Faculty of Electrical and Electronic Engineering Technology

DESIGN OF MANHOLE COVER DETECTOR USING ARDUINO GSM SYSTEM

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEDICATION

I dedicate this report to my beloved mother, Kalai Chelvi and father, Guna Segaran, for giving me undiminished encouragement and helping me by providing me with a place to stay under and work on my report. My beloved friends and collegues at work who always make it a statement to help me out to stay strong eventhough in recent times being affect in the flood.

ABSTRACT

In Malaysia, these manholes are found in two types, mostly cover the normal underground drainage system and some of the manhole cover for telecommunications company. The problems we encounter are these manholes are not always monitored and due to that many theft cases of the manhole covers are identified. Among these problems, the loss of a manhole cover can cause fatal accidents as well. Therefore, the purpose of this project to develop a system that can reduce the theft of manhole covers. The objective of this project is to design a device detector using electronic circuit to alert and send messages via a mobile phone to a control center about the status of the manhole cover of telecommunication companies. This manhole detector system used an Arduino Uno as a microcontroller to control the input and output of the system is a buzzer to give warning and a GSM Module to transmit and receive data to a mobile phone via SMS. Therefore the outcome of this design of this system is able to detect the unauthorized opening of Manhole cover by using the Magnetic Sensor. The system is able to will generate notification in the form of SMS to notify the opening of manhole covers in the area via the Arduino and GSM SIM900 as integrated. This prototype design solves the issue of theft detection of the manhole cover and can be further implemented.

ABSTRAK

Di Malaysia, lubang lurang ini terdapat dalam dua jenis, kebanyakannya meliputi sistem saliran bawah tanah biasa dan beberapa penutup lurang untuk syarikat telekomunikasi. Masalah yang kami hadapi ialah lubang lurang ini tidak selalu dipantau dan disebabkan itu banyak kes kecurian penutup lurang dikenal pasti. Antara masalah ini, kehilangan penutup lurang boleh menyebabkan kemalangan maut juga. Oleh itu, tujuan projek ini untuk membangunkan satu sistem yang dapat mengurangkan kecurian penutup lurang. Objektif projek ini adalah untuk mereka bentuk alat pengesan menggunakan litar elektronik untuk memberi amaran dan menghantar mesej melalui telefon bimbit ke pusat kawalan tentang status penutup lurang syarikat telekomunikasi. Sistem pengesan lurang ini menggunakan Arduino Uno sebagai mikropengawal untuk mengawal input dan output sistem ialah buzzer untuk memberi amaran dan Modul GSM untuk menghantar dan menerima data ke telefon bimbit melalui SMS. Oleh itu hasil reka bentuk sistem ini dapat mengesan pembukaan penutup Lurang yang tidak dibenarkan dengan menggunakan Penderia Magnetik. Sistem ini mampu akan menjana pemberitahuan dalam bentuk SMS untuk memaklumkan pembukaan penutup lurang di kawasan tersebut melalui Arduino dan GSM SIM900 secara bersepadu. Reka bentuk prototaip ini menyelesaikan isu pengesanan kecurian penutup lurang dan boleh dilaksanakan selanjutnya.

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LIST OF SYMBOLS

δ	-	Voltage angle
μ	-	Micro

LIST OF ABBREVIATIONS

V	-	Voltage
cm	-	Centimeter
m	-	Milli
IoT	-	Internet of Things
GSM	-	Global System for Mobile Communications
SMS	-	Short Message Service
RFID	-	Radio Frequency Identification
LCD	-	Liquid Crystal Display
MHz	-	Megahertz
GHz	-	Gigahertz
HTML	-	Hypertext Markup Language
Wi-Fi	-	Wireless Fidelity
PIR	-	Passive Infrared
IR	-	Infrared
PWM	-	Pulse Width Modulation
USB	-	Universal Serial Bus
LED	-	Light-emitting diode
GND	-	Ground
SIM	-	Subscriber Identity Module
DC	-	Direct Current
AC	-	Alternating Current
GPRS	-	General Packet Radio Service
TX	-	Transmitting
RX	-	Receiving

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CHAPTER 1

INTRODUCTION

1.1 Background

A manhole cover or maintenance pit cover is a movable plate that forms a cover over the manhole opening, this hole is large enough for people to pass through and the hole is used as an entry point for a vault or pipe underground. This was designed to avoid any person or objects from falling in. Manhole covers comes in a various shapes and sizes, some have larger form factors, and some are made of lighter materials. But the focus here in more on the manhole covers used for telecommunications company, where it houses a lot of expensive cables, for example fiber cables, huge power surging cables and many more. Since the manhole covers are made from metal, people often steal it and sell it as scrap metal for a good amount of price. Hence why the manhole covers are being stolen. This costs a lot to the government or the certain telecommunications company to replace back those covers. There are even cases where people fall into the manhole and have died. Moreover, moving vehicles can even get stuck.

Therefore, a system has been proposed to monitor the manhole cover remotely without having a dedicated team or person nearby. The implementation of GSM technology for communication is required to utilize the function of long-distance monitoring. In this project, the usage of a sensor will determine the opening of the manhole cover and sends the data through a development of a GSM module system which is transmitted signals over the air. With the help of this system the person in charge or officials can get alert messages right

on their smart phone devices. The proposed system will be able to monitor the status of the manhole cover.

1.2 Problem Statement

Manhole covers that are made from metal, making on average stolen and sold it as scrap metal for a good amount of price. Hence why the manhole cover is missing. The problem arises when a manhole cover that is stolen cannot be detected because it costs a lot to the government to replace back those covers and even then, are the worst-case scenario where the manhole covers are exposed to pedestrians. This will cause the second problem which is many accidents such as people falling into a manhole and vehicle tires can get stuck.

1.3 Project Objective

The main aim of this project is to propose a systematic and effective methodology to create a simple system which can be used underground in a manhole architecture. Specifically, the objectives are as follows:

a) To design a device detector using electronic circuit to reduce the theft of telecommunication company manhole covers.

b) To design a system that can alert and send messages to control center.

1.4 Scope of Project

The scope of this project are as follows:

a) Automate a system which has sensors that can monitor the status of the telecommunication manhole cover.

b) Develop a simple cover to house the electronic components close to manhole cover position in unattended areas.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Manhole is known as underground vertical construction which can enable access to utilities such as the sewage system, a drainage system, and the size of it is as big as a man can go in. This is for any inspection, modification, or the cleaning process to be done from within the underground. According to the history of manholes built some of them have transformed from using bricks to concrete nowadays and the manhole covers range from plastics to metal depending on use. In Malaysia, these manholes are found in two types, mostly cover the normal underground drainage system and some of it cover the manhole for telecommunications company. Some of these manholes are not always monitored and due to that many theft cases of the manhole covers are identified. According to an article shown in greater detail in [Appendix A] by the New Straits Time titled "300 missing covers reported stolen." Therefore, in modern time, these manholes are being upgraded with technologies to overcome these issues. In this chapter we will see a research from previous study and projects done in optimizing the monitoring of manholes.

2.2 Previous Research Studies

Based on the topic of Manhole Cover Detector, here are the previous studies that are related by noticing the implementation of Arduino as a microcontroller and GSM is widely used in these research papers.

2.2.1 Monitoring System for Manhole Management Using IOT

In this journal, it is observed that in most areas which has a recurring issue of not having a manhole monitoring team. Therefore, the need of a huge number of manpower to deal with the condition of monitoring the manhole from damages like manhole clogging. So, [1], has developed a system to counterfeit this issue by creating a system that is able to detect these harsh conditions while alerting through an audible alarm. The technology that is used here is a base of IOT and it can alert the authorities on the matter at hand via sending messages through a GSM Module. Their system can collect data and maintain the system through these collected data from the sensors.

2.2.2 Ultrasonic Sensor and GSM-Arduino Based Automated Sewerage Management

In this research, the design of a prototype was introduced as USenSewer which is an automated sewerage system that uses an Ultrasonic sensor which is paired with an Arduino Microcontroller and a GSM and NRF module. This was introduced in Bangladesh as they often suffer from issues like flooding, water depletion and unplanned city development due to having clogged up the manhole system. To make the system work, the ultrasonic sensor and an NRF module acts the blockage detection, after reading the information, Arduino will transfer the data through a GSM Module and informs the city council to collect and remove the blockage. According to [2] the system manages to automatically remove the wastage of the drainage system and is stable to receive and transmit data.

2.2.3 **Automated Detection** of **Manhole Status** and **Prevention** of **Accidents Using PIR Sensors**

In this article paper, according to [3], the manhole which are uncovered may lead a serious issue to people on the streets. An estimation of over 80% from 12 million manholes need to have at least a level of maintenance. Therefore, in this paper, an automation system is designed using the technology of the WiiLSW positioning sensor will detect the status of the manhole whether open or closed, by detecting this it will send the data through LpWAN IOT built into the senor. While the status shows open, the PIR sensor will be activated to signal if any nearby movement around the manhole and it will alert if someone is too nearby producing sound via the siren generator built in this circuit. By doing so preventing accidents caused by manholes are greatly reduced.

2.2.4 **IoT based Intelligent Manhole Cover Management System**

Another journal based on the project of [4], states that by attaching the sensors that detect changes for example, gas sensors, water overflow sensors and a tilt sensor under the manhole cover itself is said to lower the cost effectively. These sensors are then configured to Arduino board where it will read the data collected by the sensors and send the output to GSM where an offline message will reach the municipal officer mobile phone to be noted with the collected data. The system is built upon have issues to detect the damaged and relocated manhole cover. By doing so, this project has resulted in a low-cost and flexible solution to monitor and manage the manhole covers infrastructure in the city. This project has been proven to be part of an intelligent system which is used in smart cities.

2.2.5 Secure Manhole Monitoring System Employing Sensors and GSM

In this research conducted by [5], they have pointed out that it is a major threat happening because of the opening of manhole covers which can cause accidents and fatal loss of lives. Having identified the issues, a system was implemented to detect the opening of the manhole lid, either because of the overflow of underground water or changes in temperature and it will be able to alert the surrounding when that happens. Apart from that the system can monitor the water level and temperature by using ultrasonic and temperature sensors that will transmit the data back to Arduino Uno microcontroller and then sends a signal to the mobile device via a GSM module. In ensuring the project works, it has achieved the solution to alert the concern authorities on the issues of the manhole cover being open for public safety.

2.2.6 Manhole Covers Intelligent Monitoring Terminal using RFID and Acceleration Sensor.

This project focusses on the usage of RFID technology to transmit data of the status of manhole cover. Radio frequency had been the choice of [6], due to it being the longest-term operation to make their goals meet. For this project an urban city was a location where many manholes cover got damaged or either stolen and they have designed the system using a 3-axis acceleration sensor which reads the if the manhole cover lid is opened, it will then send a series a signal to the low power Microcontroller which then sends an alarm through a 2.45GHz RFID transmitter and read by the receiver. These signals are passed through electromagnetic waves, in the end, allowing for an accurate GPRS location of the manhole cover.

2.2.7 Underground Drainage Monitoring System

A journal from [7], states at these times in 2019, the initiative to develop smart cities in India has been a challenge them. An important sector for a smart city is the infrastructures that run underground. To accomplish the need to monitor the underground drainage system, this team has come out with the idea of configuring various sensors to detect the readings of sewage overflow, gas detection, either is it harmful and the manhole lid opening. These ultrasonic sensor and MQ-7 temperature sensors are transmitting the data read through Arduino Uno and passes information through a GSM module which then a SMS is received to the government authorities to take necessary actions. This system additionally includes a 16-bit display LCD to show the readings as well on the site.

2.2.8 Automated Monitoring System for Manhole

The next research paper was studied that a system that is designed to monitor the automated manhole system in real time. In this, we can see the hardware choice for this is a tilt sensor, gas sensor, water level sensor to sense all the parameters which will be then transmitted to an Arduino Mega, which will be connected to a Wi-Fi module ESP8266 and a GSM module to send the output to a person in charged. Based on [8], the focus is mainly on design a software to monitor all the status and parameters of the manhole. Using a web framework, HTML and My SQL he has proposed that with an easy-to-use interface can create a comprehensive view of the manhole. As this was only a proposed idea by the author, the outcome will supposedly be able to maintain and monitor the manhole in real time.

2.2.9 Automated IOT for Underground Drainage and Manhole Monitoring System

In this paper a system which was designed by [9], involves the use of a transmitter which is paired with a few sensors for example, tilt sensor and temperature sensor. This will

have the parameters read and transmitted to the microcontroller which is PIC16F877A. The receiver then collects the data and by using the monitor to output the readings. By using IOT, the data from the microcontroller will be sent over towers as a communication device where it will display the location and status of the manhole. This project is not given a study on how the data transmits from the tower and no mention of any use of GPRS systems which is ineffective for real time monitoring.

2.2.10 Manhole Covers Missing Alarm Monitoring System

In this journal, according to [10], he has implemented a design of the system by creating an alarm module which consist of a magnetic switch and a RFID transmitter which will read whether the manhole had been open, if open the signal will be sent to the wireless relay module where it has an RFID receiver, which will be then connected to the mobile phone and a computer software via a GPRS module as well. In this project the alarm system will receive the information via an app using WeChat and a software was made to monitor the manhole status in real time as well at the manhole management center. As a result, this monitoring system can cover a solution to the huge amount of manhole cover theft and can be used in a wide area around the cities.

2.3 Overview of Technologies Used

Based on all the research papers that is mentioned by authors the main technologies used as a microcontroller here are Arduino Uno, PIC16F877A and RFID. For the sensors used mainly are Ultrasonic Sensor, Tilt Sensor, Reed Sensor, IR sensor and for the receiver part mainly uses a GSM and Wi-Fi Modules. These are listed as commonly used technologies from all the research studies from [1], [2], [3], [6], [7] [9]. Table 2.1 illustrates