UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PRELIMINARY INVESTIGATION OF VISUAL FEATURES FOR AGV LOCALIZATION APPLICATION

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics and Automation) (Hons.)

by

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DECLARATION

I hereby, declared this report entitled “Preliminary Investigation of Visual Features for AGV Localization Application” is the result of my own research excepts as cited in references

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirement for the degree of Bachelor of Manufacturing Engineering (Robotics and Automation) (Hons). The member of the supervisory committee is as follow:

…….

(Dr. Fairul Azni bin Jafar)

ABSTRACT

This thesis basically discusses in the preliminary investigation of visual features for the AGV localization application. In general, there are 2 components involved in these research visual features and recognition process. Visual features are one of the richest sources that can be extracted from environment and believe that if applying this features it may help extraction recognition process precise and accurate. According to previous research, the complicated methods are needed to perform recognition process. Therefore, by applying the visual features the recognition process can be determined. The objective of these researches is to develop visual features based localization system for AGV application and validate the performance of the proposed localization method. In research methodology develop on a vision system and perform the localization system is done in order to get a result. There are 5 experiments is conducted and each of the experiment have different objective to need achieve, the final result shows the 86.68% of success rate of recognition meanwhile the error rate is 13.32%. Thus, the purposed of this localization method is applicable for used but still have a minor error needed to be improved in future.

ABSTRAK

Tesis asas ini membincangkan tentang siasatan awal terhadap ciri-ciri visual untuk aplikasi penyetempatan AGV. Secara umumnya, terdapat 2 komponen yang terlibat dalam penyelidikan yang ciri-ciri visual dan proses pengiktirafan. Ciri-ciri visual adalah salah satu sumber yang paling kaya yang boleh diekstrak dari alam sekitar dan percaya bahawa jika memohon ini menampilkan ia boleh membantu proses pengiktirafan pengekstrakan lebih teliti dan tepat. Menurut kajian sebelum ini, kaedah yang rumit diperlukan untuk melaksanakan proses pengiktirafan. Oleh itu, dengan menggunakan ciri-ciri visual proses pengiktirafan boleh ditentukan. Objektif kajian ini adalah untuk membangunkan ciri-ciri visual sistem penyetempatan berdasarkan permohonan AGV dan mengesahkan prestasi kaedah penyetempatan yang dicadangkan. Dalam metodologi penyelidikan membangunkan pada sistem penglihatan dan melaksanakan sistem penyetempatan itu dilakukan untuk mendapat hasil. Terdapat 5 eksperimen dijalankan dan setiap eksperimen mempunyai objektif berbeza yang perlu dicapai, dan kesemua keputusan akhir eksperimen menunjukkan 86.65% kadar kejayaan pengiktirafan, sementara itu kadar kesilapan adalah 13.35%. Oleh itu, tujuan kaedah penyetempatan ini sesuai untuk digunakan tetapi masih mempunyai kesilapan kecil perlu diperbaiki pada masa yang akan datang.

DEDICATION

Dedicated to my beloved parents, Mohamed bin Yaacob and Zakiah binti Mohd Zain and to my supervisor, Dr. Fairul Azni bin Jafar, and not forget all my friends who have guided, encouraged and inspired me to finishing this thesis.

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AGV	-	Automated Guided Vehicle
ANN	-	Artificial Neural Network
CCD	-	Change Coupling Device
FYP	-	Final Year Project
IC	-	Integrated Circuits
LGV	-	Laser Guided Vehicle
MKR	-	Muratec Keio Robot
PSM	-	Projek Sarjana Muda
SIFT	-	Scale Invariant Features Transform

CHAPTER 1
INTRODUCTION

1.1 Background

Nowadays, mobile robot plays an important role in an environment where it has an ability to perform tasks such as navigate where it can be avoided and handling when in dangerous environment such as hazardous and unsafe condition, temperature, radiation and corrosive. So it will help human to control and performing at dangerous situation tasks in proper way and also can avoid humans from to unexpected accidents.

Other than that, autonomous of mobile robot can be divided into three types which is non-autonomous, semi-autonomous and fully-autonomous robots. For the Non-autonomous robots where the robots are controlled by human to performing the task and only operate when receive commands from human controllers, for semi-autonomous robots it can be start by human and also navigate by its own, this type of robots suitable in dangerous condition where the robot have a full control meanwhile in less dangerous condition situation human can control the robot. Last but not least is fully-autonomous robots whereby robots operate by themselves without human interrupts and this type of robots suitable for repeated work such as welding where it needed fixed point to join and the efficiency can be managing. Thus, every types of autonomous mobile robots are used based on the environment of work space, to solve the limitation and error by the human being.

The term of localization has been defined by determining the exact of location meanwhile robot localization is the capability of robot to establish its own position and

orientation based on the environment. If the robot doesn't know where it is, this will give difficulty for mobile robots to analyze the exact position where it is. There are several methods for localization, which is following the process such as a priori map that include a graph with metric, position estimation, features matching and estimation. The common problem of localization of mobile robots is how to detect and manipulate the obstacle toward its environment, a mobile robot has the capability to differentiate between obstacle and environments in order to have a good result of localization.

Over the past years, localization of mobile robot becomes an attractive issue where there is a lot of methods applied to the localization mobile robot. There is a lot of features that can be taken as a reference in the mobile robot localization, visual features is one of the methods that have been used, which can be divided into two categories global and local features. For global features which can be exactly from the image such as histogram, integral invariants and image gradient. Meanwhile, for the local features actually manipulated from high relevance in the image such as wavelet- based features, photometric invariants, kernel PCA- based features or Scale Invariant Features (SIFT). In general, large space in memory is needed for storing the whole image in the robot system. Thus, every technique of localization has their own constrains and limitation based on application.

1.2 Motivation

Today there is a lot of autonomous mobile robots taking part in manufacturing where the function of autonomous robots is to help human to do difficult task such as designing or producing a complex part. Every robot in this world need an instruction or language for robot understanding “what they have to do” and “how to do it”. Actually, mobile robots in manufacturing can do various tasks and one of the tasks is for material handing where the robot can move from one place to another place such as an Automated Guided Vehicle System (AGV) and its can be divided into three categories which are driverless trains, pallet truck and unit load carrier as shows in Figure 1.1 and Figure 1.2.

Figure 1.1: Driverless train AGV.

(Source:<https://en.wikipedia.org/wiki/Automated_guided_vehicle#/media/File:Agv.tugger2.jpg.>20/10/2015)

Figure 1.2: Pallet truck AGV.

(Source: < http://www.jbtc-agv.com/en/Solutions/Products/Forked-Automatic-Guided-Vehicles-AGVs> 20/10/2015)

Figure 1.3: Unit load carrier.

(Source:<http://www.frog.nl/Referenties/Andere/Roto_Smeets.html?newlang=en>10/10/2015)

Based on real application of guidance system, AGV pathways are defined and vehicles are controlled to follow the pathways. There are three technologies that are used in the commercial system for vehicle guidance, which are imbedded guide wires, paint strips and self-guide vehicle where it helps AGV to move from one location to another location.

In other words, this system is successfully proven for navigating and localization for the AGV to move to one location and another. Thus, by implementing a new system such as visual features for AGV where it acts just like the brain, it can navigate and localize without burdent the system of mobile robot.

1.3 Problem Statement

The problem of mobile robot localization is the ability and way of answering the question “where am I”, “Where am I going”, How do I get there”. These types of question needed to answer by the mobile robots its self in order to localize or navigate. When talking about location, pose or position mobile robot may refer to the global coordinate system. The coordinate system is a one of more numbers and coordinate uses in the system in order to determine exactly the position of the point where is it mobile robot located.

According to the previous researches, the methods of performing robot localization were very complex and requiring tedious calculation for interpreting data where every mobile robot must have a brain in order to store all this valuable information and needed large memory space in robotic system so it may burden the processor of mobile robot. However, by implement another method for such as visual features for localization believe may help the robot performance. There are lots of information can be extracted from a visual such as histogram, integral interval and image gradient. Thus, this project is to preliminary investigating of visual features for mobile robot localization application.

1.4 Objective

The purpose of this project is to perform a preliminary investigation of visual features for AGV localization application.

The ultimate goal of this project are:

i. To develop visual features based localization system for AGV application.
ii. To validate the performance of the proposed localization method.

1.5 Scope and limitation

The scope of the project are as follows:

i. This project is conducted in indoor environment which is images captured inside block B FKP during day time.
ii. Eight positions are used for visual features localization, and images are captured in every position.
iii. Images captured under florescent light.
iv. According to this experiment, there is no mobile robot attach for visual features localization, only used color video camera. However, no navigation is consolidating while localization process.
v. Fixed the height of video camera while taking images at every position.
vi. According to the type of camera used in this project, not using the omnidirectional camera for localization.

1.6 Chapter Structure

This report consists of five chapter that were divided into 2 part which are Final Year Project 1 (FYP 1) and Final Year Project 2 (FYP 2). Chapter 1, chapter 2 and chapter 3 was structured in FYP 1 and the rest 2 chapter will be continuing in FYP 2. The first chapter is an introduction of the project. Consist of background of the study involve mobile robot localization, motivation that shows the previous method used in AGV in order to move, objective, scope and limitation and lastly the report structure.

The second chapter is all about the literature review. This chapter include information about review mobile robot, previous method of mobile robot navigation and localization system.

The third chapter describe a design localization system using visual features, according to the objective of this project color and shape takes as visual features in order to achieve localization. It's includes Gantt, overall methodology flow chart, detail explanation of localization system using neural network and expected result in localization system.

As continuation from FYP 1, FYP 2 covers chapter four and five. The FYP 2 more focusing in experimental and finding the result and discussion of the result. The chapter 4 will be present as a result meanwhile chapter 5 is conclusion of the project whether it is successful or not based on the objective and addition of future suggestion in order to improve this project.