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# Automatic Headlight Beam Management System for Vehicles

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***Abstract*: Nowadays, most people driving vehicles tend to leave the high beam always on. Many people don't realize how dangerous can be leaving the high beam on when an opposite vehicle approach. People find it tedious to control the high beam as they would have to turn on and off multiple times within a short span. This is where our algorithm comes into action. The Automatic Headlight Beam Management System for Vehicles automatically controls the vehicle's beam and headlight with the predefined variable such as location, time, opposite vehicles approach. The Automatic Beam Management System for Vehicles employs modules such as camera, GPS, microcontroller to achieve the desired result. This system gathers live video recording from the camera modules and makes it greyscale with an intensity such that only the headlight will be visible. Then, colour inversion technique is applied to easily identify the opposite vehicle's headlight. This confirms the approach of a vehicle. The method is employed in such a way that street lamps are not confused as vehicles. This data is then shared with a microcontroller which changes the beam.***

***Keywords*: Headlight, beam, accident, vehicles, camera, image processing.***

## I. INTRODUCTION

For illumination, during the night every car is provided with a headlamp. These headlamps consist of high and low beams. Low Beam provides illumination close to the car whereas High Beam provides illumination to a farther distance in situations where proper illumination is not available. High Beam usage in unnecessary situations is very dangerous as it can cause temporary blindness to the opposite driver, which can lead to accidents. The use of high beam is to increase illumination. But, people have a misconception by keeping the high beam always on. This method employs a camera to detect the oncoming traffic. The live recording from the camera is image processed so as to detect the approach of a vehicle. Techniques such as greyscale, black intensity, color inversion is applied to the recording.

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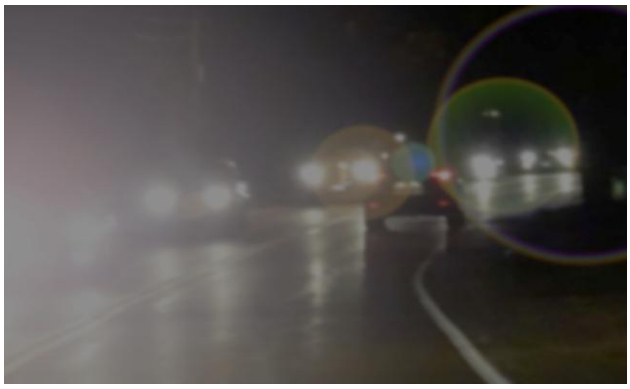
By doing so, the approach of the vehicle can easily be identified so as to change the vehicle's beam. Similarly, once the vehicle has passed, the camera's processed recording is used to find such and this is data is used to change the beam accordingly. By doing so, the headlight is managed effectively. This method can also make use of the existing car camera for this method.



GPS is used so as to detect whether the vehicle is in a metropolitan city or on a highway. Using such criteria, the microcontroller would decide the headlight beam. By doing so, the headlight can be independently controlled without the intervention of the driver. Thus, by pairing the microcontroller with the camera, GPS effective headlight management can be achieved.

## II. LITERATURE SURVEY

Automatic Headlight Beam Controller[1]: Aslam Musthafa R, Bala Krishnan T, Seetha Raman N, Shankar M. This project involves automatically switching the headlight to low beam when an oncoming vehicle is detected automatically. This is done so as to reduce the stress caused by the headlights to the eyes. Thus, manual intervention by the driver is avoided. In realtime, this system was able to change into low beam when the LDR detects the opposite vehicle's headlight. The 135 degree was the maximum spread angle of a headlight according to this method. The threshold level plays a vital role here. This is because the light from sources other than vehicles headlight has an intensity that would be very much below the threshold level for triggering the system into action. The usage of LDR acts as a drawback as the system wouldn't be able a differentiate headlights and high-intensity streetlights.Automatic Vehicle Headlight Management System to Prevent Accidents Due To Headlight Glare[2]: Lakshmi K, Nevetha R, Ilakkiya S N, Ganesan R: This project is made to reduce the headlight glare caused by high beam in vehicles.

LDR (Light Dependent Resistor) is used in this project. The resistance of the device changes according to the input light intensity. Consider a situation where a high beam is involved. The high beam is detected by the LDR. This information is then sent to the microcontroller. The intensity of incoming light with the desired intensity value is compared by the microcontroller. When the intensity value is detected to be morethan the desired intensity value, the intensity of light is reduced. This relieves the automobile driver from the irritating situation. The usage of LDR acts as a drawback as the system wouldn't be able a differentiate headlights and high-intensity streetlights. Dynamic Traffic Control System using RFID Technology[3]: Priyanka Nalawade, Prajakta Waghere, et al, 2017. The Radio Frequency Identification technology is used. RFID tags are fixed on all vehicles and is read by the RFID readers on the traffic junction signals . Depending upon the number of vehicles, green signal will be set automatically and the proposed system provides special priorities for emergency vehicles like police vehicle, ambulance, VIP vehicles, etc. RFID also proposes a system for finding stolen vehicles. However, the RFID tag reader must be nearby the emergency vehicles for this to work.

Design And Implementation Of Automatic Headlight Dimmer For Vehicles Using Light Dependent Resistor (LDR) Sensor[4]: Okrah. S. K, Williams. E. A, et al. This system acts as a headlight dimmer that can act automatically with the data from the Light Dependent Resistor (LDR) sensor. This system is designed to switch the on-coming vehicle's headlight from high beam to low beam to prevent the glare to affect the human eye. The high beam switches automatically to a low beam, therefore it reduces the glare effect caused by the high intensity of approaching vehicle's headlight. It also removes the need for manual intervention of the driver to switch between headlights. The system uses LDR which might not be able to correctly differentiate between the headlight and other light sources such as street light, etc. Intelligent Headlight System[5], Keerthi V N, Hitesh Kumar S P, Nagaraja V H, Hanumanthegowda C, Aravinda D: This intelligent headlight system makes a dynamic adjustment to the headlights in a horizontal and vertical position and also turning direction indication. This is a very advanced and complicated system than the old adaptive headlight system to overcome all problems faced by adaptive headlight Systems. They have proposed the use of LDR(Light Dependent Resistor) to control the intensity of light depending upon the external lighting conditions automatically. It also has two ultrasonic sensors that are used to detect the ditch and upcoming vehicles. The system also uses LDR which might not be able to correctly differentiate between headlight and other light sources such as street light, etc. Automatic Headlight Beam Control System[6], Vithalkar Akashay Ganesh, Khavare Vinayak Vithal, Maitshapharang Syiemlieh, Gawande Prashik Babarao, Supriya Y Sawant: In the luxury or high-end vehicles an expensive system is used, in which automatically switches on the headlight and reduces the angle of the high beam to limit the illumination of the light to the lane in which the vehicle is moving. In this system, a similar function is achieved at a cost 2000 INR that is much less than the system used in the high-end vehicles. This system uses an Arduino Uno R3 microcontroller and two phototransistors, one placed in the dashboard of the vehicle and others on top of the roof. The operating range of this system is 100 meters. If the luminosity is low than the visible condition, the headlight is turned on and if the oncoming vehicle is within the range of 100 meters, the high beam is turned down to low beam. But this system renders unusable at sharp turns and also due to the internal lighting of the car.

## III. AUTOMATIC HEADLIGHT BEAM MANAGEMENT ALGORITHM (AHBM ALGORITHM):

The method Automatic Headlight Beam Management System for Vehicles assists the opposite driver to avoid headlight glare using the AHBM algorithm. Also, it assists the driver in setting beam using factors such as location, time, etc. The foremost variable involved in the algorithm is the location of the vehicle. The AHBM Algorithm checks the location. If the location is outside the city limits the location register is set '0'. And the AHBM begins. Then the time is checked, for most countries, the sunlight starts to fade after 18:30 which is why this is set as the second condition. If the headlight is turn off it is turned on. During this period, if any opposite vehicle approaches the host, the vehicle the algorithm is implied on, the high beam is turned off until the opposite vehicle leaves the vicinity. This info is gathered from the microcontroller using the suitable image processing algorithm onto the data received from the camera.

### A. Ahbm Algorithm

The AHBM Algorithm involves variables such as location, headlight status, time, headlight beam status, opposite vehicle, opposite the vehicle's headlight beam. These variables are represented by loc, hl_stat, time, hbm_status, oppV, oppV_hbm.

1. Start
2. while loc = 0
3. initialize hl_stat, time, hbm_stat, oppV, oppV_hbm
4. while (time > 18:30)
5. if hl_stat = 0
5. hl_stat= 1
6. end if
7. hbm_status=1
6. while(oppV == 1)
7. hbm_stat = 0
8. end while
9. hbm_stat = 1
10. end while
11. end

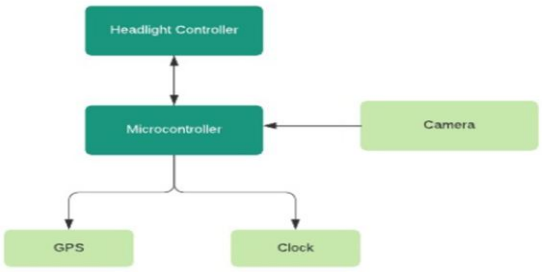



**Fig. 2. Flow of data to Headlight Controller**

## IV. MODULES

### A. Microcontroller:

The microcontroller in the system manages the toggling on and off of the high beam in the vehicle's headlight upon the information received by the GPS and the camera systems. The system also makes use of the information received from the GPS present in the vehicle to make decisions on whether to turn on or off the high beam depending upon the changing routes and roadways used. While the camera processes the images of the oncoming vehicles for better detection and recognition. The microcontroller in the system manages the toggling on and off of the high beam in the vehicle's headlight upon the information received by the GPS and the camera systems. The system also makes use of the information received from the GPS present in the vehicle to make decisions on whether to turn on or off the high beam depending upon the changing routes and roadways used. While the camera processes the images of the oncoming vehicles for better detection and recognition.

### B. GPS:

The GPS is a positioning system that provides location and time information to the user independent of weather conditions, location when there is a line of sight to GPS Satellites to a minimum of three satellites. This module is placed within the vehicle. This module helps in detecting the location such as a highway, urban or rural areas. This is done to control the headlight accordingly. The location information is then sent to the microcontroller to process the information.

### C. Camera System:

The camera acts as a key module in the system. The camera is used in the detection of the oncoming vehicle. The camera sends info about the oncoming vehicle to the microcontroller when the camera finds the source of light at the predefined angle range and not any other. This would help the system to avoid miscalculating street light as a vehicle. The process uses a greyscale camera. When a light source of a car is detected, the camera gathers the info and sends it to the microcontroller for processing. A low-resolution camera with a high field of view and distance is sufficient for this system.

## V. MATLAB SIMULATION:

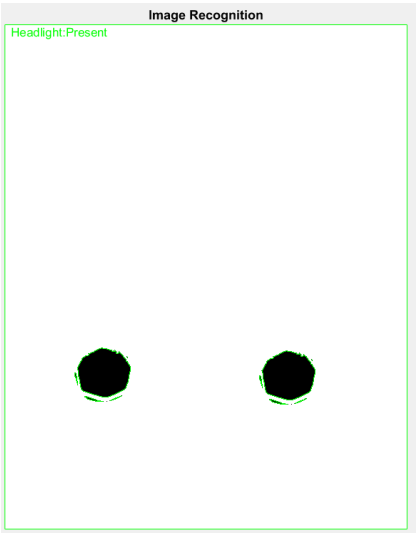



**Fig. 3. Matlab Simulation Result**

The working of the AHBM Algorithm can be proved by using Matlab Simulation. The AHBM Algorithm is implemented in MATLAB to provide basic working solution. In this MATLAB Simulation, images are fed for Headlight Detection. It is programed to take input images which is then converted into greyscale. However, this can be fine tuned for further enhancement by filling holes. Using imfill, holes are filled and the image is complemented. By using bwboundaries the boundaries are marked and flags are set if they are greater than 1. Thus, the basic implementation of the AHBM Algorithm is done and is successfully executed in MATLAB for Simulation

## VI. RESULT

The current Automatic Headlight Beam Management System for Vehicles uses image processing which is why it is more accurate than the previous system which identifies vehicles using LDR. The AHBM Algorithm can also be programmed in such a way to avoid confusion between street lamps and other light sources. This cannot be done with the algorithms with LDR. Thus, the AHBM System is less prone to errors and also is more efficient in identifying the opposite vehicles.

## VII. CONCLUSION

Thus, the AHBM System can be more effective than the systems using LDR as the camera's would be able to differenctiate vehicles from other sources of light. The rate of accuracy is higher than the LDR. The AHMB System can further be upgraded with automatic overtake flash. There is multiples scopes for further upgrading this systems as the camera module can be used for many purposes.

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