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Reducing headlight intensity to improve street visibility

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ABSTRACT

Driving at night is dangerous. High headlight glares can make a driver temporarily blind thereby escalating the chances of fatal accidents. Many factors are considered when analyzing automobile transportation in order to increase safety. One of the most prominent factors for night-time travel is temporary blindness due to elevated headlight intensity. This is particularly prominent on single lane roads. Also, higher speed due to decreased traffic levels at night increases the severity of accidents. Proposed software module masks the high intensity headlights, preventing temporary blindness that a driver may face and hence improving the view.

Keywords: *Computer Vision, OpenCV and Python, Temporary Blindness.*

1. INTRODUCTION

The frequency of traffic collisions in India is amongst the highest in the world. According to National Crime Records Bureau report, more than 135,000 traffic collision related deaths occur in India. In New Delhi, frequency of traffic collision is 40 times more than London. Most of these deaths occur at peak timing during evening or night. A number of factors contribute to the risk of collision, including vehicle design, speed of operation, road design, road environment, and driver skill, impairment due to alcohol or drugs, and behavior, notably speeding and street racing. Almost all high-income countries have decreasing death rates, while the majority of low-income countries have increasing death rates due to traffic collisions. Traffic collisions often result in injury, death, and property damage. Worldwide, motor vehicle collisions lead to death and disability as well as financial costs to both society and the individuals involved. In 2013, 54 million people suffered injuries from traffic collisions. This resulted in 1.4 million deaths in 2013, up from 1.1 million deaths in 1990. About 68,000 of these occurred in children less than five years old. Middle-income countries have the highest mortality rate with 20 deaths per 100,000 inhabitants, 80% of all road fatalities by only 52% of all vehicles. While the death rate in Africa is the highest, the lowest rate is to be found in Europe.

1.1. Night time accident

During Night time the driver goes partially blind due to the high glaring headlights shining directly on the eyes of the driver.

1) Pedestrians: Due to partial temporary blindness pedestrians can dash on car.
2) Drivers: Due to temporary blindness drivers may dash on other cars or hit the pedestrians or can cause other major accident.

1.2. Driver impairment

Driver impairment describes factors that prevent the driver from driving at their normal level of skill. Common impairments include:
1) Alcohol: According to the reports from govt. agencies, fatally injured drivers consumed some quantity of alcohol before the collision in almost 40% of cases.
2) Sleep deprivation: Various factors such as fatigue or sleep deprivation might increase the risk, or large number of hours driving by same driver might increase the risk of an accident.

3) Distraction: Drivers distracted by mobile devices had four times greater risk of collisions as compared to those who were not. Phone dialing is the most dangerous distraction, increasing a drivers' chance of crashing by twelve times. This risk is followed by reading or writing.
4) Drug use: Including some prescription drugs, over the counter drugs notably opioids, marijuana and other illegal drugs.

1.3. Distraction by headlights

In order to drive safely, you need to be alert and focused on everything around you. Unfortunately, drivers are increasingly becoming distracted and failing to keep their eyes on the road. Driving at night can pose many dangers, but one of those dangers is meant to help drivers navigate the road. The list of distractions drivers face is from texting, phone calls, radio and drinking, eating. However, the car lights themselves are posing more distraction for some drivers. While brighter headlights benefit the driver by illuminating the road and making it easier to see, it does the opposite for the driver on the other side of the road. Being able to see what's in front of you on the road at night is the key to being able to adjust to dangers. While headlights allow driver to brighten the road ahead to increase his ability to see, he may also be limiting the ability of an oncoming driver to be able to see clearly because of the glare from his headlights.

1.4. Problems faced by Drivers

When drivers drive at night high intensity headlight glares can cause following problems:

1) It is not easy to see objects: A minimum amount of contrast is required to be able to distinguish objects from their backgrounds. Since glare reduces that contrast by flooding it with light, objects in the road seem to disappear into the background.
2) It becomes harder to judge distances: Just as limited contrast causes objects to be harder to see, it also makes it harder to determine distance between objects. Without contrast, the scene becomes two-dimensional, making it impossible to judge distance between objects.
3) Reaction time is less: When driving at night, you can only see as far ahead of you as your headlights allow. When this is limited further by the glare of oncoming traffic, you may not see an object in the road in time to be able to avoid it.
4) Involuntary reactions by sudden glares: If a driver is temporarily blinded by a sudden high intense light, driver may avert his eyes involuntarily and, in the process, take his eyes off the road. It may take a few seconds to regain your composure, which is very dangerous when traveling at high speeds.

1.5. Previous work

Night Time Vehicle Detection for Driving Assistance
Light Beam Controller is a paper presented by P.F. Alcantarilla, L.M. Bergasa, P. Jim´enez, M.A. Sotelo, I.Parra, D. Fern´andez in Department of Electronics in University of Alcal´ in Spain. In this paper they present an effective system for detecting vehicles in front of a camera-assisted vehicle during night time driving conditions in order to automatically change vehicle head lights between low intensity and high intensity avoiding glares for the drivers.

Another paper "Night-time Vehicle Detection for Automatic Headlight Beam Control" by Pushkar Sevekar and S.B. Dhonde in International Journal of Computer Applications sums up various approaches to solve this problem also in their paper a method for intelligent headlight control is presented. Many researchers have worked in area of night-time vehicle detection for headlight control.

Sungmin Eum et al proposed a system with the images captured in two different settings namely low exposure and auto exposure using a single camera module. A fixed thresholding is applied to low exposure images whereas LoG filtering is applied to auto exposure images so that significant features of images can be obtained. These results are integrated for light blob detection. When headlights are detected, Kalman filtering algorithm is used for tracking. Tracking is then followed by classification of light blob into headlight, tail-light, street light or nuisance light using a pattern recognition-based classifier.

In vision-based approach, camera mounted on a room mirror inside windshield captures images. These images are then processed to detect headlight blobs present in image.

2. MAIN RESULTS

2.1. Vehicle Detection

Detecting vehicles with the help of haar cascade is reliable and easy approach, haar cascade can detect vehicles on basis of their appearance features such as color, shape or typical pattern is feasible during day time. The same thing can't be done during night time. For night time detection of vehicles, headlights and tail lights are the most reliable features.

2.2 Headlight Detection

Headlight detection can be done by multiple ways. One approach is to mask a light blob which has area more than threshold value. Another approach is to measure distance between two light blobs and identify headlights, but this approach isn't useful when headlights are incident on camera and light is scattered.

2.3. Thresholding

Thresholding is the simplest method of image segmentation. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity I (i, j) is less than some fixed constant T (that is, I (i, j) < T), or a white pixel if the image intensity is greater than that constant.

Fig1: Original image

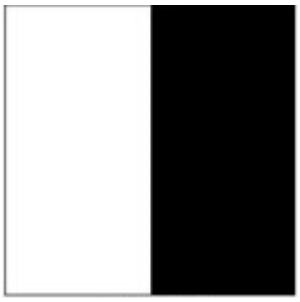

Fig 2: Binary Thresholding

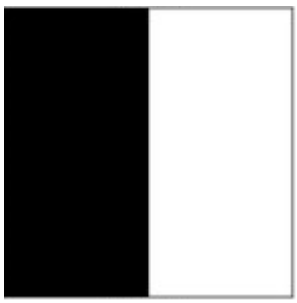

Fig3: Binary Inverse Thresholding

2.4 Blob detection

A Blob is a group of connected pixels in an image that share some common property. A number of different algorithms exist for finding the BLOBs and such algorithms are usually referred to as connected component analysis or connected component labeling. Blob of light is an indeterminate roundish shape. FindContour function is used to determine contours of blobs. contourArea function is used to find areas of contours. A threshold area is set, all the areas above the threshold values are detected as blob. The method of analyzing an image which has undergone binarization processing is called “blob analysis”. A blob refers to a lump. Blob analysis is image processing's most basic method for analyzing the shape features of an object, such as the presence, number, area, position, length, and direction of lumps. Blob is defined as a region of connected pixels. Blob analysis is the identification and study of these regions in an image. The algorithms discern pixels by their value and place them in one of two categories: the foreground or the background, the blob features usually calculated are, area and perimeter, diameter, blob shape, and location. Since a blob is a region of neighboring pixels, analysis tools typically consider touching foreground pixels as a part of same blob. Consequently, what is easily identifiable by the human eye as several distinct but touching blobs may be interpreted by software as a single blob. Furthermore, any part of a blob that is in the background pixel state because of lighting or reflection is considered as background during analysis.

2.5. Blob masking

Blob masking can be done by two ways, one with changing value in hue, saturation, value image format or by masking the headlight with some color. boundingRect function is used to find upper left and lower right coordinates of rectangle. With rectangle function of open-source computer vision we draw a rectangle around blobs and mask the blob by filling rectangle with any color.

Fig 4: Masking by manipulating hue, saturation, value

Fig 5: Headlight masking by functions

2.6 Video feed enhancement

Enhancement of a frame is subjective process. Video enhancement can be done by multiple ways. Histogram equalization concept is useful in this scene. CLAHE (Contrast Limited Adaptive Histogram Equalization) is used, where separate parts of image are considered and contrast considered is limited only to that part, this improves overall visibility in video.

2.7 Histogram Equalization

Histogram equalization is a technique for adjusting image intensities to enhance contrast. It is not necessary that contrast will always be increase in this. There may be some cases were histogram equalization can be worse. In that cases the contrast is decreased.

Fig 6: Before Histogram equalization

Fig 7: After Histogram Equalization

To make it clearer, you can see that the pixels seem clustered around the middle of the available range of intensities. What Histogram Equalization does is to stretch out this range. After applying the equalization, we get histogram like the figure in the center.

3. CONCLUSIONS

In this paper a software module to enhance the street view is proposed. So proposed system will process all the frames every-time and give clear image of the street that will help pedestrians and drivers. The purpose of this project is to give clear idea to user, of what lies ahead on the streets. This software will help the people, like drivers or pedestrians to clearly understand the road and maintain their safety while preserving their life and life of other human beings.

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