Faculty of Electrical and Electronic Engineering Technology

AUTONOMOUS PARCEL COLLECTOR FOR THE DOMESTIC AREA USING MICROCONTROLLER

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BACHELOR OF ELECTRICAL ENGINEERING TECHNOLOGY (INDUSTRIAL AUTOMATION AND ROBOTICS) WITH HONOURS

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AUTONOMOUS PARCEL COLLECTOR FOR THE DOMESTIC AREA USING MICROCONTROLLER

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A project report submitted
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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honours

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DEDICATION

I want to express my sincere appreciation to my beloved parents for all of their love, sacrifices, and support throughout my life. At first, I'm grateful for their understanding and patience, which were necessary to finish making this job. For as long as the day I remember, I've been motivated by their struggle to learn how to read, write, and study. I was at a loss for words to express how grateful I was for their loyalty, encouragement, and belief in my capacity to realize my goals. Last but not least, I'd like to express my gratitude to everyone who helped, directly or indirectly, with my project. I want to thank everyone for their feedback and recommendations, which are essential to the successful conclusion of our study.

ABSTRACT

Autonomous robots have a significant part in society in this new era of globalisation. There have been many different types of autonomous robots developed. This technology is used in a variety of settings, including the office, military, hospital operations, sports, agriculture, education, and more. An autonomous line following robot, out of all the autonomous robots, has been intended to protect workers who work in hazardous settings. At the same time, it is practical and safe for people, as social separation is required during the COVID-19 pandemic to prevent the virus from spreading. This gives rise to the concept of a autonomous parcel collector robot. The robot may travel within a home area while collecting parcels for consumers using the line following method. This prototype of an autonomous parcel collector robot will be developed first by a computing unit. It is set up to give instructions to the other parts. Line following requires the use of a motor driver and sensors. The robot can receive and drop off objects using a servo motor and a loading base. The well-designed algorithm will be implemented in the computer unit for the purposes of carrying out instructions. This enables the robot to collect packages even when no one is present. The robot's lowest parcel collection time on that particular track was 48 seconds under steady conditions, which was much faster than any outcomes when the robot was carrying more weight. In addition, the robot's motors needed more power to move along the uneven road. Yet, the robot cannot move uphill even when the motor is driven at 100% duty cycle. To enable the robot to execute work more effectively and of higher quality, it is advised that the existing motors and chassis be replaced with stronger ones which comes with a larger power supply.

ABSTRAK

Robot autonomi mempunyai peranan penting dalam masyarakat dalam era globalisasi baharu ini. Terdapat pelbagai jenis robot autonomi yang dibangunkan. Teknologi ini digunakan dalam pelbagai tetapan, termasuk pejabat, tentera, operasi hospital, sukan, pertanian, pendidikan dan banyak lagi. Robot yang mengikuti garis autonomi, daripada semua robot autonomi, telah bertujuan untuk melindungi pekerja yang bekerja dalam tetapan berbahaya. Pada masa yang sama, ia adalah praktikal dan selamat untuk orang ramai, kerana pemisahan sosial diperlukan semasa pandemik COVID-19 untuk mencegah virus daripada merebak. Ini menimbulkan konsep robot pengumpul bungkusan autonomi. Robot itu boleh bergerak dalam kawasan rumah sambil mengumpul bungkusan untuk pengguna menggunakan kaedah garisan berikut. Prototaip robot pengumpul bungkusan autonomi ini akan dibangunkan terlebih dahulu oleh unit pengkomputeran. Ia disediakan untuk memberi arahan kepada bahagian lain. Garis berikut memerlukan penggunaan pemandu motor dan penderia. Robot boleh menerima dan menurunkan objek menggunakan motor servo dan tapak pemuatan. Algoritma yang direka dengan baik akan dilaksanakan dalam unit komputer bagi tujuan melaksanakan arahan. Ini membolehkan robot mengumpul pakej walaupun tiada sesiapa yang hadir. Masa pengumpulan bungkusan terendah robot di trek tersebut ialah 48 saat dalam keadaan stabil, yang jauh lebih cepat daripada sebarang hasil apabila robot membawa lebih berat. Selain itu, motor robot memerlukan lebih kuasa untuk bergerak di sepanjang jalan yang tidak rata. Namun, robot tidak boleh bergerak ke atas bukit walaupun motor dipandu pada kitaran tugas 100%. Untuk membolehkan robot melaksanakan kerja dengan lebih berkesan dan berkualiti tinggi, dinasihatkan agar motor dan casis sedia ada digantikan dengan yang lebih kuat yang disertakan dengan bekalan kuasa yang lebih besar.

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CHAPTER 1

INTRODUCTION

1.1 Background

Over the past centuries, there have been changes in this society, technology affects people and allows them to use intelligent instruments in their lives, especially autonomous robots. It is an automatically operated machine that provides many advantages to people[1]. Each created robot have performed according to a set of behaviours from the big data.

Nowadays, autonomous robots have already become a part of our lives. Autonomous can substitute humans for completing some simple duties, such as those requiring a great deal of physical strength within a more extended period. So, free space for employees to focus on matters requires mental ability and creativity[2], [3]. After being programmed by software, an autonomous robot can perform task more precisely and efficiently. It also can improved product quality and quantity and decreases the rate of products failure.

In this new era of globalisation, autonomous robots play an important role in society. There are many kinds of autonomous robots created. People apply this technology in many fields, including office, military, hospital operations, sports, agriculture, education, and others[4]. The autonomous robot also involves material handling, driverless training, and others that provide faster production and efficient material transportation between the workstation or logistics instead of the traditional delivery system[5], [6]. These represent the advanced technology in this field and promise many beneficial advantages. From all the autonomous robots, an autonomous line following robots has been designed to protect workers that work in dangerous environments, such as radioactive, toxic, explosive or even monitoring[7], [8]. Both these help workers avoid unnecessary fatal accidents. At the same time, it is practical and safe for people since social distancing is necessary during this pandemic COVID-19 to prevent the spreading of the virus.

Furthermore, rather than going out and shopping for goods, people are increasingly opting to buy things online and have them delivered by a courier, avoiding close contact with others who may be carriers of the positive virus. Some of the carriers are unaware that they are carriers of the positive virus. In this scenario, people collecting parcels had become a regular ritual; if an autonomous robot can collect parcels from courier services in place of people, not everyone will be able to manage their parcel at any time. As a result, an independent parcel collector is highly suggested.

The autonomous parcel collector is a self-contained robot with a line follower base that may collect freight from a courier service and return it to a container or location designated for it. The robot will then return to the station or a set position to await the following order. Users may be confident that the package collector will do the work safely and timely. This project is highly recommended because there have been several complaints from friends, neighbours, and even parents who have had difficulty getting packages. To summarise, an autonomous parcel collector is a robot that assists the owner in receiving the delivery in good condition and assures the owner's safety while doing so.

1.2 Problem statement

Due to the pandemic of covid-19, many cases of parcel delivery have occurred, the most common issue is that when the house owner is not present, the courier service will simply place the package in front of the door and leave it, or they will leave a message stating that no one has attempted to collect the package. This could be quite inconvenient for the parcel's owner.

Aside from that, parcel damage from courier service throwing, parcels missing due to no one at home and perhaps taken by strangers, buyers exposing themselves to strangers who may or may not be from the courier company, and the virus covid-19 can easily transmit while in close contact with someone. These issues have led to the conclusion that if a robot can substitute a person, the owner can direct the parcel collector to receive the box from the mail carrier without being exposed to anyone. Even if the package contains a virus, sanitisation can be done before the owner accepts it. Besides, failing to attempt the collection of the parcel might cause the owner to collect the parcel at the courier company's warehouse or outlet.

1.3 Objective

The main aim of this project is to propose a systematic and helpful prototype to solve the problem of miss attempt to collect parcel from courier service, by combining both hardware and software, the objectives are as bellows:

a) To develop a prototype of an autonomous parcel collector for the domestic area using a microcontroller.

b) To design the line following algorithm software and embedded to a microcontroller

c) To analyse the effectiveness of the proposed method for the parcel collector mechanism.

1.4 Scope

The work scope for this project is to develop a prototype of autonomous parcel collectors by using various components, including both software and hardware. At first, this prototype of autonomous parcel collectors will be carried out by a computing unit. A general-purpose, high-level, interpreted programming language, which allows users to implement the instructions in form of code. Through the computing unit, the robot will execute the instructions according to the procedures.

The motor driver is utilised to control the motions of a line follower-based autonomous parcel collection prototype. The prototype can follow the pre-determined course by employing an infrared sensor. This prototype has several limitations due to a lack of expert experience. Around 500 g is the maximum weight that may be sustained while collecting a parcel. While the service area is restricted to residential and landed houses exclusively. The operating time is determined by the length of the journey path as well as the time it takes the courier service crew to load the parcel onto the robot, therefore it may vary for various users. If there are any prospects in the future, certain modifications and innovations can be made to minimise the constraints and raise the robot's efficiency, such as replacing this project with a GPS module that does not require any set-up path. While boosting the chassis' stiffness to support the parcel's increased weight.

1.5 Summary

The majority of the data relating to autonomous robots will be gathered in this study, including articles, books, papers, and videos. All of the gathered data will serve as resources for this project and be helpful. In conclusion, the objectives given above will guide this project to determine its efficiency in resolving the difficulties as a result of the issues that have already occurred in the present. The scope is here to fix the systems and approach that this project will use.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

An autonomous robot is one that can act independently of human control. In recent years, after a significant amount of work and effort, autonomous robots have become more prevalent in everyday life. The rapid advancement of automation, navigation, and robotics has drastically altered society's lifestyle and environment. By developing a system that employs a sensor to allow an automated robot to follow a designated path. Without any surprise, this kind of project has become of great importance in the field of automation[9].

2.2 Autonomous robot

Elmer and Elsie, the first autonomous robots, were built by W. Grey Walter in the late 1940s. They were the first robots in history to be designed to "think" like biological brains and to be capable of exercising free will. Because of their shape and the way, they moved, Elmer and Elsie were sometimes mistaken for tortoises. They were capable of phototaxis, which is the movement caused by light stimulation[10], [11]. Since autonomous robots have become a big topic, a lot of research has gone into changing, creating, and innovating them to make them easier to do the task ahead. Autonomous robots are capable of replacing humans as high-intensity employees without exposing them to hazardous working conditions, high energy consumption, or poor operation hours[6]–[8]. Due to the influence of automation in the 21st

century, people have grown accustomed to the presence of autonomous robots. Many different types of autonomous robots have been developed to make human and working life easier.

2.2.1 General-use autonomous robot

General-use Autonomous Robot is an intelligent machine that can multitask, doing all or most of the tasks assigned to it in each sector. It was made in a very broad sense. Thus, there is an autonomous robotic exploration using a utility function based on Renyi's General theory of Entropy[12]. It was created with the intention of performing exploration tasks while observing the landscape in order to properly incorporate fresh data into the map. All of this is useful not just for mapping, but also for searching and rescue operations during disasters. Besides, for human society, a general-purpose humanoid service robot with a set of simple action skills such as navigation, gripping and recognising items or people is being considered[13]. Working plans or steps are based on probabilistic methodologies when a complete voice command is provided.

Figure 2.1: General-use autonomous robot [12]

2.2.2 Military autonomous robot

This type of autonomous robot is developed for military use, especially scouting, adsorb enemy fire, engaging the target, either attacking or defending. Lethal autonomous weapons (LAWs) are a sort of autonomous robot warfare system that can search for and engage targets independently based on pre-programmed limitations and descriptions. It is possible to operate in the air, on land, on water, underwater, or in space. As of 2018, the autonomy of current systems was limited in that a human must give the ultimate command to attack, but there are exceptions with certain "defensive" systems[7], [14]–[16].

Figure 2.2: AR drone using UAV[14]

2.2.3 Delivery robot

An autonomous robot that provides delivery services. In specific cases where the robot cannot resolve itself, such as when it becomes caught in an impediment, an operator can watch and manage the robot remotely. Food delivery, package delivery, medical delivery, and room service are all possible applications for delivery robots. Delivery robot service for several sectors, including grocery, food and beverage, packaging, hospital, room service etc. The waiter robot is one of the solutions to restaurant automation. By pairing with LCD and keypad, endow the ability to order food and beverages, while approaching to order, the waiter robot can bring the cooked food along for delivering to customer.[6], [17]–[19]

Figure 2.3: Waiter robot [17]

2.2.4 Construction robot

It's an autonomous robot that works on construction sites and does heavy lifting, material handling, earthmoving, and surveillance. These robots must be able to move around and fix themselves to the work area, handle building supplies, and interact with humans and other machines. The existence of construction robots allows the workers to complete the assigned job efficiently while decreasing the risk on construction sites. Autonomous robotic take part in demolition, design support, production, and quality control are some of the construction phases where new robotic technologies could have a bigger impact in the coming years, in terms of increased safety and lower costs, and across a variety of industries[20]. As a result, a multipurpose construction robot has been designed specifically for civil applications[21]. It can be used to detect gas leaks in homes and businesses, to monitor shopping malls, parking lots, offices, industries, banks, and museums, aid rescue operations during natural disasters and their aftermath, and provide food and other essentials to people living in remote areas where human access is difficult or dangerous[22], [23].

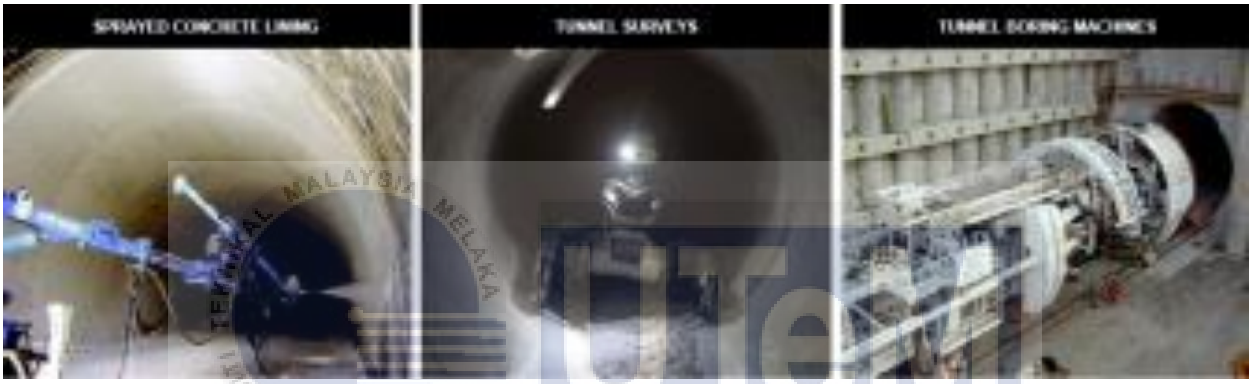

Figure 2.4: Infrastructure sector [20]

2.3 Autonomous line follower robot

Of all the different types of automated robots, the automated line follower robot is one of the most interesting topics that has recently gained a lot of interest in the robotic sector. Autonomous line follower robots are clarified under the ‘Mobile Robot’ They entail the assignment of operations and tasks such as movement, turning, obstacle recognition and avoidance, and other key parametric tasks to which the robot is subjected[1]. As a result, automated line follower robots have become the backbone of managing robots in the uncharted territory[19], [24]. Aside from that, automated line follower robots with advanced control technologies could be useful in the industrial sector. Because traditional delivery systems need a lot of human energy and time, an automated line follower robot can be used to replace them as a more efficient and energy-saving delivery system[6], [25]–[27].

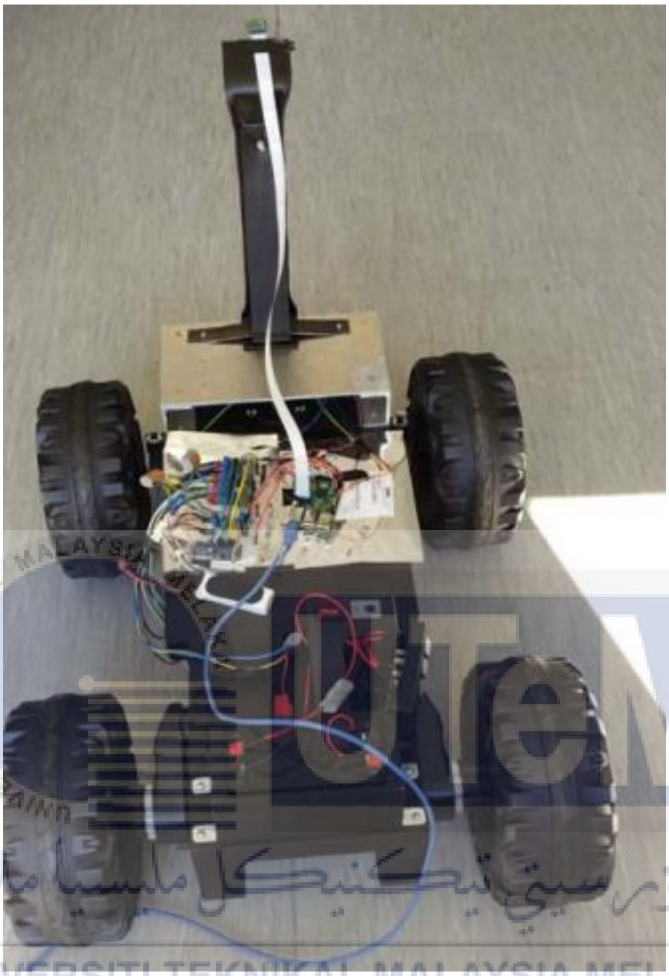

Figure 2.3: Line follower robot with real time Viterbi[28]

2.3.1 Application of autonomous line follower robot

There are various uses for autonomous line follower robots that are common in our environment. Every household needs to tidy its home. With the evolution of technology, autonomous line follower robots have been developed for domestic application use, which assist users in completing daily cleaning tasks such as floor cleaning, collecting garbage etc[25], [26]. For example, Mi Robot Vacuum-Mop, acts as a professional floor cleaning expert to keep the floor spotless. Besides that, this approach can be used in automobile applications. These