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Headlight Low-Beam and High-Beam Control using Raspberry Pi

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Abstract: ***Accidents occurring on the road are increasing phenomenally due to increase in vehicles. Very few measures are taken by the authorities to get the figures under control. Accidents occur more during night time then day time. This is due to low visibility and sometimes maybe due to the ignorance of the oncoming traffic headlight which would blind a person temporarily. It is expected the oncoming traffic should switch to low-beam but some don't which would cause temporary blindness. Hence, to solve the problem of headlights of a vehicles, an effective system is proposed for detecting vehicles through camera and assist the driver by automatically controlling headlight. The automatic system would assist the driver to automatically switch between the high beam and low beam on detection of a vehicles headlight.***

Keywords: camera assistance, high beam, low beam, vehicles headlight.

1. Introduction

Due to low visibility or no visibility during night time, it is difficult to drive your vehicle in such conditions. Hence headlights are used to improve visibility. There are two modes used while the headlight is operational- low beam mode and high beam mode. Low beam as the name indicates uses less intensity for small region of visibility in front of the vehicle as compared to high beam which utilizes high intensity and covers a large area in front of the vehicle.Currently, all low end and mid-range vehicles make use of manual switching between the low and high beam, so here lies the problem. Whenever the headlight is in high beam mode, the driver in the vehicle in front is glared with bright light which would temporarily blind him which may lead to an accident. To avoid this, it is up to the driver to switch to the low-beam mode. But some ignorant drivers think that this is a hassle and leave the headlight in high beam mode.

To solve this problem, an automatic headlight switching system is proposed which switches between high beam and low beam with the help of a raspberry pi processor which uses a camera mounted inside the car with the camera eye with full view of the front and makes decision whether to switch from current mode or not.

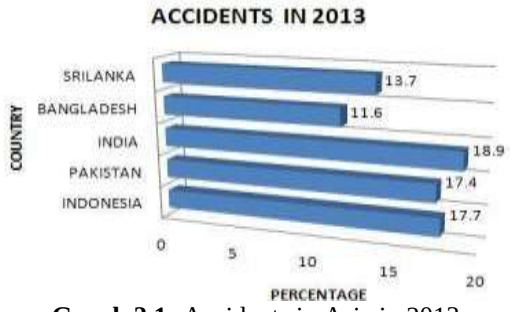
2. Problem Statement

Headlight are used by the vehicles to assist the driver for navigating during night time. Sometimes this assisting headlight might cause irritation or discomfort to on-coming traffic. When the headlight is in high-beam mode, the bulb which is part of the headlight system emits bright light which is bright enough to temporarily blind the person in front. This phenomenon is defined by the term called as Troxler effect.

This term is used frequently in the medical world which is defined as temporary blindness caused by bright light. This is also known as 'fading effect'. When a light source of around 1000 lumens is exposed to naked eyes, a glare is experienced which is nothing but temporary blindness which would last even after the light source is removed due to over exposer of cones and rods present inside the human eye.This phenomenon is called as Troxler effect. This effect would result in the delay in the reaction time of the driver which is actually increased to 1.5s from the standard 0.5s. For example, let us consider a vehicle travelling at 100mph who according to the standard reaction time of 0.5s would stop at a distance within 63 feet. But due to the Troxler effect, the driver's reaction time is reduced to 1.5s i.e., he would travel up to 119 feet before coming to a stop which is plenty of distance for a mishap to occur. Numerous accidents are reported where the main cause was the use of high-beam mode headlights. For the oncoming traffic, only the bright light is seen when using high-beam, which would obstruct the view and the driver won't be able to notice the vehicles size and this may lead to accidents due to Troxler effect.

To avoid this the high-beam should be switched to low-beam for others convenience for a short while until the oncoming traffic passes by.

The graph 2.1 gives an idea of accidents that occurred in Asia in the year 2013.



Graph 2.1: Accidents in Asia in 2013

3. Design and Implementation

The system will use a Raspberry pi which utilizes broadcom SoC and contains main components like Graphics, CPU, memory and many other components. Operates on Linux which enables the processor to consume less power and with high computing power. Fig 3.1 illustrates the diagram of Raspberry Pi.

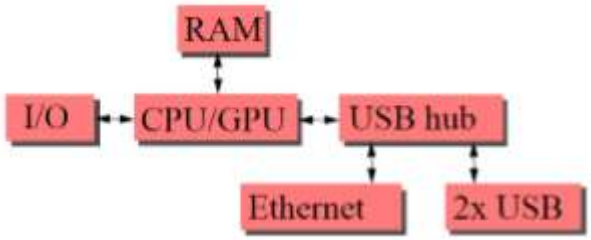


Figure 3.1: Functional diagram of Raspberry Pi

The system makes use of high resolution camera which is connected to the Raspberry Pi and is mounted inside the car next to the windshield, so that the camera eye will have full view of front portion of the car.

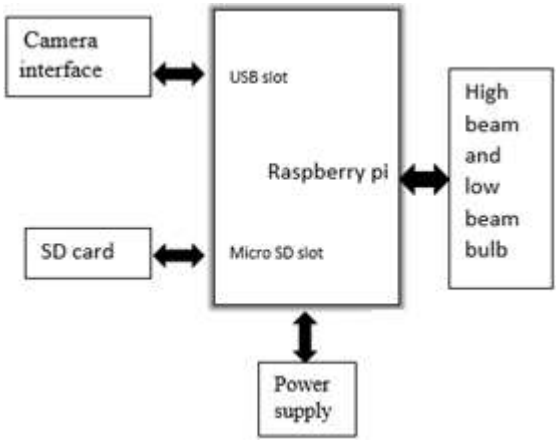


Figure 3.2: Block Diagram of hardware unit

The raspberry pi takes in a power of 5v to operate. The camera is mounted on to the rearview mirror as shown in fig. 3.3. The camera would capture the video of the front and sends it the raspberry pi through the means of Ethernet patch cord. The fully connected hardware is shown in the fig 3.4. The working of the system is shown in the form of flow chart in fig 3.5.

Figure 3.3: Camera mounting in the vehicle

Figure 3.4: Hardware setup of the system

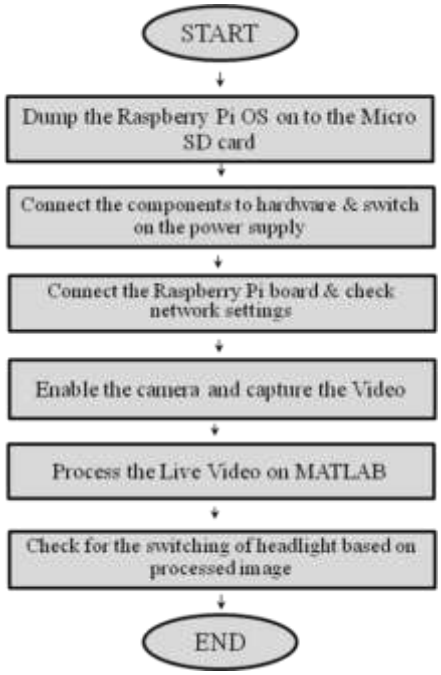


Figure 3.5: System flow diagram

4. Discussion

The vehicles make use headlights fitted with two bulbs so that low beam and high beam can be used. The high beam is used when there are no other source of light during night time.

The low-beam is used when other source of light are present like street lights. The high beam have long range but less coverage whereas the low beam have short range but have high coverage. High beam mode is normally used in highways.

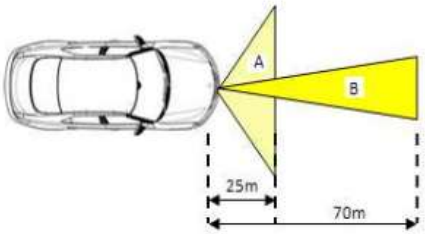


Figure 3.6: Range of low beam bulb (A) and high beam bulb (B)ofa car

As shown in the fig 3.6, the range of low beam is approximately 25m which is a short range as said before but it provides more coverage and high beam provides long range with less coverage. It is necessary to switch from high beam to low beam so as to avoid inconvenience to the oncoming vehicle.

Figure 4.1: Comparison between low and high beam

The camera acquires the image in RGB format which is then converted to grey scale for better processing. The program mainly concentrates on thresholding algorithm. A threshold value is set. This value can be accordingly set and varies during day and night time. As the name indicates, any pixels with a value below the threshold value is made into a null pixel. This constitutes the threshold algorithm for the system.

Figure 4.2(a): Input image

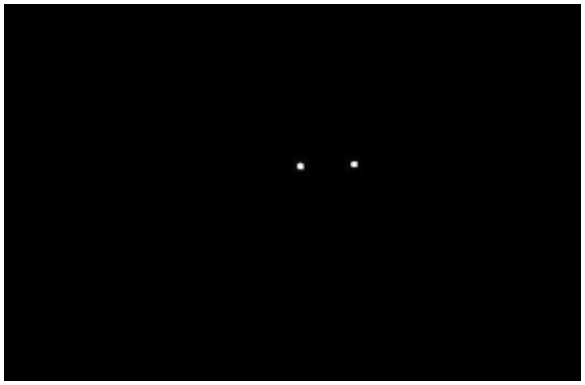


Figure 4.2(b): RGB to grey

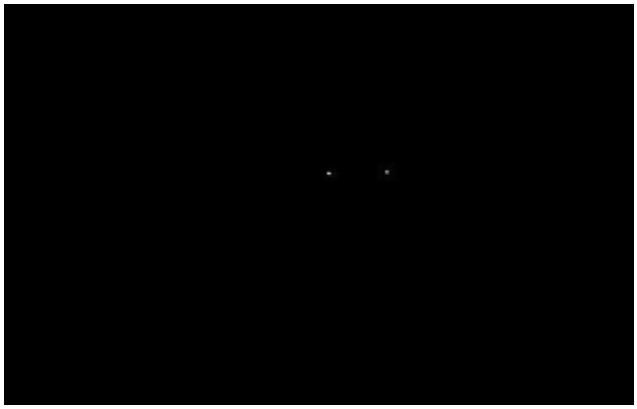


Figure 4.2(c): Removal of noise

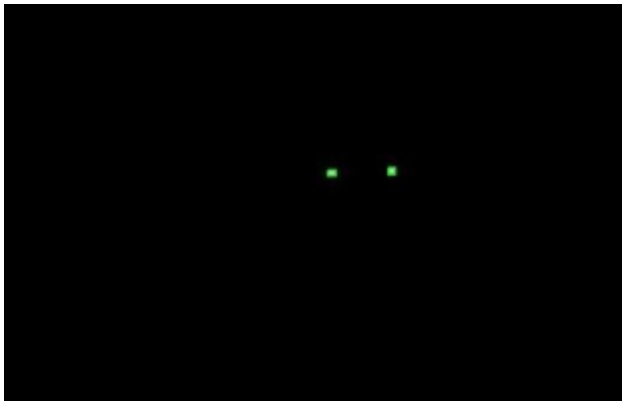


Figure 4.2(d): bounding box

The color image obtained from the camera is shown in fig 4.2(a), as it can be seen in the image a vehicle with its headlight turned on is approaching. This is converted to grey scale image where the entire color image is converted to a grey scale vale from 0-255. Using threshold and eliminating null pixels, we get the image where only the high intensity light region are visible which are surrounded by bounding box as shown in fig 4.2(d). The algorithm is created in such a way that it will consider both the low beam and high beam light from the oncoming traffic to turn the vehicles headlight to low beam mode so as to not cause inconvenience to the opposite vehicle.

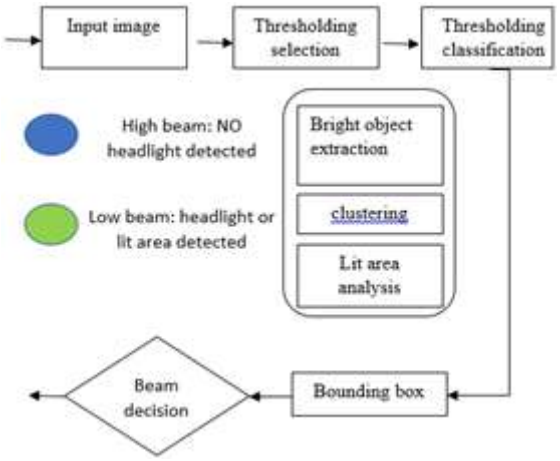


Figure 4.3: Block diagram describing the process

5. Conclusion

Using high-beam where it is not requires is mainly due to the ignorance of the driver. When high-beam is used, the oncoming vehicle experience high glare that would cause temporary blindness which might lead to mishap. To avoid this, the driver is expected to switch to low beam mode. But some ignorant drivers ignore this. To solve this problem, an automatic headlight switching system is proposed where the headlight switches from high beam to low beam and vice versa depending on the surrounding. This system is very helpful, cheap to build, easy to install and economical. By implementing this system, the accidents occurring due to the mention problem would surely reduce and is also convenient since it will automatically switch between high beam and low beam.

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