PERFORMANCE ANALYSIS OF PATH PLANNING ALGORITHM FOR AUTONOMOUS MOBILE ROBOT.

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PERFORMANCE ANALYSIS OF PATH PLANNING ALGORITHM FOR AUTONOMOUS MOBILE ROBOTS.

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This report is submitted in partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering with Honors'

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DEDICATION

This project is wholeheartedly dedicate to my beloved parents, who have been my source of inspiration and give me the strength when I almost give up, who continually provide their moral, emotional, spiritual, and financial support.

To my brothers, sisters, mentor, friends, and classmates who shared their words of advice and encouragement to finish this project.

And lastly, I truly thankful to the Almighty ALLAH for giving me the strength, protection and health.

ABSTRACT

This project relates to the fundamental problem of the autonomous mobile robot are localization, mapping, and path planning or motion planning. This project, analysis one of the problems related to path planning that affects the performance of the mobile robot. Three objectives that had been done from this project which is: first is to analyze the performance of the path planning algorithm (Probabilistic Roadmap and Dynamic) by changing the distance between a node and the number of node parameter. The second objective of this project is to implement the result that the algorithm had calculated and using the data as the optimum parameter for Thymio mobile robot. The final objective of the project is to validate the PRM P.P algorithm by comparing between simulation and experiment result with respect to accurate measurement. Because of the limitation of time and resource, the scope of the project is finding a suitable algorithm by simulation and the best result will be chosen to run it on the real world experiment. The mobile robot that uses on the project is differential drive robot Thymio. The software that uses on this project are Matlab 2015 version is to run and simulate the path planning and mobile robot while Aseba Studio uses to program Thymio mobile robot. What this project was able to find is the parameter of the path planning does affect the character of the mobile robot.

ABSTRAK

Projek ini memkaji masalah berkaitan dengan asas robot autonomi adalah penyetempatan, pemetaan, dan perancangan jalan. Oleh itu, terdaptt tiga objective yang telah dilakukan dalam project ini: pertama ialah menganlisis prestasi lagorithm perancangan jalan dengan menukar jarak antara dua nod dan jumlah bilangan nod. Kedua ialah mengimplementasikan hasil kira yang dapat dari algorithma dan masukan data parameter kepada robot Thymio. Terakhir ialah mengesahkan membandingakan antara hasil simulasi dan eksperimen dunia dengan menukarkan ketepatan titik sampai. Skop project bertujuan mencari algroithma yang sesuai melalui simulasi dan mencari hasil terbaik untuk menjadikan sebagai rujukan kepada robot mudah alih. Skop yang lain ialah mengunakan Thymio robot dan mengunakan keadah global algroithma. Persisian yang digunakan dalam projek ini adalah Matlab versi tahun 2015 untuk menjalankan simulasi antara algorithma dan robot mudah alih manakala Aseba Studio digunakan untuk memprogramm Thymio robot. Apa yang dapat ditemuai oleh projek ini ialah paramter perancang jalan algorithma ada mempengaruhi sifat perjalanan robot mudah alih.

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LIST OF SYMBOLS AND ABBREVIATIONS

AGV	:	Automated Guided Vehicle
AMR	:	Autonomous Mobile robots
SLAM	:	Simultaneous Localization and Mapping
UAV	:	Unmanned Aerial Vehicle
DOF	:	Degrees of freedom
NASA	:	The National Aeronautics and Space Administration
HIV	:	Human Immunodeficiency Virus Infection
A.I	:	Artificial Intelligence
VPL	:	Visual Programming Language

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CHAPTER 1

INTRODUCTION

The new era of Industry 4.0 has come with new and improve technology [1]. Internet of thing is related to Industry 4.0 and developing application that there are uses today [1]. There are many types of applications, tools, machines, and systems involved in the industry for their production. One of it's a robot, so this research paper study about part of the key factor of mobile robots. There a lot to discuss this robot as continues in chapter to come.

1.1 Introduction

Sustainability and green technology has become a term for all modern research and project. It becomes a term and objective for new era tools because to reduce the usage of energy. The idea is that when the usage of energy is reduced, the source like oil, water, and coal can be used for the future generation. The alternative way to

reduce energy is by creating a device that can harness the power of wind and sun (wind energy, solar energy). But the imported aspect of all this saves money.

Majority of industry want to save money on buy energy and cut the cost of the working hour. Use less energy are equals to less money. So the next question is how to reduce energy but still have a big output or production? By reducing working hours and increases production by using a robot as their alternative operators. The advantages of the robot are that it can do repeating work with less error, it will not have self-motivation issue, it does not need sleep and does according to the program. However, the disadvantage of a robot is that: to do complex work, it first needs to be pre-programmed intelligently. The robot is not like a human who can think for themselves. The old model robot that been used consumed a large amount of energy. Thus there are some advantages of using a robot and some disadvantages of using it.

The usage of energy is one of the issues in a robot or any machines when they work for long hours. In fact, engineer and researcher are focusing on this area to improving the utilization of resources. Another alternative is by reducing motion or movement the robot has to take. For example, there are two points the beginning point, and the endpoint. If the engineer is able to reduce the travel distance between two points, it should be able to reduce the energy used by the robot. Hence in theory, less traveling distance will result in less energy use.

At industry, there are many shape and size of robots, so basely there are two types: articulated robot and wheel robot. Articulated robot for example arm robot used as the assembly line, welding, spray painting and a lot more. For the second part, the wheeled robot (mobile robot) use to deliver items and component to its final destination. The type of robot used on this research is a mobile robot.

The mobile robot is made of two words: mobile and robot. The definition of mobile is one's ability to move freely. While a robot is a machine that has a movement like a human depend on their design. So those two words combine made a robot that can move freely without need any help or aid form anyone [2]. The design of the mobile robot are endless, but the two basic types of movement are wheel robot and leg robot [12]. The wheeled robot has resembled of an automobile which the movement they made just like a car. The legged robot can be the referent of animal, so they travel by using their legs.

In industry conveyor belt is commonly used to transport object. Similarly, the base function of using a mobile robot is for traveling or transporting device. In addition, the main advantages of a mobile robot are flexible, it can navigate on the working space following a path and changing path according to situations [4][5][6]. Furthermore, the mobile robot can work with any scale and working space. Another advantage of the mobile robot, it can deliver multiple areas [8]. So one robot can cover more ground at the workspace. If one mobile robot broke down, it does not affect the working area. Table 1.1 shows the difference between the conveyor belt and the mobile robot.

Table 1.1 Conveyor Belt and Mobile Robot

Conveyor Belt	**Mobile Robot**
Use a large of space for installs	Does not need large space to move
Cannot change direction when it already installs	Can easily change direction
When one breaks down, the operation must stop	Will not stop operations even one break down

Table 1.1 Continue

A large cost of maintenance	Low cost of maintenance
It takes a long time to service one big conveyor belt.	It takes less time to service a mobile robot
Non intelligence device	Intelligence device
Operate with loud noise	It does not produce loud operating noise
Nonflexible	It a flexible device

There a lot of services that a mobile robot can do for example transporting and exploration. The issue of transporting has been explained in the above section and continues in the next chapter. The exploration is a very interesting topic because it already been used at NASA for planetary exploration [9][15][18]. It uses an intelligent algorithm that also will be explained in the next chapter.

Overall, as exploring mobile robot can bring a lot of benefits. This understanding is important to improve key feature on a mobile robot. The ideas of green technology are important for the benefit of the industry. By reducing the working hour and reducing the movement duration can save time and energy. By doing that, this will enhance industry capacity for delivering maximum output and minimize budget and time consumption. Several industries maximize usage of the robot in the production line because of the production process need to be precise, accurate and precision. With mobility and flexibility of certain mobile robot design. It can withstand multiple varieties of task and function that needed to be done with high accuracy.

Because of that, the mobile robot and path planning is a wide area of research. More on that will explain in the problem statement, the objective of this project or thesis paper, scope and so on.

1.2 Problem Statement

First, Path planning is tightly dependent on the map representation method. The second statement is: Majority of the path planning algorithms are developed for a robot to traverse using a graph map or graph theory such as A* algorithm, Dijakstra algorithm, and Probabilistic roadmap algorithm. The last part: A metric map or occupancy grid map is a map representation that is commonly used in an autonomous mobile robot with low-cost sensors.

Overall, a their key issue on need to be solved or at least understand the concept of why it hard to overcome the problem that mobile robot had to face and its relationship to path planning.

1.3 Objectives

The objective of this paper and project are:

1. To analyse the performance of path planning algorithm (Probabilistic Roadmap and Dynamic algorithm) by changing the distance between node and number of node parameter.
2. To implement the optimum parameters for PRM algorithm and implement it with Thymio mobile robot.
3. To validate a PRM path planning algorithm by comparing between simulation and experiment result with respect to accurate measurement.