BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

METHANE CONTROL AND MONITORING SYSTEM FOR A BIOGAS DIGESTER

BY

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BU/UG/2012/72

JUNE 2016

DECLARATION

I LUWEDDE SANDRA Reg No BU/UG/2012/72 hereby declare that this project report is my original work except where explicit citation has been made and it has not been presented to any Institution of higher learning for any academic award.

Sign: ……

Date: ----------

APPROVAL

This is to certify that the project report under the title "*methane control and monitoring system for a biogas digester*" has been done under my supervision and now is ready for examination.

Mr. Matovu Davis

Department of Computer Engineering

Sign: ……..

Date: ……

DEDICATION

I dedicate this work to my lovely family and Mr. Matovu Davis for the love and care they

have always showed me.

ACKNOWLEDGEMENT

First and fore most I would like to take this opportunity to thank the almighty Lord for providing protection and life to me and everyone around me during the time of my research. For it was through the health and strength I had that I was able to make it to this level

Secondly I would thank my parents and family who have looked after my welfare and finances and assured that I carried on my education successfully may the good Lord award them abundantly.

Furthermore I extend my sincere gratitude to my supervisor Mr. Matovu Davis who has tirelessly worked with me to ensure that all the works in this report are up to the recommended standards.

I thank Busitema University Department of Computer Engineering for render enough time for us to ensure we learn a lot as computer engineering is concerned and this has made it possible for me to come up with this project.

Lastly but not least I would convey my thanks to all my friends who stood by my side to help me come up with better structures as required for my project research to make it to this level. May the good lord provide for them in their times of need.

ABSTRACT

The system development is being motivated by the need to reduce pressure on the forests and high electricity tariffs. A good number of urban households using electricity for lighting (33.5%), the low percentage of the same households using it for cooking (6.3%) implies that some households have electricity connected to the houses but do not use it as the main source of energy for cooking. If the biogas project is scaled up, it could allow Ugandans who live too far from the power grid to generate their own energy. The new sources of energy such as biogas are still poorly developed.

The methane control and monitoring system for a biogas digester composed of one microcontroller that controls when to turn on and turning off of the heater, the motors, pump, and other components depending on the user input and the current temperature in order to obtain the desired methane level.

The heater and the pump are off while the system is running normally at normal temperatures.

The heater, motor and the pump are turned on automatically when the user input is not reached and when temperature is below 40 and when the user input is reached, the heater the pump and motor are turned off when user input is reached. The motor representing the pump are turned on automatically when the user input is not reached and when temperature is above 40, the pump and the motors are turned off when user input is reached.

For purposes of demonstration, a simple biogas digester has been designed which shows how the users can use the system.

TABLE OF CONTENTS

LIST OF ACRONYMS, ABBREVIATIONS, FIGURES AND TABLES

List of Figures

List of Acronym

AD- Anaerobic Digestion

CH4- Methane

IDE- Integrated Development Environment

KVIC- Khadi and Village Industries Commission

LCD - Liquid crystal display

UDBP- Uganda Domestic Biogas Programme

CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND

Biogas is a type of gas produced by the breakdown of organic matter. Methane constitutes the combustible portion of biogas. Examples of waste that produces biogas include human excreta, manure, animal slurry, fruit and vegetable waste, meat packing waste, dairy factory waste, brewery, distillery waste. Biogas is the source of domestic energy for both rural and urban areas in Uganda. This energy can be used as a fuel for cooking and electricity generation.

A biogas digester is a tank where organic waste is converted to methane gas by bacteria. The organic waste is put in the biogas digester. These organic materials are subsequently fermented in the digester. The fermentation process requires appropriate temperature. The digester is airtight with a pipe connection. The digester has to be filled with a required quantity of waste every day depending on how often the gas is used and the energy required by the user. The gas pipe is connected to the kitchen fireplace through connection pipes or a gas storage container. The combustion of this biogas has very little odour or smoke. These systems are easy to operate but less effective in terms of biogas production.

In 2010, the Uganda Domestic Biogas Programme (UDBP) made interviews by visiting all owners of biogas digesters within three research areas Kapchorwa district, Mukono district, Mbarara district. In every village, 15 to 20 household biogas digesters were interviewed on how the biogas digester was working. They observed some negative experiences with biogas. People still used the electricity for electronics like radio, Television, the fridge, also firewood, charcoal and paraffin were still used, the gas was only enough for one stove, on big occasions they didn't use the biogas at all, sometimes the light bulbs were dim. This was because biogas could not provide all energy needs. On top of that, small-scale farmers have often not been able to get sufficient feedstock for their biogas digester, because they lacked the necessary livestock to ensure a steady generation of biogas for lighting and cooking (Karakezi, 2002). As farmers have

difficulties generating sufficient gas supply from their digester, they often continue to use charcoal and firewood for cooking as well paraffin, thereby limiting the environmental and health benefits that can be achieved through efficient use of the technology [1] .

In Uganda, despite the introduction of biogas in the 1950's, the technology has not received considerable acceptance and as a result its penetration has remained low. Several installed plants have failed and those working are not working to the expectation of the owner. A survey of 144 biogas plants was carried out after which performance monitoring of selected digesters in the districts of Luwero, Kampala, Wakiso, Mbale, Jinja and Mukono. It was found out that over 55% of the surveyed biogas systems were not operational and others not performing to the users expectations. Most systems monitored were operating in the temperature range between 18^0c and 25^0c with methane gas levels being low [2].

1.1 PROBLEM STATEMENT

Most of the biogas digesters are not operational and others are not working to the user's expectation. The uncontrolled variation in temperature and limited stirring of the waste has led to very low levels of production of methane gas. Waste on the upper surface contributes most of the biogas neglecting the lower layers of waste in the biogas digester hence low methane production. Very low and very high temperature restricts biogas production by affecting the livelihood of the bio-organisms to digest the waste. Therefore there is need for a better system to improve on the production of methane gas.

1.2 OBJECTIVES

1.2.1 MAIN OBJECTIVE

To design and develop a methane control and monitoring system for a biogas digester that will regulate methane levels in the digester.

1.2.2 SPECIFIC OBJECTIVES

i. To review literature on the existing biogas digesters.
ii. To design all modules that are needed to control and monitor methane levels for the biogas digester and integrate them.
iii. To implement a prototype of proposed system.
iv. To test and validate the proposed system to meet the requirement

1.3 JUSTIFICATION

Despite a good number of urban households using electricity for lighting (33.5%), the low percentage of the same households using it for cooking (6.3%) implies that some households have electricity connected to the houses but do not use it as the main source of energy for cooking. The main reason is the high electricity tariffs. The new sources of energy such as biogas are still poorly developed. If well developed, these sources could reduce pressure on the forests. Unless logical and realistic solutions are devised, the threatening effects of energy crisis are likely to cause terrible sufferings and regrets in the immediate future [3]. If the biogas project is scaled up, it could allow Ugandans who live too far from the power grid to generate their own energy [4].

1.4 SCOPE

The proposed system only concentrates on two factors that is temperature by ensuring waste is in suitable temperature ranges for methane production and exposure of the waste to the surface in order to regulate methane levels. This was done by use of stirrers and pipes. Methane level is regulated depending on the user input. This project is applied only to domestic biogas digesters. The project is scheduled to last for seven months starting November 2015 to May 2016.

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