UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF AUTOMATIC GRASS CUTTER

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

by

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2011

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Design and Analysis of Automatic Grass Cutter

SESI PENGAJIAN: 2010/11 Semester 2

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I hereby declare that this report entitled **Design and Analysis of Automatic Grass Cutter** is the result of my own research except as cited in the references.

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Author's Name	:	**Siti Noorfatehah Binti Zaini**
Date	:	**14 APRIL 2011**

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UteM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic and Automation) with Honours. The member of the supervisory committee is as follow:

………………………..

Supervisor

ABSTRAK

Alat Pemotong Rumput Automatik (AGC) mampu meneruskan tugasan sekiranya wujud halangan di hadapannya dengan bergerak ke arah lain bagi mencapai matlamatnya. Pergerakan ini adalah bagi mematuhi arahan untuk memotong rumput dengan laluan dan dalam perimeter yang khusus iaitu (2.5M (P) x 1.5M(L)) . Projek ini dirancang untuk rekabentuk sebuah Pemotong Rumput Automatik yang kecil dan mudah dibawa supaya boleh melakukan tugas dengan lancar semasa mengelak halangan yang wujud. Sistem Pemotong Rumput Automatik adalah dikawal oleh PIC mikropengawal dan simulasi bagi rekabentuk yang terpilih.

ABSTRACT

An Automatic Grass Cutter (AGC) has ability to continue it tasks if any obstacle exists in front of its way by moving in another direction to achieve its goals. The movement of AGC is in order to cut grass with path planning and in specific perimeter (2.5M (L) x1.5M (W)). This project is aim to design a small and portable automatic grass cutter that can perform their tasks efficiently while avoiding the obstacle. The system of AGC is control by using PIC microcontroller and the simulation of selected design.

DEDICATION

Dedicated to my father, Zaini Bin Mahamud and my mother, Siti Faridah Binti Abd.
Rahman. To my supervisor, Puan Silah Hayati Binti Kamsani, lecturers and friends
for all of their help and friendship.

ACKNOWLEDGEMENT

All Praise to Allah, the Lord of the Worlds, and prayers and peace be upon Muhammad Rasulullah S.A.W, His servant and Messenger. Alhamdulillah, with Allah blessings and guidance, I have completed this project great even though there are many hardship and obstacle along the way.

First of all, I would like to express my appreciation and deep respect to my supervisor, Puan Silah Hayati Binti Kamsani for the guidance and encouraged during finishing this project. Her constant guidance and support during my thesis writing is invaluable to me and continuous direction and opinion regarding the flow of the project has invaluable contribution to achieve the objectives project.

Thanks to my family, who has been the loveliest advisor to give continually support and inspiration throughout my campus life. Their supports are meant so much to me in finishing this project.

Last but not least, I thank everyone who involved directly and indirectly in this project. The sacrifice and commitment given towards me earning my Bachelor's Degree are indescribable and without them, this PSM report will not good completed like this.

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LIST OF ABBREVIATIONS

ADC	-	Analog Digital Converter
AGC	-	Automatic Grass Cutter
AGV	-	Automated Guided Vehicles
BOM	-	Bill of Material
DC	-	Direct Current
GPS	-	Global Positioning System
IC	-	Integrated Circuit
IR	-	Infra Red
LED	-	Light Emitting Diode
PIC	-	Peripheral Interface Controller
PLC	-	Programmable Logic Controllers
PWM	-	Pulse Width Modulator
RAM	-	Random Access Memory
USB	-	Universal Serial Bus

CHAPTER 1
INTRODUCTION

Robot as identified by Capek (1921) is a computer controlled machine that is programmed to move, manipulate objects, and accomplish work while interacting with its environment. Robots are able to perform repetitive tasks more quickly, cheaply, and accurately than humans. The word robot has been used since to refer to a machine that performs work to assist people or work that humans find difficult or undesirable. Capek also defined autonomous robots as robots which can perform desired tasks in unstructured environments without continuous human guidance. Many kinds of robots have some degree of autonomy. Different robots can be autonomous in different ways. A high degree of autonomy is particularly desirable in fields such as space exploration, cleaning floors, mowing lawns, and waste water treatment. Meanwhile mobile can be defined as able to move or be moved easily (Steel, 2003). On the other hand, automatic is when a device, procedure, or system can self-activates (or is executed) under programmed or specified condition and performs specified functions (BusinessDictionary.com) and grass cutter is a device used to cut grass, as a lawn mower (Dictionary.com). Thus, Automatic Grass Cutter (AGC) can be defined as systems that self activates or is executed under programmed or specified conditions and performs specified functions in grass cutting.

This Automatic Grass Cutter robot is categorized as domestic robot. Domestic robots for vacuuming and lawn mowing are mobile units that use autonomous mobile robotics technology. Outdoor robots, such as those for lawn mowing, are designed to avoid rollover and collision incidents (Sahin and Guvenc, 2007). A mobile robot is one which can move around its environment independently. In order to do this the robot needs to be able to navigate, and the range and accuracy of navigational ability required will vary depending on the size of the robot and the type of task it carries out. Types of mobile robot currently in production include the domestic robot, which comes in a variety of forms ranging from the robot vacuum cleaner to the robot dog. Potential future uses of the mobile robot include robot paramedics, farmhands and border guards (wiseGEEK.com). Figure 1.1 shows the domestic robots under the service-robot category assist humans in performing everyday chores. This task-based classification of robots shows the location of domestic robots in the robot family tree.
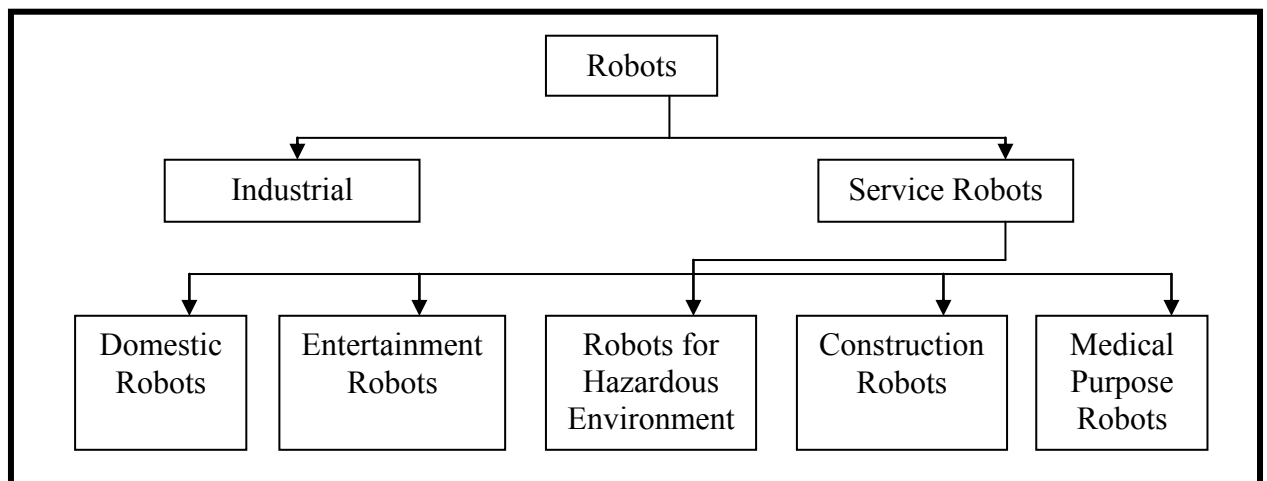
Figure 1.1: Robot types (Sahin and Guvenc, 2007)

1.1 Problem Statement

Generally, in Malaysia, there is no Automatic Grass Cutter technology yet by using mobile robot. By using Automatic Grass Cutter, robots technology can replace or ease the role of human. Robots are able to perform repetitive tasks more quickly and accurately than humans. In order to cut grass with path planning and in specific perimeter (2.5M (L) x1.5M (W)) and to make sure it will perform the task by Automatic Grass Cutter (AGC), this robot will be designed and analyzed to make sure it will perform the task as Automatic Grass Cutter in lawn mowing. This specific perimeter is chosen because to make as testing parameter of AGC. The robots should know the area that it will perform the tasks. This robot also can estimate their starting position to move to the end position. Besides that, the robot will operate in day where there is plenty of sunlight by using solar panel. This robot cannot operate in rainy day. These AGC operate in simple movement, with a predetermined environment. If any obstacle exists in front of its way, it can avoid and continue it tasks by moving in another direction to achieve its goals.

1.2 Objectives

Objectives for this project that need to be achieved:-

i) To design a small and portable automatic grass cutter that can perform their tasks efficiently while avoiding the obstacle.

ii) To analyze the selected design by using cutting speed, feed rate and machining time formula.

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1.3 Scope

Project scopes are important in order to design this project, and it is required to analyze the project. The scopes will cover design and programming of a mobile robot. Part of design will include the application of drawing software such as electric and electronic part are related in programming where are needed to develop the interface between programming, electronic circuit and mechanical system. The scopes of this project are:-

  i.   The system of Automatic Grass Cutter is control by using PIC microcontroller and the simulation of selected design.
 ii.   It will perform the tasks only in lawn area of perimeter (2.5M (L) x1.5M (W)).
iii.   This project will not cover on the fabrication Automatic Grass Cutter.

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CHAPTER 2

LITERATURE REVIEW

This chapter will present the literature reviews relevant to this project. It will show the overview in autonomous mobile robotic, the application of mobile robotic, the service robot and the domestic robot. Moreover, it includes PIC microcontroller programming, interfacing of sensors and actuator, obstacle avoidance mechanism, path planning, sensor, and algorithm concept that will be stated after.

2.1   Autonomous Mobile Robotics and Their Applications

Due to rapid development in the present information and communication systems, robots are designed to be widely used in small and large scale in every area of daily life and industries. They are employed to reduce human dependencies in performing a task and to reduce time for production while maintaining consistent quality of production outputs. Mobile robots are widely used in manufacturing industries, advance surveillance systems and for domestic use as well. Mobile robot is divided in two types. First, the industrial robots and second, is service robots. A service robot is a robot that is capable of providing services to its owner. These robots generally are autonomous but can be controlled, either remotely or manually, by built-in systems. They also might be synced up with Wi-Fi home networks or smart environments (wiseGEEK.com). Service robots can differ in specific functions, but their jobs usually can be described as helping humans perform tasks that are dangerous, difficult, dirty, repetitive or distant. A service robot can ease the workload of a human being in this way, especially if the task is frequent, such as

with home chores. Moreover, service robots also can be used in domestic robot, entertainment robots, robots for hazardous environments, construction robots and medical purpose robots. Service robots are particularly useful in the automotive industry, where heavy lifting and fine calibrations are required to build a vehicle.

Example for service robot application is in hospital, Automated Guided Vehicles (AGV), security and outdoor. Figure 2.1 shows the TransCar AGV. This TransCar AGV is the ideal healthcare industry automated guided vehicle. This AGV moves routine and on-demand deliveries of medical supplies (Swisslog.com). TransCar automated guided vehicles travel across multiple-floor facilities with narrow aisle-ways and human traffic, and relieves hospital staff of heavy lifting tasks. This AGV system does not require embedded wire, tape, or chemically applied guide paths.

Figure 2.1: TransCar AGV (Swisslog.com).

Meanwhile, the other application in AGV is for industry and retail applications. Figure 2.2 shows the AGV systems for industry and distribution. These automated guided vehicle systems have flexible and advanced navigation systems, and interface with elevators, doors and lifters. These AGV system link storage and production with light payloads to full pallet transport (Swisslog.com).

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Figure 2.2: AGV systems for industry and distribution (Swisslog.com).

On the other hands, domestic robots also are service robots. Domestic robots are widely popular. A service robot used around the home can do anything from vacuum a carpet to mow a lawn. A domestic robot can help its owner clean pools, mop floors and iron clothes. Some robots can even help homeowners clean up after pets. In cases like these, a robot can routinely pick up fur that has been shed or it can clean litter boxes after cats have used them, ensuring that the litter boxes remain fresh and that odors are controlled.

The example of application in domestic robots is lawn wowing. For example, modern houses include a compound often used as garden with grass which grows and need to be maintained at a short height. Conventional lawn mowing is often a hassle and time consuming in cutting the grass. The task of manual lawn mowing can be replaced by automatic lawn mower using a robot programmed to perform such task (Baloch and Timothy, 2008). Figure 2.3 shows this Robomower from FriendlyRobotics. The Robomower uses V-shaped patterns for mowing. When the Robomower detects an obstacle, it stops and turns.

Figure 2.3: Robomower from FriendlyRobotics (Sahin and Guvenc, 2007)

Another example of domestic robots is Automower from Husqvarna as shown in Figure 2.4. Hobbyists use autonomous lawn mowers like the Automower as an inexpensive platform for building mobile robots.

Figure 2.4: Automower from Husqvarna (Sahin and Guvenc, 2007).

Domestic robots for vacuuming and lawn mowing are mobile units that use autonomous mobile robotics technology. Moreover, vacuum robot also under the domestic robot. Figure 2.5 shows the Trilobite from Electrolux. This device returns to the charging station, charges itself, and continues vacuuming. While the Figure 2.6 shows Trilobite from Electrolux in action. The Trilobite establishes a map of the room as it vacuums. Magnetic strips are needed to mark stairs and doors.

Outdoor robots, such as those for lawn mowing, are designed to avoid rollover and collision incidents. Indoor robots, such as those for vacuuming, have less demanding environmental conditions but still face obstacles. Obstacle-avoidance technology is thus applicable to both cleaning and lawn-mowing robots.

Figure 2.5: Trilobite from Electrolux (Sahin and Guvenc, 2007).

Figure 2.6: Trilobite from Electrolux in action (Sahin and Guvenc, 2007).

Real-time control of autonomous vehicles is designed using embedded systems architecture. A field bus is used for communication between sensors, controllers, and navigation system modules (Sahin and Guvenc, 2007).

Robots are often expensive and costly which often discourages people from buying costly robotic devices. The success of manufacturing a low cost inexpensive for example an automatic lawn mower will allow house owners to maintain their lawn without spending much time and money because an autonomous robot can mow the lawn of a given specific area of the garden without any human supervision.

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