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IMAGE BASED AUTONOMOUS INDOOR PARALLEL PARKING ASSIST ON OMNI-DIRECTIONAL VEHICLE (ODV)

EDWIND LIAW YEE KANG

Report submitted in partial fulfillment of the requirements
for the award of the degree of
Bachelor of Engineering (HONs) in Mechatronics Engineering

Faculty of Manufacturing Engineering
UNIVERSITI MALAYSIA PAHANG

June 2016

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LIST OF SYMBOLS

x'	Center of mass in coordinate X in contour
y'	Center of mass in coordinate Y in contour

LIST OF ABBREVIATIONS

CATIA	Computer Aided Three-dimensional Interactive Application
ODV	Omni-Directional Vehicle
OpenCV	Open Source Computer Vision

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ABSTRACT

Nowadays, Omni-Directional Vehicle (ODV) has been widely used in many fields to perform autonomous missions. Equipped with sensors and pre-programmed navigation systems, ODV can be designed to replace humans in performing dangerous tasks in various fields such as planet exploration and industrial applications. In this research, the implementation of image processing techniques on vehicle's control has been proposed to develop autonomous indoor parallel parking assist on ODV. The image processing algorithm is first developed using Visual Studio C++ and OpenCV. The electrical circuit of the ODV has been designed and installed. Then, the developed image processing algorithm is integrated with the microcontroller of the ODV, Arduino Mega 2560. After that, an experimental environment has been constructed and set-up to test and analyze the performance of the developed system. As a result, the proposed and developed system is able to work in indoor lighting range.

ABSTRAK

Pada zaman kini, Kenderaan Omni-Directional (ODV) telah luas digunakan dalam pelbagai bidang untuk melaksanakan tugas-tugas berautonomi. Dilengkapi dengan alat pengesan dan sistem navigasi yang telah diprogramkan, ODV boleh direkakan untuk menggantikan tenaga manusia dalam melaksanakan tugas berbahaya dalam pelbagai bidang seperti penerokaan planet dan aplikasi perindustrian. Dalam pengajian ini, pelaksanaan teknik pemprosesan imej dalam pengawalan kenderaan telah digunakan untuk mengembangkan parkir paralel autonomoi pada ODV. Algoritma pemprosesan imej pertama kali dikembangkan dengan menggunakan Visual Studio C++ dan Open CV. litar elektrik ODV telah direkakan dan dipasangkan. Kemudian, algoritma pemprosesan imej yang telah dikembangkan telah diintegrasikan dengan pengawal mikro ODV, Arduino Mega 2560. Selepas itu, suatu alam sekitar yang bersifat uji kaji akan dibina dan distrukturkan untuk menguji dan menganalisis prestasi sistem.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Over the years of continuous revolution in the automotive vehicles, autonomous features have been the key in advancing the automotive technology. According to NHTSA of US, autonomous or self-driving vehicles are defined as the vehicle that can operate without the needs of direct input or manipulation from the driver [1]. Lately, many self-driving vehicles have been developed for industries and factories. For example, Google has been working on developing autonomous or self-driving vehicle. The vehicle will take the passengers to the place that they want to be with just a press of a button. Figure 1.1 below illustrates how the self-driving vehicle developed by Google.

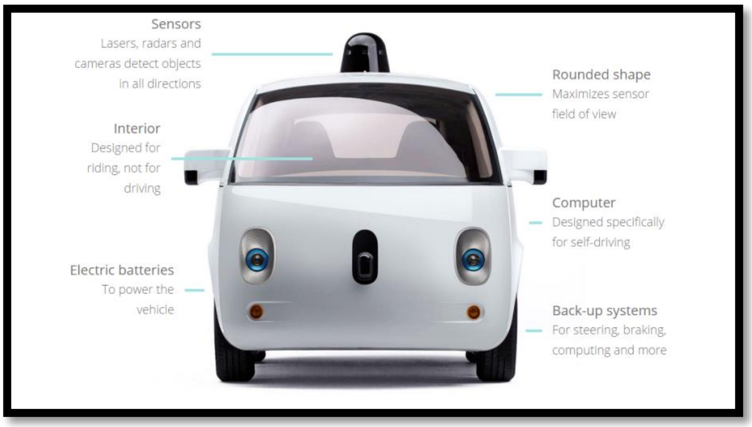

Figure 1.1: Self-driving vehicle by Google

Source: Google 2015

Moreover, a Canadian company which is in expertise maker of field and service robots, Clearpath Robotics, has successfully developed new self-driving car named OTTO. The moving platform is specially designed for carrying load in industrial environments like factories and warehouses [2]. Hence, it is believed that the revolution that will be implemented on the vehicle is the autonomous feature.

Other than autonomous features, another revolution that has been made over automotive vehicle is the technology of omnidirectional driving. Compared to conventional automotive vehicles, Omni-Directional Vehicles can change the travel direction without steering the rear and front wheels. Omnidirectional driving has featured the vehicles relatively lower turning radius in comparison to conventional vehicles. This makes the Omni-Directional vehicle (ODV) ultimately helpful in tight environment especially in floor of factory or any other manufacturing environments [2]. This can be supported by the fact that omnidirectional driving has also been implemented on forklift.

Figure 1.2 below shows the figure of omnidirectional forklift. Thereby, it is noticeable that the popularity of omnidirectional driving is increasing especially in the field of industry.

Figure 1.2: Omnidirectional forklift

Source: Oemoffhighway 2015

In this research, an image based automatic indoor parallel parking assist system is to be developed for the Omni-Directional vehicle (ODV). As a part of autonomous features, automatic parking is necessary to be implemented onto the vehicles. This is because autonomous or self-driving vehicle will definitely need to be able to perform the automatic parking. The vehicle will need to determine the availability of the parking lot and perform the parking. In general, the car park can be mainly categorized into outdoor and indoor car parks. There are also various types of parking methods that a vehicle can perform. For example, there are angular parking, perpendicular parking, parallel parking. In this paper, the discussion will only focus on how the Omni-Directional vehicle (ODV)

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