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FACULTY OF ENGINEERING

DEPARTMENT OF AGRICULTURAL MECHANIZATION AND IRRIGATION ENGINEERING

DESIGN AND SIMULATION OF AN AUTOMATIC DRIP IRRIGATION SYSTEM FOR TEA PLANTS USING AN ANFIS-BASED ET CONTROLLER

CASE STUDY: KASAKU TEA ESTATES

BY

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A final year Project Report submitted to the Department of Agricultural Mechanization and Irrigation Engineering as a partial fulfillment of the requirements for the award of a Bachelor of Agricultural Mechanization and Irrigation Engineering.

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ABSTRACT

Irrigation has been the backbone of civilized society since time immemorial. The urge to meet one's survival needs civilization to learn and embrace different agricultural practices, hence irrigational methods and techniques. With population increasing at an exponential rate and land areas being curved short to provide lodging for the enormous population, several new and innovative practices have become inevitable for prolonged nourishment for the human race. Water which happens to be the most central resource for survival is becoming scarce these days and we will be in jeopardy if adequate measures are not taken right away.

The focal point of this project seeks to solve the above mentioned challenges at hand and trying to figure out some better techniques in this technologically prolific era however, the design crop is tea. Although many and innovative techniques have been employed towards Automatic irrigation, they mostly involve simple moisture monitoring control logic for their operations which come with wastage of water resources if not monitored properly.

An Evapotranspiration controller based on adaptive neural fuzzy inference structure was adopted in this project because of it being a powerful tool in prediction of complex phenomena. The ANFIS model was first tested with regression to check its validity against Penman Evapotranspiration model and proved to be outstanding with MSE of 0.037 and Coefficient of determination of 0.960 while regression gave MSE of 0.096 and Coefficient of determination of 0.886.

The proposed algorithm for irrigation scheduling prohibits water stress because it ensures that moisture depletion does not reach 100% that represents permanent wilting point and irrigation will always occur when depletion reaches 50% from which it will deliver water up to 60% of the available water from where it begins applying real time crop water requirement and stops after delivering 95% of field capacity. All this was to ensure that there is negligible or no loss through depletion beyond the root zone.

The model was prototyped and simulated in Simulink Matlab 2013 environment.

DECLARATION

I ASHABA MARTIN, declare that this project report is a true outcome of my efforts and has never been submitted to any institution of higher learning for any award.

Signature .....

Date 26TH MAY 2016 .....

APPROVAL

This report has been submitted to the Department of Agricultural Mechanization & Irrigation Engineering with the approval of the following supervisors.

Main Supervisor

Mr. Mugisha Moses

Signature..... Date .....

Co-Supervisor

Mr. Salanjaye Wilberforce

Signature..... Date .....

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DEDICATION

To my parents, Mrs. Kyampeire Jonah and Mr. Manshur Monday, Uncle Robert Mugabe and Family, thanks for the care you have granted unto me and also watching my back during the pursuit of my academics at Busitema University. May God reward you in abundance.

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ACRONYMS

ANFIS	Adaptive neural fuzzy inference system
ET	Evapotranspiration
ETc	Crop Evapotranspiration
FAO	Food Agricultural Organization
AutoCAD	Automatic Computer Aided Design
MS	Microsoft word package
WBIC	Weather-Based Irrigation Controller
USDA	United States Department Of Agriculture
FAO	Food and Agricultural Organization
TQFP	Thin Profile Quad Flat Package
PDIP	Plastic Dual Inline Package
MSE	mean square error value

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CHAPTER ONE

1.0 Introduction

1.1 Background of the study

Tea, Camellia sinensis belongs to the family Theaceae and today cultivated varieties are hybrids of the original tea plants, Thea sinensis and Thecae assamica(Sarwar et al. 2011). Tea is grown in India, china, US, Europe, Middle East, Russia, Indonesia and Vietnam.

In East Africa, tea is grown in Uganda, Kenya, Rwanda, and Tanzania in which Kenya is a leading exporter followed by Uganda, Tanzania, Rwanda and Malawi.

Tea (Camellia Sinensis) being one of Uganda's exports is grown in districts of Kanungu, Bushenyi, Rukungiri, Kabarole, Wakiso, Kibaale, Nebbi, Kisoro, Hoima and Mbarara and total area under tea plants in Uganda is estimated to be 21,000ha (Cali & Managua 2011).

Over 90 percent of Uganda's processed and graded tea finds its way to international markets through the Mombasa Auction market where it is branded and consumed as Kenyan (Nakaweesi, 2012). Uganda earns $90-100 million per year from the tea exports, employs about 62000 people supporting more than 500,000 dependents in Uganda (Nakaweesi, 2012). However there are setbacks encountered in tea cultivation that dwindle the outputs such as rise in temperatures associated with global climate change. Uganda lies in a tropical region, on the equator, but the country has a high altitude, with most of the country lying on a high plateau. Uganda has a bimodal precipitation pattern, with two distinct wet and dry seasons each year. In the dry season, agricultural production of the country lowers down and so requires employment of irrigation(Goulden ,2008).

In 2012, from January to September, there was a decline in the amount of tea produced where the country registered 20-25 million kilograms compared to over 30 million kilograms due to the dry weather conditions experienced (Nakaweesi, 2012). Irrigation is therefore fundamental to not only avert the setbacks due to harsh climatic changes but also increase production of tea plants and agriculture as a whole.

Existing methods of irrigation in Uganda involve transfer of water from the source using containers like watering cans and Jerry cans to manually apply water to the crops. The challenges with such

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