

**BUSITEMA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER ENGINEERING**

**DESIGN AND CONSTRUCTION OF A STORAGE SYSTEM FOR
HOME HAZARDOUS CHEMICALS**

BY

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DECLARATION

I Orishaba Isaac, REG NO- BU/UG/2012/91, hereby declare that this Project report is my original work and has not been presented for a degree in any other University or any other award.

Signature.....

Date.....

DEDICATION

This project report is dedicated to Dr. Tukahabwa Martin the executive director of kigezi cleverland investments. I am very appreciative for the support you offered to me. May the Almighty God richly bless you.

APPROVAL

The undersigned certify that they have read and hereby recommend for acceptance of Busitema University a Project report entitled “*design and construction of a storage system for home hazardous chemicals*”

Dr. SEMWOGERERE TWAIBU

Department of Computer Engineering

Signature:

Date:

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Mr. Orishaba I .

ABSTRACT

Most of the chemicals which we use at home for various activities like spraying, cleaning, fueling, bush burning are hazardous in nature. Some of them are corrosive in that a leakage or a spill may affect the durability of other equipment (like utensils, cutlery) which consequently may cause the family to be continually buying such property on top of misusing the chemicals themselves which also leads to wastage. Other chemicals (for example petrol, paraffin, and brake fluid among others) are so flammable that any mishandling can cause fire outbreak in a house hence leading to the destruction of property. The rest are poisonous in a sense that once mistaken to be drinks or food stuffs may result into accidental poisoning especially in children. In Uganda, some homes have cupboards, shelves, and drawers where such chemicals are stored but it's so unfortunate that these cupboards are not customized for that purpose, the same cupboard used for storing books, food stuffs, utensils, screens and even such chemicals hence a leakage of container in one shelf affects other items stored in another shelf. This project was therefore aimed at developing storage system for customized storage units which can accommodate such chemicals so that we reduce on the number of chemicals outside the storage unit, which come as a result of having very many family members who access the storage unit for various intensions, and end up leaving some of items like chemicals outside the storage unit thus the home insecure in in terms of chemical storage. This project focused on how we can safely store these chemicals through minimizing the access to such storage units, monitoring and capturing the inflow and out flow of chemicals and providing an alert in case one forgets to return the chemical he/ she picked. The work is arranged mainly in six chapters, Chapter one includes the introduction of a system. Chapter two discusses the literature related to the system, Chapter three illustrates the methodologies used in coming up with the working prototype of the system, Chapter four includes system design and analysis, Chapter five is contains the implementation and testing of the system and chapter six contain the summary of the work, discussions, conclusions and recommendations.

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LIST OF ABBREVIATIONS

PIR	Passive infra-red
RFID	Radio frequency identification
EEPROM	Electrically erasable programmable read only memory
PWM	Pulse width modulation
DC	Direct current
EMS	Emergency medical service
WHO	World health organization
IC	Integrated circuit
AC	Alternating current
LCD	liquid crystal display
DAC	Digital to analog converter
DDR	Data direction register
DDRAM	Double data RAM
EPROM	Erasable programmable read only memory
I/O	Input/output
LDR	Light dependent resistor
VLSI	Very large scale integration
SSD	Seven segment display
ADC	Analog to digital converter
PIN	Personal identification number
GSM	Global system for mobile communicate
SMS	Short message service

CHAPTER ONE

INTRODUCTION

This chapter consists of the background of the study, problem statement, objectives of the study, justification/significance, scope of the project and the limitations of the system developed.

1.1 BACK GROUND

The chemicals and cleaning products that sit side by side in cupboards, the basement and the roof space could be extremely harmful if they are mixed or used incorrectly [1]. Working safely with chemicals in the home is really no different than working with them in the workplace, Sometimes the chemicals used are more hazardous and we use larger quantities in the workplace, but the safety principles are the same. Some examples of hazardous wastes found around the home include antifreeze, batteries, brake fluid, chemical strippers, chlorine bleach, contact cement, drain cleaners, insecticides, lawn chemicals, nail polish remover, spot removers, toilet and oven cleaners and used motor oil [1].The potentially harmful substances used daily in homes usually have one or more of the following characteristics [1] :

- i. Corrosive - They eat or wear away at many materials;
- ii. Flammable - They easily ignite;
- iii. Reactive - They can cause an explosion or produce deadly vapors.
- iv. Toxic - They are poisonous to humans and animals

In Uganda, accidental poisoning among children is on the rise in many homes, according to the latest research by Uganda Pediatric Association [2]. The research which was carried out between 2011 and 2012 studied 108 children admitted with various types of poisoning at Mulago Hospital. Of these, 38% were female and 62% were male, aged between one month and 144 months (12 years). However, the age group most affected by poisoning was found to be one to five years. The study reveals that the poisons kept in the household were within reach of the children in 52.8% of the cases. Such poisons ranged from paraffin, to rat poison, medicines and syrups, pesticides, alcohol and food poisoning. Of the poisons found within the household, 57% of the poisons were found in the cupboard, which were left unlocked and 23% were on the floor [2].

Most of these poisons (87.5%) are linked to housewives, as they are the primary caregivers.

Most of the poisoning in the home happened in the morning hours between 8:00am and 12:00 noon, when the caregiver is probably busy with chores. The most common poisoning was paraffin (32%) followed herbicides/pesticides poisoning (30%), and medicines. In fact, while paraffin was found to be the number one cause of poison, the report showed that there was little chance that it was got from a lamp [2].

World Health Organization (WHO) estimate 0.3 million people who die every year due to various poisoning agents, it is estimated that over 16, 000 children under 14years die annually from poison-related diseases [3].

These incidences happen because of poor/unsafe storage of chemicals, mixing chemicals with other food products, picking many chemicals from the cabinets which a person does not want to use at the same time and end up forgetting to return them to their store, picking chemicals and taking long minus retuning them which consequently makes it easy for one to forget.

1.2 PROBLEM STATEMENT

Lack of proper storage mechanisms for hazardous chemicals have left many homesteads in Uganda being vulnerable to very many catastrophes like accidental poisonings [2], fire outbreaks, corrosion of other household products and spoiling of the chemicals before they are used up [4].

There is a need to come up with the method of enhancing the safe storage of these household chemicals which have remained damped everywhere in most of the homes due to lack of proper regulatory measures despite the fact of labeling these chemicals with the statement “keep out of reach of children” which some people have misinterpreted as hiding chemicals away from children sight.

1.3 OBJECTIVES

1.3.1 Main objective

To design and construct a storage system for home hazardous chemicals in order to ensure home safety.

1.3.2 Specific objectives

- i) To gather and analyze the requirements for the design and construction of a

storage system for home hazardous chemicals.

- ii) To design and implement an access control module for the system
- iii) To design and implement a regulatory module for the inflow and outflow of chemicals during system usage
- iv) To construct a prototype of the whole system
- v) To test and validate the performance of the system

1.4 JUSTIFICATION

Some family members for example children explore their environment as part of their natural development. They learn about new things by playing with them, trying to open containers, mimicking what they see adults do, like drinking from the beer bottle you leave on the table, putting things in their mouth and so on. A child is exposed to poison without knowing that it may be harmful and children do not know the difference between what is safe and what is dangerous hence unsafe storage of household chemicals may negatively affect their lives and consequently put the house at a risk of fire exposure in case they are flammable.

The implementation of a storage system for hazardous chemicals in homes will;

- i. Help to reduce on fire outbreaks in homes, corrosion of other household products, accidental poisoning among children, intentional poisonings as a result of psychological reasons among others.
- ii. Lower / minimize the wastages that usually happen due to mishandling of chemical.
- iii. Protect the chemicals from environmental effects like sunshine, too much coldness and hotness.
- iv. Lower government health care costs
- v. Create a safer home environment and improved relations with family members.
- vi. Increase efficiency and reduced costs from compliance with hazard communication regulations.
- vii. Improve safety for caregivers and others through consistent and simplified communications on chemical hazards and practices to follow for safe handling and use.

- viii. Greater awareness of hazards, resulting in unsafe use of chemicals in homes and in laboratories.

1.5 PROJECT SCOPE

The system consists of three modules which are inter-connected together to achieve the main objective. It controls the accessibility to chemical storage unit, monitor and control the inward and outward movement of chemicals during the usage of their storage unit and provide an alert to the owner of the house in case of misunderstanding between the caregiver and the system.

The digital device is based on arduinoYuno (a 16-bit ATmega328p) as a controller which is good for low power devices and the door is opened using a very high precision dc motor connected to the PWM pins of the microcontroller for automatic opening and closing.

The system can only be installed on home chemical storage units like cupboards, shelves, cabinets among others and secondary school laboratories whose operations need serious consciousness.

The system has been developed for a period of 8 months starting from August 2015 up to April 2016.

This project entirely focuses on the design and construction of a prototype for storage system for home Hazardous chemicals hence the prototype is not a finished product to use however further designs could be adopted to have the idea implemented in home steads.

1.6 SYSTEM LIMITATIONS/ ASSUMPTIONS

- i. The system developed was based the assumption that all chemicals stored in the storage unit are tagged hence storing both tagged chemicals and untagged chemicals will not solve the problem.
- ii. The system was also developed based on the assumption that the tags used are sticker tags so that once you remove it from the container , it becomes spoilt immediately, otherwise use of removable tags will not solve the problem.
- iii. The developed system cannot work in absence of power.

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