CHAPTER 1

INTRODUCTION

1.1 Background of Project

Automation is the technique, method, or system of operating or controlling a process by electronic devices, which reducing human intervention. In Robotics, the autonomous robotic referring to a technology (vehicle, machinery, navigation and etc.) that can functions independently, without help of human. Focusing in navigation area, autonomous navigation refers to the ability of the vehicle to be navigated from its starting point to the directed point accurately and safely without the needs of human driver. In this aspects, accuracy, reliability of automatic navigation and coverage are issues that seriously being centralize.

Studies carried out by the Malaysian Institute Road Safety Research (MIROS) claimed that 80.6% of accidents were attributed to human negligence while driving (Chelvi, 2016). In the study, it said reckless driving, speeding, inattentive and driving under the influence of alcohol or driving when feeling tired are the main cause for accidents. With awareness of this situation, autonomous navigation is seen as an initiative to minimize the human intervention in navigation, in order to reduce human negligence while driving. This is because, an autonomous technology is something that believes can increase the safety and efficiency not only the driving also the traffics.

In order to provide a secure and effective navigation system, path planning is a technology that highly use in autonomous navigation. According to the definition of path planning by (The RoboRealm, 2006) path planning can be define as a module that has been use to determine a route from one coordinate location to another coordinate location. Path planning is something that requires the automation of mechanical systems that have sensors, actuators and computation capabilities. Generally, path planning is a method that
widely used in many fields, such as artificial intelligence, control theory, and also robotics. In artificial intelligence field, path planning is defined as “a search for a sequence of logical actions that transform an initial robot state onto a desire goal state” (Qidan Zhu, Yongjie Yan, and Zhuoyi Xing, 2006). In the control theory field, path planning deals with many issues such as stability, feedback, and optimality (A. Smith, Ding, Ulusoy, 2012). On top of that, in robotics, path planning playing a major role on how to move a robot vehicle from one point to another point. Path planning is an important primitive for autonomous navigation of the mobile robot which requires the robots to finds the shortest and easiest way (avoiding all the obstacles) between the two points (source and goal).

In order to plan the pathway for navigation, path planning requires the use of map of the covering area in order to search the shortest way to the goals avoiding the obstacles along the way. The most common map is occupancy grid map which the environment is discretized into squares of arbitrary resolution on which obstacles are marked (Correll, 2011). This type of map is widely used in Astar (A*) algorithm’s application.

Astar (A*) algorithm is one of the most famous algorithms in path planning. It is widely used in path planning of robotics navigation due to its ability to adopt the distance used, altered or add another distance (Andrej Babinec, 2014). This resulting in wide range of alternating the distance as it is the basic principle of this Astar (A*) algorithm. This Astar (A*) algorithm operates by the combination of heuristic searching, and scanning based on the shortest direction. The Astar (A*) algorithm is define as follows:

\[
F(v) = g(v) + h(v)
\]  

Where 
\( v \) = node on the graph  
\( F \) = total cost of the path between the source point to goal point  
\( g \) = cost of the path from the start node to current point node \( v \)  
\( h \) = heuristic cost (estimated smaller cost from the current point to goal point)
1.2 Problem Statement

In autonomous navigation that requires the robot to be operate safely and efficiently, the common issue that the developer face is it failed to avoid the obstacle with the minimum pathway. In some cases, the robot with an obstacle avoidance technology is able to avoid the obstacle but the question that remain in developer’s mind is the path founded by the robot is the shortest? This is important to take into account the path that being chosen by the robot is the shortest distance.

As mentioned by Vo Thi Huyen Trang and team, from Astrakhan State Technical University, Russia, they state that, the problem is cause by “operating environment that can be static (fixed obstacles and know in advance) or dynamic (obstacles may not be fixed in advance or do not know)” (Vo Thi Huyen Trang, Tran Quoc Toan, A.A. Sorokin, 2017).

As a step to improve people way of live, this project will design and implement an Astar (A*) algorithm for autonomous navigation system.

1.3 Objective of The Study

The general purpose of this project is to develop an algorithm which is able to provide the shortest path with ability to avoid any obstacles that presence along its way from any two point (source and goal) of the map. The project specifically aims to implement the set of rules of path finding for the autonomous navigation, which can be implemented into any comparable navigation system. In this regard the specific objectives of this project will include:

i. To implement the Astar (A*) algorithm for path planning.
ii. To analyse the Astar (A*) algorithm output using simulation and experiment.
iii. To verify the capability of the Astar (A*) algorithm for path planning navigation.