

VACUUM ROBOT

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A proposal project submitted in fulfillment of the requirement for the award of the diploma of Electrical Engineering (Computer) Department of Electrical Engineering Polytechnic Seberang Perai (PSP).

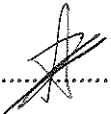
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PROJECT REPORT COMFORMATION


I hereby declare that the work in this report is my own except for quotations and summaries
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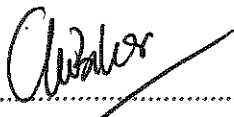
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Dedicated to,

Thanks to Allah,

For give me a good health and strength while making this report.

My beloved family,

Who has always been my epitome of love and always pray for my strength to finish up this report.

My beloved relatives,

My siblings,

Thank you for your support and pray.

The person who has been very understanding and helpful,

Mr. Amir bin Abu Bakar,

For the support and guidance. Hope that I always be remembered.

My unforgettable friends,

My housemate, my coursemate and all DTK students intake June 2015,

Our struggle not yet ends.

Finally, friends that always together during this third years study,

Hopefully achieved what we aspired.

ABSTRACT

The main objective of the product is to design and develop a vacuum robot. This vacuum robot is designed and produce mainly to vacuum the floor automatically. This vacuum robot is very useful for all the people who had limited time and hectic lifestyle to make sure their house floor are clean on time. This vacuum robot is handle by a detector or called sensor to detect obstacle. After the detection it will vacuum and keep it in its storage, if it detect obstacles it will avoid it. By using this vacuum robot, people can make sure their house floor are being vacuum on time and can save their time to do other thing. Furthermore, we can save money by using this vacuum robot rather than hiring other people to sweep and vacuum the floor. This project have a sensor only to maintain its main objective. This product is able to vacuum the house floor on time set.

ABSTRACT

Objektif utama projek ini adalah untuk mereka bentuk dan membangunkan vakum robot. Vakum robot ini direka dan dihasilkan terutamanya untuk membersihkan lantai secara automatik. Vakum Robot ini amat berguna kepada semua orang yang terlalu sibuk dan tidak mempunyai masa yang lapang untuk memastikan lantai rumah mereka bersih tepat pada waktunya. Robot vakum ini dikendalikan oleh pengesan atau sensor yang digunakan untuk mengesan halangan., jika ia mengesan halangan, ia akan menghindarinya. Dengan menggunakan robot vakum ini, orang dapat memastikan lantai rumah mereka sering dalam keadaan yang baik dan bersih pada setiap waktu dan dapat menjimatkan masa mereka untuk melakukan perkara lain. Tambahan pula, kita dapat menjimatkan wang dengan menggunakan robot vakum ini daripada menyewa orang lain untuk membersihkan lantai. Projek ini hanya mempunyai sensor untuk mengekalkan objektif utamanya. Produk ini dapat membersihkan lantai rumah pada sesuatu masa yang ditetapkan.

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I would like to thank to Allah, whom with His willing giving me the opportunity to complete this Final Year Project which is title Vacuum Robot. This final year project report was prepared basically for student in final year to complete the undergraduate program that leads to the diploma of Engineering in Electronic (Computer). This report is based on the methods given by the polytechnic.

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CHAPTER 1

Introduction

1.0 Introduction of Mobile Robot

A mobile robot is an automatic machine that is capable of locomotion. Mobile robots have the capability to move around in their environment and are not fixed to one physical location. Mobile robots can be "autonomous" (AMR - autonomous mobile robot) which means they are capable of navigating an uncontrolled environment without the need for physical or electro-mechanical guidance devices. Alternatively, mobile robots can rely on guidance devices that allow them to travel a pre-defined navigation route in relatively controlled space (AGV - autonomous guided vehicle). By contrast, industrial robots are usually more-or-less stationary, consisting of a jointed arm (multi-linked manipulator) and gripper assembly (or end effector), attached to a fixed surface. The components of a mobile robot are a controller, control software, sensors and actuators. The controller is generally a microprocessor, embedded microcontroller or a personal computer (PC). Mobile control

software can be either assembly level language or high-level languages such as C, C++, Pascal, Fortran or special real-time software. The sensors used are dependent upon the requirements of the robot. The requirements could be dead reckoning, tactile and proximity sensing, triangulation ranging, collision avoidance, position location and other specific applications.

1.1 Objective

The main objective of this project is to make an autonomous vacuum that can carry out a task.

The objective of this product are,

- i. To design a vacuum robot which is portable and automatic operation
- ii. To make a vacuum robot which is fully autonomous
- iii. To build the mechanical and electrical part of the cleaning robot

1.2 Scope and Limitation

Scope project are important element in this project. It can make sure the project can be finished on the time. Because to make a good project there must have a scope.

- i. Able to vacuum the floor according to the time set.
- ii. To developed vacuum robot that operated using battery.
- iii. To developed small and light vacuum robot is operated on the floor without any obstacles and can be used on any flat floor.

1.3 Problems Statement

Nowadays, people are busy with their works, they don't have time to sweep or vacuum the floor. Especially for those who are working in shift. They always complain that they did not have time to sweep and vacuum the floor and had resulted their house floor became dirty and dusty. In the meantime, some of the people do hire other people that offer them services to sweep and vacuum the floor during weekend. This had cost them a lot just to make sure that their house floor are clean.

CHAPTER 2

Literature Review of Project

2.0 Introduction

In today's world, time is money. Most families consist of young children and working parents. In such a scenario, cleaning becomes a time-consuming and exhausting task, especially in larger homes. A robotic vacuum cleaner does all the work by itself and requires no supervision. By investing in one of these machines, you can save yourself a lot of time and effort. People keep on busying on their works and they have no enough time to clean their house. Employ a maid, it will be quite costly and unsecure for those who have kids or

senior citizens at home. There might be cases happen which we cannot predict for example kids been kidnaped or abuse, senior citizens been bully and so on. So I hope my invention would help those who are facing situation. A robotic vacuum cleaner is an autonomous electronic device that is intelligently programed to clean a specific area through a vacuum cleaning assembly.

2.1 The study of existing vacuum

A robotic vacuum cleaner is an autonomous electronic device that is intelligently programed to clean a specific area through a vacuum cleaning assembly. Some of the available products are discussed below.

- A) iRobot. In 2002, iRobot launched its first floor vacuum cleaner robot named Roomba. Initially, iRobot decided to manufacture limited number of units but Roomba immediately became a huge consumer sensation. Due to its increased market demand, a series of following robots have been launched in the market:



1. Roomba

- Launch Date: 2002
- Manufacturer: iRobot (American)
- Type of Use: Dry Vacuum
- Technology: IR, RF and auto-charging mechanism
- Price: \$500



2. Scooba

- Launch Date: 2005
- Manufacturer: iRobot (American)
- Type of Use: Wet Washing of Floor
- Technology: IR with virtual wall accessories
- Price: \$500



3. Neato XV-11

- Launch Date: 2010
- Manufacturer: Neato-Robots XV series (California)/China
- Type of Use: Vacuum Cleaning
- Technology: Laser range finder technology, SLAM (Simultaneous localization and mapping) and auto-charging
- Price: \$399

Figure 1: Types of Vacuum

2.2 COMPARISON

A comparison of robots that we researched with the top selling robotic cleaners in international market on the basis of general specifications like operating time, charging time, scheduling, floor type, battery indicators and navigation features is summarized in Table below.

FEATURES	NEATO -XV	ROOMBA	SCOOBA
OPERATING TIME(HRS)	1.5	2	1.2
CHARGING TIME(HRS)	3	4	2
SCHEDULING	YES	YES	YES
BATTERY INDICATORS	YES	YES	YES
FULL-bin INDICATOR	YES	YES	YES
REMOTE CONTROL	YES	YES	YES

Table 1: Comparison between Vacuum Robot

From this table, we know that the NEATO-XV has more operating hours compare to others which means its battery is better than others of the smart cleaner. Furthermore, it only takes 3 hours of charging the NEATO-XV compare to ROOMBA but the SCOOBA only takes 2 hours to charge and it only operate 1.2 hours. We can conclude that all this vacuum above carry out the similar function but it has different battery lifetime of each of the cleaner. NEATO-XV is the only robot has battery efficiency and less power consumption because it only takes 3 hours to charge and it can operate for 1.5 hours. Based on this specification that had inside NEATO-XV we can take it as a reference to improve our project.

This section describes the related projects are generally particularly in terms of throughput. The robot that we create is autonomous which can move automatically without being controlled by owner. The purpose that creating this robot is to help those senior citizens who cannot move physically and for those who don't have time to clean their houses. This robot function to vacuum. The size of the robot that we create is more likely size of oval which can spin easily. This robot can be charged anytime because it has a rechargeable battery built-in it. There are buzzer built-in the robot which can reminds the owner whenever the job is done, the dumpbox is full and low battery.

The control process of the Vacuum Robot is control by a few categories:

- Arduino UNO
- L293D Motor Driver

2.3 Arduino UNO

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.



Figure 2: Arduino Uno

2.4 L293D motor driver

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that it can control two DC motor with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit (IC)*. It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller. There are two Enable pins on I293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge we need to enable pin 1 to high. And for right H-Bridge we need to make the pin

or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits. The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

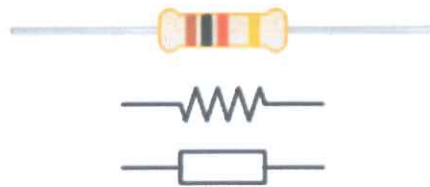


Figure 4 : Resistor

2.5.2. Sensor

A sensor is a device that measures a physical quantity and converts it into a 'signal' which can be read by an observer or by an instrument. For example, a mercury thermometer converts the measured temperature into the expansion and contraction of a liquid which can be read on a calibrated glass tube. Video cameras and a digital cameras have an image sensor. There are many different types of sensors. Some are used in everyday objects, and some are separate

2.5.3. Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to additionally include devices composed of a single cell. Primary (single-use or "disposable") batteries are used once and discarded; the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times using mains power from a wall socket; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and smartphones.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smartphones, to large lead acid batteries used in cars and trucks, and at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers.

Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline. This is somewhat offset by the higher efficiency of electric motors in producing mechanical work, compared to combustion engines.

2.5.4. Capacitors

A capacitor is a passive two-terminal electrical component that stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. While capacitance exists between any two electrical conductors of a circuit in sufficiently close proximity, a capacitor is specifically designed to provide and enhance this effect for a variety of practical applications by consideration of size, shape, and positioning of closely spaced conductors, and the intervening dielectric material. A capacitor was therefore historically first known as an electric condenser.

The physical form and construction of practical capacitors vary widely and many capacitor types are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The non-conducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy.



Figure 5: Capacitor

2.5.5. PCB Board

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. Components (e.g. capacitors, resistors or active devices) are generally soldered on the PCB. Advanced PCBs may contain components embedded in the substrate. PCBs can be single sided (one copper layer), double sided (two copper layers) or multi-layer (outer and inner layers). Conductors on different layers are connected with vias. Multi-layer PCBs allow for much higher component density.

FR-4 glass epoxy is the primary insulating substrate. A basic building block of the PCB is an FR-4 panel with a thin layer of copper foil laminated to one or both sides. In multi-layer boards multiple layers of material are laminated together.

Printed circuit boards are used in all but the simplest electronic products. Alternatives to PCBs include wire wrap and point-to-point construction. PCBs require the additional design effort to lay out the circuit, but manufacturing and assembly can be automated. Manufacturing circuits with PCBs is cheaper and faster than with other wiring methods as components are mounted and wired with one single part. A minimal PCB with a single component used for easier modeling is called a breakout board. When the board has no embedded components it is more correctly called a printed wiring board (PWB) or etched wiring board. However, the term printed wiring board has fallen into disuse. A PCB populated with electronic components is called a printed circuit assembly (PCA), printed circuit board assembly or PCB assembly (PCBA). The IPC preferred term for assembled boards is circuit card assembly (CCA) and for assembled backplanes it is backplane assemblies. The term PCB is used informally both for bare and assembled board

2.5.6. Arduino

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language and the Arduino development environment. Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing.). The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

2.5.7. Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations



Figure 6: Relay

2.5.8. Perspex

Poly(methyl methacrylate) (PMMA), also known as acrylic or acrylic glass as well as by the trade names Plexiglas, Acrylite, Lucite, and Perspex among several others (see below), is a transparent thermoplastic often used in sheet form as a lightweight or shatter-resistant alternative to glass. The same material can be utilised as a casting resin, in inks and coatings, and has many other uses.

Although not a type of familiar silica-based glass, the substance, like many thermoplastics, is often technically classified as a type of glass (in that it is a non-crystalline vitreous substance) hence its occasional historic designation as acrylic glass. Chemically, it is the synthetic polymer of methyl methacrylate. The material was developed in 1928 in several different laboratories by many chemists, such as William Chalmers, Otto Röhm and Walter Bauer, and was first brought to market in 1933 by the Rohm and Haas Company under the trademark Plexiglas.

PMMA is an economical alternative to polycarbonate (PC) when extreme strength is not necessary. Additionally, PMMA does not contain the potentially harmful bisphenol-A subunits found in polycarbonate. It is often preferred because of its moderate properties, easy handling and processing, and low cost.

L293D MOTOR DRIVER

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that it can control two DC motor with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit (IC)*. It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller. There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge we need to enable pin 1 to high. And for right H-Bridge we need to make the pin 9 to high. If any of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch

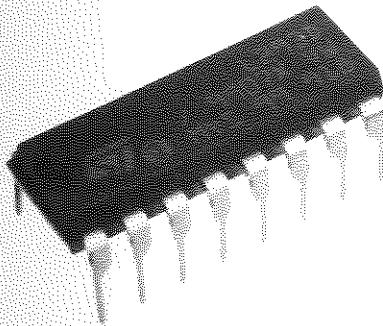


Figure 7: L293D Motor Driver

2.6 Summary

In our conclusion, this chapter is explaining about problem and comparison from toward existing product. We can find a different benefit, circuit design, function, quality from the other product. Component used in circuit is such a similar but there are also have a different component.

CHAPTER 3

Methodology

3.0 Introduction

This chapter is discussed about the methodology that has been used to complete this project. Methodologies are methods or procedure used to implement the project in detail. These are very important in this project to ensure the project is completed in the specified time. In addition, there are ways to test the fabricated circuit.

In creating a project, some steps to go through before the project is completed. These steps should be done with almost care so as to produce a quality project. In this project, there are several steps have been performed. Further explanation will explain step methodology.

3.1 Methodology

Methodology can be the 'analysis of the principles of methods, rules, and postulates employed by a discipline', 'the systematic study of methods that are, can be, or have been applied within a discipline' or 'a particular procedure or set of procedures'.

Methodology includes a philosophically coherent collection of theories, concepts or ideas as they relate to a particular discipline or field of inquiry. Methodology refers to more than a simple set of methods, rather it refers to the rationale and the philosophical assumptions that underlie a particular study relative to the scientific method. This is why scholarly literature often includes a section on the methodology of the researchers.

Each step of project is a process to complete the project. Every step must be followed one by one and must be done carefully. If some error occurs it can make a project probably could not operate or do not look neat and perfect.

Before the project finish, various process needs to be done according to proper procedures to ensure that projects do not have any problems. Among the measures the work done in preparing this project are:

- Process of designing circuits
- Circuit board trace
- Soldering process in circuit board.

3.2 Flow Chart

A flow chart is defined as a pictorial representation describing a process being studied or even used to plan stages of a project. Flow charts tend to provide people with a common language or reference point when dealing with project or process.