DEPARTMENT OF ELECTRICAL ENGINEERING

FINAL YEAR PROJECT REPORT

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

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

JUNE, 2024

DECLARATION

I, Chakuwa Gabriel, 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.

Signature ……… ………………………….   Date: 11/06/2024

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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 Engineering at Busitema University under the supervision of;

Mr. Andrew Rwendeire

Signature: ....

Date: ....28th/06/2024.....

ENG. Kigozi John

Signature: ....

Date: ....08/07/2024..............

DEDICATION

I dedicate this report to my family and friends, whose unwavering support and encouragement have been instrumental throughout this journey. To my colleague, Mr. Amanya Moses, with whom I collaborated on this project, and to our supervisors, mentors, and instructors, whose wisdom and guidance have illuminated our path to knowledge and innovation. I extend this dedication to all road users, whose safety and experiences underscore the necessity for ongoing advancements in vehicle technologies. Finally, to all the passionate engineers and researchers who tirelessly work to enhance road safety and develop smarter technologies, I express my deepest gratitude.

ACKNOWLEDGMENT

I want to express my gratitude to Almighty God for giving me the strength to complete this project successfully. My sincere thanks to my supervisors, Mr. Andrew Rwendeire and ENG. Kigozi John, for their unwavering guidance. I am also grateful to my project partner, family, and friends for their support.

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ABSTRACT

This innovative project introduces a novel method to elevate 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. This dynamic adaptation optimizes visibility and minimizes glare, effectively addressing the complexities associated with diverse lighting conditions, and resulting in enhanced road safety and driving comfort. The integration of hardware tools such as 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. Furthermore, 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, thus, ensuring an unparalleled driving experience.

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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