

**BUSITEMA
UNIVERSITY**
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

TOPIC

**DESIGN AND IMPLEMENTATION OF AN AUTOMATIC
MONITORING AND CONTROLLED IRRIGATION AND
SECURITY SYSTEM FOR GREENHOUSE FARMING.**

PROJECT REPORT BY:

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

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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 and ensuring crop security remain key challenges.

This project introduces the design and implementation of an Automatic monitoring and 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 security, are managed through a mobile application, allowing farmers to oversee and monitor their greenhouse operations from anywhere.

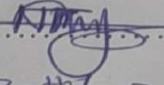
This approach reduces manual labor, conserves resources, and enhances crop security, providing a scalable, cost-effective, and sustainable solution for modern greenhouse management that boosts productivity and ensures optimal plant health. It also aligns with the Uganda's Vision 2040, which emphasizes 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.

DECLARATION

I **NTUYO NELSON**, 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. I share equal responsibility for the content and accuracy of this report.

Name: NTUYO NELSON

Signature:.....

Date: 30th/05/2025.....

APPROVAL

This is to certify that the project report titled Design and Implementation of a Mobile controlled irrigation and Security system for Greenhouse farming submitted by NTUYO NELSON 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's Degree in science of Electrical Engineering.

Approved by:

Mr. MUGWANYA PATRICK

Signature..... 

Date.....29th/05/2025.....

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 parents Mr. NANFUNGIRI ESAU, Mrs. RACHEAL ESAU and all my sister and brother Agnes and Grant for their continuous support and encouragement in this journey, am always proud of you. I also dedicate this work to my Lecturers Prof. Okou Richard, Mr. Mugwanya Patrick and Miss Lucy Nabwire 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.

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LIST OF ABBREVIATIONS

GDP	Gross Domestic Population
UN's	United Nations
FY	Final 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

References

- [1] "General Agricultural Sector Guide," Uganda Revenue Authority (URA), 2024. [Online]. Available: <https://ura.go.ug/en/general-agricultural-sector-guide/>. [Accessed 23 11 2024].
- [2] "Uganda - Country Commercial Guide," 13 10 2023. [Online]. Available: <https://www.trade.gov/country-commercial-guides/uganda-agricultural-sector>. [Accessed 23 11 2024].
- [3] "DC Motor," [Online]. Available: <https://byjus.com/physics/dc-motor/>. [Accessed 24 11 2024].
- [4] R. Weinberg, "What Are Communications APIs?," no. March 22, 2023, 2023.
- [5] "Africa's Talking," [Online]. Available: <https://africastalking.com/about>. [Accessed 26 11 2024].
- [6] "Humidity and Temperature Sensors: Essential Tools for Facilities Management," 23 10 2024. [Online]. Available: <https://www.forestrock.co.uk/blog/humidity-and-temperature-sensors/>. [Accessed 25 11 2024].
- [7] "Espressif Systems ESP32-WROOM-32 MCU Modules," Mouser Electronics, [Online]. Available: https://eu.mouser.com/new/espressif/espressif-esp32-wroom-32-modules/?srsltid=AfmBOoryPtFN8wsX_H-Kc_B5D5ydig0zcu-e9-ZklzER7jgBn4B6Juqq. [Accessed 26 11 2024].
- [8] "An Innovative IoT-Based Intelligent Control System for Agricultural Greenhouses," *Xin Wang*, vol. 2, no. Vol. 2 No. 3 (2024), p. 3, 2024.
- [9] B. M. M. Danita, "IoT Based Automated Greenhouse Monitoring System," 2018.

- [10] "Smart Greenhouse Design Based Internet of Things (IoT) With Microcontroller Arduino Uno," vol. 16, no. Vol 16, No 1 (2023), p. 1, 2023.
- [11] S. J. S, "IOT Based Greenhouse Monitoring and Controlling System," 2021.
- [12] P. Verma, "GSM Based Motor Control for Irrigation," p. 56, 2016.
- [13] "Big Opportunity: How To Earn Profitably From Greenhouse Farming," Roohaz agro-farm limited, 26 02 2018. [Online]. Available: <https://businessfocus.co.ug/big-opportunity-how-to-earn-profitably-from-greenhouse-farming/>. [Accessed 24 11 2024].
- [14] [Online].