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Design and develop pool cleaning robot / Muhammad
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FACULTY OF ELECTRICAL ENGINEERING

BEKU 4973

FINAL YEAR PROJECT

DESIGN AND DEVELOP

POOL CLEANING ROBOT

DESIGN AND DEVELOP POOL CLEANING ROBOT

Muhammad Rahimi Ismail


**Bachelor in Electrical Engineering
(Control, Instrument & Automation)**

JUNE 2012

Supervisor Declaration

“ I hereby declare that I have read through this report entitle **Design and Develop Pool Cleaning Robot** and found that it has comply the partial fulfilment for awarding the Degree of Bachelor of Electrical Engineering (Control, Instrument and Automation)”

Signature



.....

Supervisor's Name : **En Zamzuri AB Rashid**

Date : **June 8, 2012**

**DESIGN AND DEVELOP
POOL CLEANING ROBOT**

MUHAMMAD RAHIMI ISMAIL

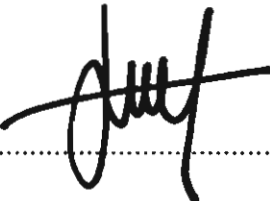
**A Report Submitted in Partial Fulfillment of Requirements for the Degree
of Bachelor in Electrical Engineering (Control, Instrumentation and Automation)**

**Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

JUNE 8, 2012

Student Declaration

“ I hereby declared that this report is a result of my own work expert for the excerpts that have been cited in the references”

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Date : **JUNE 8, 2012**

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In The Name of Allah the Most Merciful and Most Compassionate

At first, I wish to convey gratitude to ALLAH S.W.T. for bestowing the strength and patience in completing the Final Year Project on ‘Design and Develop Pool Cleaning Robot’.

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ABSTRACT

Pool Cleaning Robot (PCR), is a robot that is used to clean the pool. The proposed PCR in this research is to ease the human life beside of to save much time and cost. In brief, the PCR invented is capable to clean the floor and wall at the same time. This PCR can move forward and make a turn automatically. The PCR is equipped with two brushes to maximize the cleanliness process. The advantages of this PCR compared than other PCR is, it can clean wall and floor automatically. Besides that, it also can maneuver around without using remote control or any human control devices. The assumption done in this research is, the pond is emptied before the cleaning process is started.

ABSTRAK

'Robot Pencuci Kolam (PCR)' adalah robot yang digunakan untuk mencuci kolam atau takungan. Kajian dan pembinaan robot PCR adalah untuk memudahkan urusan sehari-hari manusia di samping bagi menjimatkan masa dan kos. PCR ini direka khas untuk beroperasi membersihkan lantai dan dinding dalam masa yang sama. PCR ini juga berkemampuan untuk bergerak dan membuat putaran dengan sendiri. PCR ini dilengkapi dengan dua berus untuk memberikan cucian pada lantai dan dinding. Di antara kelebihan PCR ini dengan PCR lain adalah ia mampu untuk mencuci lantai dan dinding secara automatic selain boleh berpusing tanpa kawalan daripada manusia. Andaian yang digunapakai dalam kajian ini adalah kolam dikeringkan dahulu sebelum proses pencucian bermula.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

The PCR is applications of a robotic system to ease and reduce the use of human as a worker to clean the pool. The robot is designed to work on the dry pool.

In this project, DC motor is use as movement devices and a couple of mechanical concept to support the movement

The movement of the PCR is controlled by using Arduino and several motor driver circuits beside of a sensor to control the maneuver of the robot.

It is fully design by using AutoCAD software before the development is started. The AutoCAD drawing is made as a planning method to ease the development process.

1.1 Problem Statement

From the existing pond cleaning robot, most of the robot has the problem to maneuver and turn accurately. The robot also uses the remote control and was monitored by human while cleaning the pond. The robot is unable to brush and clean the wall.

From the existing problem, the newly proposed robot is capable to move straight and make a turn accurately by using a few sensors, controller and other devices. The robot is automatically operated with preplan motion for the movement.

1.2 Objective

The objectives of this research are:

1. To design and develop Pond Cleaning Robot (PCR) which can clean the pool.
2. To draw PCR by using an AutoCAD software.
3. To develop the controller for movement and cleaning process.
4. To test the functionality of the cleaning process.

1.3 Project Scope

1. The robot only can clean the emptied pond.
2. The movement is based on pre-plan approach.

1.4 Organization of the Thesis

These theses contain 5 chapters which explain deeply on the works that is done to complete the task. The first chapter contains an introduction of the project. The induction give an early impression to the project such as a project objective and problem statement.

The second chapter will discuss about a literature review used to get the research background and relevant concept regarding the project. Each concept founded, will be discussed and chosen to get the best design to used on the project.

Project methodology is the third chapter which express about the selected method deeply. The used method will be discussed and compared.

The forth chapter is about the preliminary result that touch the currently progress and the action taken to complete the first Final Year Project (FYP).

Chapter 5 will make a deep discuss about the step taken to finish up the task. The discussion will discuss not only the achievement, but also a problem occurs due to the process. Other than that, all the advantages, disadvantages due to finish up the robot, problem and solving method are also will be discussed in these chapters. The analysis is about the analysis done to get the result regarding of the development of the PCR.

Conclusion and suggestion is the last chapter. Conclusion will conclude on the result, achievement of the project. The suggestion is used to state an improvement that can be made on the project. This chapter is used to state the improvement that can be applied on the project to make sure that thr project will get to be used long life.

CHAPTER 2

LITERATURE REVIEW

2.0 Overview

This chapter describes the basic objective of Pool Cleaning Robot development, specification and the method that can be utilized for movement and cleaning process. The hardware design and development will also be describes in the topic.

2.1 Introduction

The Pool Cleaning Robot (PCR) is a robot that can be used to clean a pool. Nowadays, the usage of the traditional cleaning method to clean the pool is widely used and the task is quite tiring and requires a lot of man force. [1].

Thus, as the consequences the usage of robot in this field can assist to lighten up their work. The demands for cleaning robot are increasingly for the task on many fields [2].

Even though the robot can help and assist human to clean the pool, there are limitation of the current robot. The robot cannot accomplish all type of work unless it is

capable to do the jobs [3]. Most of the cleaning robot has the brush or sucking device which is in static position and cannot move to clean all part of the wall.

The usage of the robots to help human, have to be made as small as it possible to ease the human to control them. The invention of the robotic system has to be in a small size but also has a lightweight characteristic to make it portable [3].

2.2 Mechanical Design

Normally, most researches is focus to the way the robot doing cleaning. The robot should have the brush on the x-axis for brushing the floor and brush on the y-axis to brush the wall. On the wall function also, the brush need to move back and forth to allow fully cleaning on the wall.

On the base (x-axis), pair of wheeled, brush and y-axis will be attached. The control circuit and battery will be on the base. The y-axis is a lead screw that is used to move the brush (wall) back and forth.

The sensor and limit switch is used to sense the wall to make a right turn while the limit switch is used to control the movement of the limit screw.

To clean the surface, a brush is used. The brush should be small and light [2]. The robot should also able to smooth up the impact from the collision with the wall [2]. The wheel is use as a movement method to move the robot from one place to another [1].

The rotation generate from the DC motor will do the cleaning function for the robot [1]. To achieve the goal to clean the pool, the control system of the robot will perceive an external information by the used of sensor and limit switch [4, 5]. From the received input from the limit switch, the control system will decide the way to move to reach the desired achievement [4, 5].

The robot has automatic function to take the right corner after reach the end of the pool [6]. The robot also can be remotely controlled [7].

In the design by [2] has come out with a LEGO MINDSTORM. On the trial, LEGO MINDSTORM can be used to get the picture of the POOL [2]. The concept which is used on the vacuum inhaler sweep is a practical idea that can minimize the size of the robot [2].

The robot is planned to be custom by using an aluminum steel on the chassis of the base (x-axis) and metal welding on the holder of the wall brush. On the y-axis, the slide type will be used on the lead screw to allow smooth movement.

2.3 Cleaning Method

In the study done by [6], the pool cleaning robot named as Tigershark is developed. The tigershark cleaning robot has a function to clean the pool in the unattended case and filter the water at the same time to keep the water clean [6]. Besides, while it is cleaning the pool, a pair of rotational brushes in front and at the back of the motor can secure the housing when the robot hitting the wall [9].

There are the cleaning robot which has a sucking and cleaning function and at the same time, it capable to clean the pool from garbage, micro-organism and dust [4].

Instead of brushes, the usage of towel can also be applied to clean the pool [7]. The towel is attached to the roller which is driven by 2 motor in the front and at the back. When the back motors rotate in clock wise, the front motor will rotate in anti clock wise. So, the rotation of the front and back motor will allow the towel to move backward and forth to clean the floor [7].

2.4 Movement Method

The pool cleaning process normally requires human to clean wall, floor and angle of the pool. In order to apply the same function as human done, the movement of the robot will determine the way of the cleaning method to be decided and applied. The PCR is planned to move along the wall first before starting to clean middle side of the pool.

The automatic movement is made of two limit switches which are attached on the robot's body that will give the direction to control and make a turn after they are pushed [2].

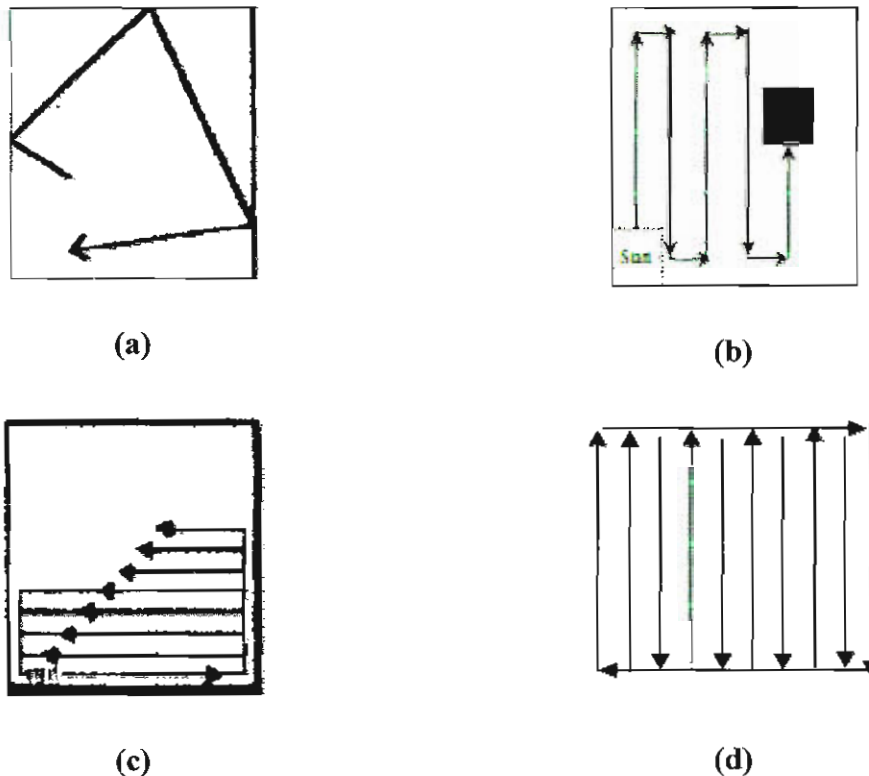


Figure 2.1 : (a) Random Turning, (b) Novel Turning, (c) Rectangular Turning, (d) Square Turning [1]

In the recent studies, there are four types of movement to control the robots movement which are random turning, novel turning, rectangular and square turning. The movement is as figure 2.1 (a), (b), (c) and (d).

The random turning movement method is used when the robot is freely moved without any control. It can be used on the robot with a gripping brush or wheel that can help the robot to climb when hit the wall as mention in [1].

The novel turning and rectangular turning require a straight moving path to ensure the robot move according to the desired output [2]. The robot usually can move in straight line if the motors used in the robot provides the same speed and torque value. The weight of the robot is also need to be balanced between the left and the right side.

The straight movement also can be obtained by using an infra red sensor (IR) by attaching it on the side on the robot to make the robot move in the planned path while moving [8]. It also can be implemented to make a right turn on the end at the wall [8].

For high precision use, the Global Positioning Sensor (GPS), Laser ranger Finder and encoder can be use to get more accurate position [8].

For the remotely controlled robot, the movement can be controlled by human on the shore

2.5 Fuzzy Logic

A fuzzy control system is a control system based on fuzzy logic which is a mathematical system. The fuzzy do the analyses analog input values in terms of logical variables which were on continuous values between 0 and 1 [13].

In digital logic, the discrete values only operate two characteristic which is either 0 or 1 (true or false). Fuzzy logic is based upon uncertainties where there is an inherent impreciseness [13].

The fuzzy will calculate the suitable result after it is set to the parameter. It eases the time to make a analysis because all the result is calculated automatically and the answer is 100% correct.

The fuzzy logic is used to compare to the other journal paper from the other university around the world. The result should be the same if the journal paper is using the same method as the PCR.

2.6 Summary

In this chapter, an intensive literature reviews have conducted to understand other people's project. The explanation of several literature review article such as journals, conferences, publications and other sources will help to get the various overview about the project

CHAPTER 3

PROJECT METHODOLOGY

3.0 Introduction

This chapter explains about the project's methodology that is applied in this project. The methodology is a process that can explain about the project execution from the beginning until it is completed. Every selection of components and actions that have been done while implementing the project will be explained. The methodology needs to be done to ensure the project that has combination of hardware and software development will be developed systematically, smoothly and successfully.

3.1 Methodology of the Project

There are several phases of methodology to be used to achieve the objectives of this project. The first phase to conduct an intensive is literature review regarding the project. It is used to acquire information the ideas and concept of the project based on the previous researchers. The information can be found through books, journals, internet, files and etc.