

# **STORAGE WATER TANKS CLEANING ROBOT**

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**Tajuk Projek** : STORAGE WATER TANKS CLEANING ROBOT

**Sesi Pengajian** : 

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**For my beloved mother and father**

Inah binti HJ. Khamis

Mohamed bin HJ. Tengah

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## ABSTRACT

This project report is to design and build a storage water tanks cleaning robot. The cleaning robot are enter to replace the human labor and to reduce the time and danger for human in the storage water tanks. This method can save on maintenance costs and reduced water wastage. In addition, the robot are controlled using the Graphical User Interface (GUI) to control all the movement such as forward, reverse, turn right, turn left, activated the pump, lamp and also can view the surface inside the storage water tanks via web cam camera. The operation of this robot is to slowly suck the sludge to accumulate in the bottom of the robot and the pumped flow out through the hose pump for water filtration process. The project are used Microcontroller (Pic16f877a) who became 'Main Brain' to operate the relay circuit to move the dc gear motor, pump circuit and lamp circuit. This all operation are use serial communication via RS232 cable to communicated the computer to Microcontroller and give the output to move the cleaning robot. Furthermore, this kind of robot must be waterproof to operate in water at high water pressure.. This report describes the construction of their robot in terms of body building mechanical design and circuit development until make the software that can control all the operation in this storage water tanks cleaning robot.

## ABSTRAK

Projek ini adalah untuk mereka bentuk dan membina sebuah robot pembersih tangki simpanan air. Robot pembersih akan masuk ke dalam tangki simpanan air untuk menggantikan tenaga kerja manusia. Oleh itu, secara tidak langsung ia dapat mengurangkan masa pembersihan dan risiko bahaya ketika berada dalam tangki simpanan tersebut. Kaedah ini boleh menjimatkan kos penyelenggaraan dan mengurangkan pembaziran air. Di samping itu, robot yang dikawal menggunakan Graphical User Interface (GUI) untuk mengawal semua pergerakan robot seperti ke hadapan, kebelakang, belok kanan, belok kiri, serta mengaktifkan pam, lampu dan juga boleh melihat permukaan dalam tangki air simpanan melalui kamera yang telah dipasang pada hadapan robot. Robot ini beroperasi dengan menyedut lumpur secara perlahan-lahan yang akan terkumpul di bahagian bawah robot dan dipam mengalir keluar melalui hos pam untuk proses penapisan air. Projek ini menggunakan Mikropengawal (Pic16f877a) yang menjadi 'Otak Utama' untuk mengoperasi litar relay untuk menggerakkan DC gear motor, litar pam dan litar lampu. Kesemua operasi adalah menggunakan komunikasi bersiri melalui kabel RS232 untuk disampaikan daripada komputer kepada Mikropengawal dan memberi keluaran untuk menggerakkan robot pembersih tangki simpanan. Tambahan pula, robot jenis ini mesti kalis air supaya dapat beroperasi didalam air pada tekanan air yang tinggi. Laporan ini menerangkan tentang pembinaan robot dari segi mereka bentuk binaan badan secara mekanikal dan pembuatan litar elektronik sehingga membuat perisian yang boleh mengawal semua operasi dalam Robot Pembersih Tangki Simpanan.



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## LIST OF ABBREVIATIONS

PVC	-	Poly Vinyl Chloride
PIC	-	Peripheral Interface Controller
IC	-	Integrated Circuit
EEPROM	-	Electrically-Erasable Programmable Read-Only Memory
PROM	-	Programmable Read-Only Memory
RAM	-	Read All Memory
WDT	-	Watch Dog Timer
ICSP	-	In Circuit Serial Programming
USB	-	Universal Serial Bus
UART	-	Universal Asynchronous Receiver/Transmitter
RPM	-	Rotation per second
DC	-	Direct Current
LED	-	Light Emitting Diode
PCB	-	Printed in Circuit Board

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## **CHAPTER I**

### **INTRODUCTION**

In this chapter, the introduction of the Storage Water Tanks Cleaning Robot will be explained. This Chapter will explain the objective, problem statement that must be face and the scope of works.

#### **1.1 Introduction**

Water tanks are liquid storage containers, these tanks are usually storing water for human consumption. A water tank provides for the storage of drinking water, irrigation agriculture, fire suppression, agricultural farming and livestock, chemical manufacturing, food preparation as well as many other possible solutions [1]. Water storage tanks must be maintained so that the quality of water in the tank is clean. Because of contaminated water can lead to diseases that can harm consumers. Unscheduled tank cleaning will affect the health of users. Therefore, storage water tank cleaning should always follow the schedule that have ready set by the user. There are two methods that usually used to clean the water tank. First is using manual method where a manual worker would get himself in the tank and scrub the wall that called conventional water cleaning that mostly cost so expensive. The second method is using

automated water tank cleaning. The development of underwater operations robot can solve one of the fundamental problems of clean and potable water to the people by cleaning the water storage tanks, which store water for long time and get sludge deposition at the bottom of the tanks. It is also an effective method to minimize time and danger thus saving human labor.

## **1.2 Problem Statement**

In the modern era, people are very concerned about the rapid and cost-effective facilities. Therefore, project that suitable for use in this modern era is cleaning robot that works in a water storage tank. This robot serves as a tool to clean dirt and sludge in the water tank without removing the total amount of water in the storage tank. Therefore, the cost of cleaning can be reduced and avoid wasting water. Cleanliness in the water storage tank is essential to avoid unwanted presence of disease.

## **1.3 Project Objective**

There are two objectives of this project:

- a) To develop cleaning robot to work in storage water tank.
- b) To create controller that can move the cleaning robot.

## 1.4 Project Scope

The scope of this project are:

- a) Design and build the water tank cleaning robot. For example, build the robot that can operate under the water and for specific storage tank with a flat surface only.
- b) Study and design controller that can control the movement of the robot.
- c) Develop the mechanism in the robot such as camera video that provided to allow an operator to monitor the progress of the vehicles

## **CHAPTER II**

### **LITERATURE REVIEW**

This chapter focuses on the theory of every part of the robot design. Resources obtained from journals, thesis and website containing all information related to the project.

#### **2.1 Introduction**

The International Standards Organization (ISO) defines a robot as “an automatically controlled, reprogrammable, multi-purpose, manipulative machine with some reprogrammable axes, which may be either fixed in place or mobile for use in industrial automation applications”.

## 2.2 Conventional Water Tank Cleaning



Figure 2.1 : Conventional Water Tank Cleaning

Davis, J. and Lambert, R., 2002 state there are three steps for conventional cleaning and disinfecting a water tank. [1]

a) Step 1: Cleaning the tank

Empty the tank. Open the outlet valve/tap and drain out any remaining liquid. Clean all internal surfaces. Use a mixture of detergent and water to clean all internal surfaces of the tank.

b) Step 2: Disinfecting the tank

To effectively disinfect the tank, fill it with clean water up to  $\frac{1}{4}$  level only. It is important to not fill the tank too much as this will reduce the concentration of the chlorine solution and limit the effectiveness of cleaning.

c) Step 3: Chlorine testing

Refill the tank with clean water and allow standing for 30 minutes. Test the residual chlorine left in the tank using a comparator.

## 2.3 Types Of Cleaning Robot System

These types of cleaning robot system that are :

### 2.3.1 Oil Tank Sludge Cleaning Robot



Figure 2.2 : Oil Tank Sludge Cleaning Robot

This Oil Tank Sludge Cleaning Robot are used to clean the bigger Oil Tank that in petroleum industry. To clean oil storage tank manually not only means a flammable, explosive and toxic environment working conditions but also an operation of low safety, low efficiency, long time and environmental pollution problems. Recently robots have been successfully applied to clean tank appearance and tubes to fully reflect the advancement of robot technology and its practicality. As a result, the mobile sludge cleaning robot is developed. It is equipped with high pressure water jet and shoveling to clean the sludge in the oil storage tank to relieve workers from high intensity labor and poor environmental hazards and improve security and reduce the sludge clearing cycle.[2]

To improved the adaptability of Oil Tank Sludge Cleaning Robot to complex conditions and enhance robot automation and intelligence operations this development requirements must be improved to high level.