IMPLEMENTATION OF PLATOONING STRATEGY FOR AUTONOMOUS MOBILE ROBOT

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B.ENG. (HONS.) MECHATRONICS

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BAARATH S/O KUNJUNNI

Report submitted in partial fulfilment of the requirements

for the award of the degree of

Bachelor of Engineering in Mechatronic Engineering

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June 2015

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering in Mechatronics.

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I hereby declare that the work in this thesis is my own except for quotation and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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LIST OF SYMBOLS

ω	Angular velocity
θ	Heading/ angle
$\dot{X}$	Speed in x direction
$\dot{Y}$	Speed in Y direction
m	Mass

LIST OF ABBREVIATIONS

WMR	Wheeled Mobile Robot
UDP	User Datagram Protocol

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ABSTRACT

Current studies show automated mobile robot is being widely researched to reduce human work and ease the job. Hazards and human limitations have been the main reason for the demand for a more versatile and robust mobile robot especially in machining industries and military base. However, still often require this kind of robot as assisting equipment in public places such as shopping mall, airport to help senior citizens and disabled people who are unable to carrying things with them when they move around. In this project, an automated mobile robot was developed perpendicularly with proposing platooning system to be used. The model of the platooning strategy analyzed via simulation and experiments. The robot was built together with myRIO as main controller. The Kinect was used for human detection and acquiring distance data. MATLAB was used as interface to send the distance data from the Kinect to myRIO using UDP. Results found that the automated mobile robot successfully detect and follow human to the target location while carrying some objects. It is believed that this robot can reduce the burden of human especially senior citizen and disabled people when carrying heavy things in public places. Moreover, this robot also can contribute more in completing heavy task in human daily life.

ABSTRAK

Kajian menunjukkan robot mudah alih automatik sedang banyak kajian dijalankan untuk mengurangkan kerja-kerja manusia dan memudahkan kerja. Bahaya dan batasan manusia telah menjadi sebab utama permintaan untuk robot mudah alih yang lebih serba boleh dan mantap terutama dalam pemesinan industri dan pangkalan tentera. Walaubagaimanapun, masih sering memerlukan ini jenis robot sebagai membantu peralatan di tempat-tempat awam seperti pusat membeli-belah, lapangan terbang untuk membantu warga emas dan orang kurang upaya yang tidak dapat membawa perkara dengan mereka ketika mereka bergerak. Dalam projek ini, robot mudah alih automatik telah dibangunkan selaras sistem platun yang akan digunakan. Model strategi platun yang dianalisis melalui simulasi dan eksperimen. robot ini dibina bersama-sama dengan myRIO sebagai pengawal utama. Kinect telah digunakan untuk mengesan manusia dan memperoleh data jarak MATLAB digunakan sebagai antara muka untuk menghantar data jarak dari Kinect ke Myrio menggunakan UDP. Keputusan mendapati bahawa robot mudah alih automatik berjaya mengesan dan mengikuti manusia ke lokasi sasaran sambil membawa beberapa objek. Ia dipercayai bahawa robot ini boleh mengurangkan beban manusia terutama warganegara emas dan orang kurang upaya apabila membawa barang yang berat di tempat-tempat awam. Selain itu, robot ini juga boleh memberi sumbangan yang lebih dalam menyelesaikan tugas berat dalam kehidupan seharian manusia

CHAPTER 1

INTRODUCTION

This chapter mainly emphasizes on the general idea of this study along project background, problem statement, objectives of the project and the project scope covered.

1.1 BACKGROUND STUDY

Robotic devices had conquered the current world in many fields. The significance of robotic devices is reflected in their widening use. There is different type of robotic devices, and one of the popular device is mobile robots. A widely used type of mobile robots are the wheeled mobile robots (WMR). A popular configuration for the WMR is the differential-drive system. This type of robot is opted for its simplicity in design and manoeuvrability.

Mobile robots have been widely researched and developed to assist humans in their daily activities. Automated mobile robot is being widely researched to reduce human work and ease the job. Decreases in assembling efficiency and expanding work expenses have conveyed an expanding inclination to mechanize fabricating exercises. The common use of mobile robots can be seen in industries, and army. However, due to extensive research in mobile robots, there has been increase in the mobile robot applications. Figure 1 show the mobile robot application based on its type.

High demand on the autonomous mobile robot contributed to the extensive research on this field. Hazards and human limitations have been the main reason for the demand for a more versatile and robust mobile robot. Works such as mining, transportation and

handling of radioactive substances are hazardous to humans. Thus, robots are much preferred to conduct these tasks in order to reduce human casualties due to hazards and ease the job. Furthermore, due to human limitations such as capability to transport heavy objects or detect small errors in any field brought upon the development of robots

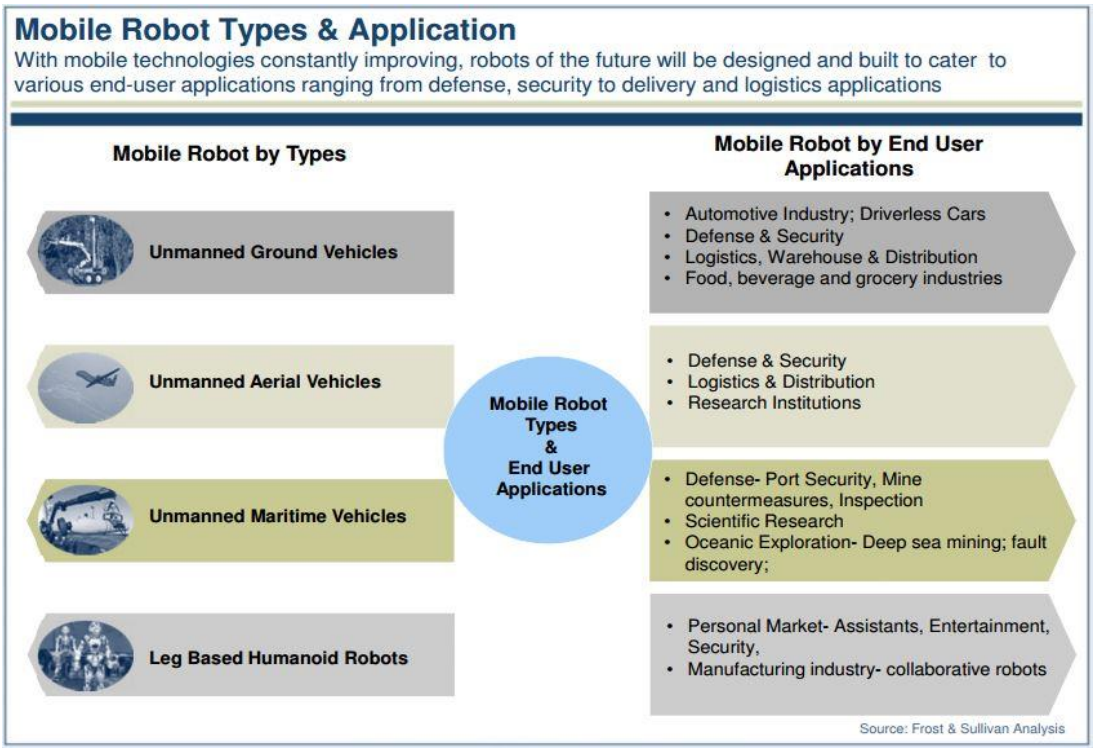

Figure 1.1: Types and application of autonomous mobile robot.

Source: Frost & Sullivan Analysis ,2014

An important key aspect to the operation of the WMR is its ability to locate itself within a frame of reference. This aspect is commonly known as localisation. A simple example of a device that is able to track its position in a defined space is the common computer mouse. Odometry has been an important aspect in localisation of WMR. Selection on the type of odometer used will affect the localisation of the WMR [1].

Automation of WMR does not only depend on the tracking system, an effective system to control and drive it is also equally important. The control algorithm is made up of the mathematical model of the behaviour and properties of the WMR. The mathematical model can be represented in two ways, which are kinematic and dynamic modelling. Often dynamic modelling will be omitted when developing the mathematical model of the WMR [2]. However, using both modelling is preferred for the precision of the system [2].

The navigation of autonomous robots is a relevant and widely studied topic in the field of robotics [3]. The case of navigating robot in the presence of humans and other robots is still new to the field of robotics [4].

A well-known approach that deals with navigation of vehicle or mobile robots is the platooning system. A platoon is a particular formation where the first robot is the leader and the other robots are followers. Each robot has to follow the previous robot in orderly manner to hold the formation. This system can be implemented on human-robot interactions where the robot can follow a human by maintaining a certain distance based on the platooning strategy. In this system the human is the leader whereas the robot is the follower.

In this project, the platooning strategy will be studied in order to develop a human following robot. This robot can be used in various sectors to ease our life.

1.2 PROBLEM STATEMENT

Motion has always been a big concern for us from the very beginning. Moving around from a place to another is very important in our daily life. One of the biggest problems when moving around is the luggage or things we carry with us. Normal people will find it easy to move around carrying light and medium weight objects. However, when it comes to heavy objects it is difficult to move around while carrying. We often require assisting equipment such as trolley. Furthermore, disabled people are more affected as they would be unable to carrying things with them when they move around. They often need people to assist them in carrying their luggage. Many people have damaged their backbone by carrying heavy objects with them.

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