DESIGN AND DEVELOPMENT OF WASTE TRAP AND REMOVAL SYSTEM FOR MONSOON DRAINS APPLICATION USING PLC-BASED SYSTEM

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This Report Is Submitted In Partial Fulfillment OF Requirements For The Degree of Bachelor In Electrical Engineering (Control, Instrumentation, and Automation)

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DECLARATION

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

Signature : .....

Name : MOHD NIZAM BIN OTHMAN

Date : MAY 2009

APPROVAL

"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation, and Automation)"

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Date : MAY 2009

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ABSTRACT

In Malaysia, most of the rivers and channels cross the residential area. In the early days, rivers and channels were clear and not polluted. However, due to development activities, the river has been polluted especially at the residential area. This project is about the waste trap and the removal system that really needed to overcome problem of pollution. A waste trap system will be designed and developed in order to trap all the rubbish/sediment contained in the water flow in the monsoon drain. Removal system will be included to remove the rubbish that has been trapped, to a container. This project consists of both mechanical and electrical part of the system. The mechanical part will be controlled by using Programmable Logic Controller (PLC). When the container is fully loaded, it will automatically put/throw the trapped rubbish into another container. This project is suitable to be used either in monsoon drain or river. Litter and rubbish will be trapped before the water flow get into the sea. These actions can avoid from the bad smell and water pollution. From the study has made the implementation of the rubbish traps is one of the best methods to control the floating waste materials in the rivers in order to reduce pollution.

ABSTRAK

Di Malaysia, kebanyakan sungai mengalir dari punca kawasan perumahan. Dahulunya, sungai dan saliran amat bersih dan tidak tercemar. Walaubagaimanapun, akibat daripada aktiviti pembangunan, sungai dan saliran telah tercemar terutamanya di kawasan perumahan kediaman. Projek ini adalah mengenai sistem perangkap dan pemindahan sampah yang amat diperlukan untuk mengatasi masalah pencemaran. Sistem perangkap sampah akan direka dan dibangunkan untuk memerangkap sampah dan sisa-sisa terbuang yang terkandung didalam system perparitan dan saliran. Sistem pemindahan akan turut disertakan bagi memindahkan sampah yang telah diperangkap kedalam bekas atau takungan yang lain. Projek ini mengandungi dua bahagian iaitu bahagian mekanikal dan bahagaian elektrik. Bahagian mekanikal akan dikawal oleh *Programmable Logic Controller* (PLC). Apabila bekas takungan sudah penuh, ia akan secara automatic memindahkan sampah itu ke dalam bejas takungan yang lain. Hasil projek ini sesuai diaplikasikan untuk sistem perparitan, saliran, dan sungai. Sampah dan sisa buangan akan diperangkap sebelum air mengalir ke sungai dan laut. Hal ini dapat mengelakkan daripada berlakunya pencemaran air dan penghasilan bau yang kurang menyenangkan. Kaedah ini diyakini adalah salah satu cara terbaik untuk mengurangkan pencemaran.

CONTENT

LIST OF FIGURE

CHAPTER I

INTRODUCTION

This chapter consists of the introduction, problem statement, objectives, and the scope of project

1.1 Introduction

Rivers provide water for drinking and therefore life, agriculture - the rice, fruit and vegetables we eat, industry - the cars and computers we use, domestic use and washing and bathing. They are also important as breeding areas for fish, birds and mammals, home to many different (and some unique species of) plants or animals and micro-organisms. This diversity is important for life as a whole, the main mode of transport for many local communities, recreational areas for boating Rivers provide water for drinking and therefore life, agriculture - the rice, fruit and vegetables we eat, industry -

the cars and computers we use, domestic use and washing and bathing. They are also important as breeding areas for fish, birds and mammals, home to many different (and some unique species of) plants or animals and micro-organisms. This diversity is important for life as a whole, the main mode of transport for many local communities, recreational areas for boating, rafting, picnics, swimming and fishing.

A living river supports a complex web of life: from microorganisms to plants and mammals; thanks to its chemical, biological and physical characteristics. Life depends on free- flowing, living rivers. Throughout history, man has built settlements, villages and cities near or next to rivers. Also, think of the diverse wildlife like orangutans, crocodiles, fish or fireflies that live alongside or in rivers. They are the arteries of the Earth. They carry life-giving microorganisms and minerals through the landscape. Only when living rivers flow freely and dynamically can they support and give life. There is a complex balancing act going on the whole time that enables life to continue its varied cycles: from micro-organisms that you can't see to algae, plants - and people. Reproduction, hatching, migration also depends on them. The smallest change to the river flow and natural temperature control can affect life, sometimes irreversibly. We are destroying this delicate web by polluting rivers, destroying our catchment area, overexploiting our river resources and introducing exotic species to our rivers; also by building dams. There are 117 major rivers in Malaysia but they're becoming more and more polluted.

1.2 Problem Statement

1.2.1 Disposal of Litter

People used to throw household waste into the river without causing much harm. The waste was mostly organic (plant of animal material) and so was biodegradable (the plants and animal material is broken and is absorbed into the environment). For example, goods that people bought in the market were wrapped in banana leaf, which quickly rotted away. In the 1950s, however, plastic was introduced to wrap goods: plastic does not disappear quickly, and it is a toxic (poisonous) substance. There were now many items in household bins that were dangerous to the environment. At the same time, factories and industries appeared, and these caused serious problems, as they dumped their waste in the river. At first, people didn't notice that there was anything wrong. The river usually carried away all the garbage and people forgot about it. But then the amount of garbage increased with the population and the increase of factories and the river became blocked in places. Blockages were often due to metal and plastic items which did not rot away. This meant that the garbage stayed in the same place and the water became polluted. It became unsafe to drink the water and it was also unpleasant to be near the river as it stank from all the rotting garbage.

1.2.2 Water Pollution

There are different types of pollution: mainly chemical and organic and both can cause untold and permanent damage to rivers and the environment. And to humans! 97% of our tap water comes from rivers - our drinking water comes from rivers. It is therefore imperative that we look after our rivers. In 5 years, the number of clean rivers fell by 49% (1993 there were 81 clean rivers; in 1997 there were 24). In 5 years, the number of

polluted rivers increased by 11% (1993 there were 12 polluted rivers; in 1997 there were 25), source taken from Department of Environment (DOE), 1999.

The number one pollutant in Malaysia is organic waste from sewage, animal waste and excessive soil deposits. Organic - human and animal - waste can cause disease and death. Carcasses or feces dumped illegally into our rivers can cause cholera, typhoid and hepatitis A, which sometimes result in death. Oxygen is used up to break down organic waste. If there is a large amount of organic waste, it can deprive river vegetation and animals of much needed oxygen. This can result in killing them, destroying river habitats and part of our food chain. Even though industries and agriculture come a close second, toxic chemical by-products which being dumped into the river, in fact could also risk people's health.

1.2.3 Method of Traditional/Conventional Trapping

Nowadays, we are still using the conventional trapping method that is not relevant anymore in term of the effectiveness and the functionality. The old method usually uses net to trap all the litter and waste at the river/drainage.

1.2 Objectives of Project

The main objectives of this study are:

- to design and develop a waste trap and removal system for monsoon drain application.
- to reduce the use of manpower in order to trap and remove waste.
- to improve the old waste trap system with a better system (automatic system).
- to build a teaching and learning kit for future use

1.3 Scope of project

Scope is very important in order to produce a project. This is because scope limit a project to a certain level that need to be achieved. Scopes of this project are:

- design and develop a waste trap and removal system
- this project has a capability to replace the conventional waste trap system by implement it with the use of Programmable Logic Controller by using several material and equipment and CX-Programmer as the programming language.

CHAPTER II

LITERATURE REVIEW

This chapter briefly explains about the researches that have been done during this project. These researches include several projects that related to this project and theory of components used for this project

2.1 Waste Trap

Waste trap remove litter, debris, and coarse sediment from water. Some designs also provide oil separation. These substances are collectively referred to as gross pollutants.

There are two main categories of waste trap. They are grouped according to storing a dry or wet load; collected items are either stored above (dry) or below (wet) standing water levels. Traps that store trapped items in a dry state are generally

cheaper to operate as the collected material can be delivered to local landfill facilities without issue.

Wet loads traps are more complicated and thus more expensive to operate. They require suction equipment for cleaning and the wet wastes are classified as toxic liquids. Disposal is via an environmentally controlled waste station under strict guidelines.

Waste trap is divided into six groups that are:

i. Floating debris traps – litter capture on permanent water bodies

ii. In-pit devices - Litter and sediment capture in existing pits

iii. Trash Racks and Litter Control Devices – Hard or soft litter capture devices on drains.

iv. Sediment Traps – Sediment removal only, on drains

v. SBTR Traps – sediment and litter capture for drains or pipes.

vi. Proprietary devices – range of devices, mainly for pipes.

2.2 Design of Waste Trap

Different traps can be designed using one or a combination of the screening, stilling or stopping the flow of water, flow separation, sedimentation and flotation. The design of a GPTs should be specific to the location it is to be used in. A GPTs that works well at the entrance of an urban wetland will be less effective in the centre

of a concrete work area, for instance. Traps are designed to meet the mid rainfall expectations of the given area; swales may be placed upstream to help cope with higher rainfall situations. Some factors to be considered in GPTs design are:

i. Size of particles to be caught in that location

ii. Physical space available for the trap

iii. Frequency of storms or other major water influxes

iv. Average flow rates over a year

v. Maintenance requirements – the ease and safety of access for maintenance work

vi. Frequency of maintenance that is practical in the location (obviously less often in remote places, more often in high pollution areas)

vii. Estimated loading in the area

viii. Safety and aesthetics of the trap being exposed or enclosed

2.3 Common/Former Used Waste Trap

2.3.1 CleansAll WasteTrap (from Australia)

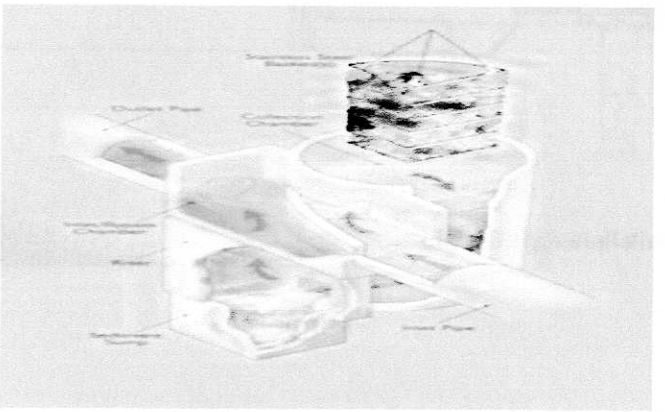

Figure 2.1: CleansAll WasteTrap

The patented CleansAll Waste Trap is a high performance trap with a unique basket system used both for the capture and removal of pollutants such as litter, sediments and oils. The basket system not only ensures the excellent capture rate of gross pollutants but also allows for the pollutants to be removed easily with no confined space access requirements, providing a very low cost of maintenance and one of the most effective whole of life cost effective waste trap. All of the components of the CleansAll waste trap are manufactured from high strength pre-cast concrete to simplify the installation process and ensure that the waste trap has a design life at least as long as the drainage line it is installed on. The CleansAll waste trap was developed in conjunction with the University of South Australia and continual research is developing new applications for the system.

2.3.2 CURATOR Petrol Separators (from Germany)

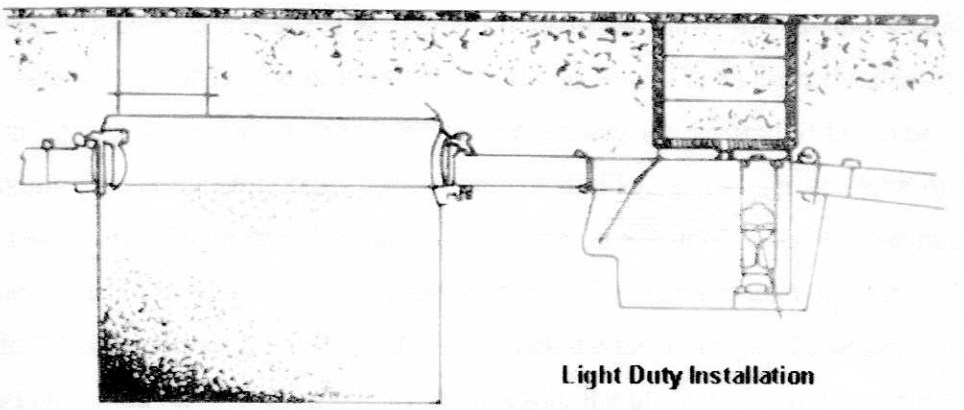

FIGURE 1

Figure 2.2: CURATOR Petrol Separators

International Production Specialists is the exclusive U.S. importer of the world-famous CURATOR Petrol Separator, which is made in Germany by Passavant Werks, A.G. The separator dominates the European market, where every parking lot and service station must have one. The first CURATOR model was produced more than 50 years ago and its engineering, design and practicality have withstood the multiplicity of demands placed upon it over that long period of time.

CURATOR Petrol Separators are gravity-type oil-water separators that take advantage of the differences in the specific gravities of water, oil or gasoline to achieve separators effectively and economically. Water may contain oil in three major forms: "free oil," "emulsified oil," or "dissolved oil." Gravity-type separators will not separate emulsified or dissolved oil from water. Separation when those conditions exist requires other technology.

A gravity separator has a chamber that is designed to provide flow conditions sufficiently quiescent so that globules of free oil rise to the surface of the water and form a separate oil mass that can be removed mechanically. The "rise rate" of oil globules (their vertical velocity) is the speed at which oil particles move toward the separator surface because of the difference in densities of oil and water. The closer the density of the oil or the grease is to that of water, the longer it takes for separation to occur. The surface loading rate is the flow rate to the separator divided by the surface area of the separator. The CURATOR Petrol Separator I.P.S. offers is designed to have a rise rate of oil globules that is equal to or greater than the surface-loading rate. The CURATOR Petrol Separator is engineered to approach the ideal design of a separator that has no short circuiting turbulence or eddies. As a result, the ultimate in gravity separation can be experienced with efficiencies and size.

Flow rate to the separator must be determined in order to effect proper separation. The amount of rainfall accounts for a large portion of the flow into the separator.

When determining the number of unit separators that are needed to handle flow, consider additional waste water sources (other than rain) such as water taps, spillage collecting points, etc