



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

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

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING.

**DESIGN AND IMPLEMENTATION OF AN AUTOMATED MONITORING AND
CONTROLLED IRRIGATION SYSTEM WITH SECURITY FEATURES FOR
GREENHOUSE FARMING IN UGANDA.**

BY

NYANGOMA GORRET

(BU/UG/2021/3698)

SUPERVISORS

ASSOC. PROF. OKOU RICHARD

MR. MUGWANYA PATRICK

A final year project Report submitted to the department of Electrical and Electronics Engineering in partial fulfillment of the requirement for the award of the degree of Bachelor of science in Electrical Engineering at Busitema University.

JUNE, 2025

ABSTRACT

Greenhouse farming is essential for enhancing crop growth and maximizing agricultural output by providing a controlled environment for cultivation. However, maintaining optimal growing conditions due to climate change and ensuring crop security remain key challenges.

This project introduces the design and implementation of a mobile-controlled irrigation and security system to improve the efficiency and safety of greenhouse operations. The system utilizes Internet of Things (IoT) technology and a network of sensors to monitor vital environmental parameters such as soil moisture, temperature, and humidity, enabling automated irrigation adjustments based on real-time data to optimize water usage and support healthy plant growth.

The system also integrates a security module with motion detection and surveillance features to protect the greenhouse from unauthorized access or intrusions. All system functions, including environmental monitoring, alert notifications, and remote control of irrigation and security, are managed through a mobile application, allowing farmers to oversee and control their greenhouse operations from anywhere.

This approach is intended to reduce dependence on manual labor, conserves resources, and enhances crop security, providing a scalable, cost-effective, and sustainable solution for modern greenhouse management that boosts productivity and ensures optimal plant health. It also aligns with the Uganda's Vision 2040, which emphasizes sustainable agricultural modernization, as well as regional and global frameworks like the African Union (AU) goals and Sustainable Development Goals (SDGs) particularly SGD 2 which aims at achieving zero hunger.

A prototype was designed, developed and tested using locally available electronics and other accessories. The expected outcomes resulting from the prototype testing were found to confirm the theoretical objectives detailed in the report.

DECLARATION

I **Nyangoma Gorret (BU/UG/2021/3698)**, hereby declare that this project report is my original work and has not been submitted to any institution or office for the award of any certificate or document. Any information or content referenced from other sources has been properly cited in this document.

NYANGOMA GORRET

Signature:



Date:

12th/06/2025

APPROVAL

This is to prove that the project report titled Design and Implementation of a Mobile controlled irrigation and Security system for Greenhouse farming submitted by NYANGOMA GORRET has been examined and approved as a valid and original submission. This report satisfies the requirements of Busitema University needed in partial fulfillment of the requirements for the award of Bachelor in science of Electrical Engineering.

Approved by:

MAIN SUPERVISOR

Name: PROF. OKOU RICHARD

Signature: 

Date: 17th June 2025

CO-SUPERVISOR

Name: MR. MUGWANYA PATRICK

Signature: 

Date: 12th /06/2025

DEDICATION

I dedicate this project to God Almighty my creator, my source of wisdom, knowledge and understanding. He has been the source of my strength throughout this program.

Much dedication goes to my beloved Father Mr. Birungi Edward, brother Mr. Kato John Baptist and my Mentor Mr. Twesige Brian for their continuous support and encouragement in this journey, am always proud of you.

I also dedicate this work to my Lecturers who have 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.

ACKNOWLEDGEMENT

My deepest gratitude goes to God for His provision, protection and grace throughout my life and knowledge that helped me up to the completion of this project as well as the academic journey.

I appreciate the Head of department, Eng Kilama Goerge for leading us well and nurturing us through this great institution, Busitema University where I have been trained to take up my destiny of royalty and dominion.

I also appreciate my Supervisors, Prof. Okou Richard and Mr. Mugwanya Patrick who have shown exemplary leadership and guidance in this project. I cannot forget my fellow course mates for their help and support all of whom I have had direct contact with and who have impacted me during this program. I say a big thank you.

Table of Contents

CHAPTER ONE: INTRODUCTION	1
1.1 BACKGROUND	1
1.2 PROBLEM STATEMENT	2
1.3 OBJECTIVES	3
1.3.1 Main Objective.....	3
1.3.2 Specific objectives	3
1.4 JUSTIFICATION / SIGNIFICANCE OF THE PROJECT	3
1.5 SCOPE	4
1.5.1 Technical Scope.....	4
1.5.2 Geographical Scope	4
1.5.3 Time Scope	5
CHAPTER TWO: LITERATURE REVIEW	5
2.1 MAIN CONCEPT OF THE PROJECT.....	5
2.1.1 Automated Systems	5
2.1.2 Microcontroller Technology	5
2.1.3 ESP32 module Technology.....	5
2.1.4 Sensing Technology	6
2.1.5 Feedback Mechanism	6
2.2 RELATED SYSTEMS	6
2.2.1 An Innovative IoT-Based Intelligent Control System for Agricultural Greenhouses	6
2.2.2 IoT-Based Automated Greenhouse	7
2.2.3 Smart Greenhouse Design Based on Internet of Things (IoT) with Microcontroller Arduino Uno.	7
2.2.4 GSM and IoT-Based Greenhouse Monitoring and Control System	8

2.2.5 IoT and GSM-Based Greenhouse Control	8
CHAPTER THREE: METHODOLOGY	12
3.1 REQUIREMENTS ELICITATION	12
3.2 DATA COLLECTION METHODS.....	12
3.2.1 Document Review	12
3.2.2 Interview.....	12
3.3 SYSTEM DESIGN.....	12
3.3.1 Hardware Tools/Components	13
3.3.2 Software Tools used.....	16
3.3.3 Block diagram	17
3.4 SYSTEM IMPLEMENTATION	18
3.4.1 Hardware Implementation.	18
CHAPTER FOUR: RESULTS AND DISCUSSIONS	21
4.1 System performance results.....	21
4.1.1 Irrigation System	21
4.1.2 Security system	21
4.1.3 Graphs showing the system operation of the components	21
4.2 Summary of the work done	23
4.3 Conclusion	23
4.4 Recommendations.....	24
REFERENCES	25
APPENDDDIX 1.....	26

LIST OF FIGURES

Figure 1: Showing a personal computer	13
Figure 2: Showing a wifi module used for the development of end-point IoT	13
Figure 3: Showing a microcontroller which acts as the brain of the system.....	14
Figure 4: Showing a Dc Servo-motor used for controlling water.....	14
Figure 5: Showing a Humidity and Temperature Sensor for monitoring environmental conditions.	15
Figure 6: Showing a soil moisture sensor to measure the amount of water within a material sample.....	15
Figure 7: Showing Jumper wires used to connect different components in the system.....	16
Figure 8 : Showing a breadboard where all the connections were done	16

LIST OF TABLES

Table 1: 2.3 COMPARISON TABLE OF EXISTING SYSTEMS.....	9
Table 2 : Bill Of Quantities	20

LIST OF ABBREVIATIONS

GDP	Gross Domestic Population
UN's	United Nations
FY	Financial Year
DC	Direct Current
GSM	Global System for Mobile Communications
API	Application Programming Interface
SMS	Short Message Service
AU	African Union
SDGs	Sustainable Development Goals
ESP8266	Wi-Fi module
IoT	Internet of Things
TCP/IP	Transmission Control Protocol/ Internet Protocol