



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DESIGN AND DEVELOPMENT OF AUTONOMOUS SWEEPER
ROBOT FOR BADMINTON COURT**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Electrical Engineering Automation Industry & Robotic) with Honours

by

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I hereby, declared this report entitled “DESIGN AND DEVELOPMENT OF AUTONOMOUS SWEEPER ROBOT FOR BADMINTON COURT” is the results of my own research except as cited in references.

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Date : **11 Disember 2015**

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Electrical Engineering Automation Industry & Robotic) with honours. The member of the supervisory is as follow:

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Date : **11 Disember 2015**

ABSTRACT

Badminton court cleaner robot is one of the robots of the innovation project and yet being develop by other society. The most dominant reason of this creation, this project can ease badminton court practitioner organizer to clean up the court after match, instead of using the manual way which is individual clean up the court. In additional from the observation, interview section the organization agrees and felt satisfied with this project and welcome an innovative robot. This project created this robot with the fundamental of square shape for the body and combined the entire element such as microcontroller, actuator, vacuum, sweeper, and DC motor. This automatic vacuum robot of badminton court can just be switch on by click one button and the robot will make a move to start their cleaning job in a short time. In a nut shell, this robot can reduce labour cost and time concern and as well as the challenge of vision 2020.

ABSTRAK

Robot pembersih gelanggang badminton adalah satu projek reka cipta baru yang belum pernah dihasilkan mana mana syarikat. Tujuan utama dalam mereka bentuk dan membina projek ini adalah untuk memudahkan pengusaha gelanggang badminton mahupun penganjur perlawanan badminton untuk membersihkan gelanggang bagi menggantikan perbersihan gelanggang secara manual. Berdasarkan pemerhatian dan temuduga beberapa pengusaha dan pemain badminton menyatakan keluhan terhadap kualiti lantai gelanggang memberikan idea dan menguatkan lagi untuk membina robot ini. Cara untuk menghasilkan robot ini pada asas nya adalah dengan mempunyai badan robot berbentuk segi empat dan menggabungkan semua elemen elektronik seperti mikropengawal, penggerak, motor arus terus, penderia dan konsep penyudut habuk. Robot pembersih automatik ini bergerak secara automatik dengan hanya tekan suis on. Ia akan bergerak membersihkan lantai gelanggang badminton dengan hanya beberapa minit. Robot ini boleh mengurangkan tenaga kerja manusia dan mempunyai kriteria seperti mesra pengguna di mana ia mudah digunakan. Ini sekaligus menyahut cabaran Wawasan 2020.

DEDICATIONS

To my beloved father, Taher bin Yaakop and

mother Faridah binti Selamat

To my supervisor and all lecture

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In the name of Allah, the most gracious and the most merciful, the utmost thank to Allah with his greatest power, I have successfully complete this PSM report. A special thanks and appreciation to my supervisor, Mr Mohamad Haniff bin Harun for commitment, professionalism, advice and guidance me to ensure that this project is succeed. Secondly, I would like to express warm gratitude to the faculty of Electrical engineering especially my co-supervisor En Mohd Sulhan for full co-operation and commitment given to assist me a lot while performing this project. Finally, special thanks to my family and to those who had helped directly or indirectly in undertaking my project a success. The contributions and insights are highly appreciated

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CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter provides an introduction about this project. It starts with general information and background about autonomous robot, problem statement and it also cover the objective, problem statement and scope for the project.

1.1 Background

Our new innovation is based on basic vacuum cleaning and robot movement. Those concerned with the design of an autonomous sweeper robot for a badminton court by using Arduino as controller. It constitutes a smooth movement, silent and easy to use. With this reason, this idea have been developed an autonomous sweeper robot for badminton court which is designed to clean a badminton court by using a basic principal of vacuum, the Arduino system as an operating system, a line follows and basic linear motion as an arm for clean. Basically, this autonomous sweeper robot f move along the line guided by line at badminton court. This project also used a motor driver to drive a motor vacuum and arm robot.

By using arduino Microprocessor would control all mobilization robots. This microprocessor are made as a brain of this system. DC motor are used to propel the robot vacuum and the vacuum. However, DC motor spins too fast and has little torque to drive the loads. Thus, gear reduction is required to slow down the rotational speed and increase the torque of the motors. The robot senses the obstacles through the infrared sensor. These sensors are installed at the front of the robot.

1.2 Project overview

Autonomous sweeper robot for badminton court construction can be divided into four main parts. There are brain, actuator, sensor and vacuum. Figure 1.1 and Figure 1.2 below shows the overview of the system inside the autonomous sweeper robot.

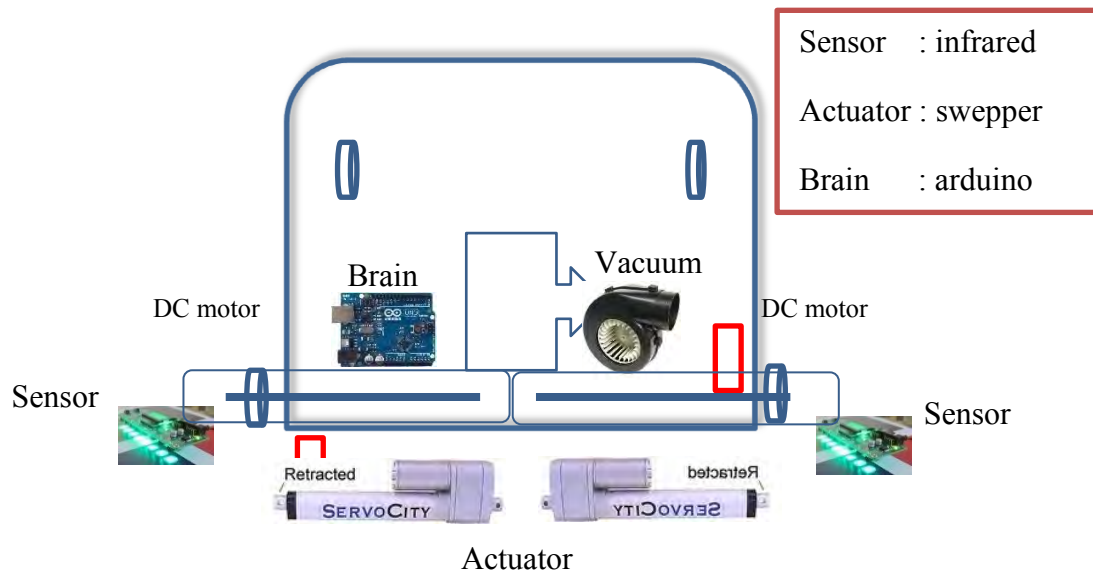


Figure 1.1 : overview robot during off

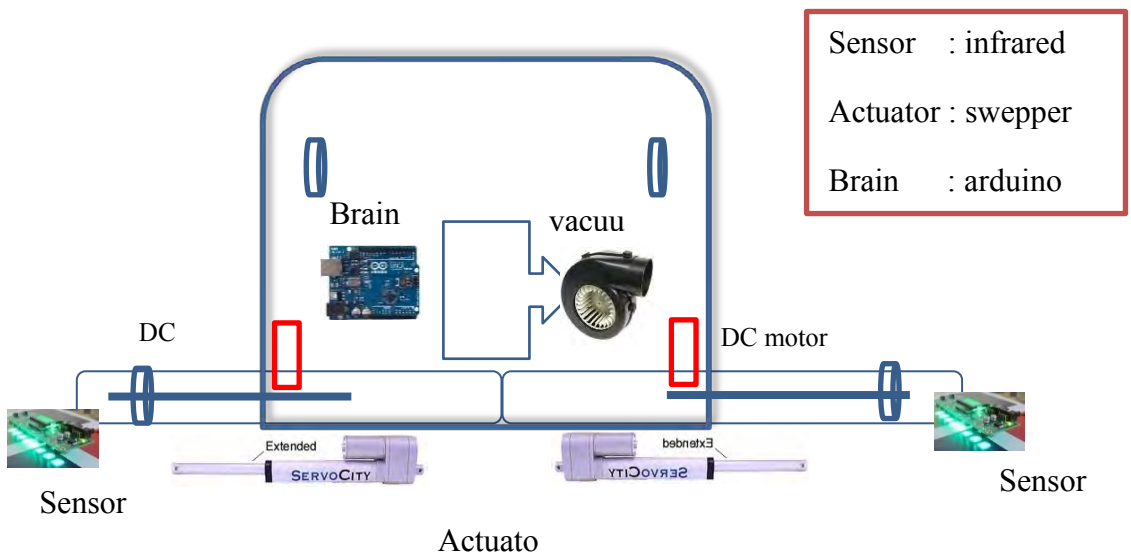


Figure 1.2 : overview robot during on

1.3 Research background

This project are highlight a product with smooth movement and easy to use compared to other products has been reviewed. The goal of this study is to use the component, mechanism or other than products that has been produced before. An autonomous sweeper robot, a vacuum cleaner-base product is used to clean badminton court's floor from dust and other dirt, besides, it also polishes the floor to make it clean, smooth surface and shiny. In general, this Vacuum robot is commonly used in the vacuum chambers for handling work pieces such as semiconductor wafers, and other types of work. The vacuum robot motions require high-accuracy and high-speed without concerning the process.

The main problem is how to create fast and precise motions with the reduction of residual vibration. In many industrial robots, the method for point-to-point motion profile which called as trapezoidal velocity profile is widely used for its fast motion. However, sudden changes in the acceleration will cause a large force to excite residual vibrations. As a modified form, s-curve velocity profile is proposed to reduce residual vibrations. In recent years, the symmetric s-curve velocity profiles have been widely used in motion control fields the research gave a method to estimate the ramp-up and the ramp-down time to improve the kinematics and dynamic performance of a vacuum.

Based on previous research, vacuum cleaner robot is the length of the flow channel between the inlet of the rolling brush blower and the outlet of the vacuum blower. To cope with the pressure drop problem of the duct flow field in a robot vacuum cleaner, a method based on Pressure Implicit with Splitting of Operators (PRISO) algorithm is introduced and the optimal design of the duct flow field is implemented. Firstly, the duct structure in a robot vacuum cleaner is taken as a research object, with the computational fluid dynamics (CFD) theories adopted, that are three-dimensional fluid model of the duct is established by means of the FLUENT solver of the CFD software.

Second, with the k- ϵ turbulence model of three-dimensional incompressible fluid considered and the PRISO pressure modification algorithm employed, the flow field numerical simulations inside the duct of the robot vacuum cleaner is carried out. Then, the velocity vector plots on the arbitrary plane of the duct flow field are obtained. Finally, an

investigation of the dynamic characteristics of the duct flow field is done and defects of the original duct flow field are analysed, the optimization of the original flow field has then been conducted.

Experimental results show that the duct flow field after optimization can effectively reduce pressure drop, the feasibility as well as the correctness of the theoretical modelling and optimization approaches are validated.

1.4 Problem Statement

In today's there are increasing number of badminton players among all level of ages, genders and they come from professionals and beginners . As we know, badminton is one of the popular sports in Asia especially in Malaysia. From this, we can relate it with the research problem. One of the problems is when there are many players use the same courts every day, or sometimes the courts receive non-stop players in one day, there will be some problems faced by the players while performing the game. Many badminton players complained about the quality of the floors at badminton courts they went. As we know the quality of the floor is very important. This is because if the floor is stucked with much dust and dirt, there will be less attractive and less effective game performed by badminton players. In addition, slippery floor will let them to frequently fall down and injured. This is due to low pressure of shoes' grip on the floor's surface area.

We can see other applications that use robot as a cleaner for example, mobile vacuum robot for home application, vacuum robot for bowling lane floor and many others. However, we do not have robot to cleaner for a badminton court, or it is difficult to have that kind of robot.

Many users are using a manual vacuum system for now. Manual vacuum is less effective compared to robotic vacuum cleaner. This is because manual vacuum cleaner needs man power to clean the entire court's floor. The organizer of badminton tournament has to spend some costs to pay the worker. Besides that, using manual vacuum cleaner requires more time to clean the floor. This will effect the time taken for cleaning process when there are big tournaments that need time to be packed carefully. Besides that, manual

vacuum consumes higher rate of electricity compared to vacuum cleaner robot. With the new technology, this innovation is made with lower electricity usage when it is operating

In order to solve the problems, the product have to be created. This project have been designed call as autonomous sweeper robot that able to clean and polish a badminton floor as the substitute of manual vacuum that use man power besides it is more practical and effective for users. Autonomous sweeper robot for badminton court is powered by batteries and user friendly.

1.5 Description of prototype

Vacuum concept

- Production of vacuum according to developing an own mobile vacuum to clean a dust and other dirt's

Rechargeble

- This product is powered by batteries. It can be recharge when the batteries are week.

Portability

Easy to carry whenever the users go and use this product.

1.6 Objective

This product is used as a vacuum, dc motor and robot arm. Its concept is almost the similar like mobile vacuum robot but has been simplify to be use at badminton court, portable and rechargeable. The objective of this product is:

- To design a mobile vacuum robot system suitable for clean badminton court
- To analyse and evaluate the electrical performance of this robot
- To make a robot badminton cleaner can use in optimum performance

1.7 Scope

To accomplish this project in order to work successfully, there are a few things defined in the scopes of the project. There are :

- The project using arduino microcontroller to achieve the automation. The arduino microcontroller will control a motor and receive the signal from a sensor.
- Vacuum robot at badminton court with different floor
- Test the speed of vacuum and the sweeper

1.8 Thesis outline

This project thesis is done basically to document the activities, outcome and concept of the project that is relevant to the project progress. The thesis consists of three main chapters for PSM 1. There are:

- Chapter 1

Describes briefly about the project's introduction and also discuss about the objectives, scopes of project and project application.

- Chapter 2

Describes about the literature review regarding background of the project and at the same times describes about the same projects that have been done of previous person and it's more to make research on different, advantages and disadvantages of previous project

- Chapter 3

Describes about the project planning where the project implementation will be divided into three phase. There are hardware, design software and electrical part. This chapter also discusses more detail about the principal of component that will be used in the project such as infrared sensor and actuator.

- Chapter 4

At this chapter will be discussing about the result and analysis. This chapter will get the truth data and do recorded to discuss. From this chapter, the analysis can be define between successful or fail.

- Chapter 5

This chapter discusses the conclusion and suggests future work to further improve the development of the system. It also stresses about the output of the project.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter informs us all about the research before the robot has been set up. To build this project, it requires the knowledge that are not readily offhand. There are three main parts need to be investigated in this project is part of robot, sensing technology and microcontroller specification. Motor is one of the methods for creating of the electronic device movement. Motors are the most importance parts of mobile robotics platform. Moreover, a sensor is a device which detects a signal on lines at badminton court. The main objective of incorporating sensors technology in robotics system is to enable the robots to move follow the line at badminton court

2.1 Movement of robot

To achieve the movement of robot system, one of the study is based on literature review, which will be discussed in detail in this chapter. For the movement of robot, research more on line follower concept, infrared, mapping and Algorithm.

2.1.1 Infrared

For according to the movement of robot, research on line follower concept by using infrared which follow the journal from (Kaiser et al., 2014) The line follower robot has great importance in industrial manufacturing process, automation, carrying cartage in a specific direction. Importance is given in this paper in investigating efficiency of the robot, response of the sensor, getting actual data of the sensors, feedback of the central processing unit depending on this response, error correction of following line, future aspects of the

line follower robot, providing some real time data of the robot and giving the preliminary steps on fabricating a line follower robot.

This robot is the basic form of the line follower robots. Much more complex form of line following robot can be manufactured depending on this basic form of line follower robot. More specifically, efforts have been put on acquiring data during test runs so that robots can be manufactured in massive way under specific requirements of purpose

The line follower is a kind of robotic vehicle which has the capability of following a line of specific colour and it may include other functions as well. From previous study, (Pakdaman and Sanaatiyan, 2009) The robots simply sense the line by measuring light intensity (converting it into voltage) reflected from the ground, where it is assumed that an ideal black floor reflects no light and the white line reflects almost the total incident light back. The main task is sensing the line and bounding the robot to stay over the line, by continuously changing the wrong moves using an efficient program through microcontroller to achieve an optimum velocity for racing with time. The program is based on the characteristic of the light reflected by the different colour of the path. Microcontroller receives the analogue signal of reflected light as a voltage relative to the colour of the path and the voltage difference for different colour ensures the correct way to go and loaded program commands the robot to go that way automatically.

According to(Chen and Song, 2005), infrared sensor, the most common sensors for a line following robot have been LDR (Light Dependent Resistor) and IR (infrared) LED (light emitting diode). But the IR LED is the most optimized sensor for line following robot. It comprises of IR-transmitter (Tx) and receiver (Rx). This special purpose LED transmits infrared rays of wave length 760 nm. These LEDs are made of gallium arsenide or aluminium gallium arsenide.

Massive use of this line follower robot is in the production line where autonomous carry the products from production to storage room. Another important use of this line follower robot is, it indicates path for blind peoples in office or house incorporating some buzzer or vibrator. Motion detector sensors can be used to detect moving object near the car. After advanced modification, it can be used in factories for loading and unloading and chemical industries to perform hazardous job. By adding robotic hand and object detector,

it can be used to pick up object where we cannot go. Figure 2.1 below shows the infrared send the line.

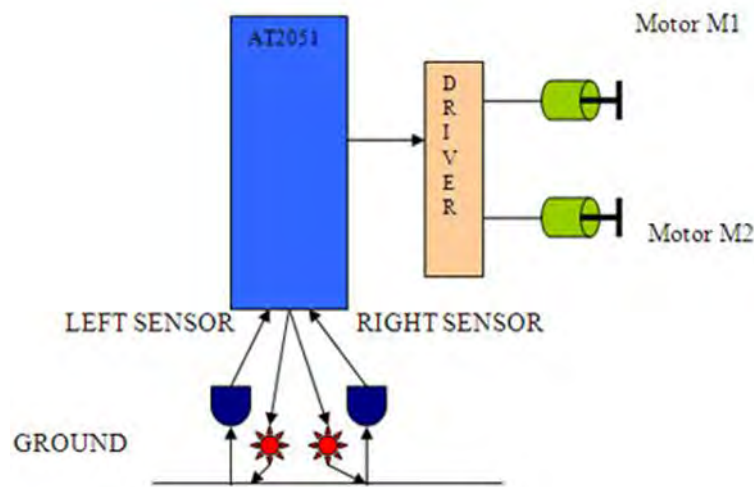


Figure 2.1.1: infrared sensor

2.1.2 Path mapping

Path mapping and finding the desired path for a mobile cleaning robot in order to perform cleaning efficiently is a difficult task. In paper of (Uddin et al., 2011), in complex indoor environments, avoiding collision with other furniture or equipment is a big problem for mobile cleaning robot. In the case wireless control link should be robust for accurate moving along the desired path. But wireless radio frequency is experienced interference created by surrounding RF devices. In this paper we propose a cleaning robot control scheme using LED-ID network as a new paradigm in the in the mobile cleaning robot application. LED-ID system uses LED and visible light as a transmission source and transmission medium respectively. Therefore control the cleaning robot and illumination both are possible simultaneously. Also other radio frequency cannot interfere with the visible light. This system allows the user to teach the robot a user preferred cleaning path and provides long time cleaning stability. We also show simulation results to prove our algorithm.

To proposed an algorithm to control the moving path through LED-ID network. In the multi-robot considered as multi reader environment is very much effective but in this

