DAZZLE DRIVER ASISTANCE SYSTEM

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Abstract—**Driving at night-time on roads with opposing lanes has always been a hassle due to the blinding effects of the opposing vehicles on high beam, this has proved a deadly effect for even the best of drivers. Drivers tend to keep their headlights on high beam just to gain more visibility and situational awareness on their side, however the onslaught of this action is the reduced visibility for the car going the other way leading to temporary blinding of the eye due to Pupillary Light Reflex that causes the pupil to constrict and dilate to allow optimal amount of light to reach the retina.**

Keywords- light, visibility, blinding-effect

I. INTRODUCTION

Due to the opposing vehicles dazzling light, the portion other than the light will be under glare or dark. Due to this effect we cannot see the humans, animals or vehicles near the dazzling light they will hide under dark and we will be slow to react after recognize the objects on road. Typical low beams illuminate the road from 50 to 75 metre in front of your car, and normal high beams shine from about 100 to 150 metre. At 60 mph it takes more than 60 metre to stop the vehicle in order not to get accident, but it will highly challenging for the drivers to react in dazzling light at night [1]. Despite the fact that the traffic volume is much lower, 42 percent of all traffic accidents occur after dark in the evening, 67 percent are pedestrian fatalities, and 58 percent are fatal accidents [2].

When we are pedestrians on road what we actually do during this situation is we will try to hide the dazzling light with our hands, after passing the vehicle we rest our hand. This is not actually safe, it may be fit for pedestrians but when we ride our vehicle like two-wheeler or four-wheeler we should always rest our hands on the handle bar or the driving wheel. We should not try these silly things to hide the dazzling light under our hands which will become serious to any one's life, may cause death to our life or on the other end driver or the pedestrians life.

For these problems dazzle assistance try to fix this with a mechatronics solution with a scrolling tinted glass on the visor of the helmet or the windshield to hide dazzling light. Here the helmet is used only for clamping the equipment and these equipment should always be move along with head to detect and obstruct accurately.
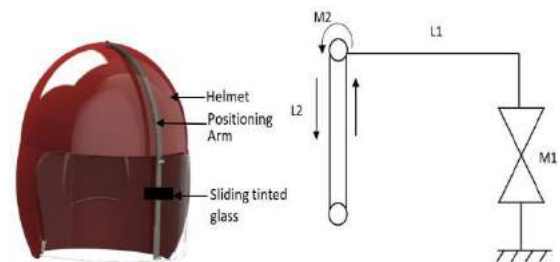

Fig. 1 Dazzle assistance fitted in helmet design and Motion plan

I. METHODOLOGY

The Dazzle Driver Assistance is a mechatronics solution which is designed to cut dazzling effect by scrolling a mini-tinted glass panel along the visor of a helmet or windshield of a car on the area only on where the light is positioned with respect to our eyes to effectively cause a multi fold reduction in direct impact of the opposing light. The tinted glass panel mounted on two rails will be curvature adaptable in order to be compatible with a plethora of visor or the windshield. The control element of dazzle assistance will use a camera fitted to top of the helmet associated with image processing by using Processing and Arduino software which will orient tinted glass itself to center towards the incoming light source, in this case a servo motors and a stepper motor is used, it is possible to find the angle of incident light source. The known distance of light's position and the driver's eye can be used to correlate the angle of incidence towards the driver's eye (in terms of x and y pixels). By knowing the angle of entry and it is possible to calculate the position of entry of the light source on the surface of the visor. Then the tinted glass slides quickly enough to continually track and effectively block that point of

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incidence. Once the sensing element deems the light incident is acceptable for normal viewing dazzle assistance slides away quickly to its resting position. By obstructing only the light core the diffraction might not occur in our eyes and there will be no glare [Fig. 5]

1) *On-road Night-time Vehicle Light Detection and Tracking Methods Overview*

Dazzle obstruction control system demands an early vehicle with dazzling light detection where only camera based approaches are suitable.

Camera Specification: There are several important parameters for camera which should be taken into considerations: sensor type, resolution of a camera and lens. Web cam of 640x480 resolution camera with wide-angle lens of 60 degree view angle. CMOS image sensor is used.

Hardware Support: Based on our need a normal computer is sufficient with at least 4GB RAM for software support. Arduino UNO for servo and stepper motor control.

Software Support: For image processing, Processing software with open CV library. For Arduino board control Arduino IDE is used.

2) *Light detection*

Obstruction of light starts with the light detection. There are several methods for light blob detection. For this Image processing is employed by the use of Processing software which is the most suitable for every beginners in image processing. Matlab can also be used for light detection and arduino programming. Processing comes with a serial library for connecting to arduino. The detected position of the light can be sent to the arduino board to control the link.

3) *Camera caliberation*

Singe camera system calibration consists of fixing two dimensional position in real-world by x and y coordinate values of light. According to the man's eye viewing angle is 180 degree horizontally and 135 degree vertically [3].

4) *Lens*

According to the camera used the viewing angle should be upto 180 degree of viewing angle, but in most of the cases available is upto 60 degree

of viewing angle. A wide angle lens of 0.4X can be used for making the viewing angle larger for camera vision.

$$0.4\,X = 60\ degree$$
$$X = 150\ degree$$

150 degree viewing angle is enough to obstruct the light which is hassle for vision.

5) *Resolution*

Resolution is the amount of detail that the camera can capture at a time, and it is measured in pixels. The more pixels that a camera has, the more detail it can capture. A 640x320 pixel web cam is sufficient to detect the vehicles light at night.

II. KINEMATICS

Kinematics is the study of motion of bodies without considering the moments or forces that cause the motion. There are many ways to represent rotation, including the following: Euler angles, Pauli spin matrices, orthonormal matrices, axis and angle, Gibbs vector and Hamilton's quaternions [4].

A. *Forward Kinematics*

Calculating the position and orientation of the end-effector in terms of the joint variables is called forward kinematics [2]. As in this case we need the joint angles in order to rotate the link to position itself to hide the light with respect to our vision. Hence the Forward kinematics is not used in this scenario.

B. *Inverse Kinematics*

The position of the end of the link to be will be given and determining the numerical value for the joint angle is called inverse kinematics. As for this situation the position will be known by processing the video and get the x and y coordinate values. By inverse kinematic approach the joint angle can be found.

1) *Geometric Solution Approach*

The end point of arm was initially at P_0 location, after receiving the signal from processing to where the arm to be placed is translated to P_1 location can be given by,
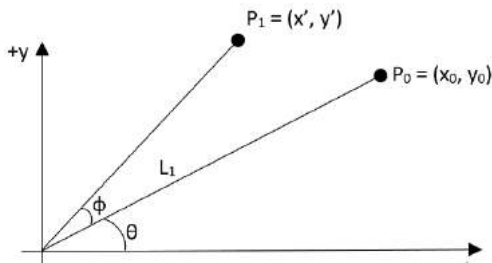
Fig. 2 Inverse Kinematics

$$\cos \theta = x_0/L_1 \qquad (1)$$
$$\sin \theta = y_0 / L_1 \qquad (2)$$
$$\cos (\phi+\theta) = x' / L_1 \qquad (3)$$
$$\sin (\phi+\theta) = y'/L_1 \qquad (4)$$

1, 2 are converting polar (θ,d) to cartesian coordinates (x_0,y_0). 3, 4 are similar.

2) Algebraic Solution Approach

$$\cos (\phi+\theta) = \cos(\phi)\cos(\theta) - \sin(\phi)\sin(\theta)$$
$$(5)$$
$$\sin (\phi+\theta) = \sin (\phi)\cos (\theta) + \cos (\phi)\sin (\theta)$$
$$(6)$$

Here 5, 6 are just trignometric identities. Now set 3 equals to 5, 4 equals to 6 and then plug in 1, 2 whenever possible.

$$x'/L_1 = \cos (\phi)\cos (\theta) - \sin (\phi)\sin (\theta)$$
$$y'/L_1 = \sin (\phi)\cos (\theta) - \cos (\phi)\sin (\theta)$$
$$x'/L_1 = \cos (\phi)\, x_0/L_1 - \sin (\phi)\, y_0/L_1$$
$$y'/L_1 = \sin (\phi)\, x_0/L_1 + \cos (\phi)\, y_0/L_1$$
$$x' = \cos (\phi)\, x_0 - \sin (\phi)\, y_0$$
$$y' = \sin (\phi)\, x_0 + \cos (\phi)\, y_0$$

Matrix form,

$$\begin{bmatrix} \cos(\phi) & -\sin(\phi) \\ \sin(\phi) & \cos(\phi) \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} x' \\ y' \end{bmatrix}$$
$$(10)$$

Translation of the arm with respect to previous position can be found in (10).

III. VEHICLE LIGHT DETECTION COMPONENTS

A. Processing

Here Processing software [Fig. 3.2] is used to detect the brightest pixel in the video. The Java code to find the brightest pixel is given Coding section of this paper. By finding the brightest pixel in a video, then a light only can be the brightest pixel if we are using a filter. Hence the light can be easily detected. Processing is an open source computer programming language and IDE (integrated development environment) built for the new media art, electronic arts, and visual design communities with the purpose of teaching the fundamentals of computer programming in a visual context [5].

B. Open CV Library

OpenCV for Processing is based on OpenCV's official Java bindings. It attempts to give convenient wrappers for common OpenCV functions that are friendly to beginners and feel familiar to the Processing environment [5].

C. Light positioning

When the code is started in the processing the brightest pixel in the video reading from the webcam is identified only by pixel units. Here it is 640, 480 pixel video hence the light positions can be easily found out by println() in processing. The x and y pixel position found can be sent to arduino to control the servo. The values are converted to angles and number of rotations depend on the length of the arm.

Fig. 3.1 Light positioning on road by processing in pixels

Fig. 3.2 Processing 3.2.3 software

D. Arduino

Arduino is an open-source electronics platform based on easy to use hardware and software [7]. Servo motor can be controlled by Arduino UNO board. The link from the helmet to obstruct the oncoming light can be obstructed by making the servo rotate in the angle of incident light.

E. Firmata

For communicating with software on the host computer, the Firmata library implements the Firmata protocol. This allows you to write custom firmware without having to create your own protocol and objects for the programming environment that you are using [8].

F. Serial Communication

Serial is used to communicate between the Arduino board and a computer or other devices. Every Arduino boards at least have one serial port (also known as a UART or USART): Serial. It communicates through USB [7].

IV. SEQUENCE OF OPERATION

Whenever the brightest pixel like bright light is found in the video by the processing algorithm in the processing software is sent to the arduino board through serial communication as stated before. The arduino will again sent back to computer for closed loop communication and then sent to the servo for controlling the servo to obstruct the light.

Fig. 4 Sequence of Operation

V. CODING

A. Processing Code

```
import processing.serial.*;
import processing.video.*;
import cc.arduino.*;
Capture webcam;
Serial port;
int x, y;
Arduino arduino;
void setup() {
  size(640, 480);
  frameRate(30);
  println(Arduino.list());
  //printArray(Capture.list());
  arduino = new Arduino(this, Arduino.list()[0],
57600);
  arduino.pinMode(7, Arduino.SERVO);
  webcam = new Capture(this, width, height);
  webcam.start();
}
// Light tracking
void draw() {
  if(webcam.available()) {
    webcam.read();
    image(webcam, 0, 0, width, height);
    webcam.loadPixels();
    float Brightmax = 0;
    int Brightestpixel = 0;
    for(int i=0; i<webcam.pixels.length; i++) {
      if(brightness(webcam.pixels[i]) > Brightmax) {
        Brightmax = brightness(webcam.pixels[i]);
        Brightestpixel = i;
      }  }
    x = Brightestpixel % webcam.width;
    y = Brightestpixel / webcam.width;
  }
  String p="pixelx="+x;
  String q="pixely="+y;
  stroke(#ff0000);
  strokeWeight(3);
  noFill();
  rect(x, y, 50, 30);
  textSize(15);
  text(p,x+55,y+10);
  text(q,x+55,y+25);
  fill(#32cd32);
  println(x,y);
  arduino.servoWrite(7,   constrain(180-3*x/16,   0,
180));
}
```

B. Arduino Code

Get the Arduino code in Arduino software.
File->Examples->Firmata->ServoFirmata. The Processing code is edited according to connect to this example program in Arduino.

VI. RESULT OF DAZZLE ASSISTANCE ON ROAD

As a result of dazzle assistance installation dazzling light will be obstructed with a tinted glass on the area only where the dazzling light with respect to our eyes and the road will be visible clearly

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol.3, Special Issue.24, March 2017

without any glare on vision. As shown in Fig. 5 in the top is without dazzle assistance and it is clear that the person near the light is not visible due to the glare of the light and in the bottom with dazzle assistance system the person is visible than before.

Fig. 5 Final result of dazzle assistance (Edited) [9]

VII. CONCLUSION

The dazzle assistance is in the developing stage as for now it can detect and obstruct single light at a time most probably the brightest light. The recently developed projects with automotive giants like Mercedes-Benz and Audi has already developed ADAS(Advanced Driver Assistance System) which is only focused on only to comfort the other drivers on road, not the driver of our own car. It is very common to protect our vehicle from accidents and not to injure any pedestrians than any other vehicles on road. Based on this approach our DADDAS is designed to protect our vehicle. By combining these ADAS and DADDAS system can increase safety on road. Thus the system focus only on single light can be improved to obstruct multiple lights.

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