISIS and design the microcontroller circuit by using ARES PCB design.
6. To test run and troubleshoot the robot and perform some analysis on rotary encoder and mouse encoder.

1.3 Scope

To understand the function of components for the robot, some theories about project background research and literature review had been studied. Components such as PIC microcontroller, mouse encoder, brushless DC motor and transwheel will be considered as main component in this project. There are some software will be used in this project which included:

1. MikroC – used for compiling hex file to PIC
2. Proteus ISIS– used for circuit simulation
3. Solidworks – used for mechanical structure design
4. WinPic800 – used for download the hex file inside PIC microcontroller
5. ARES – used for PCB layout design

Apart from that, material such as aluminium, plastic or light materials might be chosen as the material for the base of the robot.

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CHAPTER II

LITERATURE REVIEW

To have a brief understanding of the researches related to the project, a few literature reviews had been done. This chapter will describe the related literature reviews.

2.1 Literature Review 1

Title	:	Microcontroller based system for 2D localization
Author	:	Eduardo Zalama Casanova, Salvador Dominguez Quijada, Jaime Go´mez Garcı´a-Bermejo and Jose´ Ramo´n Pera´n Gonza´lez [1]
Institute	:	University of Valladolid, Spain

This paper describes a new system for the 2D localisation of moving objects which combines laser and radiofrequency technology to determine object or robot position and orientation. The described system is simple and inexpensive because common PIC microcontrollers are used and the precision (about 1 cm and 0.1°) is suitable for most mobile robot applications. The combination of photo detectors and radiofrequency technology permits the beacons to be univocally identified, which allows the absolute position and orientation of the moving object to be obtained without requiring a position estimate.

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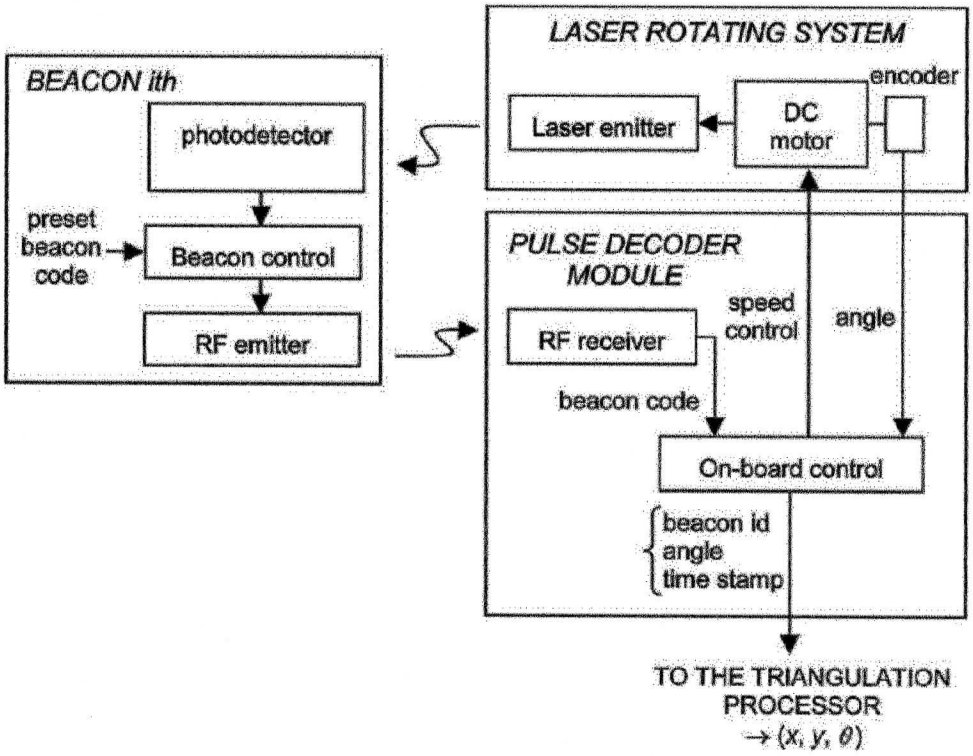

Figure 2.1: Functional diagram of the localization system

By referring Figure 2.1, a laser rotating system linked to a decoder module onboard the moving object. A beacon includes a photo detector, a control unit and a radiofrequency (RF) emitter. Each beacon is univocally identified by means of a preselectable code. The laser rotating system has an infrared laser emitter which spins through a dc motor. The pulse-decoder module is equipped with a RF receiver and a control unit.

The whole system operates as follows: the laser rotates in a horizontal plane, so that it reaches a set of beacons placed along the walls. When the laser bean falls onto a beacon photo detector, the associated control unit issues the preset beacon code through the RF emitter. On the reception of this code (through a RF receiver), the on-board control unit reads the laser angle from an encoder attached to the motor, and sends this value along with the beacon code and the current time to an on-board triangulation processor. This processor calculates the position and orientation of the robot through a triangulation algorithm.

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