BUSITEMA UNIVERSITY
Pursuing Excellence
FACULTY OF ENGINERING

P.O. Box 236, Tororo, Uganda
Gen: +256 - 45 444 8838
Fax: +256 - 45 4436517
Email: info@adm.busitema.ac.ug
www.busitema.ac.ug

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING AND INFORMATICS

FINAL YEAR PROJECT REPORT

AN ADVANCED FIRE SAFETY SYSTEM FOR SCHOOLS BY NAKIMULI MARTHA TAAKA REG NO: BU/UG/2020/2496

Tel: 0779883684/0755838065

Email: marthanakimulitaaka70@gmail.com

SUPERVISOR: DR. ODONNGTOO GODFREY

A FINAL YEAR PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF COMPUTER ENGINEERING IN PARTIAL FULFILLMENT FOR THE AWARD OF A BACHELOR OF SCIENCE IN COMPUTER ENGINEERING OF BUSITEMA UNIVERSITY

May, 2024

DECLARATION

DECLARATION

I NAKIMULI MARTHA TAAKA, hereby declare that this report, written in partial fulfilment of the requirement of the award of a Bachelor of Science in Computer Engineering degree at Busitema University, is my very own authentic work and the content of this document has never been submitted before to the Department of Computer Engineering and Informatics of Busitema University and any another institution of high education.

Signature ..... Date 12th June 2024

NAKIMULI MARTHA TAAKA

i

APPROVAL

APPROVAL

This is to certify that the project entitled "AN ADVANCED FIRE SAFETY SYSTEM IN SCHOOLS" has been produced under my supervision.

SUPERVISOR NAME: DR ODONGTOO GODFREY

Department of Computer Engineering and Informatics

Signature: .....

Date: 11/06/2024

ii

DEDICATION

I dedicate this report to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this project and on His wings only have I soared.

I also dedicate this report to my family that has encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started.

God bless you.

ACKNOWLEDGEMENT

I convey my sincere gratitude to my Supervisor, Dr. Odongtoo Godfrey and the Department of Computer Engineering and Informatics for the guidance and insight into concepts of research and project management as well as technical knowledge applicable to the design of the system. I am also grateful to Engineer Nalwanga Rosemary for the continuous guidance throughout the entire process of identifying, designing and implementing this project. I am thankful to all my friends Kasozi Akim, Natuhwera Prossy and Baluka Catherine who have been always helping and encouraging me throughout this project. I have no valuable words to express my thanks, but my heart is still full of the favors received from every person.

ABSTRACT

School fires are some of the most alarming challenges faced in our country today, however, the traditional methods have been quite inefficient and delayed causing multiple deaths and loss of property. To address this issue, an advanced fire safety system has been developed with an automated extinguishing system. This system uses smoke, temperature and flame sensors to identify a fire. By comparing the measured values of these variables in the room or atmosphere, the system is able to identify occurrence of fire after which it first and foremost alerts various stakeholders at the different stages of the fire, alerts the students in the building, alerts the fire brigade and as well directs them to the affected area. This innovation not only alerts the responsible parties in time but as well provides a time-being solution to the fire. However, it is currently limited to put off fire only in a building or room but with incorporation of more technologies, it could be advanced to be mobile i.e., to move towards the place with the fire.

LIST OF ACRONMYS

PS: Primary School

RAM: Random Access Memory

CPU: Central Processing Unit

ROM: Read Only Memory

AVR: Automatic Voltage Regulator

GSM: Global System for Mobile Communications

IDE: Integrated Development Environment

GPS: Global Positioning System

SMS: Short Message Service

OS: Operating System

Contents

DECLARATION i

APPROVAL ii

DEDICATION iii

ACKNOWLEDGEMENT iv

ABSTRACT v

CHAPTER ONE: INTRODUCTION 1

1.1 BACKGROUND 1

1.2 PROBLEM STATEMENT 2

1.3 OBJECTIVES 2

1.4 Significance of study 2

1.5 SCOPE 3

2.2 RELATED EXISTING SYSTEMS 3

How It Works 5

2.3 Developed System 7

CHAPTER THREE: METHODOLOGY 7

3.1 Data Collection Methods 7

3.2 Requirement gathering 8

3.3 System Design 8

3.4 System Implementation 10

CHAPTER FOUR: SYSTEM DESIGN AND ANALYSIS 11

4.1 System Analysis 11

4.1.1 Functional Analysis 11

4.1.2 Requirement Analysis 11

4.2 System Design 12

CHAPTER FIVE: IMPLEMENTATION AND TESTING 15

5.1 Introduction 15

5.2 Development platforms 16

5.3 Code Designs 16

5.4 Testing 16

5.5 System Operation 23

CHAPTER SIX: DISCUSSIONS AND RECOMMENDATIONS 24

6.1 Introduction 24

6.2 Summary of work done 24

6.3 Critical Analysis / Appraisal of the work 24

6.4 Challenges 25

6.5 Recommendations 25

6.6 Conclusion 25

REFERENCES 26

APPENDICES 27

Appendix A. More pictures concerning the project 27

Appendix B. Project code 28

List of Figures

Figure 1: Showing the system block diagram 10

Figure 2: Showing the flowchart of the system 14

Figure 3: Showing the physical design 15

Figure 4: Showing the lit system 19

Figure 5: Showing the state of fire 20

Figure 6: Showing the messages received by the stakeholders.....20

Figure 7: Showing the messages received …….....21

Figure 8: Showing the location of the incident.....21

Figure 9: Showing the physical appearance of the system 28

Figure 10 During system testing and verification..... 28

List of Tables

Table 1: Showing Summary of existing systems. 6

Table 2: Showing symbols used in a flowchart 13

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Buildings fire is considered as one of the most common and the most devastating disasters and emergencies. It is one the most widespread incidents which cause death and injury to many people each year. Buildings fire is regarded as the hazards facing all countries including low-income, middleincome, and high-income ones [1]. Saving school buildings against incidents such as fire is very important since students are so vulnerable to incidents especially the fire. The most school buildings are devoid of safety conditions thus such a condition increases the risk of disaster and is considered as a serious menace for students' lives [2]. As such school fires should be well understood, prevented and addressed as they are becoming rampant of late broadly in their occurrence both nationally and globally.[1]

According to data compiled by the Uganda Police Force and various educational authorities, the incidence of school fires in Uganda has witnessed a troubling rise in recent years [3]. In the past decade alone, there has been a marked increase in the number of reported incidents, with both primary and secondary schools bearing the brunt of these destructive events. The most recent ones include; Salama School for the blind (October, 2022)[4], St. Theresa Primary School Kisubi (October, 2023) [5], Lhubirira Primary School (June, 2023), among others causing the death of learners and destruction of property worth millions of moneys. Other schools include; Wairaka College (May, 2019), Budo Junior School (April, 2008), St. Bernard's Mannya SS Rakai (November 2018), St Jude PS in Nakasongola (February, 2021), Mbarara High School (April, 2016), Mother Majeri Primary School Kirinya, Bweyogerere on (April, 2017), Rugarama Nursing School (September, 2019), Mary Stuart Hostel (May, 2018).[6]

Between 2019 and 2021, an alarming total of over 300 school fires were documented across the country, averaging more than 100 incidents per year. These fires vary in scale and severity, ranging from minor blazes confined to a single classroom to infernos engulfing entire school buildings. The toll exerted by these fires extends beyond mere property damage, with numerous injuries, fatalities and even deaths reported among students and faculty. [7]

In light of these sobering statistics, it is evident that school fires represent a pressing challenge that demands immediate attention and concerted action. Efforts to mitigate the risk of fire outbreaks, enhance fire safety protocols [8]. The threat possessed by these fires on the lives and property of learners in the various institutions requires quite immediate attention and in this some equipment has been put in place to aid in fighting them in case of any occurrences. This equipment includes; fire extinguishers, smoke detectors, heat detectors, emergency exits, and Carbon monoxide detectors, among others [1]. Among these, the most commonly used in Uganda are fire extinguishers installed on the various blocks all over schools and are to be manually used in case of any fire occurrences. According to Wikipedia, a fire extinguisher is a handheld active fire protection device usually filled with a dry or wet chemical used to extinguish or control small fires, often in emergencies [9]. These measures are in place however, there is a problem with timely detection and alert of fires, more so in schools where the learners are usually in some buildings at some times and not in others, they also have limited knowledge on how to use these tools as well as have limited communication lines to the emergency services such as the institutional internal police units, fire brigade, Uganda Police among others. There is also a challenge of directing these

REFERENCES

[1] P. Among, “NBRB Report: 35% Of Uganda’s Fires Occur In Schools,” no. January, 2924.

[2] Flash Uganda Media, “School Fires in Uganda: What Causes Them and How You Can Help,” no. March, 2022.

[3] prime, “17 schools were burnt intentionally, say Police,” no. November, 2022.

[4] Aljazeera, “Dormitory fire kills children at school for the blind in Uganda,” no. October, 2022.

[5] prime, “Property destroyed as fire burns St Theresa Kisubi Girls dormitory,” no. october, 2023.

[6] new vision, “past school fires in Uganda,” no. 07 March, 2020.

[7] E. Namara, “Uganda Struggles to Fight Surge in Fires,” no. 11 November, 2021.

[8] NilePost, “Education Ministry concerned over rampant school fires, set to review safety guidelines,” no. march, 2022.

[9] R. E. D. Húmeda and R. E. D. Húmeda, “Fire extinguisher Fire extinguisher,” p. 100, 2019, [Online]. Available: https://www.businesswatchgroup.co.uk/fire-services/fire-extinguishers/types/

[1] Health, safety, and education measures for fire in schools: A review article - PMC (nih.gov)

[2] School Fires in Uganda: Possible Causes and How You Can Help - Flash Uganda Media (flashugnews.com)

[3] NBRB Report: 35% of Uganda's Fires Occur in Schools - The Nile Wires

[4] Fire extinguisher - Wikipedia

[5] 5 types of fire extinguishers: A guide to using the right class (ifsecglobal.com)

[6] What is GSM (Global System for Mobile communication)? (techtarget.com)

[7] Automation | Technology, Types, Rise, History, & Examples | Britannica

[8] What is a Microcontroller and How Does it Work? (techtarget.com)

[9] Discover types of fire detection sensors and flame detection with Pyreos sensors - EPSGlobal

[10] Global Positioning System - Wikipedia

[11] Electric motor | Definition, Types, & Facts | Britannica

[12] Fire detection - Wikipedia

[13] Motorized Linear Actuator (newport.com)