DEVELOPMENT OF DISTANCE TO OBSTACLE ESTIMATION SYSTEM BASED ON OBJECT RECOGNTION TECHNIQUE

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DEVELOPMENT OF DISTANCE TO OBSTACLE ESTIMATION SYSTEM BASED ON OBJECT RECOGNITION TECHNIQUE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer Systems) with Honours

by

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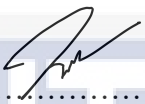
APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer Systems) Honours. The member of the supervisory is as follow:

Signature: 

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ABSTRAK

Pengecaman objek adalah bidang Penglihatan Komputer yang mengesan kehadiran objek semantik dalam gambar atau video. Seiring berjalannya waktu, keperluan dalam industri menjadi semakin luas seiring teknologi berkembang. Projek ini mencadangkan satu sistem yang boleh dilaksanakan daripada teknik pengecaman objek, yang bertajuk pengecaman anggaran jarak kepada halangan berdasarkan sistem pengecaman objek. Batasan yang ada pada ciri pengenalan objek boleh menyebabkan projek ini dibangunkan. Oleh itu, projek ini mempunyai tujuan untuk membangunkan sistem estimasi jarak ke halangan berdasarkan teknik pengenalan objek, yang dapat mengenali objek di sekitarnyadan mengira jaraknya dari kamera atau klien. Hasil akhir dari projek ini adalah menghasilkan output suara semasa memaparkan status jarak dan memberi mesej kepada pengguna sama ada jarak yang diukur berada dalam jarak selamat atau sebaliknya. Pembangunan yang dicadangkan adalah menggunakan model pengesanan SSD pra-terlatih yang dilatih pada COCO DATASETS untuk mendapatkan penglihatan yang tepat mengenai pengenalan objek. Gambar atau video langsung dimasukkan ke kamera Web, jarak diukur dengan menggunakan algoritma anggaran dan input diproses melalui Server. Kemudian kaedah google Text-to-Speech digunakan untuk menghasilkan modul suara dari kelas objek yang dikenali sebagai output akhir. Ketepatan sistem yang didapati begitu tepat, bergantung pada beberapa situasi dan ukuran. Modul penjanaan suara tidak akan menjadi masalah kerana hanya menghasilkan suara mengikut output dan dihasilkan dari perpustakaan tertentu seperti pyttsx3.

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ABSTRACT

Object recognition is a field of Computer Vision that detects instances of semantic objects in images or videos. As time goes by, the need in industry become wider as technologies expanded. This project proposed a system that canbe implement from object recognition technique, which entitled distance to obstacle estimation system based on object recognition system. The limitation exist on object recognition feature may lead to this project to be developed. Therefore, this project has a purpose on developing a distance to obstacle estimation system based on object recognition technique, which be able to recognise the surrounding objects and estimate their distance from the camera or client. The final output of this project is generating a voice output on displaying the status of the distance and give message to the user whether the distance measured is in safe distance or vice versa. The development proposed is using pre-trained SSD detection model trained on COCO DATASETS to obtain an accurate vision on the object recognition. The live image or video is feed onto the Web camera, distance is measure by applying depth estimation algorithm and the input is process through the Laptop Based Server. Then a method of googleText-to-Speech is use to generate a voice modules from class of the object recognized as the final output. The accuracy of the system found to be that accurate, depends on some situations and measurements. The voice generation module would be no problem as it is only generate the voice according to the outputs and generated from certain library such as pyttsx3.

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DEDICATION

To my beloved Mom & in loving memory of my Father.

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Alhamdulillah, thank you Allah because of His blessing and sustenance, I finally could complete and finish my bachelor degree project successfully despite the pandemic that struck the world throughout the whole year.

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LIST OF ABBREVIATIONS AND SYMBOLS

SSD	-	Single Shot Detector
RGB	-	Monocular Camera
LiDAR	-	Light Detection and Ranging
TOF	-	Time of Flight
FMWC	-	Frequency Modulated Continuous Wave
RADAR	-	Radio Detection And Ranging
ADAS	-	Advanced driver-assistance system
LRF	-	Laser rangefinders
DL	-	Deep Learning
CNN	-	Convolutional Neural Network
YOLO	-	You Only Looked Once
LQE	-	Linear Quadratic Estimation
ROI	-	Region of Interest
OpenCV	-	Open Source Computer Vision
IDE	-	Integrated Development Environment
COCO	-	Common Objects in Context

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CHAPTER 1

INTRODUCTION

1.1 Background

There are several technologies apply based on object recognition technique and done innovation on the functionality. The functionality can be innovated by adding more advance features such as distance estimation and sound output. Nowadays, those technologies have become much helps for human being. This is because as time goes by, the world evolves with new information and creation, those technologies make life easier in help doing some complex things in various fields. For example, by having distance estimation to obstacle system based on object recognition, workload for human being can be reduced or people can detect the obstacle effortlessly. Various applications of this topic that have been well discussed such as smart wheelchair, inspection robot for transmission lines, devices for visual impaired people and even for detecting moving objects. This chapter describes the background, problem statement, purposes, scope and the structure of this project.

The basic concept of distance to obstacle estimation is measuring and recognizing of objects appear. The obstacles can be recognize through some certain technology and the image will be processed through several libraries available for object recognition. In addition, the features can be added with distance estimation between the camera and the objects detected to improvise the functionality.The output also can be improved by adding sound or voice output instead of only displaying the output through laptop screen. The use of various types of algorithm also possible to be applied as the image processor, distance algorithm and sound output algorithm. This process is very important to obtain an accurate output for the client to receive information about what is there surrounds. The system is work via Third Party

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Applications here, which using laptop based Networked Server where all the computations take place. The system developed must undergo real-time testing process to ensure the system running well as it is plan based on its performance and accuracy. The database must include all kind of objects include bottles, small objects, animals and many more objects that possiblysurrounds the human.

1.2 Problem Statement

Due to some limitations on object recognition system, distance to obstacle estimation may improvise the system function. From the observations obtained, numerous workloads and activity in industries have difficult time and requires more work forces to complete the tasks. Various researches and projects have been done to fulfil the request but all the system still need improvement to achieve higher performance and accuracy to the system that presented to the user or client. The perfect and efficient system is still under rapid development from time to time.

1.3 Research Objectives

A distance to obstacle estimation system based on object recognition technique developed that able to reduce human workloads in daily applications. There are two objectives to achieve the goal, which are:

1. To develop a distance to obstacle estimation system based on object recognition technique.
2. To be able to recognize the surrounding objects and estimate their distance from the camera or client.
3. To analyze the system in real-time applications and capable to deal with complicated environment in terms of its accuracy.

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1.4 Scope of Research

The scope of this research are as follows:

- The distance to obstacle estimation of this research is based on the depth estimation algorithm.
- Object recognition technique is use in implementing the system to recognize the type of object, process and give alert through voice module generated.
- The implementation of software development on object recognition technique (SSD approach) with hardware of estimating distance (depth estimation algorithm) to obstacle contributed the most in developing the system.

1.5 Contribution of Research

This thesis may contribute in several following related areas:

- Object recognition advancements. As this thesis is improving the object recognition system, which adding another features by using the same technique; distance to obstacle estimation. This will help researches to develop a device that may help people to notice the obstacle that exist in surrounding.
- Provides a low-cost system. In this thesis, a low cost system is proposed in order to develop a more features on object recognition such as measuring distance and generate voice, using text-to-speech and have tested in terms on its accuracy.

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1.6 Thesis Outline

Based on the objectives previously presented and on the approach proposed before, thisthesis is made up of five (5) chapters, which the contents are summarized below:

- Chapter 1. Introduction. This chapter will briefly discuss on the purposes and the direction of the project such as the thesis outline, scopes, contributions and the problem statement.
- Chapter 2. Literature review. In this part, starts with some briefing of the current system of object recognition and overall overview on the research done by some authors. Then, part of technologies, methods and related works are explain in every subtopic with elaborations based on journal, articles or conference papers read.
- Chapter 3. Methodology. This chapter presents the methodology of developing distance to obstacle estimation based on object recognition technique according to its equipment, and software development.
- Chapter 4. Results and discussion. Throughout this chapter, the analysis result and discussion are obtained based on the methodology is present. The picture of developed system and models also attached here.
- Chapter 5. Conclusion and future works. This chapter will have the contents such as the conclusion and recommendations for the future betterment.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Recently, object recognition system has been widely used among people in the world and innovate into several other ways of applications. Many researches have been carried out regarding this technology in enhancing and improving the object recognition system. One of the methods of improvise the system is that adding another sensor, which be able to detect the distance between the camera and the obstacles detected. This chapter reviews articles, journals and works from previous researchers on developing distance to obstacle estimation based on object recognition technique.

2.2 Overview of distance to obstacle estimation based on object recognition technique

The applications of distance to obstacle estimation based on object recognition technique can be found in journals (Utaminingrum et al., 2016); (Romdhane et al., 2016); (Bastomi et al., 2019); (Patel et al., 2018); (Yoo et al., 2017); (Wang & Fan, 2017); (Ozawa *et al.*, 2019); (Shahira et al., 2019). The authors discuss on the technologies, methods (software and algorithms) used for distance to obstacle estimation system based on object recognition technique. The most common technologies used for the applications are laser line, monocular camera (RGB), stereovison camera, ultrasonic sensor, Light Detection and Ranging (LIDAR) sensor.(Utaminingrum et al., 2016) focused on laser line and camera technology to recognizean obstacle based on the response given by the laser line projection on the pathway. In a meanwhile, (Yoo et al., 2017) applied monocular camera, prototype robot, as wellas laser scanner as the technologies on developing distance to obstacle estimation based on object recognition.

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In the article, they presented the future use of distance toobstacle by applying prototype robot along with the mono-camera for the inspection on power transmission lines.

This is very different application on object recognition technique, in which it uses the robot that works in checking the power transmission line that transmit electricity to every building and houses. Advanced methods such asSpacer recognition and Insulator recognition were used in this project to make sure that the robot is functioning well in the electricity transmission area. Next, in the article by (Haseeb & Gräser, 2018) developed a project that focused on upgrading therange of distance estimation to obstacle into a longer detection in self-driving cars. The technologies used were monocular camera (RGB), thermal camera and laser to determine the distance between the object and the camera sensor. Figure 2.1 shows the general workflow of distance to obstacle estimation based on object recognition technique:

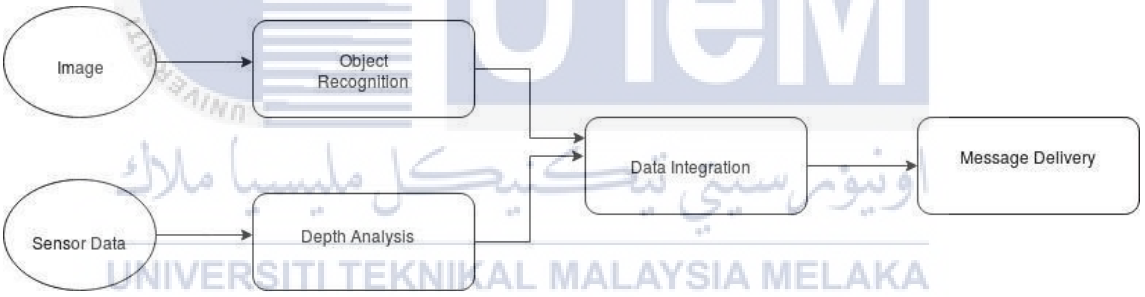

Figure 2.1 General workflow chart of distance to obstacle based on object recognition system

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