

DEVELOPMENT OF NAVIGATION SYSTEM USING SLAM AND TURTLEBOT 3 FOR WAITER ROBOT

WAN JOE YEE



**BACHELOR OF MECHATRONIC ENGINEERING WITH
HONOURS
UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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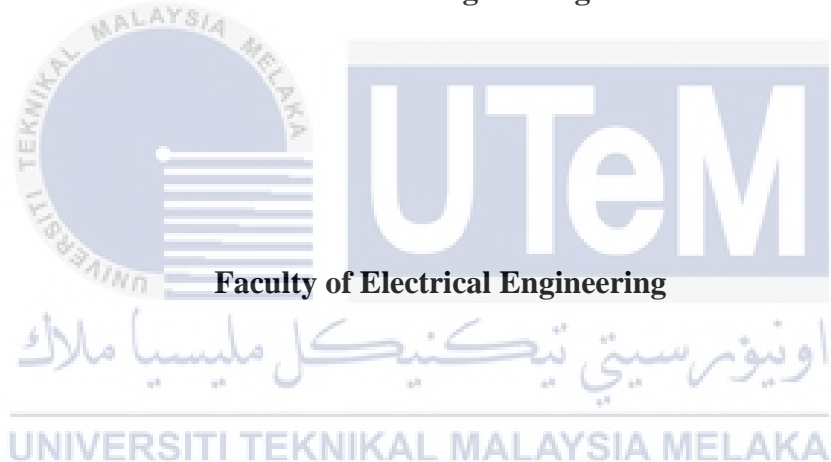
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF NAVIGATION SYSTEM USING SLAM AND
TURTLEBOT 3 FOR WAITER ROBOT**

WAN JOE YEE

**A report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Mechatronic Engineering with Honours**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I declare that this thesis entitled “DEVELOPMENT OF NAVIGATION SYSTEM USING SLAM AND TURTLEBOT 3 FOR WAITER ROBOT is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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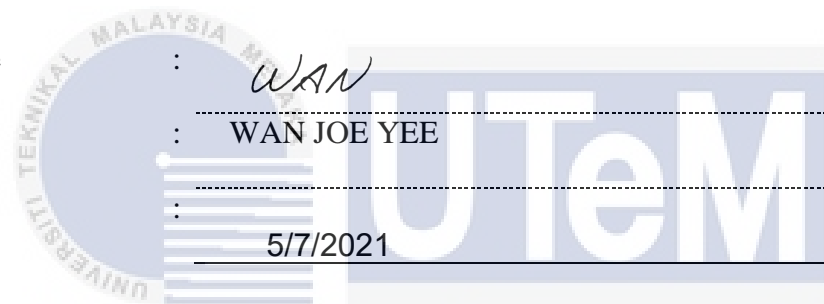
: *WAN*

Name

: WAN JOE YEE

Date

: 5/7/2021



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APPROVAL

I hereby declare that I have checked this report entitled “DEVELOPMENT OF NAVIGATION SYSTEM USING SLAM AND TURTLEBOT3 FOR WAITER ROBOT ” and in my opinion, this thesis it complies the partial fulfillment for awarding the award of the degree of Bachelor of Mechatronics Engineering with Honours

Signature :



Supervisor Name :

DR MOHD KHAIRI BIN MOHAMED NOR

Date :

5/7/2021

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DEDICATIONS

To my both beloved parents whos name are Wan Seng Toong and Soo Kwai Yoong as
the greatest support and inspiration upon accomplish this project

To my dearest supervisors , Dr Mohd Khairi Bin Mohamed Nor for being responsible ,
supportive and helpful through this project



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ABSTRACT

Since the COVID-19 pandemic had occurred, our government began to ask individuals to follow the standard operating procedure (SOP) for COVID-19 prevention, such as applying social distance for one meter, regularly sanitizing your hands, etc. . One of the places many people visit is a restaurant. Since waiters serving food at the restaurant will still have direct contact with the customers, they will be the individu that can be categories having a high risk of getting an infection. In order to solve this issue, restaurant owners began using service robots as an option to help them to serve food for customers. To allow waiter robot operated well in the restaurant, a navigation system using SLAM have been developed for delivery the meal to customer table. Turtlebot 3 have been used as the hardware platform while Robot Operating System (ROS) is a software framework to develop navigation system for waiter robot. The testing enviroment for this experiment will be the map of the restaurant environment generated by using Gmapping SLAM algorithm under different light inetensity during day time and night. Simulation in virtual world will be done for obtaining premilinary results for mapping environment and navigation. After that, the experiment on effect of light intensity to an environment have been conducted to study the light intensity in an environment will affect the accuracy of mobile robot to reach goal position. Experiment will be conducted in four conditions which are during daytime with high light intensity (Light is on), low intensity (Light is not turn on) and also night time with high light intensity (Light is on) ,low intensity(Light is not on). Based on the result , its shows that light intensity of an enviroment will affect the SLAM mapping process and this process will influnce the accuracy of the robot to reach desinagted goal positon. Gmapping SLAM mapping method will worked more accurately in an indoor enviroment with high light intensity enviroment where it could allow robot to reach goal destination correctly with averange accurracy rate up to 88% for both night and daytime condition than the indoor enviroment with low light intensity enviroment.

ABSTRAK

Sejak wabak COVID-19 berlaku, kerajaan kita mula meminta individu mengikut prosedur operasi standard (SOP) untuk pencegahan COVID-19, seperti memohon jarak sosial selama 1 meter, kerap mensanitasi tangan anda, dan sebagainya. Salah satu tempat yang ramai orang datang adalah restoran. Oleh kerana penunggu yang menghidangkan makanan di restoran masih akan mempunyai hubungan langsung dengan pelanggan, mereka akan menjadi kategori individu yang mempunyai risiko tinggi untuk mendapat jangkitan. Untuk menyelesaikan isu ini, pemilik restoran mula menggunakan robot perkhidmatan sebagai pilihan untuk membantu pelanggan menghidangkan makanan. Untuk membolehkan robot waiter beroperasi dengan baik di restoran, sistem navigasi menggunakan SLAM akan dibangunkan untuk penghantaran makanan ke meja pelanggan. Turtlebot 3 akan menjadi platform perkakasan untuk projek ini sebagai robot penunggu manakala Sistem Operasi Robot (ROS) akan digunakan sebagai rangka kerja perisian untuk membangunkan sistem navigasi untuk robot penunggu. Bukti ujian untuk eksperimen ini akan menjadi peta persekitaran restoran dan peta akan dijana dengan menggunakan algoritma Gmapping SLAM di bawah intensiti cahaya yang berbeza pada waktu siang dan malam. Simulasi di dunia maya akan dilakukan untuk mendapatkan keputusan premilineri untuk persekitaran pemetaan dan kaedah navigasi. Selepas itu, 4 Eksperimen kesan intensiti cahaya kepada persekitaran akan dijalankan menggunakan perkakasan dan kehidupan sebenar untuk memeriksa bagaimana intensiti cahaya dalam persekitaran akan menjejaskan ketepatan robot mudah alih untuk mencapai kedudukan matlamat. Eksperimen akan dijalankan dalam 4 jenis persekitaran yang pada waktu siang dengan intensiti cahaya yang tinggi (Cahaya dihidupkan), intensiti rendah (Cahaya tidak dihidupkan) dan juga waktu malam dengan intensiti cahaya yang tinggi (Cahaya dihidupkan), intensiti rendah (Cahaya tidak dihidupkan). Berdasarkan hasilnya, menunjukkan bahawa keamatan cahaya environment akan menjejaskan proses pemetaan SLAM dan proses ini akan mengembang ketepatan robot untuk mencapai posidon gol yang ditakdirkan. Kaedah pemetaan SLAM Gmapping akan berfungsi dengan lebih tepat dalam environment dalaman dengan environment intensiti cahaya yang tinggi di mana ia boleh membolehkan robot untuk mencapai destinasi matlamat dengan betul dengan kadar ketepatan average sehingga 88% .



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LIST OF SYMBOLS AND ABBREVIATIONS

COVID-19	-	CoronaVirus Diseases
SOP	-	Standard Operating Procedure
PSM	-	Projek Saujana Muda
ROS	-	Robot Operating system
ACML	-	Adaptive Monte-Carlo (ACML)



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CHAPTER 1

INTRODUCTION

1.1 Motivation

According to statistics from World Health organization (WHO), it stated that the covid-19 disease has been wide spread all around the world with 57,639,631 confirmed Covid-19 case with 1,373,294 death since late of year 2019 Until November Year 2020 which causes some challenge to countries from all over the world. [1]. Since the human contact is the source that spread this covid 19-disease, so some of the restaurant are planning to deploy non face to face service such as using robot in order to minimize risk in getting virus infection.[2]

Using robot in a contactless coffee shop has gain high accepted due to its functionality and innovativeness [3]. This causes restaurant owners started to use service robot as an alternative to serve for the customers. The restaurant like Kimbo Restaurant & Café at Egypt[4], Rong Heng Seafood Restaurant at Singapore[5], and CH Premiere Restaurant at Kuching, Sarawak[6]are some of the examples of the application of waiter robot.

By these statement ,it has sparked my motivation to create projects that related with waiter robot .So with availability of robot technology as servant to do task such as serving food for customer, so human waiter will be having social distancing with the customers and having less risk of getting infection of COVID-19 disease from them and also help the industry to solve the problem with COVID-19 SOP.

1.2 Problem statement

During this COVID-19 pandemic, the new norm had been introduced such as maintain social distancing as far as one meter, maintain extra hygiene and lock down in area which has a lot of COVID-19 cases in order to prevent the infection wide spread. One of the places that a lot of people will gather are restaurants. Since waiters who are serving food at the restaurant will be always having closed contact with the customers, they will be the individual that can be categories as who had high possibility to get infection by the COVID -19 diseases. In order to solve this problem, the waiter robot can be used as a non-contact service tools to serve the customer. The waiter robot will first move to the kitchen site through autonomous navigation to collect food order by customer. After the food are collected, the waiter robot will move from the kitchen site to the selected table for serving food to customer. Using waiter robot can maintain social distancing with their customer and prevent risk of infection by COVID-19 to the customer.

1.3 Objective

The objectives of this project are

1. To develop the robot navigation system to serve in designated environment.
2. To evaluate the accuracy of robot navigation system using position error method.