

TUNNEL INSPECTION ROBOT II

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**This report is submitted in partial fulfillment of the requirements for the award of
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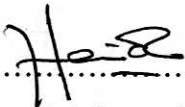

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I would like to dedicate this thesis to my beloved family and everybody that given me encouragement and support from start till the end.

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ABSTRACT

The purpose of this project is to design and construct a new version of tunnel inspection robot equipped with new application such as a gas sensor and water detector. This new robot is developed on a new platform that is more functional so that the robot can work under various condition and surfaces.

The tunnel inspection robot is made up of a moving platform controlled by two DC motors. On top of the moving platform is a turntable controlled by a stepper motor via wireless system made up of a transmitter and receiver. On top of the turntable is a miniature camera connected remotely to a computer system for monitoring and manual steering of the robot. Together with the camera is search light for lighting up dark areas.

The robot is also equipped with a gas sensor to detect methane gas and inform the operator of poisonous gasses in the environment. A water detector device is also attached to ensure that the robot can avoid water logged places to prevent flooding of the robot. The new robot is also equipped with an obstruction detector to enable the robot to move automatically unobstructed. The new robot is more rugged so that it can reach dangerous and difficult areas.

Apart from that, the tunnel inspection robot has been integrated with software to provide security for accessing the robot. This is to avoid abuse or wrong utilization of the Tunnel Inspection Robot.

ABSTRAK

.Tujuan projek ini adalah untuk mereka bentuk dan membina sebuah robot pemeriksa terowong versi baru dan dilengkapi dengan aplikasi baru seperti pengesan gas dan pengesan air. Robot ini dibina daripada platform yang baru supaya lebih berperanan untuk bekerja di dalam pelbagai keadaan dan permukaan.

Robot Inspeksi Terowong dibina dari pelantar yang digerakkan oleh dua motor DC. Diatasnya terdapat kamera dan lampu yang digerakkan oleh motor stepper yang dikawal melalui sistem tanpa wayar. Visual kamera tersebut dapat diakses melalui sistem komputer untuk tujuan pemantauan dan kawalan manual untuk robot.

Robot ini juga dilengkapi dengan pengesan gas yang boleh mengesan kewujudan gas metana untuk sistem penyedaran sekeliling. Sementara itu, ia juga dilengkapi pengesan air untuk mengelakkan robot daripada tenggelam didalam air. Robot baru ini juga dilengkapi dengan pengesan halangan supaya robot dapat beroperasi didalam mod separa automatik. Robot baru ini adalah lebih lasak dan boleh bekerja didalam sebarang kawasan berbahaya sebagai sistem pemeriksa atau sistem pemerhati yang lebih berkesan.

Selain daripada itu, visual dari robot telah di gabungkan dengan perisian yang memberikan sistem keselamatan kepada robot. Ini adalah untuk mengelakkan robot daripada disalah guna.

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CHAPTER I

INTRODUCTION

1.0 Introduction

This chapter will start with overview of the project. It is followed by objectives, statement of problems, scope of project and project methodology.

1.1 Overview

Robotics is rapidly expanding into human life especially with new challenges emerging through this century. Interacting, exploring and working with human make the robot involves directly with human's lives. The successfulness in introducing robot in human environment will rely on the development of competent and practical system that are dependable, safe and easy to use in order to minimize humans work. In order to be able to work, interact and cooperate effectively with humans, this robot must be accommodated with the abilities and skills that are compatible with humans. In the area of human-friendly robot design, the focus is on new design concepts for the development of intrinsically safe robotic systems that possess the requisite capabilities and performance to interact and work with humans.

1.2 Objectives

The main objective of this project is to design and develop a new version of tunnel inspection robot that can work in any condition and state. The tunnel inspection robot should be small and easy to be controlled. The inspection robot is to be used in a tunnel for inspection purposes, testing of complex pipe system and maintenance of the tunnel or pipe system. Inspecting a tunnel is a dangerous and difficult job for human. An alternative option is needed in order to make the job safer. Therefore, a small medium size robot has been designed in order to do the job. Besides, the robot can also function as a surveillance or inspection system to replace human in dangerous or hazardous situations. This robot is also useful within collapsed structures or hazardous structures and rescue operation inside disaster prone areas.

Sometimes one may need to determine whether a partially collapsed or damaged building is safe to enter or not. The tunnel inspection robot can easily enter the building and make inspection. This can prevent more casualties as the robot instead of human is sent to do the inspection job. Tunnel inspection robot is designed to move around the rough terrains, dangerous obstacles and narrow spaces that would be difficult and hazardous to be accessed by human inspectors. Furthermore, this tunnel inspection robot can inspect a structure faster than human inspector. More time can be saved by using the inspection robot. If the inspection result can be received earlier, faster action to curb or cure the problem can be taken. This might help to prevent the problem from getting worse.

1.3 The Tunnel Inspection Robot

Tunnel Inspection Robot II is a small remote controlled mobile robot that is capable of moving inside a small-enclosed path that could be dangerous or inaccessible to human. Figure 1.0 shows how a tunnel inspection robot II looks like.

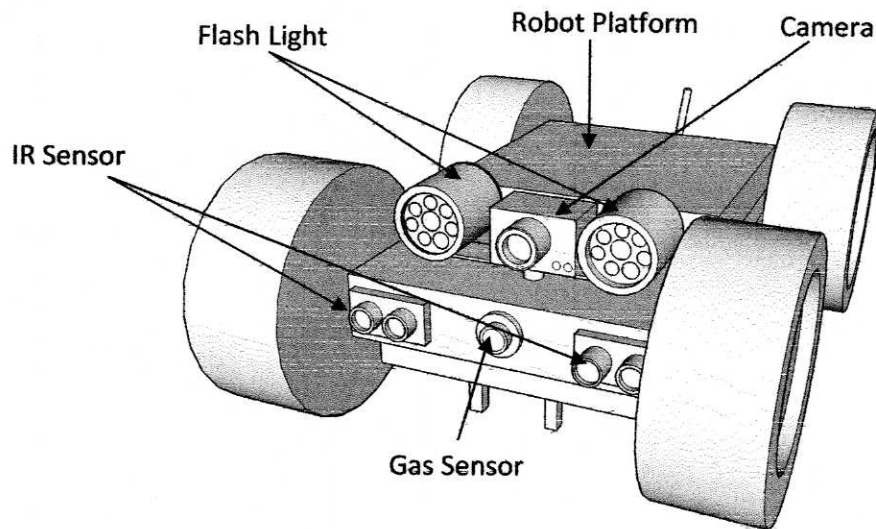


Figure 1.0 Tunnel Inspection Robot II

The Tunnel Inspection Robot II consists of a movable platform that equips with search light and video camera. Both the search light and the video camera are set on the turntable. The turntable can be remotely control to turn left or right so that the camera can capture the situation on that side. Both of the robot and the turntable are controlled using wireless system to avoid entanglements. The wireless camera is used for surveillance purpose as the camera will receive and transmit video signals using radio frequency system. The search light provided on the tunnel inspection robot act as a medium of lighting up dark areas.

Moreover, the tunnel inspection robot also has been equipped with water detector, obstruction sensor and gas sensor. The water sensor is equipped to detect the water existence, thus give signals of possible danger. This is for

avoiding the possible danger that can harm the robot as the robot could not function in water. Meanwhile, the obstruction sensor makes the robot to be able to detect obstacle in front of it. When it detects any obstacle, it would stop and try to find another path that is obstacle-free by itself. With the obstruction sensor, it could operate in semi automatic mode.

1.4 Statement of Problem

It is obvious that inspection or maintenance work in the tunnel or pipe area is quite dangerous for human; there might be a gas leakage or the structure of the tunnel or pipe is unstable that it might collapse anytime. The tunnel or pipe is a complex system; it consists of various sizes and shapes of structure, which makes it difficult for human to enter it without having enough background information on the tunnel. Therefore, it is not advisable for humans to do inspection and testing in a dangerous area such as in complex tunnel system or in hazardous structure. Moreover, it is difficult for human to reach narrow and small places such as in the complex tunnel system and collapsed building. Hence, the Inspection Robot II was design with hope to overcome these problems.

1.5 Scope of work

The scope of this project is to:

- a) design a new robot platform that can function in various conditions.
Selecting and choosing a rugged robot platform with ease control on robot movement. Besides, design the robot structure so that all the applications can be placed within the platform chosen.
- b) design and develop an obstruction detector so that the robot can operate in semi automatic mode.
- c) design and develop a water detector device to prevent the robot from going into deep water end or to prevent the water from causing a short circuit.
- d) design and develop circuit of gas sensor that can detect methane gas and attach it to the robot.
- e) Attach all the application together on the robot platform.

1.6 Methodology

a) Research and study on:

- Suitability of the new robot platform
- The inspection work difficulties
- Water detector application
- Obstruction sensor
- Gas sensor application

b) Develop:

- The new robot design and appearance
- The transmitter and receiver
- The circuit of obstruction sensor
- The circuit of water detector
- The circuit of gas sensor

c) Implement and Testing:

- The circuit of whole project
- The whole system

The details of the project methodology will be explained in Chapter 3.

1.7 Thesis Structure

This thesis consists of five chapters. Chapter I will focus on the introduction of the project. The important overview or description including the statement of problem, objectives and scopes of project are described in this chapter. It also illustrates some overview of the project methodology.

Chapter II explains the development of the Tunnel Inspection Robot II. Discussion will be based on the robot platform selection and the sensors used such as gas sensor, water sensor and obstruction sensor. It will also discuss on the security software developed using the Visual Basic 6 software.

Chapter III will indicate the methodology of the project. This chapter explains the procedures that have been used in order to complete this project. It includes the hardware development. The methodology can be reuse as a guideline for improvement of this project.

Chapter IV mainly focuses on the result and analysis done in this project. This chapter will illustrate a few tests that had been conducted in several levels and stages in order to enhance the successful rate of the project. The purpose of the test, expected result, procedures, result, discussion, and conclusion for each test will be discussed further in this chapter. All testing and verification results are included and aided with figures and tables.

Chapter V is a complimentary of the previous four chapters. It describes on the overall project and discussion on the result achieve. Future recommendation on the ideas of upgrade that can be made to this project to make it more reliable in the future is also discussed. All matters that occur including the problems and unachieved objectives will be described clearly in this part.

CHAPTER II

LITERATURE REVIEW

2.0 Introduction

This chapter will explain the overall theory and the project development concept. The objective is to describe the perspective and the procedures that were used in previous research and to show how this project can be related to the existing theories.