“ADAPTIVE HEADLIGHT AND EMERGENCY BRAKE ALERT SYSTEM”

A Project submitted to

SHIVAJI UNIVERSITY, KOLHAPUR

In partial fulfilment of the requirement for the award of Degree

BACHELOR OF TECHNOLOGY
in

ELECTRONICS AND TELECOMMUNICATION ENGINEERING
by

MR. AMEY RAJENDRA GUNDE. **(PRN NO- 2020080908)**

MR. SANKET BASAVRAJ MUTNALE. **(PRN NO- 2020082096)**

MR. ANIKET TUKARAM TAKKEKAR. **(PRN NO- 2020082103)**

UNDER THE GUIDANCE
of

PROF. SUSHIL R. SANKPAL (E&TC)

Department of Electronics and Telecommunication Engineering

Sant Gajanan Maharaj College of Engineering, Mahagaon.

Kolhapur- 416 503, Maharashtra, India

2023-2024

SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING, MAHAGAON

CERTIFICATE

This is to certify that**, MR. AMEY RAJENDRA GUNDE, MR. SANKET BASAVRAJ MUTNALE** and **MR. ANIKET TUKARAM TAKKEKAR.** has successfully carried out and completed the project work on

"ADAPTIVE HEADLIGHT AND EMERGENCY BRAKE ALERT SYSTEM"

Under my guidance in satisfactory manner during the year 2023-24 for the partial fulfillment of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND TELECOMUNNICATIONS ENGINEERING

As per the rules and regulations of

Shivaji University, Kolhapur

This report represents the bonafide work of the students.

Prof. S. R. SANKPAL **Project Guide**	**Prof. V. K. SALUNKE** **Project Co-Ordinator**
Prof. A. B. FARAKTE **HOD**	**Dr. S. H. SAWANT** **PRINCIPAL**

“ADAPTIVE HEADLIGHT AND EMERGENCY BRAKE ALERT SYSTEM”

By,

MR. AMEY RAJENDRA GUNDE, MR. SANKET BASAVRAJ MUTNALE, MR. ANIKET TUKARAM TAKKEKAR

is approved for the Degree of Bachelor of Technology
in

ELECTRONICS AND TELECOMMUNICATONS ENGINEERING

SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING, MAHAGAON

of

Shivaji University Kolhapur

Examiners:

1. **Internal: ………………**

2. **External: ………………**

Date: / / 2024

Place: Mahagaon

ACKNOWLEDGEMENT

We wish to express our deep, sincere gratitude to our guide Prof. S. R. Sankpal and Head of the Department, Prof. A. B. Farakte for their excellent guidance, encouragement, support, and insightful comments throughout the period of our bachelor's degree. Whatever knowledge and experience we have gained during ours study here; we owe it to him. He has been our pillar of strength during times of downfalls.

We would like to extend our deep sense of gratitude to Project Co-ordinator Prof. V. K. Salunke for his constant guidance and support during the tenure. We would like to thank our Principal Dr. S. H. Sawant. for providing all necessary facilities to complete our project work. Our work could not have been completed without the support of our colleagues, other teaching as well as non- teaching staff members of the Electronics and Telecommunication Engineering department.

We are also thankful to founder chairman Hon. Dr. Annasaheb D. Chavan, Hon. Dr. Y. A. Chavan and Hon. Dr. S. A. Chavan, Directors, SGM Group, Mahagaon, for giving us the opportunity to carry out our project work. Finally, we dedicate this work to our parents. Our deepest thanks and appreciations are reserved for all our family members and friends, whose blessings have been our inspiration to complete this work.

MR. AMEY RAJENDRA GUNDE.

MR. SANKET BASAVRAJ MUTNALE.

MR. ANIKET TUKARAM TAKKEKAR.

TABLE OF CONTENTS

Accredited by NAAC with B++ and ISO 9001:2015 Certified Institute

Sant Gajanan Maharaj College of Engineering,Mahagoan

Site – Chinchewadi, Tal-Gadhinglaj, Dist.-Kolhapur, PIN: - 416503

A Synopsys on Project

"Adaptive Headlight and Emergency Brake Alert System"

Under The Guidance of

Prof. S. R. Sankpal

(E&TC Department)

Submitted By, Final Year B.Tech. (E&TC)

Sr. No.	PRN	Name of Student
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Department of Electronics and Telecommunication Engineering

(ACADEMIC YEAR 2023-24)

SYNOPSIS

Name of the Course : Final Year B.Tech (Electronics & Telecommunication Engineering)

Name of the Students :
1. Mr. Amey Rajendra Gunde
2. Mr. Sanket Basavraj Mutnale
3. Mr. Aniket Tukaram Takkekar

Date of Submission

of Synopsis **: 03** / 11 /2023

Name of the Guide **:** Prof. S.R. Sankpal

Proposed Title

of the Project **:** “Adaptive Headlight and Emergency Brake Alert System”

INDEX

1. Abstract:

This project aims to assess the effectiveness of innovative automotive safety technologies in preventing rear-end collisions and enhancing overall road safety. The two main components of this study are the evaluation of flashing brake and hazard systems (FBHS) and the development of an adaptive headlight system (AHS) for accident prevention. The first aspect of this project focuses on mitigating accidents caused by the blinding glare of upper lamps from oncoming vehicles, which can often lead to impaired visibility and increased accident risks. The second aspect of the project is dedicated to minimizing rear-end collision risks through the implementation of flashing brakes and hazard systems. These systems will be designed to improve communication between vehicles, thereby reducing reaction times and enhancing overall road safety. When the vehicle's sensors detect abrupt deceleration, the Flashing Brake and Hazard Systems will activate, rapidly blinking the vehicle's brake lights and hazard lights. This eye-catching visual alert will effectively inform the following drivers of the sudden stop or potential danger ahead, encouraging them to react promptly and safely.

2. Title Of Propositions Dissertation:

The project "Adaptive Headlight and Emergency Brake Alert System" endeavors to conceive and create a mechanism that adapts headlights for varying road conditions while integrating an alert system for emergency brake situations.

3. Introduction:

The first aspect of this project focuses on mitigating accidents caused by the blinding glare of upper lamps from oncoming vehicles, which can often lead to impaired visibility and increased accident risks. To address this challenge, an adaptive headlight system will be developed and integrated into vehicles. The adaptive headlight system will utilize advanced sensors and image recognition technology to dynamically adjust the direction and intensity of the vehicle's headlights. This intelligent system will automatically respond to the presence of oncoming vehicles, pedestrians, and various road conditions, thereby reducing glare and improving visibility for both the driver and other road users [1].

The second aspect of the project is dedicated to minimizing rear-end collision risks through the implementation of Flashing Brake and Hazard Systems. These systems will be designed to improve communication between vehicles, thereby reducing reaction times and enhancing overall road safety. When the vehicle's sensors detect abrupt deceleration, the Flashing Brake and Hazard Systems will activate, rapidly blinking the vehicle's brake lights and hazard lights. This eye-catching visual alert will effectively inform the following drivers of the sudden stop or potential danger ahead, encouraging them to react promptly and safely [2].

4. Rationale:

In the present day, nighttime driving with traditional headlight systems is a significant contributor to accidents. Those who drive regularly are familiar with the challenges of navigating highways after dark, often due to the blinding glare emanating from oncoming vehicles. As many drivers resort to using high beams on national and state highways, it becomes a considerable inconvenience for traffic traveling in the opposite direction.

Accidents are significantly influenced by the actions of drivers. One way for a driver to become aware of potential hazards and respond appropriately is by closely observing brake lights. Rear-end collisions are typically the result of a driver's lack of attention or delayed reactions.

5. Problem Statement:

In the realm of automotive safety and visibility, a pressing need exists for an innovative solution to enhance driver safety during nighttime driving and sudden braking situations. Traditional headlights lack adaptability, potentially resulting in reduced visibility and accidents. Moreover, the absence of a standardized emergency brake signaling method is a significant road safety concern. This project aims to tackle these issues by developing an adaptive headlight system that dynamically adjusts headlight angles based on road conditions and integrating an emergency brake light flash feature. The primary objective is to improve road safety, reduce accidents, and enhance communication between drivers and other road users during emergencies. This cost-effective solution is intended for broad vehicle integration, promoting overall road safety and driver comfort.

6. Objectives:

1. **Enhance Nighttime Safety:** Improve the driver's visibility at night and during adverse weather conditions, reducing the risk of accidents caused by poor visibility.
2. **Minimize Glare:** Implement technology to prevent blinding oncoming drivers or drivers in front of the vehicle by intelligently controlling headlight beams.
3. **Adapt to Road Curvature:** Develop a system that automatically adjusts the direction of the headlights to match the curvature of the road, enhancing the driver's ability to see obstacles and road signs around corners.
4. **Enhance Rear-End Collision Prevention**: Reduce the risk of rear-end collisions by promptly notifying following drivers of sudden braking actions.
5. **Adapt to Braking Severity:** Implement technology that adjusts the intensity and frequency of the brake light flashing based on the severity of the braking event, allowing for differentiation between normal braking and emergencies.
6. **Integrate with Existing Brake Lights:** Ensure seamless integration with the vehicle's existing brake lights to maintain compliance with safety regulations and minimize the need for additional vehicle modifications.

7. Literature Survey:

Paper No.	Name Of Paper	Author	Findings
[6]	Design of Automatic Headlight Based on Road Contour and Other Headlight Light	Dzulfiqar Dwi Yanto	1. This study uses the BH1750 module as the main component to detect other vehicles facing in front of it. 2. This study also used the MPU6050 module to assess road contours. 3. In laboratory testing, the MPU6050 module as an accelerometer, the BH1750 module as a lux meter, MG995 Servo Motor movement testing and overall tool testing is tested.
[7]	Automated Headlight Intensity Control and Obstacle Alerting System	Arpita K	1. This paper is aimed to design and perform a smart vehicle headlights control system to adjust vehicle headlights automatically according to the surrounding lighting condition. 2. The system device automatically switches the headlight to low beam when it senses a vehicle approaching from the opposite side using Light Dependent Resistor (LDR) sensor. 3. Automatic headlight intensity beam is controlled by using photo transistor and XBee, which is not efficient for measure the intensity of light.
[8]	Investigating the Cognitive Response of Brake Lights in Initiating Braking Action Using EEG	Surej Mouli	1. This article was found that both the bulb-based lights evoked slower responses than all of the LED lights. 2. This study investigated EEG analysis of brake lights based on conventional bulbs and newer LED designs. 3. P3 components were analyzed from channel Pz for 22 subjects with ten different brake light assemblies, and analyzed for statistical differences in terms of the latency of the cognitive component from the brake light onset.
[9]	Effects of Flashing Brake Lights on Drivers' Brake Reaction Time and Releasing Accelerator Gas Pedal Time	Mohammd Sadegh Sohrabi	1. The article found by increasing the age of the driver, a significant decrease in brake reaction time is observed (11.58 ms). 2. the flashing brake lights were used to decrease the driver's brake reaction time and prevent the rear-end collisions. By using flashing brake lights with a frequency of 7 Hz, the brake reaction time decreased 323.42 ms.

8. Feasibility Study:

A feasibility assessment for the "Adaptive Headlight and Emergency Brake Alert System" reveals strong potential for successful implementation. The market demand for advanced automotive safety features is evident, with a clear need for adaptive headlight technology and effective emergency brake alert systems. The necessary technology to develop these features is available, and initial cost projections indicate financial feasibility. The project is positioned for a rapid return on investment due to increased sales and reduced road accidents, making it financially viable.

Market research indicates a robust customer interest in advanced safety systems, with vendors expressing enthusiasm for the potential benefits, including enhanced product offerings, improved convenience, and expanded market presence. Regulatory compliance and maintenance demands appear manageable, positioning the project as an achievable opportunity. The implementation of the "Adaptive Headlight and Emergency Brake Alert System" not only stands to boost vendor profitability but also significantly enhance customer satisfaction by ensuring safer driving experiences.

9. Preface:

9.1 : AHS (Adaptive Headlight System)

The adaptive headlight system is an optimal and cost-effective solution to prevent frequent accidents at night. The designed system provides step-wise turns of the headlamps on either side based on the controlled input given to the stepper motor attached to the lamps on either side. The maximum degree of turn achieved on the left headlamp is 37 degrees, and on the right-hand side, it is 43 degrees. The DC generator voltage input ranging from 0 to 5 volts triggers the microcontroller unit, thereby generating an equivalent output voltage for the stepper motor. The stepper motor transduces this voltage value into corresponding turning angles and provides an adequate turn at the bends. Hence, this system is reliable and ensures efficient and safe driving. It also costs less and can be included in low-end cars as well [3].

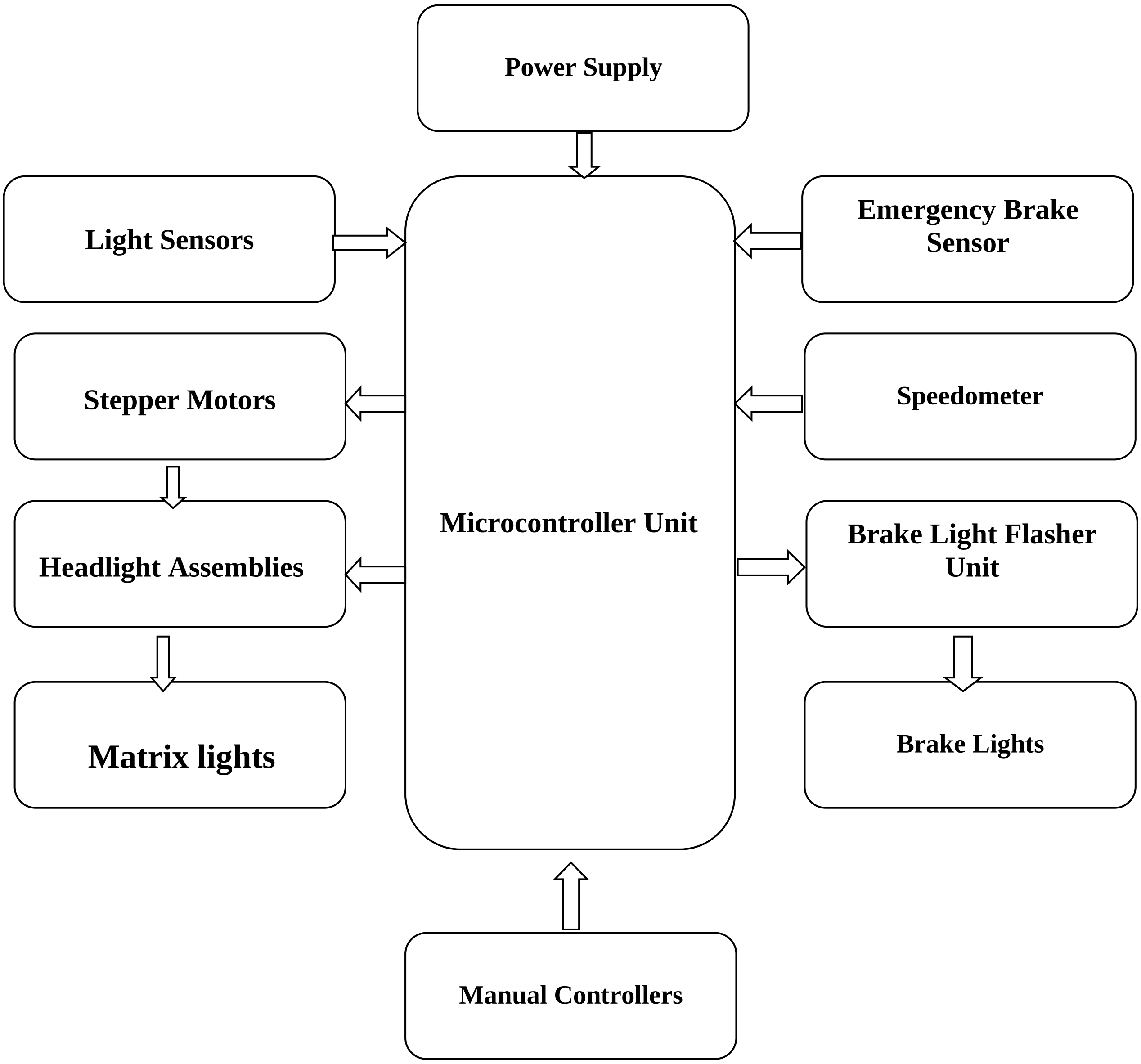
9.2 : Matrix LED

A matrix display is a visual technology that uses a grid of individually addressable elements, typically LEDs or pixels, to create dynamic and versatile visual content. These displays are widely used in various applications, from electronic billboards and digital signage to LED video walls and information boards. The matrix configuration allows for the creation of text, images, animations, and even video content, making it a flexible and adaptable choice for both indoor and outdoor settings. Matrix displays are favored for their ability to convey information effectively, attract attention, and provide real-time updates. They have become integral in public transportation systems, stadiums, retail environments, and countless other contexts where dynamic and eye-catching visuals are crucial. The resolution, size, and color capabilities of matrix displays can vary, enabling them to meet diverse requirements and offer captivating, high-impact visual experiences [4].

9.3 : EBL (Emergency Brake Lights)

Emergency brake lights (EBL), or brake light flashers, are a safety feature in some vehicles designed to enhance visibility and alert other drivers in emergency braking situations. When the driver applies the brakes forcefully or suddenly, the brake lights flash rapidly to draw more attention to the fact that the vehicle is slowing down or stopping abruptly. This added visual cue can help reduce the risk of rear-end collisions, especially in situations where a driver might not have enough time to react to a sudden stop. The flashing brake lights are often achieved through a brake light modulator or flasher unit, which rapidly cycles the brake lights on and off during hard braking. This feature is separate from the regular brake lights, which illuminate steadily when the brakes are applied under normal circumstances [5].

10 Methodology:



1. **Microcontroller Unit (MCU):** The MCU serves as the central control unit for the entire system. It receives inputs, processes data, and generates commands for the various components.

2. **Light Sensors:** These sensors detect ambient light conditions and gather data about the surroundings.

3. **Stepper Motors:** The adaptive headlight system employs stepper motors to adjust the angle of the headlights based on the MCU's commands.

4. **Headlight Assemblies:** The actual headlight units that emit light, which can be adjusted by the stepper motors.

5. **Matrix lights:** Matrix lights for cars are advanced lighting systems that use an array of individually controllable LEDs to adaptively and precisely adjust the vehicle's headlights, providing improved illumination without blinding other road users, enhancing safety and visibility during night driving.

6. **Emergency Brake Sensor:** A sensor that detects sudden braking or deceleration.

7. **Speedometer:** A speedometer is an instrument in a vehicle that measures and displays the current speed of the vehicle.

8. **Brake Light Flasher Unit**: This unit controls the flashing of the brake lights during emergency braking situations.

9. **Brake Lights:** Vehicle's brake lights that flash during an emergency braking event.

11 **Facilities Required:**

1. Hardware:

   Controllers, lights, sensors, light drivers, circuit design lab.

2. Software:

   PCB design tools, simulation tools, computer lab, research paper access.

12 **Approximate Expenditure:** Rs. 20,000/-

13 Outcomes:

After completion of dissertation work, we will be able to

- Design of Hardware of project and debugging of that hardware.
- Good knowledge of response time in road.
- Prepare demonstration for project.
- Publish at least one paper in National/International journal.
- Use Latex for technical report writing.

14 Time schedule:

Month	Work
August-September	• Problems found • Topic selection presentation • Topic Finalization
October-November	• Preparation for synopsis and problem definition. • Synopsis presentation. • Study of Controller and peripheral interfacing. • Study of basic algorithms needs a special hardwareplatform.
December-January	• Phase 1 submission. • Schematic designing and layout designing.
February-March	• Hardware modular testing • Hardware and software test.
April-May	• Documentation and Report Writing.

15 References:

[1] Ms. Aishwarya J. et al “Adaptive Headlight System for Automobiles” International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 [2020].

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[3] Kirthanaa Raghuraman et al “Adaptive Headlight System for Accident Prevention” 2019 International Conference on Recent Trends in Information Technology. 11 March 2019.

[4] T. E Arijaje et al “Design and Construction of LED Matrix Display” OP Conference Series: Earth and Environmental Science l 2018 IOP Conf. Ser.: Earth Environ. Sci. 173 012007 [2018].

[5] Min-Chih Hsieh et al “A Simulation-Based Study of the Effect of Brake Light Flashing Frequency on Driver Brake Behavior from the Perspective of Response Time” Behav. Sci. 2022, 12, 332. https://doi.org/ 10.3390/bs12090332. 14 September 2022.

[6] Dzulfiqar Dwi Yanto et al “Design of Automatic Headlight Based on Road Contour and Other Headlight Light” Conference: 2020 2nd International Conference on Industrial Electrical and Electronics (ICIEE) October 2020.

[7] Arpita K et al “Automated Headlight Intensity Control and Obstacle Alerting System” ternational Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org NCESC - 2018 Conference Proceedings Special Issue – 2018.

[8] Surej Mouli et al “Investigating the Cognitive Response of Brake Lights in Initiating Braking Action Using EEG” IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 23, NO. 8, AUGUST 2022.

[9] Mohammad Sadegh Sohrabi “Effects of Flashing Brake Lights on Drivers’ Brake Reaction Time and Releasing Accelerator Gas Pedal Time” Health in Emergencies and Disasters Quarterly. 2019.

[10] https://ieeexplore.ieee.org/Xplore/home.jsp

[11] https://www.ijert.org/

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3	Mr. Aniket Tukaram Takkekar	24	Aniket

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LIST OF FIGURES

LIST OF TABLES

LIST OF ABBRIVATIONS

Abbreviations	Full forms
AHS	Adaptive Headlight Systems
EBAS	Emergency Brake Alert System
MCU	Main Control Unit
CAN	Controller Area Network
PCB	Printed Circuit Board
LED	Light Emitting Diode
ADAS	Advanced Driver Assistance Systems
USB	Universal Serial Bus
SPI	Serial Peripheral Interface
I2C	Inter Integrated Circuit
HEVs	Hybrid Electric Vehicles
LDR	Light Dependent Resistor
I/O	Input Output
MEMS	Microelectromechanical System
V2X	Vehicle-To-Everything
PWD	Pulse Width Modulation
HUDs	Head-Up Displays
IDE	Integrated Development Environment