BUSITEMA UNIVERSITY
Pursuing Excellence

P.O.Box 236, Tororo
Gen:+256-454448842
Dir: +256-454448864
Mob: +256-782999874
Fax: +256-454436517
Email:ar@acadreg.busitema.ac.ug
Website:www.busitema.ac.ug

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FINAL YEAR PROJECT REPORT

DESIGN AND IMPLEMENTATION OF A MULTI-BRIGHTNESS INTENSITY VEHICLE HEADLIGHT MANAGEMENT SYSTEM

BY

AMANYA MOSES BU/UP/2020/1208

Supervised by:

Mr. Andrew Rwendeire

Eng. Kigozi John

A Final Year Project Report Submitted to the Department of Electrical and Electronics Engineering as a Partial Fulfillment for the Award of Bachelor of Science in Electrical Engineering.

JUNE, 2024

DECLARATION

I, Amanya Moses, declare that the work presented in this project report is my own, except for properly referenced citations and quotations. I also affirm that this project has not been submitted for a Bachelor's of Science in Electrical Engineering degree award at this or any other institute of higher learning.

Name: Signature:

Amanya Moses 

Date: 18th/June/2024

APPROVAL

This project report titled "Design and Implementation of a Multi-brightness Intensity Vehicle Headlight Management System" has been thoroughly developed and is now officially submitted to the Department of Electrical and Electronics Engineering at Busitema University under the supervision of;

Mr. Andrew Rwendeire

Signature: .....

Date: 28/06/2024

ENG. Kigozi John

Signature: .....

Date: 08/07/2024

DEDICATION

I dedicate this report to my family members and friends, whose unwavering support and encouragement have been my guiding light throughout this journey. To my supervisors, mentors, and instructors, whose wisdom and guidance have illuminated my path to knowledge and innovation. To all road users, whose safety and experiences drive the need for continual improvement in vehicle technologies. Lastly, to all the passionate engineers and researchers who continuously strive to make our roads safer and our technology smarter.

ACKNOWLEDGMENT

I would like to express my profound gratitude to Almighty God for granting me the strength and wisdom to successfully complete this course and project. His guidance has been my cornerstone throughout this journey. I am deeply thankful to my supervisors, Mr. Andrew Rwendeire and Mr. Kigozi John, for their invaluable guidance and unwavering support, which were crucial in bringing this project to fruition.

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ABSTRACT

This project introduces a novel approach to enhancing the intelligence of car headlights by implementing a multi-brightness intensity level framework. The system autonomously adjusts the headlights based on ambient light conditions and the presence of other vehicle headlights. Operating on seven intensity levels, from parking to full brightness, the system dynamically adapts to diverse lighting conditions, optimizing visibility and minimizing glare. The integration of hardware tools including the Arduino Uno Controller, light-dependent resistors (LDR), LED panel, and BJT driver collectively contributes to the system's ability to improve visibility and reduce glare. Additionally, the utilization of Arduino software and the implementation of the PWM algorithm enable the development of an intelligent headlight system that effectively responds to varied lighting scenarios. As a result, this approach enhances road safety and driving comfort by effectively addressing the complexities associated with diverse lighting conditions.

LIST OF ACRONYMS

AHO	Automatic Headlight On
ALS	Ambient Light Sensor
AR	Augmented Reality
BJT	Bipolar Junction Transistor
GSM	Global System for Mobile Communication
GUI	Graphical User Interface
HID	High-Intensity Discharge
IoT	Internet of Things
LCD	Liquid crystal display
LDR	Light Dependent Resistor
LED	Light Emitting Diode
LRC	Lighting Research Center
PCB	Printed Circuit Board
PWM	Pulse Width Modulation
RAC	Royal Automobile Club
RFID	Radio Frequency Identification

CHAPTER ONE: INTRODUCTION

1.1 Background

The evolution of automotive lighting, crucial for driving safety traces a century-long journey through technological breakthroughs. Headlamps, the focal point of this evolution, have not merely followed advancements but propelled them forward. From the pioneering dual-beam systems in the 1910s to the introduction of halogen headlights in 1962 and the advent of adaptive lighting systems in the 2000s, automotive illumination has continually adapted to meet the demands of changing driving conditions. The integration of light-emitting diodes (LEDs) in the 1990s marked a paradigm shift, introducing extended lifespan, directional light, and energy cost reductions[1].

The surge in popularity of light-emitting diodes (LEDs) has ushered in advancements in sustainability and safety, but it has also brought forth a critical problem – dazzling headlights. Drivers, particularly older individuals and those with specific eye conditions, increasingly report the blinding effects of oncoming headlights, leading to discomfort, compromised visibility, and even avoidance of night driving. This concern, substantiated by surveys and research from organizations like the RAC and The College of Optometrists, highlights a growing need for intervention. Notably, the potential compromise to road safety posed by glare, as evidenced by studies indicating reduced driver performance and slower reaction times. Simultaneously, energy consumption costs remain pivotal in aligning with sustainable practices.

According to the Lighting Research Center (LRC) naturalistic study, Preliminary findings, suggest a nuanced relationship, with an estimated 15-20% increase in reaction times during glare exposure. This research endeavors to provide valuable insights and metrics that can inform advancements in lighting technology and enhance road safety for all motorists, potentially reducing glare-related incidents by up to 30%[2].

The project draws inspiration from various studies, such as the one proposing an enhanced method for controlling headlight intensity using Ambient Light Sensor (ALS), NI myRIO, and LabVIEW[3]. This initiative aimed to develop a multi-brightness intensity headlight management system for Ugandan drivers, considering the unique challenges faced in the region.

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