BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

SEWAGE MONITORING AND BLOCKAGE DETECTION SYSTEM

BY

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Declaration

I, **ALINAITWE DANSON REG. No: BU/UG/2013/127** do hereby declare that this Project Report is original and has not been submitted for any other degree award to any other University before.

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Approval

This Dissertation Report under the title **'Sewage monitoring and Blockage detection system**' has been submitted with the approval of the following supervisor.

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Dedication

With singular honor, I dedicate this report to my beloved family for the financial, motivational and moral support that you extended towards the success the of this project and my academics at large. I pray that the almighty God bless you abundantly.

Acknowledgment

I would love to express my heartfelt thanks to the almighty God for giving the courage and strength to finish my project. Theoretical work that is never put into practice becomes almost useless. I need to appreciate the work done by the university administration towards the existence and success of this project.

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Abstract

Sewer flooding in residential areas poses great challenges to sewer network operators. The damage caused by waste water from manholes can be enormous due to high quality additions and installations in basements and underground car parks. It is not economically justifiable to prevent flood during extreme precipitation by expanding sewer networks. Instead, it is necessary to analyze the potential dangers that arise due to flooding, assess the associated risk, and establish a risk management program. In order to describe the potential hazards, area-related geographic data can be used as it is normally collected and managed by the microcontroller interfaced with ultrasonic sensors. In this paper, I implemented an Arduino based technology system interfacing with ultrasonic sensors for monitoring urban sewage manholes which may be useful for governments as well as local agencies to take immediate action on critical flooding situation.

List of acronyms

RFID	Radio Frequency Identification
USB	Universal Serial Bus
GSM	Global System for Mobile Communications
GPRS	General Packet Radio Service
McRAIT	Multiple-channeled Redundant Array of Independent RFID Tags
RAMP	RFID based Autonomous mobile pipelines
HPMS	High-Performance Mobile Sensors
CCTV	Closed Circuit television
NWSC	National Water and Sewerage Corporation
MySQL	My Sequence Query Language
Php	Hypertext Preprocessor
HTML	Hypertext Markup language
IEEE	Institute of Electrical and Electronics Engineers
LAN	Local Area Network

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CHAPTER ONE: INTRODUCTION

1.1 Study Background

A sewage system is designed for the purpose of collecting and transporting waste matter from various drains, disposals and other sources within the community to a sewage treatment plant or other facility such as a lagoon. Ideally, the waste matter is transported via the sanitary wastewater system comprising of drains and sewers without any spillage or leakage whatsoever. However, sanitary wastewater systems can be enormous in scale, making their management and maintenance extremely a challenging task. Even in smaller urban centers, managing and maintaining the local sanitary wastewater system can be difficult [1].

Problems often arise from the demands placed upon these systems, which may be found in widely varying states of repair. Such demands generally include severe weather conditions (such as heavy rains or freezing temperatures), accumulation of obstructive materials (e.g., grease, sediment, roots or other debris), and groundwater infiltration, to mention but a few. In addition, community growth within the community, has led to increased strain on an existing sanitary wastewater system. When the wastewater collection system becomes taxed beyond capacity, manhole overflows and /or backflow into residential areas may result.

The adverse conditions preceding an overflow (or other similar event) often exist over an extended period of time (usually several days or weeks), gradually worsen, and, if not detected and rectified, cause the inevitable result. During the time preceding such an overflow event, wastewater begins to accumulate in one or more localized areas within the collection system, until gradually the level of the wastewater becomes so high it breaches the nearest outlet usually a manhole opening or else backs upstream where further problems can be caused.

A sewer overflow can pose significant health hazards within a local community. The cleanup operation can be costly, and an overflow can bring about an interruption in sewer service. Also, a sewer overflow can harm the local environment and result in potential state and/or federal penalties.

Currently in Uganda, manual inspection methods are being deployed whereby there has to be an overflow first so that the administrator can be alerted of any abnormalities in the sewers which are slow, laborious and time consuming. To overcome all these therefore, there is need design "a real-time sewage monitoring and blockage detection system" that can monitor all buffers that lead to floods of sewage for the administrators to address sewage issues pro-actively.

1.1.1 Impacts of sewer overflows

Sewage overflows exert physical, chemical and biological effects on the receiving environment. This may result in human health, environmental and aesthetic impacts, which can be both acute and cumulative. Such impacts are dependent on the characteristics of the discharge and receiving environment [2].

1.1.2 Potential human Health Impacts

As sewer overflows may contain raw sewage, they can carry pathogens (disease causing organisms). These include bacteria, viruses, protozoa (parasitic organisms), helminthes (intestinal worms), and inhaled mould and fungi. Thermo tolerant coliforms and enterococci can be used as indicators of pathogen pollution.

The diseases they may cause range in severity from mild gastroenteritis (causing stomach cramps and diarrhea) to potentially life-threatening ailments such as cholera, dysentery, infectious hepatitis, and severe gastroenteritis. Human health impacts can be dependent on the duration of exposure to, and the levels of pollutants in the overflow. Humans can be exposed to pathogens through:

- overflows into drinking water sources
- direct contact with overflows in public areas such as parks, streets, or to swimming or boating waters. [3]

1.1.3 Potential Aesthetic Impact

Sewage overflows can cause unpleasant sights, even if their human health and environmental impacts are successfully managed. They can be perceived as offensive, and undermine the confidence of the community in the effectiveness of sewerage authorities [4]

1.2.0 PROBLEM STATEMENT

Sewage overflow and flooding is tremendously a big problem in sewage systems in Uganda if not managed and monitored effectively in time and majorly they caused by blockages within the sewers/ drains. On a daily basis, sewage collection systems have to be always supervised by the sewage administrators to check whether there are any pipe blockages that can hinder the smooth movement of sewage in sewers and drains. The major problem with these unmonitored blockages is that, they have always posed a big threat on the sewage pipelines with much pressure on one side hence overflows and flooding at manholes (buffers) which results in environmental and health harm.

1.3 OBJECTIVE

1.3.1 Main objective:

- The main objective of the project was to design and develop a real-time sewage monitoring and blockage detection system that will be able to monitor all manholes in urban areas and big institutions such as universities and hospitals.

1.3.2 Specific Objectives

- To review, identify and analyze the existing literature on real-time sewage monitoring systems and study the current methods employed in monitoring the sewage systems.
- To design modules of the system in accordance with analyzed user requirements and functional requirements.
- To develop a real time sewage monitoring and blockage detection system
- To test all the sub-systems of sewage monitoring and blockage detection system

1.4.0 SIGNIFICANCE / JUSTIFICATION

Sewage monitoring and blockage detection is very paramount and yet sewage administrators have tried to deploy manual methods but have not been able to overcome the problem of overflows and flooding. This brings to us the need to have real time sewage monitoring and blockage detection system in place and once deployed it will help sewage administrators greatly to perform well in their service delivery that is, detecting and unblocking of the sewers before polluting the environment hence reducing on the health risks of the people around the local communities. With the high inconvenience associated with the manual inspection methods, the proposed system shall ensure that real-time sewage levels are monitored from a central point by the administrators.

1.5.0 SCOPE

1.5.1 Technical scope

The proposed system is based on the microcontroller technology monitoring the sanitary sewage systems and detecting blockages in real-time. This project shall entirely focus on a prototype development of an ultrasonic sensor based sewage level monitoring system installed at the top of the manhole. HC-SR04 Ultrasonic sensors will be used to sense the sewage height by placing the sensors at specified positions beneath the manhole cover, calculating the level of sewage by time of flight of the ultrasonic wave and correlation with respect to the dimension of the manhole, to get a more accurate value. The ultrasonic sensors will be interfaced with the microcontroller which will obtain variables from the sensor and updates it each time new information comes in such as height, time stamps, sensor id and volume after comparing the dimensions of the manhole, etc. as will be specified and communicate to the LCD within the administrator's vicinity.

1.5.2 Geographical scope

The system is only limited to urban areas and institutions like Universities and big hospitals where there are a number of manholes to be monitored simultaneously.

1.5.3 Time scope

Duration wise, the system has been designed and implemented in a period of over six months.

1.5.4 Limitations

Because the system requires power supply, it does operate when there is power breakdown.

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