

BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

FINAL YEAR PROJECT REPORT

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**DESIGN OF POWER LOAD MONITORING AND CONTROL SYSTEM FOR AN OFF-
GRID INSTITUTION SETTING**

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BU/UP/2021/1339

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**Final Year Project Report Submitted to the Department of Electrical Engineering in
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Engineering Degree.**

ABSTRACT

The increasing demand for electricity during peak hours in off-grid institutions, such as schools and hospitals, sometimes leads to overloading and potential disruptions. Manual methods of managing power usage are inefficient and unable to dynamically respond to fluctuations in energy availability. This project aims to design and implement a power load monitoring and control system specifically tailored for off-grid settings to optimize energy usage and ensure system reliability.

The main objective is to develop a system that continuously monitors energy consumption, assesses the stored power in batteries, and integrates control mechanisms to enhance energy efficiency. In situations where the available power from the generation sources is insufficient to meet peak demand, the system will prioritize essential loads, such as ICU units in hospitals, while selectively disconnecting non-essential loads. This dynamic adjustment will be based on realtime power availability, ensuring uninterrupted service to critical areas while minimizing energy consumption and promoting cost savings. The system will also optimize power usage during low generation periods from the off-grid power source, thereby improving overall efficiency and sustainability

DECLARATION

I, KYENYI ABUDALLAH, Registration Number BU/UP/2021/1339, under the supervision and guidance of the University supervisor, declare that this report is my own work, and that the information gathered and used has not been used to obtain any academic award in any other learning institution, with the exception of extracts and summaries for which the original references are stated here.

Signature:

Date: 30/05/2025

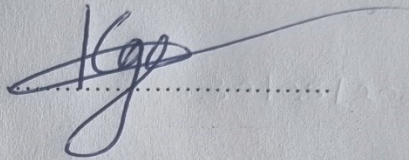
APPROVAL

This is to certify that KYEYI ABUDALLAH created this report and submitted it for scrutiny. With my permission as a university supervisor, it is now ready for submission to the Department of Electrical Engineering.

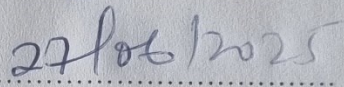
Supervisor Name:

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Signature:



Date:



DEDICATION

I dedicate this report to the special people in my life who, with or without my knowledge, have made substantial sacrifices to assist me get here. I am especially grateful to my beloved dear ones, Mr. KIDANDAIRE ALI and Ms. NAMUGOSA HAMIDAH, for their words of support and push for persistence. My colleagues and supervisor have never left my side and are incredibly special. May God definitely bless them.

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First and foremost, I'd like to thank the Almighty God for allowing me to reach this point in my academic career despite various obstacles.

Second, I'd like to thank my supervisor, Eng. Kilama George for his ongoing supervision, support, and advice, which has resulted in the prompt submission of this study report.

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LIST OF ACRONYMS

SHS	Solar Home System
UNES	Uganda National Electrification Strategy
DC	Direct Current
IT	Information Technology
GSM	Global System for Mobile Communication
HTTP	Hyper Text Transfer Protocol
LED	Light Emitting Diode
LCD	Liquid Crystal Display
APIs	Application Programmer Interface
UI	User Interface
SDK	Software Development Kit

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Component Compatibility and Power Budgeting: Ensuring all modules, especially sensors, relays, and microcontrollers, operated within the same voltage and current range required careful power budgeting and hardware selection.

6.2 Recommendations

Stable WiFi Network Access: The system should be deployed in locations with reliable WiFi coverage or integrated with offline data logging to maintain performance in remote areas.

Modular System Design: Future designs should adopt a modular approach to allow easy upgrading or replacement of sensors, communication modules, or relay units.

Energy-Efficient Load Control: Incorporating adaptive algorithms to shed or restore non-essential loads more efficiently can improve battery usage and prolong operational time.

6.3 Conclusion

A power load monitoring and control system was successfully developed using microcontrollerbased logic and WIFI communication. The system was capable of detecting drops in power supply, prioritizing essential loads, and switching off non-essential loads accordingly. Alerts were transmitted via WIFI to the monitoring interface when thresholds were breached. The system achieved the project's key objectives by enhancing energy efficiency and reliability in an off-grid institutional setting.

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8.0 APPENDIX

8.1 APPENDIX 1: Equipment, instruments and prototype diagrams

