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Automatic Headlight Dimmer Using Image Processing

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Abstract: This paper describes the Automatic headlight system for vehicle; this technology will decrease road accidents by 75 percent. According to the survey conducted Europe, major reason for death for below 45 age is road accidents around 1700000 causing more than 400000 deaths a year. Major road accidents occur normally at night time due to blurriness, intensity of light. This can be avoided by implementing adaptive front lighting system using image processing, implementing this will lead to traffic safety. It is active safety system providing an optimized vision to the driver during night time and other poor-sight conditions of the road by adapting the headlight angle and intensity. To avoid such incidents we will implement headlight dimmer using image processing that will make dimmer high to low and vice versa sensing in front vehicles' light, that will reduce manual intervention of the driver and task will become much easier.

Keywords: Image Processing, Front light, Accidents, Road safety.

1. INTRODUCTION

The most car accidents happen when most people are on road, during evening after 6PM. And the most road accidents take place when the people are out drinking late at night. In comparison, 53% of all fatal accidents between 9pm and midnight were alcohol related in past. Things get even worst after midnight.

From 12:01 to 6am, alcohol was a factor in full 71% lethal crashes. Sunlight provides the strongest light source in day. At night, there are a variety of man-made lights that help drivers to drive safely. Our eyes will adjust to lower levels of light, but they have difficulty when switching from bright to dark, or vice-versa. It will not function properly. This can happen a lot on the roads at night when you look directly into the headlights of incoming vehicles headlight. Headlight helps driver at day time can be very dangerous at night.

During pitch-black conditions when there are no other sources of light, high beam is used. While other cases, low beam is used. But in a two-way traffic, in this case vehicles plying on both sides of the road. So when the bright light from the headlight coming from the opposite direction falls, it glares him for a certain amount of time. This causes disorientation.

This discomfort will result closing of the driver's eyes for certain amount of time which will be enough to meet with an dangerous accidents. This fraction of distraction is the prime cause for accidents at night time especially on highways. Number of accidents can be reduced by three approaches

1) Encouraging driver in safe manner, proper training, and harsher policing.
2) Good road infrastructure
3) Improved safety measures and latest technology

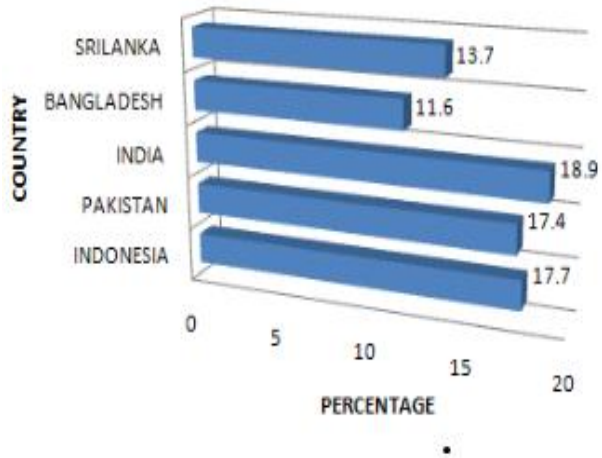

Fig 1 Accident Report during night time in Asia

2. SAFETY AT NIGHT TIME

Good vision is very important for driving safely. The investigations show that more than 90% of the information perceive is by vision. Most of the time speed and danger recognition are strongly dependent on the light distribution. We all know daytime, weather conditions, road condition changes vision including reading signs on road and identifying object even at shorter length.

Automatic high/low beam system firstly invented in 1952 by general motor called "Autroic Eye". It was a photo resistor to automatically adjust automobile headlight beams from "high beam" to "low beam" when the light become brighter causing increase in glare. Valeo, the world leader in automotive Technology developed a technology for vehicle lamps, which is called bending lights. And the AFS (AdaptiveForward Light System) developed by Opeland Hella.

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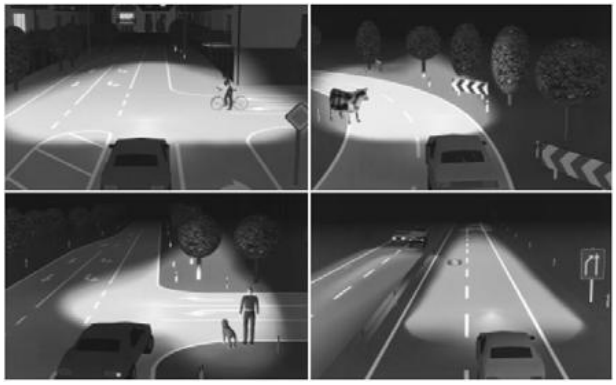

Fig 2 Light Distribution at night

3. THE HEADLIGHT BEAMS

Conventional headlamp modules do not fulfil the demands to generate convenient light functions. Therefore, new concepts have to be developed The requirement of the headlight is from 6.00 pm till 5.00 am in India. It is important during late night time. The headlight will be between the bright and dip modes by the driver using a switch. The bright mode is used when there are no other sources of light on the streets.Long highways, a pitch black street with no lights are the locations where one will use a bright beam. The low beam is less intense than the bright beam. The dip beam is gives less range. The high beam has a longer range with very less field coverage. Dip beam is less intense (700 lumens) and high beam with higher brightness index (1200 lumens) under a standard distance of 50 feet from the vehicle. Figure.3 shows the range of the low beam and the high beam.

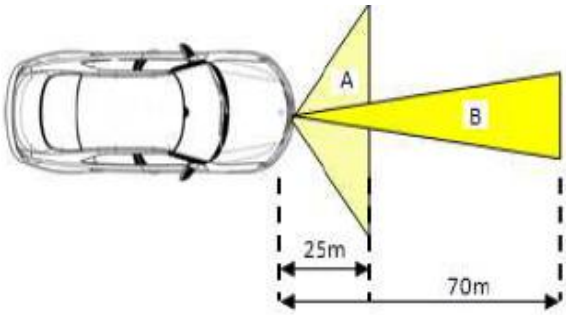

Fig 3 High and low Beam

4. ACCIDENTS DUE TO TROXLER EFFECT

There are many accidents caused because of Troxler effect. Many accident reports have been witnessed with where a large vehicle, hitting smaller vehicle while over-take. It might be obvious to blame the driver, they will compliant to have not seen the smaller vehicle coming. This is the most common example of Troxler effect in our day-to-day life. Due to excessive brightness, the driver of the large vehicle is blinded. So he is unable to see the smaller vehicle even though it is right direction. According to Forbes This can be avoided if the headlight is dipped to low beam mode. Unlike traditional cameras which use film to capture and store an image, digital cameras use a solid-state device and that called an image sensor.

4.1 The Human Eye and its Sensitivity

The human eye is a very sensitive part of the body. It works an entire day without any rest. Our eyes are very adaptable for a particular range of human vision. We have two visions called the scotopic and photonic vision. Human eyes behave differently in conditions. During bright surroundings, human eyes can resist up to 3 cd/m2. For photonic vision. During dark and unlit conditions, our eye switches to scotopic vision and that has a range of 30-45 µcd/m2. It takes only 4 seconds for our eyes to change from photopic to scotopic vision. This is also an example of Troxler effect. As the brightness increases, the focus on an object increases. This will increase the response time of that person. Figure. 7 show as the luminous index increases, the reflection percentage logarithmically.

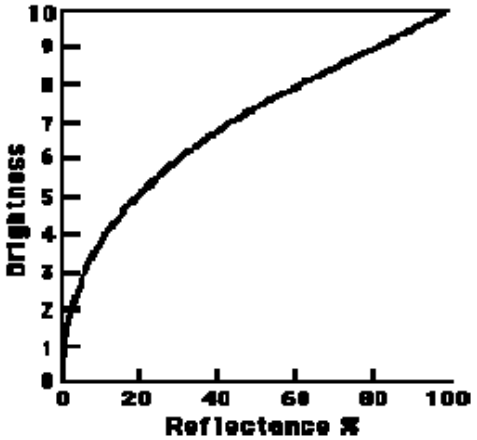

Fig 4 Relation between brightness and Refectance

Another study shown in Figure 4 represents the actual adaptable conditions and limits of the human eye. This shows the variation of eye response to different luminosity and brightness. Fig 5 shows Eye Response to different brightness level.

5. IMAGE PROCESSING

Digital image processing uses of computer algorithms to create, process, communicate, and display digital images. Digital image processing algorithms used to Convert signals from an image sensor into digital images Improve clarity, remove noise. Extract the size, scale, or number of objects in a scene, Prepare images for display and Compress images for communication across a network. Image transforms play a critical role in many image processing tasks, which includes image enhancement, analysis, and compression, restoration. Image Processing Toolbox provides many image transforms which includes Hough, Radon, FFT, DCT, and fan-beam projections.

Light detection

1) Automobile lights detection: There are many approaches to detect lights. The common includes fixed thresholding Digital image processing uses of computer algorithms to create process, communicate, and display digital images. Digital image processing algorithms used to convert signals from an image sensor into digital images

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Advanced approach is multi thresholding
Thresholding is fast but lacks the ability to capture objects' which causes to LoG and LoG approximation filters

Advantages-
1) The method uses image preprocessing, blob detection and classification steps.
2) The classifier operates on raw pixels eliminate the feature extraction.
3) The method does not require parameter tuning except the threshold.
Feature extraction is usually done after blobs are extracted and after that blob pairing and classification. Features are often calculated on already segmented images.

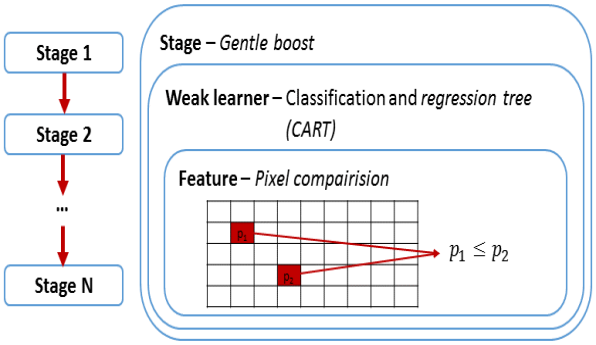

Fig 7 Structure of the binary classifier in vehicle

The concept of the tracking algorithm is explained below. An object is tracked using the extended Kalman filter due to non-linearity of the motion model. Extended Kalman filter: The state S = [x y d v] of the Extended Kalman filter consists of detection coordinate and the distance between the lights in the image, Velocity. It is assumed that the relative velocity between the two coming vehicles changes slowly, therefore the constant velocity model is used. The measurement vector is: Z = [x y d]. As the translation functions between world and image plane coordinates are not linear the Extended Kalman filter is used.

Test video sequences have been labelled. Video resolution is 1280 x 720 but they are scaled 640 x 360 at the time of testing. The detection algorithm is evaluated frame by frame by box intersection. If vehicle coming from opposite side automatically our headlight will be switched to lower beam. In this thesis, a night time traffic monitoring system is implemented for detecting the headlights, pairing the headlights and to make our headlight to lower beam as per situation.

6. CONCLUSION

Accident is a serious problem for drivers. This is caused due to the sudden exposure of our eyes to a very bright and constantly changing light; the bright headlights of vehicles in this case. This can cause a temporary blindness called the Troxler effect. Nowadays this becomes the major reason for night accidents. The driver should actually turn down the bright lights immediately to avoid glare. Hence, is the idea for the design and development of a automatic headlight dimmer using image processing. It gives the driver to use high beam light when required. But it automatically switches the headlight to low beam when it senses a vehicle approaching from the opposite side. It is also observed that the system can be placed in the low cost models without any major changes

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