
# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## DESIGN AND DEVELOPMENT OF PIPELINE INSPECTION ROBOT

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Robotic and Industrial Automation) with Honours.

by

**NURLIYANA BINTI MAJID**

**B071510056**

**930214075034**

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# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Design and Development of Pipleine Inspection Robot

SESI PENGAJIAN: 2017/18 Semester 2

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I hereby declared this report entitled “Design and Development of Pipeline Inspection Robot” is the results of my own research except as cited in references.

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# APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor Electrical Engineering Technology (Robotic and Industrial Automation) with Honours. The member of the supervisory is as follow:

……..

(Project Supervisor)

# ABSTRAK

*Robot pemeriksaan saluran paip pada dasarnya adalah robot yang akan digunakan untuk memeriksa bahagian dalam saluran paip untuk sebarang kerosakan atau halangan. Salah satu wilayah dasar industri minyak dan gas adalah kenderaan minyak dan cecair yang berbeza melalui sistem saluran paip. Selepas beberapa lama, paip-paip ini akan mengumpul lintah dan lain-lain yang akan membawa kepada pengurangan dalam kapasiti penghantaran paip, mengurangkan kebolehpercayaan, kehilangan kuasa akibat tekanan pam yang lebih tinggi diperlukan dan aliran tidak teratur.. Berdasarkan kepada isu-isu yang disebutkan di atas, penyelesaian ini dipilih untuk menyelesaikan masalah dengan menggunakan projek robot pemeriksaan ini. Projek ini berfungsi untuk menghantar input video secara langsung kepada tenaga kerja yang menggambarkan jenis kerosakkan yang terdapat dalam saluran paip.*

# ABSTRACT

The pipeline inspection robot is basically a robot that will be used to check the inside of the pipeline for any damage or barrier. One of the basic areas of the oil and gas industry is the different oil and gas ports through the system pipeline. After a while, this pipe will collect leeches and others which will lead to a reduction in capacity pipe transmission, reducing reliability, loss of power due to higher pressure required and irregular flow. Based on the above-mentioned issues this solution was selected to solve the problem by using a robotic project check. The project works to send input video directly to the workforce that describes the type of damage found in the pipeline

# DEDICATION

First of all, all praise and dua' belongs to the Allah Almighty, The Most Beneficent and The Lord of all the world for let me through this journey of knowledge of education, that is full of benefits and never let me alone. Be upon the final massager Prophet Muhammad SAW, upon His family, and His Noble Champion.

This project is dedicated to my beloved parents who always be my number one inspiration, my loving sibling that made me stronger person, and friends that always extremely supportive along this journey.

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| | | |
|---|---|---|
| CAD | - | Computer Aided Design |
| CAM | - | Computer Aided Manufactring |
| PIR | - | Pipline Inspection Robot |
| mm | - | Millimeter |
| min | - | Minute |
| rev | - | Revolution |
| rpm | - | Revolution per minute |
| mA | - | miliAmpere |
| V | - | Voltage |
| MHz | - | MegaHertz |
| GB | - | GigaByte |
| KB | - | KiloByte |

# CHAPTER 1

# INTRODUCTION

## 1.0 Introduction

In this segment comprise of the project background, problem statement, objective, work scope and thesis outline.

## 1.1 Project Background

In our present society, there are plenty types of pipes are being utilized for erect important lifelines like gas and water source. Furthermore, pipes also are widely used in chemical industries and in harbor countries for carrying diesel, oil, petrol etc. The longer the usage of the pipe, the sooner it will get defects and damaged occurred in pipeline. Less inspection activities to the scrap part of the pipeline only, which cause eventually into a pipeline system with uncertain integrity. Many accidents have

occurred from fluid leaks owing to the cracks and corrosion of pipelines. These accidents wreak havoc on plants, animals and humans. It is therefore vital to prevent the occurrence of such fluid leaks and save ourselves the disaster. The uninspected sections of the pipeline system need to be done. This project provide statistics on the "robotic inspection technology".

Pipeline inspection robot is a smart method for controlling and inspecting inside pipeline systems by utilizing information technology. Thus, this project is created by utilizing a Raspberry Pi 3 Model B, (RPi3). The Raspberry Pi 3 Model B is the third generation.

Raspberry Pi connected by serial communication to Android. Raspberry Pi gives Wi-Fi correspondence Arduino and the client which is Android phone. At the point when a defect detected, it will be display live using the Raspberry Pi Camera through the Android phone.

The robot movement using manually control by human using Android application. The Android phone used Pi_Car application which allows the user to take the live video stream from Raspberry Pi and control the motor.

## 1.2 Problem Statement

In industry, home, power plant etc. we observed that there are various problems occurs inside the pipeline system such as crack, corrosion, dent mark, bulging and metal loss. It is difficult to inspect the pipeline which the depth and diameter of the

pipeline is unreachable. In additional, less maintenance work also the main reason for the defection in pipeline system. So, with the help of "PIPELINE INSPECTION ROBOT" (PIR), we will inspect the pipeline for solve the problems.

## 1.3 Objectives

The objectives of the project are:

i. To develop pipeline inspection robot
ii. To integrate the camera and wheel robot with android application
iii. To analyze the performance of pipeline inspection robot

## 1.4 Scope of Study

The scope of study for this project is to develop a reasonable method to capture the internal condition of a pipeline system. After that, design a prototype of pipeline inspection robot with measurement of 192.2 mm x 325.5 mm x 139.5 mm which will inspect the pipeline with live streaming video while control the robot movement. The project mainly focus on inspection inside PVC pipeline with diameter of 9 inches and length of 5 feet by utilizing Raspberry Pi. The Raspberry Pi Camera function as live video streaming for the inspection method. Furthermore, the robot movement will be manually controlled and inspect using live streaming camera.

## 1.5 Thesis Outline

In this theory, it is isolated into three principle segments which is Chapter 1, Chapter 2, and Chapter 3.

The Chapter 1 expand more about project background, problem statements objectives, and scope of study.

Chapter 2 includes of literature review. Literature review will analyze and talk about the past research which related with pipeline inspection robot. The distinctive sorts of pipeline inspection robots likewise will be elaborate in Chapter 2.

Chapter 3 comprises of methodology of the project. In this section will clarify about the part and programming utilized including the specifications. This part will demonstrate the flow of finishing the project.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

This section study about the past research which identified with the project. This part will relate the distinctive of principle cerebrum of the pipeline inspection robot and the better one will be chosen. The reason for this section is to acquire learning, expertise and data to build up the project.

## 2.1 Pipeline Inspection Robotic System

In modern era of industrialization pipeline is the most common way of inbound and outbound transportation of the fluids. The maintenance and inspection of pipe line is also necessary to prevent it from blockage and leakage. Sometime pipelines are used to carry toxic fluids so it will become harmful to do manual inspection and

maintenance. Inspection of underground pipeline is also a complicated task for human. Robots are used to remove the risk involved and complexity of the task related to pipe inspection and maintenance. A pipeline inspection robot (PIR) is a device used to run through pipelines for inspection, measurement and cleaning operations.

## 2.2 Related Research

The advantages and disadvantages for the project that related with proposed of the project title has been done for comparison. The project weakness can be resolved with the exploration on past project, and the framework outline of existing task can be audit as references. The objective of the project can be accomplish from the related research.

### 2.2.1 Research on Pipeline Inspection Robot using Track Wheel Application

In this project, H. Ri et al, (2015) they developed a prototype of track wheel operation of pipeline inspection robot. Friction is that the power opposing the relative movement of liquid layers, material parts and strong surfaces sliding against each other. In this robot characteristics, the researcher utilizing silicone as the contact function between the robot and the pipeline. Friction is intriguing and vital in arrangement traction to encourage movement on the land. Most land vehicles have certainty contact for increasing speed, abating and dynamical course. Sharp diminishments in footing will cause loss of administration and mishaps. This is the reason why the researcher chose the rack wheel as the main traction to move or climb. While for transmit power, the researcher used gear box. The important thing of the project are programming which is Arduino Uno that been used to control the

robot. The main aim for this robot can move and also climb the pipelines. The extent of the venture is confined to 14" inward distance across of UPVC pipe. This project mainly focus for the robot to climb up 30° without skidding or slipping.

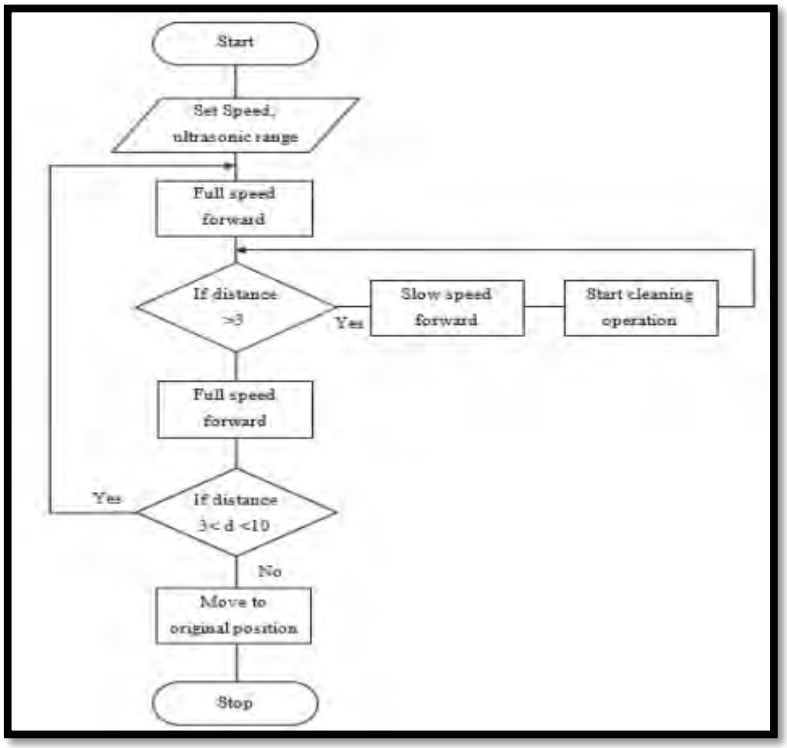


Figure 2.0: Flow Chart for Track Wheel Programming

As the result of this project, the track wheel application for the robot are lacking of power during climbing that caused the input(I) value of programming need to increased up. (Ri et al., 2015)

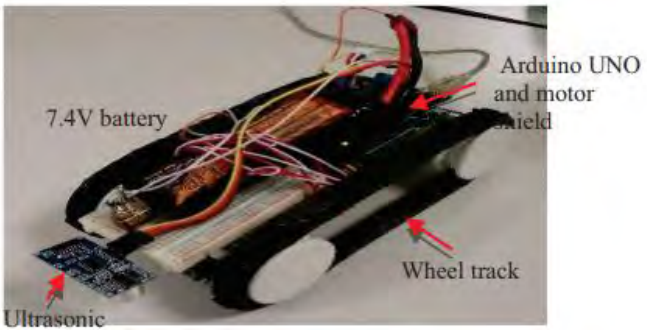


Figure 2.1: Isometric view of the Wheel Track

### 2.2.2 Research on Pipeline Inspection Robot using Two Wheel river (2WD) Application

For this system, L. Vuen (2015) design the project more for laboratory experiments at undergraduate level teaching. This is because the researcher just used Lego Mindstorms NXT Education Base set as a test bed for this project purpose. As the characteristic, the researcher used the rubber as the contact function between the robot and the pipeline. The traction as 2WD for keeping the robot movement of pushing ahead in line. The motor is synchronization is finished by intrinsical PID Controller inside the two motors. While for the inspection purpose, color sensor is snared to an alternate additional motor, turning the point of 180° to find splits that territory unit painted totally by extraordinary color tapes(Marangoni and Baron, 2014)

Table 2.0: Different Color Tapes

| No. | Types of cracks | Color Sensor Active |
|---|---|---|
| 1. | Transverse crack  | RED |
| 2. | Longitudinal crack  | YELLOW |
| 3. | Slant crack  | BLUE |