# ROBOCLEAN

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A report submitted in partial fulfillment of requirements for the degree of Bachelor In Electrical Engineering (Mechatronics)

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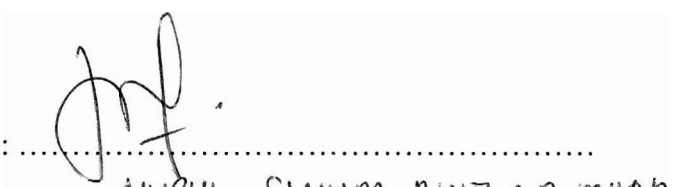
"I hereby declare that I have read through this report entitle "Robocleant" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Mechatronics)"

Signature : .....

Supervisor's Name : ALIAS BIN KHAMIS

Date : 13/5/2009.

I declare that this report entitle "*Robocleant*" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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Date : 13/05/05

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| | | |
|---|---|---|
| UTeM | - | Universiti Teknikal Malaysia Melaka |
| UTHM | - | Universiti Tun Hussein Onn |
| PSM | - | Projek Sarjana Muda |
| DC | - | Direct Current |
| IR | - | Infra red |
| LED | - | Light Emitting Diode |
| PC | - | Personal Computer |
| F | - | Farad |
| k | - | kilo |
| M | - | Mega |
| Hz | - | Hertz |
| A/D | - | Analog to Digital |
| PWM | - | Pulse Width Modulator |
| USART | - | Universal Asynchronous Receiver Transmitter |

# LIST OF APPENDIX

## ACKNOWLEDGEMENT

BISMILLAHIRRAHMANIRRAHIM…

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Last but not least, to my friends who have always be with me and compete in a positive way in enhancing our knowledge in order to achieve a great future. Guys, may success be at our side.

Once again to everybody, THANK YOU…

# ABSTRACT

This project is to build a cleaning robot focusing on cleaning the floor through mopping. As life is getting busier and more hectic each day, the need of home-used gadget is increasing rapidly. This is where the idea of Roboclean came from. Imagine a hassle-free task, no more doing the conventional way of mopping. Roboclean is an intelligent autonomous mobile robot with obstacle avoidance. It comes with an extra handy feature which is to clean the floor. It moves in multipurpose direction with the help of infrared sensors. It runs on two-wheels which are driven by DC motors. It uses rechargeable battery as power supply. The main purpose of Roboclean is to move across floors, cleaning up stains and dirts. It walks off nearly everywhere, under the table and under the chair. As it has obstacles avoidance, Roboclean should be able to not only avoid obstacle but also stair's edge and holes on the floor.

# ABSTRAK

Projek ini adalah untuk membina sebuah robot yang boleh berfungsi untuk melakukan kerja mop. Memandangkan hidup semakin bertambah sibuk, permintaan untuk peralatan yang boleh digunakan di rumah semakin bertambah. Dari sinilah munculnya idea *Roboclean*. Bayangkan hidup yang senang-lenang, tanpa perlu melakukan kerja mop mengikut cara konvensional lagi. *Roboclean* adalah sebuah robot yang pintar yang boleh bergerak sendiri serta mempunyai pengelak halangan. Ianya mempunyai satu fungsi yang menarik iaitu ia boleh membersihkan lantai. *Roboclean* bergerak dalam pelbagai arah dengan bantuan sensor infra merah. Ianya bergerak di atas dua roda yang di pandu oleh motor AT. Ianya menggunakan bateri yang boleh di cas sebagai bekalan kuasa. Tujuan utama *Roboclean* adalah untuk bergerak ke seluruh lantai dan membersihkannya. *Roboclean* boleh bergerak hampir ke keseluruhan kawasan termasuklah bawah meja dan kerusi. Memandangkan ianya mempunyai pengelak halangan, *Roboclean* bukan sahaja boleh mengelak daripada halangan, bahkan ianya boleh turut mengelak bahagian tepi tangga serta lubang-lubang di lantai.

# CHAPTER 1

# INTRODUCTION

## 1.0 Introduction

This project is tittled as 'Roboclean". The main purpose of this project is to build an autonomous obstacle avoiding robot with mopping capability. Roboclean is a cleaning robot focusing on cleaning the floor through mopping. Roboclean emerges from the need of a hassle-free task and it is free from the conventional way of mopping which can be too time consuming and tiring.

Roboclean is basically an intelligent autonomous mobile robot with obstacle avoidance. However, it comes with an extra handy feature which is to mop the floor. It moves in multipurpose direction with the help of infrared sensors. It runs on two-wheels which are driven by DC motors. It uses rechargeable battery as power supply. The main objective of Roboclean is to move across floors, cleaning up stains and dirts. It walks off nearly everywhere, under the table and under the chair. It is equipped with timer so that users can set the cleaning time according to user's need. As it has obstacles avoidance, Roboclean should be able to not only avoid obstacle but also stair's edge and holes on the floor.

In this project, PIC is used as the microcontroller due to its low cost, wide availability, large use base, extensive collection of application notes, and serial programming (and re-programming with flash memory) capability. MikroC is used as the programming language for PIC microcontroller. MikroC is a multi-usage development tool for PIC micros that uses C language as its program language.

For obstacle avoidance purposes, three infra-red sensors are used to do the distance measurement of an object or any obstacle. It works together with microcontroller to control

the movement of Roboclean so that it can move smoothly without running into walls or objects.

## 1.1 Problem Statement

As life is getting busier and more hectic each day, the need of home-used gadget is increasing rapidly. Conventional wet mopping practices which include mopping the floor, preparing and changing the cleaning solution, and wringing the mop before and after jobs would take approximately 15 minutes. Conventional mopping practices can also lead to injuries through the repeated motions of mopping and wringing. As for industries, this can increase the cost of labor.

This project had been proposed in order to overcome the problems that the conventional way of mopping has. Compared to conventional mopping, Roboclean can cut down the time taken to mop a floor as it walks off nearly everywhere, under the table and under the chair without human supervision. Besides that, it is also ergonomic and thus can reduce injuries as Roboclean doesn't require wringing.

## 1.2 Objectives

The objectives of this project are as follow: -

i. To build an obstacle avoidance robot that can automatically mop the floor in multipurpose direction.
ii. To apply the knowledge of programming into this project by building a program in microC.
iii. To have better understanding on mechanical and electronic design.

## 1.3 Scope

The scopes of work of this project are stated as below: -

i. This project focuses on the automatic mopping of an autonomous mobile robot which can move in multipurpose direction.
ii. The robot is applied only on smooth surfaces.
iii. The robot uses sponge as the mopping mechanism.
iv. Te robot employs infra-red sensor in order to coordinate its movements and avoid objects at a distance.

## 1.4 Report Organization

This report is divided into five Chapters. It starts with Chapter 1 where the rationale of this project is described. The objective, scope and organization are presented in this chapter.

Next, in Chapter 2, provides the literature review where other projects, journals and articles related to Roboclean are reviewed and analyzed to obtain some critical points in term of the process and its development. The analyzed data will help to construct the best results for this project.

Then, the third section which is Chapter 3 discusses the methodology used in this project. This section illustrates in details how Roboclean being construct in term of design, software and electrical circuit system. Here, all process, procedure and parameter used are highlighted based on the rationale and the philosophical assumptions that underlie a particular study. All relevant experimental, descriptive, theoretical and analytical techniques used in the project are outlined.

Subsequently, Chapter 4 is discussed which concludes the result and discussion. This chapter contains the results tested which are then compared to the expected results. The observation and analysis on the results are discussed. Any failure in results is analyzed and observed. Besides this, all of the final consequences of results, advantages or disadvantages found or any victory is revealed. In this part, the precision of the design is important to ensure the success of the project.

Last but not least is Chapter 5 which summarized the entire project. This chapter contains a brief summary of the entire work, including methods, results and major conclusions or recommendations arising from the work. Weaknesses, shortcomings and strengths of the project are presented. Suggestions for future work are also included together with contributions of project.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

To build this project, it requires the knowledge that not readily offhand. There are three main parts need to be investigated in order for this project to success, namely mobile robot design, sensing method and microcontroller specification. With various amounts of circuit design, embedded controller and microcontroller in the market, it is rather complicated to find the suitable components and not to mention the vast number of specification which varies according to their manufacturers. Hence, literature review is very important as it creates the concept and the framework of a project. This is an imperative step as a guide to choose the most suitable components which are going to be used for this project.

## 2.1 Overview of Related Project

For this project, a few subjects had been studied and researched as a reference to Roboclean. The first one is a product called RoboMop by RoboMop International. The second, third and fourth literature review are journals by taken from the internet. The remaining are previous thesis from UTHM students. The subjects are then compiled into a table to see the difference of each one of them.

### 2.1.1 RoboMop by RoboMop International

The RoboMop is an inexpensive robotic floor duster introduced by RoboMop International. The device consists of a hat-shaped frame with an electrostatic dust pad on

the bottom, driven by a self-propelled ball that fits into the middle of the frame. The product is powered by a rechargeable battery that can be plugged into house current. The cordless RoboMop slides silently across all floors picking up dirt, dust, lint and hair. It goes virtually anywhere including under the table and under the chair. It changes directions automatically to keep working the entire floor surface.

RoboMop gave a basic idea of how Roboclean can be constructed. Driven by only a ball without any infrared-sensor, it is a very small and simple product yet it is proved to be effective. Size matters as users nowadays prefer small products for easy storage and at the same time, quality is not neglected. Eventhough its function is to sweep the floor, whereas Roboclean is meant to mop the floor, it is one of the best examples that can be used as a reference.


Figure 2.0: RoboMop by RoboMop International

### 2.1.2 Software Implementation of Obstacle Detection and Avoidance System for Wheeled Mobile Robot

This is a journal written by Aye Aye Nwe, Wai Phyo Aung and Yin Mon Myint from Mandalay Technological University, Mandalay, Myanmar. It represents mainly on

software implementation of obstacle detection and avoidance system for Wheeled Mobile Robot. This system consists of infrared sensors and microcontroller. In this system three infrared sensors are used for left, front and right. In this robot system, the input signal is received from sensor circuit and PIC is operated according to the received sensor's signal.

This paper helps in understanding ways to implement infrared sensor thus implementing the obstacle detection and avoidance system for Roboclean. A few sensors are considered for obstacle avoiding such as bump sensor, infrared sensor, ultrasonic sensor and laser range finder. However, the writers suggested infrared sensor as the most suitable for obstacle avoiding robot because of its low cost and ranging capability. Circuit operation, sensing statements and software considerations were all explained.

The infrared sensor reading is taken and processed to avoid the obstacles. The 5V power supply is used to operate PIC board and sensor circuit board. The obstacle avoidance algorithm is simply evaluated on PIC 16F877 microcontroller based mobile robot. The type of infrared sensor is GP2D12 distance measuring sensor. The desired goal of this system is to avoid obstacles along its path and to determine the distance.

### 2.1.3 Final Report EEL5666 4/23/02; The Lemmings

This is a final report written by Justin Rice. This report deals with the building of a pair of autonomous mobile robot capable of working together. It is controlled by microcontroller – PIC16F877 and the program is written using PIC BASIC PRO. Both Lemmings have identical hardware configurations. The only difference in the software is that one Lemming starts out as a leader, and the other Lemming is a follower.

The Lemmings are based on the PIC16F877 microcontroller running on a prototyping board built. The PIC acts as the brains and control the robots based on inputs from the various sensors. Two PWM pins allow for easy output waveform generation and built in A/D pins allow for sensor input. Bump sensors determine when an obstacle is hit, and IR is used to avoid objects at a distance. The same IR sensors are also used for following the leader using different software controls. The robots are also able to send simple messages using the sound from a magnetic speaker.

The Lemmings have two basic modes of operation: leader and follower. One robot will start out in each mode. The leader robot will wander around avoiding obstacles and broadcasting its location using IR. The follower robot will try to pick up the IR signal from the lead robot. When the signal is detected it will begin to follow the leader. The Lemmings then move around the room until the leader becomes trapped in a corner or runs into something that it could not detect. The robots then trade jobs after the leader has broadcast an alert using its speaker. The Lemmings then begin to advance in the opposite direction of the obstacle that confused them.

This report helps in understanding the circuit design and also in microcontroller programming. The theory, concept and methods used in Lemmings' project can be adapted by Roboclean.

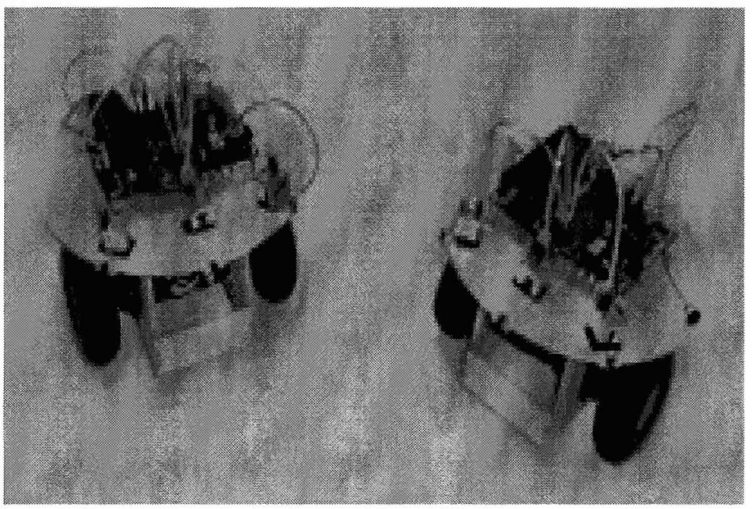

Figure 2.1: The Lemmings

### 2.1.4 Vacuum Robot (Mop'n Bot)

Mop'n Bot robot was developed in 23rd April 2003 by Michael Hall from University of Florida, Department of Electrical and Computer Engineering. The purpose of this robot is to clean a tile or linoleum floor while staying off any adjacent carpet as well as avoiding objects. The robot ware consists of six independent systems working in conjunction; actuation, bumpers, proximity detectors, carpet detectors, cleaning solution dispenser and cleaning cloth. They are all controlled by an Atmel AtMega323

microcontroller development board. Actuation is accomplished using two standard servos. The servos, bumpers and IR are used in conjunction to achieve obstacles avoidance. This robot used three infrared (IR) sensors for the forward, left and right direction. The bumpers are on the front with some side impact capabilities. The robot avoidance of obstacles was greatly improved by using bump switches. The vertical whisker was put on the front of the robot to avoid obstacles. The robot starts by finding a wall or the edge of the carpet, then follows the wall and eventually traverses the entire surface in a spiral pattern.

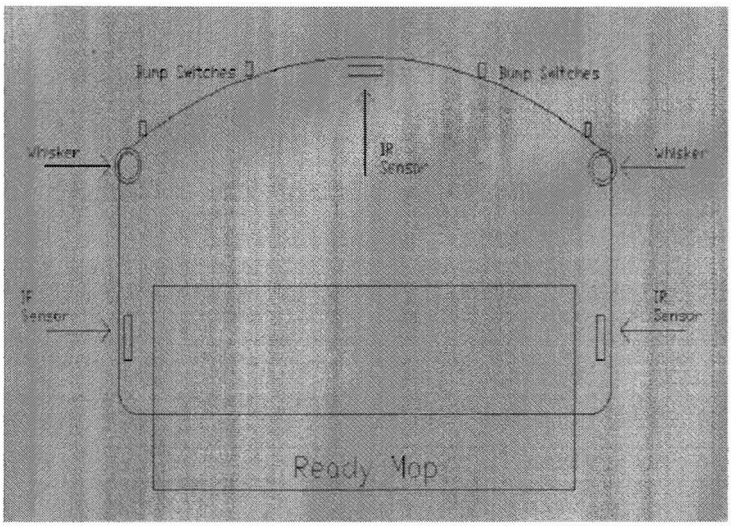


Figure 2.2: Vacuum Robot (Mop'n Bot)

### 2.1.5 Self-Charging Vacuum Cleaner Robot

Self-Charging Vacuum Cleaner Robot was developed in 2005 by Alex Choo Ching Hui. The robot was designed using PIC16F877 microcontroller that it performs as a brain of the system. This robot has special functional that it's can charge automatically by itself. It had completed by IR sensor and bump switch to avoid the obstacles. The robot was designed with only two actuated wheels driven by direct current (DC) motor for stability. The robot was programmed to move and clean up the floor independently. It also was programmed intelligently that can always checking on the condition the power of the battery. If the power of the battery is going low, the LED on the upper of the robot will be flamed and the robot will searched the charging station to charge by itself. The advantages can be that robot more smart and intelligent.