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# AUTOMATIC HEADLIGHT INTENSITY CONTROL FOR VEHICLE TO AVOID ACCIDENTS

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**Abstract:** This project focuses on reducing night-time road accidents caused by glare from high-beam headlights of oncoming vehicles. The proposed system uses light sensors to detect the intensity of incoming light and automatically switches the vehicle's headlights from high beam to low beam when excessive glare is detected. Once the intensity of light decreases, the system restores the headlights back to high beam for better visibility. A microcontroller is used to control the entire process, ensuring quick and accurate response without driver intervention. This automatic headlight control system enhances driving safety by minimizing temporary blindness caused by glare, while also improving overall comfort and visibility for drivers. The design is simple, cost effective, and easy to implement in modern vehicles. By reducing human effort and reaction time, this system provides an efficient solution for safer night driving conditions and helps in preventing accidents on highways and busy roads.

**Keywords:** Automatic Headlight Control, High Beam/Low Beam Switching, Light Sensor, Microcontroller, Glare Reduction, Night Driving Safety, Vehicle Safety System, Intelligent Lighting System, Accident Prevention.

## I. INTRODUCTION

The project aims in designing an efficient automatic intensity control for head lights of the vehicles when they approach each other to avoid accidents using LDR. Now a day's technology is running with time, it completely occupied the life style of human beings. It is being used everywhere in our daily life to fulfil our requirements. We can not only increase the speed of life but also increase security with good ideas by making use of advanced technology. In our project we use high power LED's as head light for the vehicle, One LDR detects the intensity of surrounding light, particularly fog, while the other LDR detects the headlights of oncoming vehicles. When high-intensity light from an opposite vehicle is detected, the microcontroller reduces the headlight brightness to minimize glare, enhancing safety. high power LED's as a source of head light. LDR is a special type of resistance whose value depends on the brightness of the light, which is falling on it. It has resistance of about 1 mega ohm when in total darkness, but a resistance of only about 5k ohms when brightness illuminated. It responds to a large part of light spectrum. The controlling device of the whole system for the vehicle is an Arduino UNO Microcontroller to which LDR sensor module, High power LED is interfaced to the Arduino UNO microcontroller. When two vehicles oppose each other, the intensity of head lights falls on the LDR sensor and automatically the intensity will be reduced. This system avoids accidents due to high intensity head lights of the vehicles. Ultrasonic sensor is used to detect the obs

## II. LITERATURE REVIEW

1. Smith et al. (2018) Smith et al. developed an automatic headlight dimming system using Light Dependent Resistor (LDR) sensors. The system detects the intensity of light from approaching vehicles and automatically switches the headlight from high beam to low beam. Their study showed that reducing glare improves driver visibility and decreases the risk of night-time accidents. 2. Kumar and Patel (2019) Kumar and Patel proposed a microcontroller-based automatic headlight control system. The system continuously monitors incoming light intensity and adjusts the headlight beam accordingly. Their work demonstrated that automation can reduce driver workload and improve road safety. 3. Sharma et al. (2019) Sharma and his team investigated the effects of high-beam glare on drivers during night driving. Their research revealed that excessive glare causes temporary blindness and delayed reaction times. They recommended automatic headlight intensity control as an effective solution. 4. Lee and Kim (2020) Lee and Kim

  

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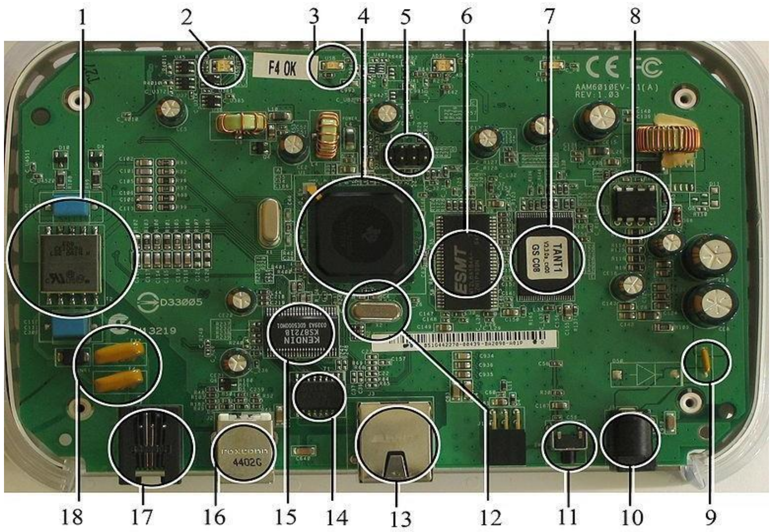
designed a smart vehicle lighting system that uses light sensors to detect surrounding illumination levels. The system automatically adjusts headlight intensity based on environmental conditions, providing better visibility and reducing energy consumption. 5. Gupta et al. (2020) Gupta and colleagues developed an Arduino-based automatic headlight controller. The system uses sensors to detect approaching vehicles and switches between high and low beams. Experimental results showed improved driving comfort and reduced glare. 13 6. Reddy and Rao (2021) Reddy and Rao introduced a low-cost automatic headlight control system suitable for both two wheelers and four-wheelers. The system was designed to be affordable and easy to install, making it practical for widespread use in developing countries. 7. Singh et al. (2021) Singh and his team used photodiode sensors for detecting light from oncoming vehicles. Their system responded quickly to changing light conditions and automatically controlled headlight intensity. The study emphasized the importance of fast response time for accident prevention. 8. Ahmed et al. (2021) Ahmed et al. integrated automatic beam control with other vehicle safety features. Their system improved night driving conditions by reducing glare and enhancing road visibility. The researchers concluded that intelligent lighting systems contribute significantly to overall vehicle safety. 9. Verma and Sharma (2022) Verma and Sharma conducted a detailed analysis of road accidents caused by improper use of high-beam headlights. Their findings indicated that automatic headlight control systems can significantly reduce accidents and improve driver confidence during night travel. 10. Patel et al. (2022) Patel and his team proposed an adaptive lighting system that adjusts headlight intensity according to traffic and environmental conditions. The system improved visibility while minimizing energy consumption, making it both safe and efficient.

## III. THEORETICAL FRAMEWORK




An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of its own.) Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale. Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure. In general, "embedded system" is not a strictly definable term, as most systems have some element of extensibility or programmability. For example, handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them, but they allow different applications to be loaded and peripherals to be connected. Moreover, even systems which don't expose programmability as a primary feature generally need to support software updates. On a continuum from "general purpose" to "embedded", large 16

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application systems will have subcomponents at most points even if the system as a whole is "designed to perform one or a few dedicated functions", and is thus appropriate to call "embedded". A modern example of embedded system is shown in fig

Real Time Issues:
Embedded systems frequently control hardware, and must be able to respond to them in real time. Failure to do so could cause inaccuracy in measurements, or even damage hardware such as motors. This is made even more difficult by the lack of resources available. Almost all embedded systems need to be able to prioritize some tasks over others, and to be able to put off/skip low priority tasks such as UI in favor of high priority tasks like hardware control Stand Alone Embedded System: These systems takes the input in the form of electrical signals from transducers or commands from human beings such as pressing of a button etc.., process them and produces desired output. This entire process of taking input, processing it and giving output is done in standalone mode. Such embedded systems comes under stand alone embedded systems Eg: microwave oven, air conditioner etc... 3.3.3 Real-time embedded systems: Embedded systems which are used to perform a specific task or operation in a specific time period those systems are called as real-time embedded systems. There are two types of real-time embedded systems.


Some embedded systems are predominantly interrupt controlled. This means that tasks performed by the system are triggered by different kinds of events. An interrupt could be generated for example by a timer in a predefined frequency, or bya serial port controller receiving a byte. These kind s of systems reused if event handle rsneed low latency and the event handlers are short and simple.

Cooperative Multitasking : A non-preemptive multitasking system is very similar to the simple control loop scheme, except that the loop is hidden in an API. The programmer define nessaseries of tasks, and each task get sits own environment to “run” in. When a task is idle, it calls an idle routine, usually called “pause”, “wait”, “yield”, “nop” (stands for no operation), etc.The advantages and disadvantages are very similar to the control loop, except that adding new software is easier, by simply writing a new task, or adding to the queue-interpreter Embedded development makes up a small fraction of total programming. There's also a large number of embedded architectures, unlike the PC world where 1 instruction set rules, and the Unix world where there's only3 or 4 major ones. This means that the tools are more expensive. It al some ans that they' re lowering featured, and less developed. On a major embedded project, at some point you will almost always find a compiler bug of some sort.

Debugging tools are another issue. Since you can't always run general programs on your embedded processor, you can't always run a debugger on it. This makes fixing your program difficult Special hardware such as JTAG ports can over come this issue in part. However, if you stop on a breakpoint when your system is controlling real world hardware (such as a motor), permanent equipment damage can occur. As a result, people doing embedded programming quickly become masters at using serial IO channels and error message style debugging.

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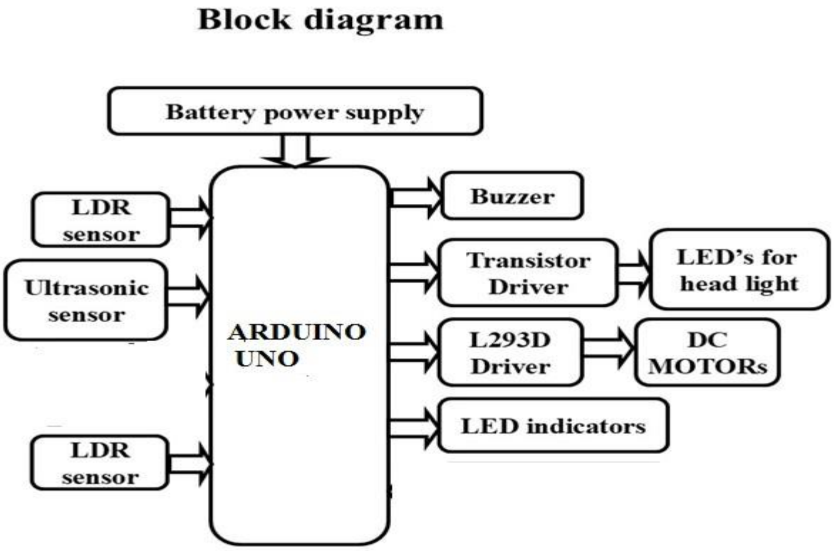
## IV. METHOD




A rechargeable battery, storage battery, or accumulator is a type of electrical battery. It comprises one or more electro chemical cells, and is a type of energy accumulator. It is known as a secondary cell because its electro chemical reactions are electrically reversible. Rechargeable batteries come in many different shapes and sizes, ranging from button cells to mega watt systems connected to stabilize an electrical distribution network. Several different combinations of chemicals are commonly used, including: lead–acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer).


Battery

Rechargeable batteries have lower total cost of use and environmental impact than disposable batteries. Some rechargeable battery types are available in the same sizes as disposable types. Rechargeable batteries have higher initial cost but can be recharged very cheaply and used many times.

Charging and discharging:

During charging, the positive active material is oxidized, producing electrons, and the negative material is reduced, consuming electrons. These electrons constitute the current flow in the external circuit. The electrolyte may serve as a simple buffer for internal ion flow between the electrodes, as in lithium-ion and nickel-cadmium cells, or it may be an active participant in the electro chemical reaction, as in lead–acid cells.

The energy used to charge rechargeable batteries usually comes from a battery charger using AC mains electricity, although some are equipped to use a vehicle's 12-volt DC power outlet. Regardless, to store energy in a secondary cell, it has to be connected to a DC voltage source. The negative terminal of the cell has to be connected to the negative terminal of the voltage source and the positive terminal of the voltage source with the positive terminal of the battery. Further, the voltage output of the source must be higher than that of the battery, but not much higher: the greater the difference between the power source and the battery's voltage capacity ,the faster the charging process, but also the greater the risk of overcharging and damaging the battery.

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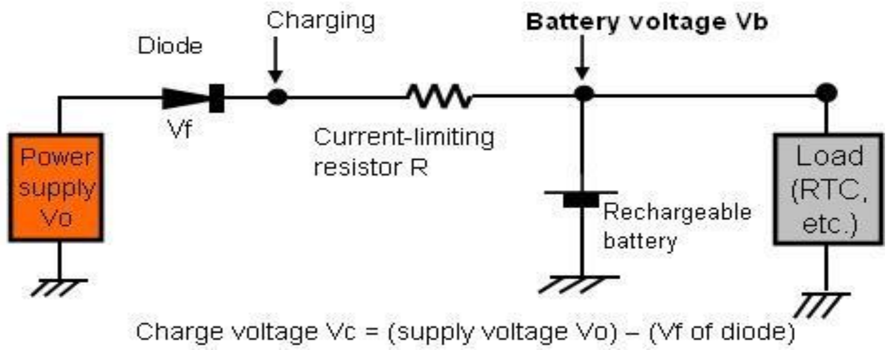
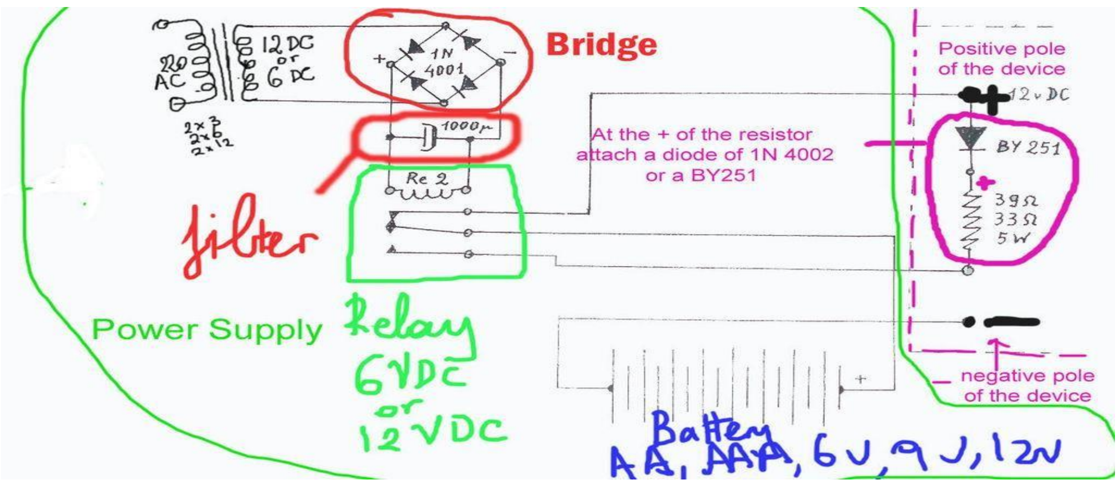
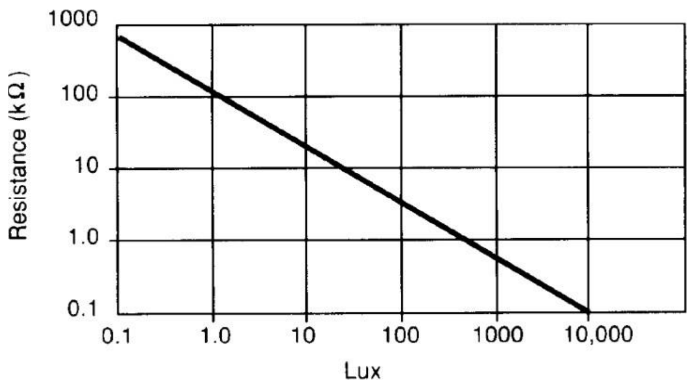
Charging circuit exampale:




Explaining of the circuit:




RESISTANCE AS FUNCTION OF ILLUMINATION:




A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energyfrom mechanical energy,is accomplished by an alternator, generator or dynamo. Many types of electric motors can be run as generators, and vice vers a.The input of a DC motor is current/voltage and its output is torque (speed).

Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radaror sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

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This technology can be used for measuring: wind speed and direction (anemometer), tank or channel level, and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates inthe air or water. To measure tank or channel level, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasono graphy ,burglar alarms and non-destructive testing.

Buzzer:
Basically, the sound source of a piezoelectric sound component is a piezoelectric diaphragm. A piezoelectric diaphragm consists of a piezoelectric ceramic plate which has electrodes on both sides and a metal plate (brass or stainless steel, etc.). A piezoelectric ceramic plate is attached toa metal plate with adhesives. Applying D.C. voltage between electrodes of a piezoelectric diaphragm causes mechanical distortion due to the piezoelectric effect. For a misshaped piezoelectric element, the distortion of the piezoelectric element expands in a radial direction. And the piezo electric diaphragm bends to ward the direction. Themetal plate bonded.

## V. RESULTS

The project successfully controls the headlight intensity automatically based on the light detected from oncoming vehicles, effectively reducing glare and improving road safety. It also detects obstacles using an ultrasonic sensor, activates a buzzer for alerts, and stops the vehicle to prevent collisions. Overall, the system performs efficiently, providing automatic lighting adjustment and obstacle avoidance, ensuring safer driving conditions.

## VI. LIMITATIONS AND FUTURE RESEARCH

In the future, this project can be enhanced by integrating automatic headlight beam adjustment based on vehicle speed and road conditions. It can also be upgraded with wireless communication to alert near by vehicles about hazards. Using advanced sensors like cameras and AI, the system can detect pedestrians and animals, providing even greater safety. Additionally, it can be implemented in autonomous vehicles as part of their smart lighting and obstacle avoidance systems.

## IX. CONCLUSION

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus, the project has been successfully designed and tested.

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