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Driver Drowsiness Detection Using Machine Learning Approach

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Abstract

Driver fatigue is a major cause of traffic accidents. The number of deaths and injuries increases every year around the world. Traffic accidents can be reduced by detecting driver fatigue. This article describes machine learning for sleep detection. Face detection is used to detect the driver's eye area and use this as a reference for eye tracking in subsequent frames. Finally, visual images are used to detect sleep and a warning system is created. This method is divided into three stages: face detection, eye detection, and fatigue detection. Image processing is used to recognize the driver's face and then extract the image of the driver's eyes to detect fatigue. HAAR face detection algorithm outputs the image and then adjusts face detection based on the output. CHT is then used to track the eyes of the visible face. Check the eyes using EAR (Early Evaluation). The proposed system was tested using the proposed system on a Raspberry pi 3 Model B with 1 GB RAM using Logitech HD Webcam C270. According to some video tests, average eye contact and tracking accuracy can reach 95.0%. Therefore, it is a cheaper and better solution for a tired driver to ask to find the road immediately.

Keywords: Haar Face detection, AdaBoost, EAR(EyeAspectRatio), Raspberrypi3

1. INTRODUCTION

Driver fatigue is one of the main causes of car accidents. If the driver's fatigue state can be predicted at an early stage and a sleep warning can be given to the driver, the probability of an accident can be reduced. This paper presents a driver drowsiness detection system using machine learning. In the first stage, face recognition and eye recognition were separated. Our main contribution to the research of the material used to complete the high mast. The first contribution of this paper is a new image representation that is extremely forgiving, called the integral image.Fast measurement. It uses the technique of remembering Haar Basis functions. To calculate these features very quickly at various scales, a representative image example is shown. A normal image can be calculated from an image using some function of each pixel. The second source is a way to create a distribution by selecting a small set of key features using AdaBoost. To achieve fast classification, the learning process must exclude most of the available features and focus on a small set of important features. This option is achieved by making a simple change to the AdaBoost process. The third benefit of this article is a way to continuously combine multiple classifications into a cascading model; This makes measurement faster by focusing on a narrowed area of the image. This object detection process classifies images based on the importance of key features. It is based specifically on our features.The threecube feature adds the numbers in the outer two rectangles and subtracts the numbers in the middle rectangle. Finally, four rectangular faces calculate the difference between pairs of diagonals.

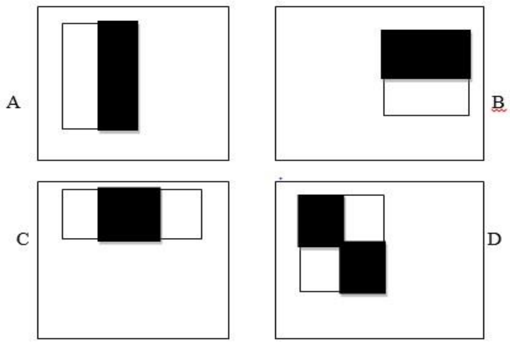

Figure1.1ExamplesforHAAR

It is based on a rectangular closed window as shown in Figure 1.1. Subtract the number of pixels in the white rectangle from the number of pixels in the gray rectangle.

A. IntegralImage

Quickly calculate the rectangle using the center of the image. The main image at position z, y has 2, the sum of the pixels above and to the left of y (inclusive): ii(x, y) = Σ*V* z, y) is the corresponding image and i(z, y)))) is the original image.

Usingthefollowingpair ofrecurrences:

s(x,y)=s(x,y-1)+i(x,y)(1)ii(x,y)=ii(x-1,y) + s(x,y) (2)

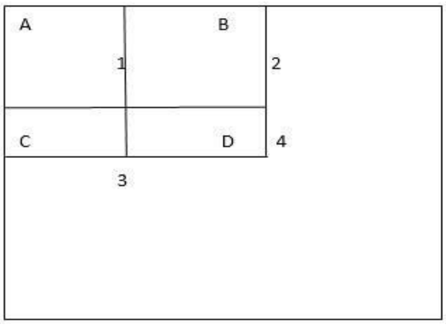

Figure1.2Pixels

(where s(z, y) is the summation line, s(z, 1) = 0 and ii(-1, y) = 0) The summation plot can be calculated from the entire old image in one go.

***B.* Learning Techniques**

Given specific techniques and training on positive and negative images, any machine learning method can be used to learn classification. In this system, a variant of AdaBoost is used to select a small set of features and train the classifier.

ALGORITHM1:AdaBoostalgorithm

- Given example images (x1, y1), (xn,yn) wherey1=0,1fornegativeandpositiveexamplesrespectively.
  - Initialize weights w1i= 1/2m, 1/2l for yi= 0,1respectively,wherem,latethenumberofnegativeand positive respectively.

- Fort= 1,T:

1. Normalizetheweights,$W_{t,i} \leftarrow W_{t,i} / \sum^{n}_{j=1} W_{t,j}$
   Sothat $w_t$istheprobabilitydistribution.
2. For each feature, j, train the classifier $h_j$whichisrestrictedtousingsinglefeature.The error is evaluated with respect to w_t,e_j=
   $\sum_i w_i |h_j(x_i) - y_j|$
3. Choosetheclassifier,h_t,withtheloweste_t.
4. Updatetheweights,$W_{t+1,i} = w_{t,i} \beta_t^{1-e_i}$

Wheree_i=0ifexampleisclassifiedcorrectly,e_i= 1,
otherwiseand$\beta_t = e_t / 1 - e_t$

•Thefinalstrongclassifieris,$h(x) = \{1, \sum_{t=1}^{T} a_t h_t(x) \geq \frac{1}{2} \sum_{t=1}^{T} a_t$
$0, otherwise$
where$a_t = 1/\beta_t$

TheAdaBoostalgorithmforclassifierlearningisdemonstrated. Each round of boosting selects one featurefromthe 180,000potentialfeatures.

Objectives

- Todetecttheleveloffatigueofthedriverandalertingthem.
- Todetectthealcoholintoxicationlevelofthe driver

I. PROBLEMSTATEMENT

Accidents occur on the roads for many reasons. The main cause of car accidents is driver fatigue.

II. METHODOLOGY

A. OverviewDesign

The main idea of driver fatigue detection is to capture the driver's eyes through the camera and accurately calculate the driver's sleepiness by completing the time. To meet these requirements, appropriate materials must be selected. For the base computer, choose Raspberry Pi 3 Model B.

B. SystemDesign

Figure1.3RaspberryPi 3ModelB

C. Software

Raspberry Pi 3 Model B and Raspberry Pi Camera are used due to their higher CPU performance and higher frame rate. Raspberry Pi 3 Model B supports C++ and OpenCV libraries. OpenCV version 3.1.0 is designed for many computer vision-related tasks. The OpenCV library supports HAAR cascade classifiers, twisted affine and template matching..

ALGORITHM 2:

DROWSINESSDETECTIONALGORITHM

The general flow of our fatigue detection algorithm is very simple.

1. First, set the camera to track the face in the stream.
2. If the face is visible, a face mask is used to remove the eye.
3. Eye area is used to calculate the eye ratio to determine whether the eye is closed.
4. If visual comparison shows the eyes have been closed long enough, the alarm will sound to wake the driver and the light will flash to notify the driver behind.

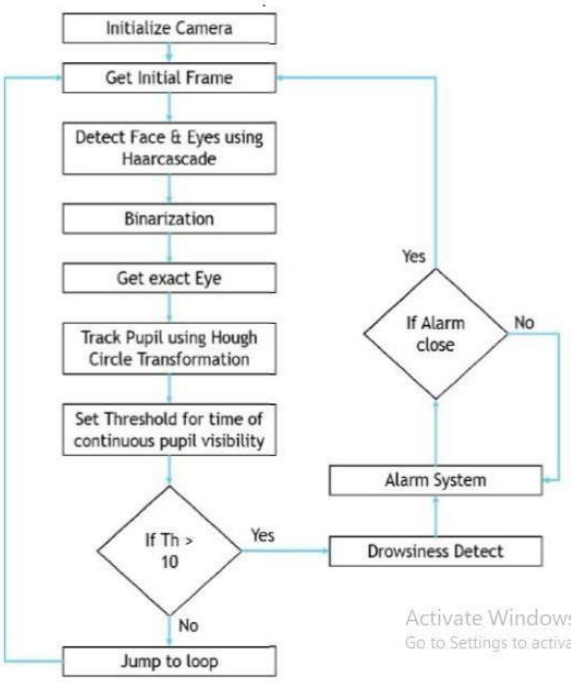

Figure1.4Algorithmflowchart

C. FaceDetection

The planning process begins with capturing the video frame by frame. The system will detect the face in each frame of the image. This is done using the HAAR algorithm for face detection. First load the data stage, then pass the received frame to edge processing, which detects all objects in different parts of the frame. Instead of checking for objects of all sizes, specify that the edge detector will only detectobjects of that size (for example, a face). The output of this module is the frame in which the face is detected.

1. HAARCascadeClassifier

It is one of the first vehicles to detect the driver's face. It is one of the few detection methods that can identify human faces. Paul Viola and Michael Jones developed this method. He examined thousands of faces in different lighting conditions. Ten subjects received the HAAR Cascade test Classifier

2. RegionofInterest

Regions of Interest (ROI) focus more on the driver's face. The formula for the temperature difference can be written as:

T= (100-|FC/2|)/100 where T is the temp valueand FCistheface degree.

D. *EyeDetection*

After the face detection system detects a human face, the eye detection function tries to detect the driver's eyes. After detecting the face, find the eye area with the following methodAssuming that the eyes are only visible in the upper part of the face, the eye region of interest (ROI) is extracted and marked as the region of interest by cropping the mouth and hair starting from the upper part of the face. Quickly eyeball correctly.

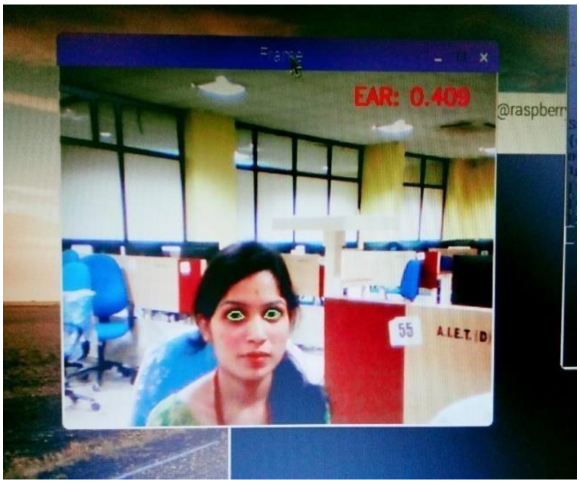

Figure1.5Eyedetectionresult

E. EyeStateandDrowsinessDetection

To detect fatigue, first check whether your eyes are closed or open. Eye Test (EAR) is used to determine whether the driver's eyes are open or closed.When calculating EAR, use the Euclidean formulatocalculatethedistance between the main points of the eye.

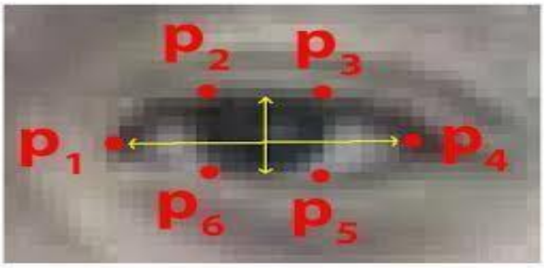

Figure1.6EARKeypoints

The equation expressing this relationship is called the eye-to-eye ratio (EAR) and is given as:

$$EAR=\frac{||p2-p6||+||p3-p5||}{2||p1-p4||}$$

The numerator of this equation calculates the distance to theeye vertically, and the denominator calculates the distance to the eye horizontally. In this model, the threshold is set to 300. If the EAR is below 300, the driver is detected to be drowsy.

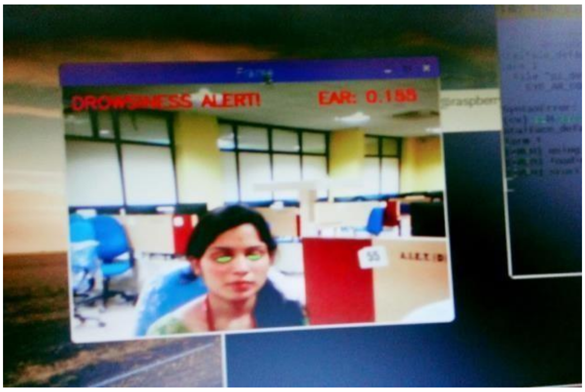

Figure1.7Drowsinessdetected

CONCLUSION

Drowsy driver detection is designed to help drivers sleep while driving to reduce traffic accidents caused by fatigue. This paper conducted experiments in a bright room with constant light. There are also some limitations such as skin lightening and darkness. The embedded device can calculate sleepy drives using a combination of the Raspberry Pi 3 Model B and the Raspberry Pi camera. Raspberry Pi 3 Model B, processor that calculates whether the drive is asleep.

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