OBJECT TRACKING AND ACQUIRING USING VISION GUIDED MOBILE ROBOT

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

by

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Date : 16 June 2017

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Degree of Manufacturing Engineering (Robotics and Automation) (Hons). The member of the supervisory committee is as follow:

…….....

(Dr. Mohd Hisham Bin Nordin)

ABSTRAK

Tujuan utama projek ini dijalankan adalah untuk membangunkan robot mudah alih yang mampu menjejak dan mengutip sesebuah objek dengan bantuan alat pengesan imej. Robot dengan bantuan alat pengesan imej ini bergerak berdasarkan imej yang telah dikesan pada pengesan imej iaitu kamera Pixy. Terdapat dua objektif projek ini iaitu untuk membangunkan robot mudah alih yang mampu untuk menjejak dan mengutip objek dan membangunkan penggenggam robot. Pengaturcaraan komputer untuk projek ini juga telah dilakukan dan ia bermula dari awal proses sehingga berakhirnya proses mengutip bola tenis. Perisian komputer yang digunakan adalah 'PixyMon' untuk kamera Pixy manakala 'Arduino IDE' untuk pengawalmikro Arduino. Data dari 'PixyMon' diambil dan diguna untuk pengaturcaraan di 'Arduino IDE'. Robot mobiliti diuji dengan tiga ujian dan keputusan ujian menunjukkan prestasi robot. Ianya jelas menunjukkan bahawa kamera pixy mempunyai batasan penglihatan apabila objek berada lebih dari 10 meter dan bekas untuk mengisi bola tenis terhad sehingga tiga biji bola tenis sahaja untuk satu-satu operasi. Cadangan untuk penambahbaikan projek juga disertakan di dalam laporan ini.

ABSTRACT

The main purpose of this project is to develop an object tracking and acquiring vision guided mobile robot. A vision guided mobile robot is a mobile robot that moves based on the image sensed by the Pixy camera. The objectives of this project are to develop a vision guided mobile robot that can track an object and develop a suitable gripper for object acquiring. More than one designs were made and the final design were improved for the best performance of the mobile robot. The programs for the sequences of the mobile robot from the start point until the end also has being developed. It involves two software which are the PixyMon for pixy camera and the Arduino IDE for Arduino programming. The data from the PixyMon is used for codes programs in the Arduino IDE. The mobile robot was tested with 3 tests and the result of all tests indicates the mobile robot performance. In this report, it is proven that the pixy camera cannot detect the object at more than 10 meters and the container can only acquire up to three tennis balls per operation. Suggestions for the future work also have being stated in this report.

DEDICATION

I am dedicating this report to my beloved parents, Zainol Azmi Bin Zakaria and Supiah Binti Sastero, who always support me with their boundless love to endeavor in achieving a success in everything I do.

To my supervisor, Dr Mohd Hisham Bin Nordin without your guidance, none of my success would be possible.

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LIST OF ABBREVIATIONS

DC	-	Direct Current

CHAPTER 1

INTRODUCTION

1.1 Project Background

Vision Guided Robot is the robot that uses a camera sensor to detect an object based on its shape or colour. The mechanism of the vision guided robot is, it gives a feedback signal to the controller when the camera sensor senses the object based on the pre-recorded shape or colour of that object. In industries, the vision guided robot often used on the robot arm. Robot arm that operates based on the vision guided have a camera sensor at the end of the arm. Usually, the camera sensor used have its own software and must be linked and synchronized with the microcontroller software.

Figure 1.1: Vision Guided Robot Arm. (Retrieved from: https://www.bastiansolutions.com/solutions/technology/industrial-robotics/industrial-robotic-solutions/vision-guided-robotics/fanuc-irvision)

Meanwhile, mobile robot is a device that can move from one place to another place controlled by some programming codes or infrared signal controller. Nowadays, mobile robot has been used widely and all the manufacturer keep improving this mobile robot from time to time because of high technology development in industries. The types of

the mobile robot that have already been used in the market and industries are unlimited. There are so many types of mobile robot depending on their tasks and utilities. Vision guided mobile robot is one of the types of mobile robot that has already been used in manufacturing industries and limited uses in sports industries. In manufacturing industries, the vision guided mobile robot often used for some process that required for detecting the object or product first before continuing to the next process. Unfortunately, in other industries such sports, hospitality, food processing and so on, there are limited uses of this vision guided mobile robot.

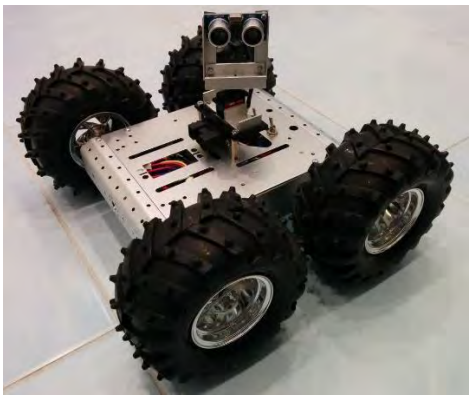

Figure 1.2: Mobile Robot (Retrieved from: http://www.geeker.co.nz/robot/chassis/4wd-aluminum-mobile-robot-platform.html)

The aim of this project is to develop a vision guided mobile robot that is equipped with arms and gripper that can acquire an object in order to help some industrial activity. The vision guided mobile robot must be able to move based on vision system using Pixy camera and perform a task of acquiring an object. The Arduino is used as the microcontroller for this vision guided mobile robot. To make this project successful, research activities, data analysis, code programming, pre-recorded images and shapes of object, designing and other process must be conducted. All the processes involved will be covered in this report.

1.2 Problem Statement

There is almost no vision guided mobile robot for industries other than manufacturing industries. The vision guided mobile robot that has been manufactured by some company only used for production in industries. Besides, there is no arms or gripper attached to the vision guided mobile robot that readily available in the market since it is only used for tracking and not for acquiring any object. Without this invention of mobile robots, people's life cannot be improved and their daily routine will remain the same along with increasing living standard and daily busyness.

1.3 Objectives

a) To design and develop a vision guided mobile robot that can track objects based on its colours and shapes.
b) To design and develop a gripper for mobile robots to acquiring the object.

1.4 Scopes

This project is focussed on the designing and prototyping of a mobile robot that can track a pre-recorded object based on colour and size. The mobile robot will use a gripper to acquire the object and uses Arduino as the microcontroller with combination of PixyCam software. The mobile robot will suit to the ground level only and have limitation of uses which is operating in daytime and bright places due to the vision sensor used which is PixyCam. Besides, this project also focusses to improving the sports industries. The prototype will be tested at the tennis court and the prototype must be able to pick up the tennis ball and returned it back to the provided box.

1.5 Importance of Study

This study is important because the vision guided mobile robot is still rarely used in the sports industries. The development of this type of mobile robot is still at the beginning. Thus, a study to create a vision guided mobile robot that use PixyCam as the image sensor, Arduino as the microcontroller with advanced of gripper to acquiring the object or doing a task should be conducted. As developments and technologies are getting advance in recent years, this kind of study must be explored and discovered because the potential of the vision guided mobile robot to improve the sports industries in our country and can generate a lot of profit to the manufacturer of the robot as well.

1.6 Organization of Report

This report consists of 3 chapters. Chapter 1 introduces the background of study, problem statement, and objectives of the project, scope and limitation of project, importance of study and organization of the report. Chapter 2 mainly discusses the literature review that is related to this project research. Chapter 3 discusses on the research methodology used to develop Vision Guided Mobile Robot.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction about the Vision Guided Mobile Robot

Vision guided mobile robot is the mobile robot that currently available in the market, especially in the manufacturing industry field. This chapter will discuss about the existing vision guided mobile robot with their specifications and limitation. The important parts of the vision guided mobile robot also will be provided in this chapter.

2.2 Existing Vision Guided Robot

Vision guided robot is a robot that is moving and operating based on the feedback from the image sensor. The image sensor will detect the image or object and sent a signal to the controller for next process. Usually, the robot that uses this vision guided is robot arm. In industries, there are so many robot arms that make a use of vision guided to complete some processes. This is because the process need to differentiate or recognizing the product or part before continuing to the next process.

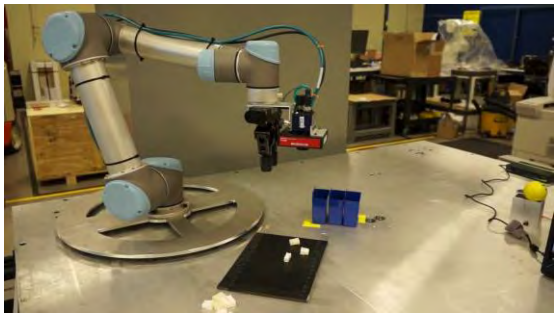

Figure 2.1: Vision Guided Robot Arm (Retrieved from: https://www.youtube.com/watch?v=w7-KGaYGuMA)

2.3 Existing Vision Guided Mobile Robot

Nowadays, there are so many types of mobile robot. For example, line follower mobile robot, also known as automated guided vehicle and vision guided mobile robot. For this vision guided mobile robot, it has been used in manufacturing industries. It helps to optimize the operation of some processes. Vision guided mobile robot usually have a 4 wheel to drive the robot, any driver, microcontroller, gripper, image sensor and the body of the mobile robot itself. The vision guided mobile robot that already made by some designer is only focused on how to make the mobile robot follow the image or colour recorded in the image sensor and use different type of image sensor. The vision guided mobile robot that uses Pixy as the image sensor is very rare because this Pixy image sensor is quite new and the cost to purchase is high compared to other image sensors.

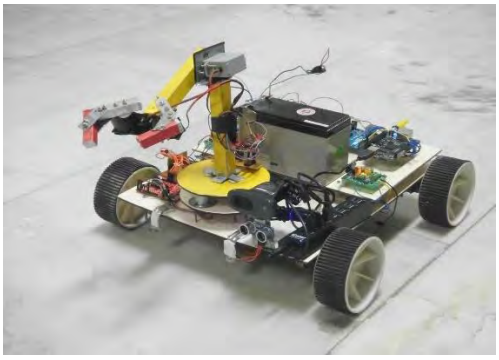

Figure 2.2: Vision Guided Mobile Robot (Retrieved from: https://www.youtube.com/watch?v=cKxxPXA_2ok)