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FACULTY OF ENGINEERING
DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING

AGRO-PROCESSING ENGINEERING PROGRAMME

FINAL YEAR PROJECT REPORT

Design and Simulation of an Optimum Air Conditioning System for grain Storage and Processing

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ABSTRACT

Maize grain storage occupies a vital role in Uganda's economy. Proper monitoring of maize grain storage is essential to reduce losses. The present system involves human effort in most of the activities which reduces work efficiency and increases time consumption. These difficulties can be avoided by this project. In this project, the controlling and monitoring of the maize grain storage area is fully automated. The main objective of the project was to design an optimum air conditioning system for maize grain storage and processing to control and maintain the temperature in storage area at a desirable value which prevents the formation of microorganisms and spoilage of grains. In this project temperature is the main parameter that is essential for proper storage of maize grains and is taken as an input parameter to be controlled automatically using the programmable logical controller and is measured using a temperature sensor.

The system was modeled using Matlab Simulink tool box and accomplished using proteus software for simulation and Embedded C Programming language for coding. The design consist of a microcontroller to receive input signals from the temperature sensor and processes the data acquired and then sends the output signal to the LCD to be displayed on the screen. The simulation results of the designed system indicated that temperature of the maize grain storage room must be kept constant by monitoring and controlling it automatically to prolong the storage period to more than one year and the simulation validated the expected behavior of system hardware if implemented.

The system is best suited for commercial maize grain dealers and processors to maintain high quality grains for longer periods.

DECLARATION

I UTHUMAN MABIRIZI hereby declare to the best of my knowledge that the work presented in this proposal is my original work and has not been presented in any institution of higher learning/University for similar awards.

Signature

Date: 17/05/2015

UTHUMAN MABIRIZI

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APPROVAL

This final year project report for the program of Agro-Processing Engineering has been submitted to the Department of Agro-Processing Engineering for examination with the approval from the following supervisor(s).

Signature Date:

Mr. Joseph D. Lwanyaga

Signature Date:

Mr. Edward L. Ssemukasa

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MAY THE ALMIGHTY GOD REWARD YOU ABUNDANTLY

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FAO – Food and Agricultural Organization

UBoS – Uganda Bureau of Statistics

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CHAPTER ONE: INTRODUCTION

1.0. Background

Maize (*Zea mays L*), is the third most important cereal grain worldwide after wheat and rice (Golob, *et al.*, 2004), maize is referred to as the cereal of the future for its nutritional value and utilization of its products and by-products (Lee, 1999). The demand for maize has been estimated to increase by 50% to 837 million metric tons in 2020 (Martinez *et al.*, 2011). According to Food and Agricultural Organization (FAO), 2006 report on maize, the demand for maize is fuelled by its diverse uses, from food processing, animal feed, to ethanol production. Maize is a basic staple food grain for large parts of the world including Africa, Latin America, and Asia (Yaouba *et al.*, 2012). In tropical and subtropical countries like Uganda, a large proportion of the grain (such as maize) is harvested and stored under hot and humid conditions, and most farmers lack proper knowledge, equipment and methods of drying and storing grains (Weinberg *et al.*, 2008). Subsequently, the grains are stored while still relatively moist and warm resulting into rapid deterioration of the grains and promote the growth of microorganisms (for example fungi and bacteria) and insects (Ekechukwua and Norton, 1999).

The world has reached a level where everything can be controlled and operated automatically, but there are still few important sectors in Uganda where automation has not been adopted or not been put to a full- fledged use perhaps because of several reasons such as cost. Agriculture has been one of the primary occupations of man since early civilizations and even today manual interventions in farming and storing grains are inevitable. In Uganda maize is produced on a seasonal basis, and in many places there is only one harvest a year, which itself may be subject to failure. This means that in order to feed the world's population, most of the global production of maize, wheat, rice and millet must be held in storage for periods varying from one month up to more than a year. Maize grain storage therefore occupies a vital place in Uganda's economy. To maintain high quality during storage, maize grains should be protected from weather (including relative humidity and temperature), growth of microorganisms and insects (Oyekale *et al.*, 2012).

Temperature and moisture content of the cereal grains are the two key features affecting the resulting quality of the grain, biochemical reactions, dry matter losses, allowable storage times and overall storage management of the grain (Lawrence and Maier, 2010). The current

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