FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FINAL YEAR PROJECT

DESIGN AND IMPLEMENTATION OF A MULTI-TENANT PREPAID ELECTRICITY MANAGEMENT SYSTEM (MPEMS) FOR SINGLE PHASE CUSTOMERS

By

KYALUZI AUGUSTINE

BU/UP/2020/1571

kyaluziaugustine4@gmail.com

SUPERVISORS

MISS. PATIENCE TUSIIMIRE

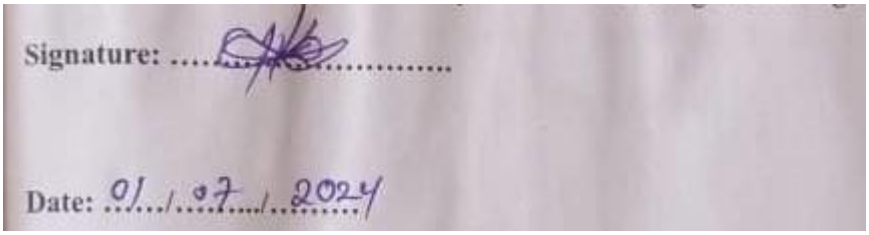
MR. BWIRE JOHN BOSCO

This Final Year Project Report submitted to the Department of Electrical and Electronics Engineering in a partial fulfilment of the requirement for the award of the degree of Bachelor of Science in Electrical Engineering of Busitema University

JUNE 2024

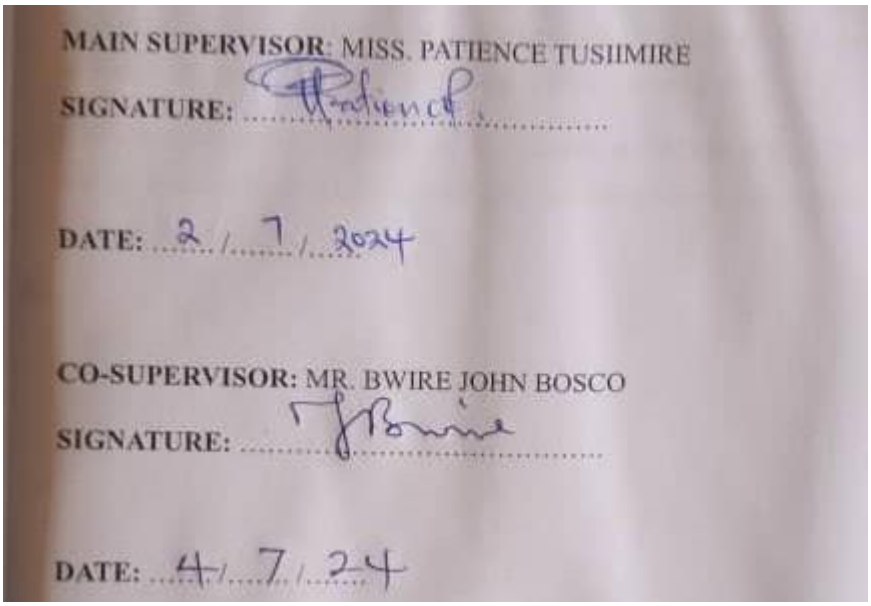
DECLARATION

I **Kyaluzi Augustine** hereby declare that this Final Year Project Report is my original work except where explicit citation has been made and has never been published and/or submitted for any other degree award to any other university or institution of higher learning for any academic award.



APPROVAL

The final year project under the title "DESIGN AND IMPLEMENTATION OF A MULTI-TENANT PREPAID ELECTRICITY MANAGEMENT SYSTEM (MPEMS) FOR SINGLE PHASE CUSTOMERS" has been done under our guidance and the report has been done under our supervision and submitted to the faculty of engineering for examination with our approval.



DEDICATION

I dedicate this report to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this project and on His wings only have I soared. I also dedicate this report to my parents, the late. Mulindwa Daniel and Mrs. Najingo Specioza who have encouraged me all the way and whose encouragements have made sure that I give it all it takes to finish that which I have started. God bless you.

ACKNOWLEDGEMENT

I convey my sincere gratitude to my supervisors, Miss Patience Tusiimire and Mr. Bwire John Bosco and the Department of Electrical and Computer Engineering for the guidance and insight into concepts of research and project management as well as technical knowledge applicable to the design of the system. I am thankful to all my friends especially my course mates who stood with me during my academic journey, more so for supporting me towards the completion of our project. I have no valuable words to express my thanks, but my heart is still full of the favours received from every person.

Acronyms

MPEMS- Multi-tenant Prepaid Electricity Management System

CIU- Consumer Interface Unit

DC- Direct current

AC- Alternating current

LCD- Liquid Crystal Diode

SBD- system block diagram

FLD-Flowchart Diagram

KWH- kilowatt hour

CTs- current transformer

NO- Normally open

NC- normally closed

GPIO- General Purpose Input/Output

GSM- global system for mobile communications

GMSK- Gaussian minimum shift keying

TDMA- time division multiple access

FDMA- frequency division multiple access

List of figures

ABSTRACT

With the introduction of YAKA system in Uganda in around 2011, which acts as a prepaid billing system, many landlords have taken it up as it saves them from having wrangles with their tenants over power bills as the tenants can manage their power bills and pay direct to the Umeme company. However, due to the high costs of installing these meters, landlords have resorted into making their tenants share the same meter as in a single block, you can find over six people sharing the same YAKA meter and also sharing the power bills which is difficult tell how much of the power each consumes. Since the tenants can't tell how much power is consumed by each individual as they have different appliances, many of these tenants end up having quarrels over power. The development of this system was therefore motivated by the need to solve this problem. The system will monitor the power consumed by each tenant, display the energy consumption of each tenant on the lcd in real time, automatically disconnect the tenant whose units have been used up, while leaving those who still have units to run. This will help eliminates the problem of people paying overdue. Two sockets have been used each representing a single tenant for demonstration purposes.

Table of Contents

CHAPTER ONE: INTRODUCTION

1. 1 Background

Uganda's main electricity distribution company, listed on the Uganda Securities Exchange and cross listed on the Nairobi Securities Exchange. We operate a 20-year electricity distribution concession from the Government of Uganda. Following reforms in 1999, Uganda adopted a single buyer electricity sector model, where Uganda Electricity Transmission Company Limited (UETCL) is the System Operator, responsible for purchasing electricity from all Independent Power Producers, import and export of electricity. UETCL is our sole supplier. As a distributor, we supply electricity to customers, involving operation, maintenance and upgrade of power infrastructure, electricity retail and provision of related services. The Electricity Regulatory Authority (ERA) is responsible for sector regulation, with their mandate including setting operating standards and appropriate end user tariffs[1]. YAKA energy meters is a prepaid energy meter which Umeme introduced to replace postpaid meters due to several challenges umeme faced with the postpaid meters such as power theft as the meters were mounted on the customers wall and they would easily tamper with the meter, some customers couldn't pay for the bill, resistance when disconnecting customers for not paying, expensive meter reading activities as the staffs had to move to every customer to take the reading and it was prone to corruption. Umeme therefore, introduced prepaid meters (Yaka) which are mounted on the pole top and a customer is given a consumer interface unit (CIU), and a card having the customer's account or meter number. This meter allows the customer to pay for power before use (buy units) and if the purchased units are done the customer is disconnected automatically and this has helped solve most of the problems Umeme was experiencing with the postpaid meters.

Yaka which was implemented in 2011 has continued to make Umeme's job easier and customers happier. From the surveys carried out yearly from the time it was implemented, Yaka has always come out as the best thing that has happened for Umeme's customers and Umeme has also become more efficient. The change from the postpaid metering system to the trendy Yaka has not only opened the business to new technological opportunities, it has come with many benefits to Umeme, the customers and to other enterprises. The benefits include; reduction of operational costs through business efficiencies by optimizing operational costs of billing disconnection and reconnection for credit control and need for cash offices at Umeme business centers, Yaka also provides the business an effortless platform through which customers debt/arrears can be collected through small manageable installments by

REFERENCES

[1] "Customer Information File," *SpringerReference*, pp. 1–28, 2011.

[2] The Independent, *UMEME POWER — Transforming Uganda*. 2018.

[3] "CUSTOMER CUSTOMER Booklet 2023 INFORMATION," 2023.

[4] F. P. D. F. Creator and F. Software, "Watt Meter Power Analyzer User ' s Manual."

[5] "Collections." .

[6] "ELECTRICITY RETAIL TARIFFS FOR THE FIRST QUARTER OF 2024 Umeme Ltd hereby informs its esteemed customers of the following Electricity Retail Tari rates applicable for the First Quarter of 2024 (January-March) as approved by the Electricity Regulatory Au," vol. 2024, no. March, p. 2024, 2024.

[7] Anonim, "2 Channel 5V Relay Module Feature : Schematic Input : Output :," pp. 2–4.

[8] W. D. Avenue and T. Floor, "Global System for Mobile Communications (GSM) Protocol Analysis and Simulation What is GSM ?," no. 301.

[9] C. Lcd, "Character LCD with I2C Interface (I2C LCD) Input / Output Connections," no. I2c Lcd, pp. 1–22, 2016.

[10] F. Costa, P. Poulichet, F. Mazaleyrat, and E. Laboure, "Current sensors in power electronics, a review," *EPE J. (European Power Electron. Drives Journal)*, vol. 11, no. 1, pp. 7–18, 2001.

[11] L. E. Richter, A. Carlos, and D. M. Beber, "No 主観的健康感を中心とした在宅高齢者における 健康関連指標に関する共分散構造分析Title."

[12] SparkFun Electronics, "4x1 Matrix Membrane Keypad," *SparkFun Electron.*, no. 916, pp. 1–6, 2011.