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REAL TIME SYSTEM FOR DETECTING DISTRACTION OF DRIVER

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ABSTRACT

According to National Highway Traffic Safety Administration [NHTSA], driver inattention/distraction is one of the major causes of road accidents. It would, therefore, be both cost and safety beneficial if a distraction detection system could be developed. This paper describes a real-time non-intrusive method for detecting distraction of driver. It uses webcam to acquire video images of the driver. Visual features like mouth & head pose which are typically characterizing the distraction of the driver are extracted with the help of image processing techniques to detect types of distraction. A study about the performance of this proposal & some results are presented.

KEYWORDS: Image Capturing, Digital Image Processing, Distraction Detection

INTRODUCTION

The driving task is a complex one, requiring a substantial degree of attention and concentration. Despite these complexities, it is not unusual to see drivers engaged in various other activities while driving, such as in-vehicle interaction with passenger, using mobile, eating/drinking, looking at things outside the vehicle, etc. These activities distracting a driver & leads to danger crashes. It would, therefore, be both cost and safety beneficial if a distraction detection system could be developed.

DISTRACTION

Driver distraction is defined as a specific type of inattention that occurs when drivers divert their attention away from their primary task of driving to focus on another activity, which reduces the driver's awareness, decision-making, and/or performance, leading to an increased risk of corrective actions, near-crashes, or crashes.

TYPES OF DISTRACTION

There are four types of driver distraction as follows.

- **Visual:** Occurs when a driver looking at something other than road such as looking an objects/events.
- **Auditory:** Occurs when a driver hearing/talking something not related to driving.
- **Physical/Manual:** Occurs when a driver is doing something physical that is not related to driving.
- **Cognitive:** Occurs when a driver thinking about something other than driving.

Table 1: Different Sources of Distraction & its Type

Sr. No.	Activity/Source	Types of Distraction
1	In-vehicle interaction with persons (like baby, child, adult, passenger) & pets in adjacent/rear seat	Visual, Auditory, Manual, sometimes Cognitive
2	Looking at things outside the vehicle (such as persons, animals, building, accident, direction boards, maps, advertisements, any other events/objects)	Visual, Cognitive

Table 1: Contd.,

3	Eating, drinking, spilling, preparing to eat/drink	Visual, Manual
4	Using/dialing mobile phone, text messaging, accessing internet	Visual, Auditory, Manual, Cognitive
5	Adjusting climate control (air conditioner/heating), vehicle control (windows, door locks, mirrors, seat, steering wheel, seat belt, radio, CD/DVD player), storing/retrieving items	Visual, Manual
6	Smoking (includes lighting & extinguishing), applying makeup, combing/fixing hair, other personal hygiene	Visual, Manual
7	Driver related factors (lost in thoughts, day dreaming, emotional-depression, angry, disturbed)	Cognitive

System Overview

The complete block diagram representation of the proposed system is as shown in Figure 1. In literature, there were many distraction detection methods appearing & the best is visual feature based approach, as human face contained much information about physical condition. Here, mouth & head tracking done in real time using webcams to detect different types of distraction of driver.

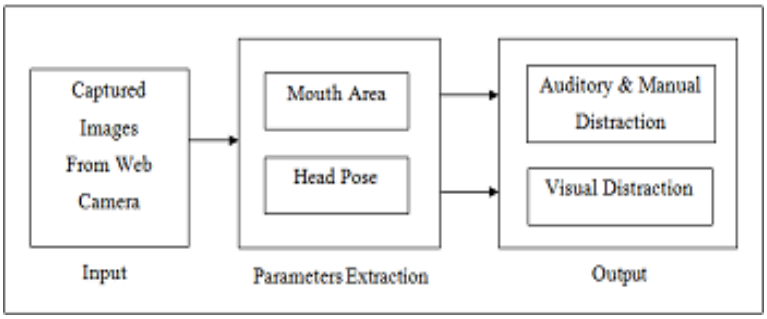


Figure 1: Complete Block Diagram of Proposed System

Image Acquisition Method

The proposed system used iBall face2face CHD12.0 webcam having 5G wide angle lens, 6 LEDs for night vision, with brightness controller, interpolated 12M pixels still image & 2M pixel video resolution. The camera is placed in front of the user, approximately 30 cm away from the face. The camera must be positioned such that the following criteria are met: First is the user's face takes up the majority of the image & second is the user's face is approximately in the centre of the image. After that converting it into gray scale, as RGB components are dependent on the lighting conditions thus the face detection may fail if the lighting condition changes. Next is face-detection step, the face region is found within the driver's entire facial image to remove unnecessary background.

Distraction Decision

The continuous distraction estimate needs to be mapped to a decision whether the driver is distracted or not. One approach is to require that the driver is looking forward for some minimum time before he or she is considered to be attentive but there will be possibilities that same time driver may be talking on mobile or talking with passenger, eating or drinking something etc. means detecting auditory & manual distraction with monitoring mouth area of driver. The other approach is that instead of looking forward, driver is looking at things outside from the vehicle windows (such as persons, animals, building, accident, direction boards, maps, advertisements, any other events/objects) or may be looking occupant in adjacent seat (like baby, child, adult, passenger, pet) means detecting visual distraction with monitoring head pose of driver.

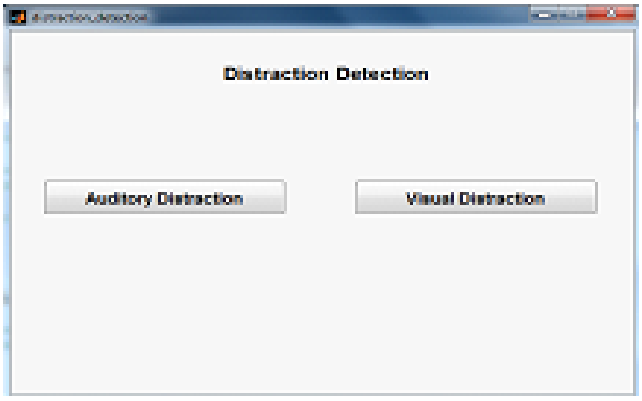


Figure 2: Main GUI of Proposed System

Inhibition Criteria

A distraction detection method determines whether a driver is distracted or not, but when and in which way the driver will be warned for distraction is determined by a warning strategy. There are situations when it is not suitable to give distraction warnings. For instance, if the driver is braking hard he or she is probably aware of the situation and should not be disturbed by a warning. For this reason, certain criteria can be set up to inhibit warnings. Common criteria include:

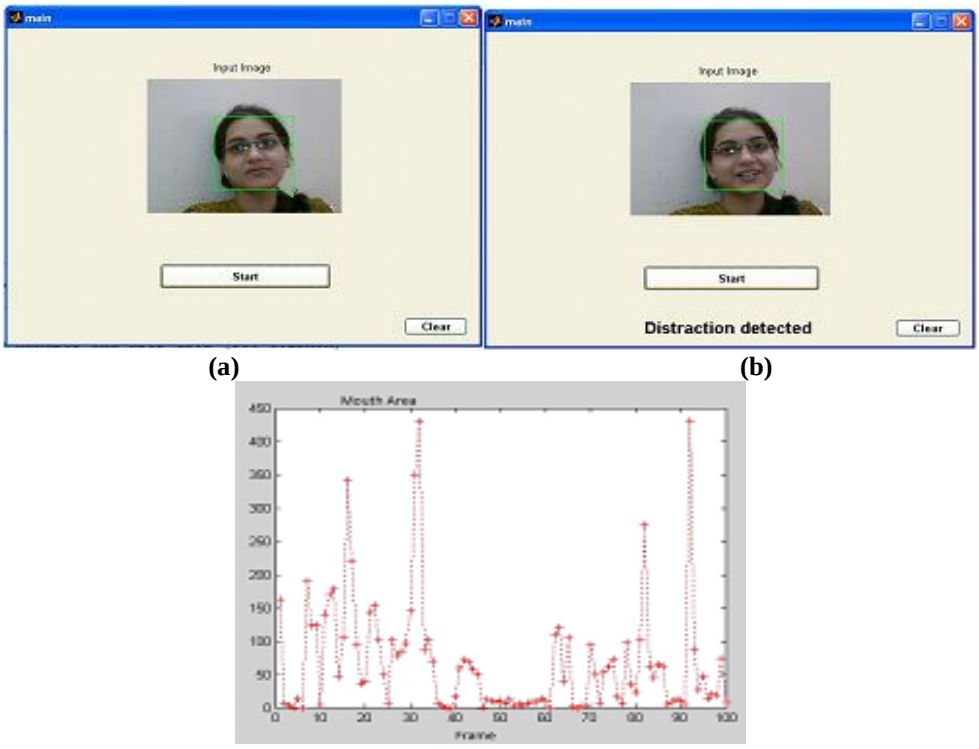
- **Direction Indicators:** Changing lanes and turning means that the driver should look over the shoulder.
- **Reverse Gear:** Reverse engaged means that the driver should look over the shoulder.
- **Brake Pedal:** No warning should be given while driver is braking, in order not to interfere with critical driving manoeuvres.
- **Steering Wheel Angle:** No warning should be given while the driver is engaged in substantial changes of direction, in order not to interfere with critical driving manoeuvres.
- **Lateral Acceleration:** No warning should be given when the vehicle makes strong movements, in order not to interfere with critical driving manoeuvres.

Distraction Detection Method

The proposed system uses Background Subtraction technique for detecting distraction of driver. The basic scheme of background subtraction is to subtract the image from a reference image that models the background scene. If the pixel difference is greater than the set threshold, then determines that the pixels appear in the moving object, otherwise, as the background pixels. As the camera is fixed, the background model can remain relatively stable in the long period of time. Using this method can effectively avoid the unexpected phenomenon of the Background, such as the sudden appearance of something in the background which is not included in the original background. Moreover by the update of pixel gray value of the background, the impact brought by light, weather and other changes in the external environment can be effectively adapted. Typically, the basic steps of the algorithm are as follows:

- Background modeling constructs a reference image representing the background.
- Threshold selection determines appropriate threshold values used in the subtraction operation to obtain a desired detection rate.
- Subtraction operation or pixel classification classifies the type of a given pixel, i.e., the pixel is the part of background (including ordinary background and shaded background), or it is a moving object.

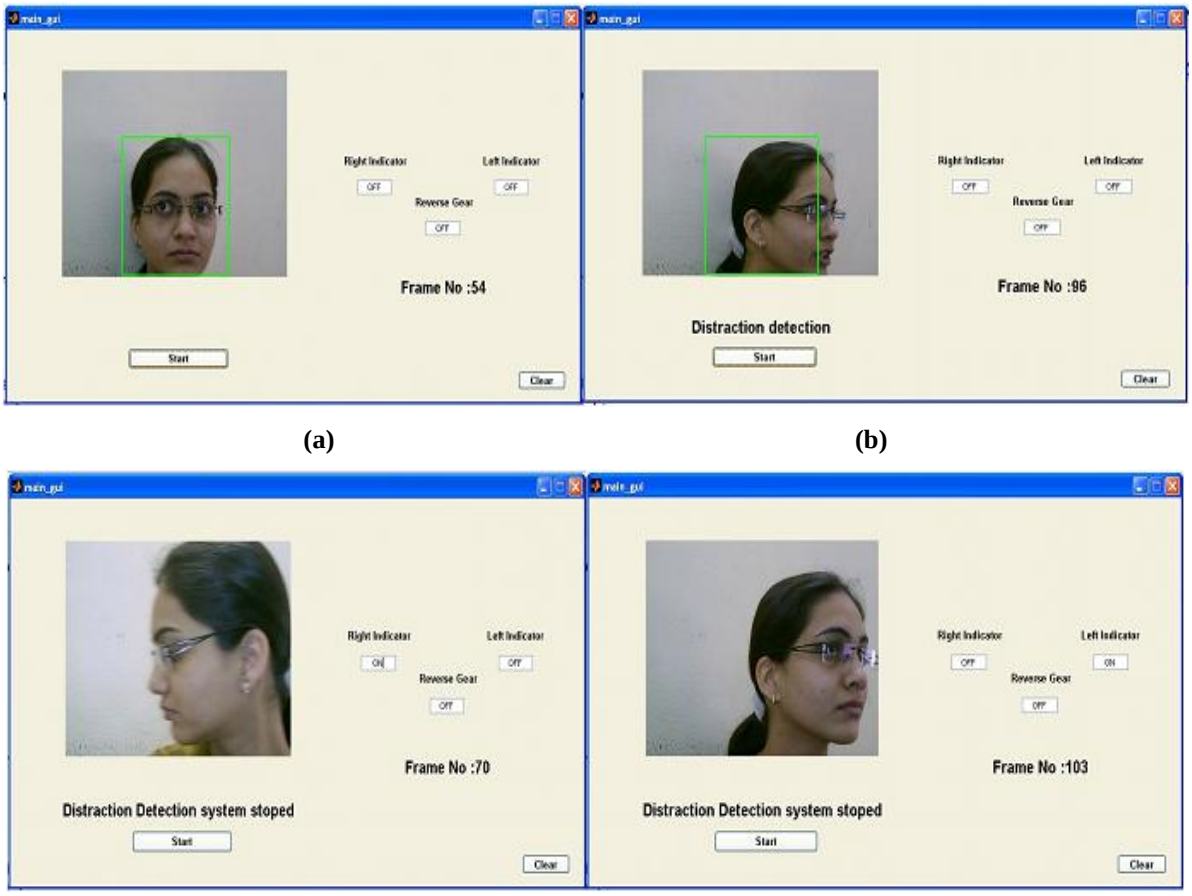
EXPERIMENTAL RESULTS



(a) (b)

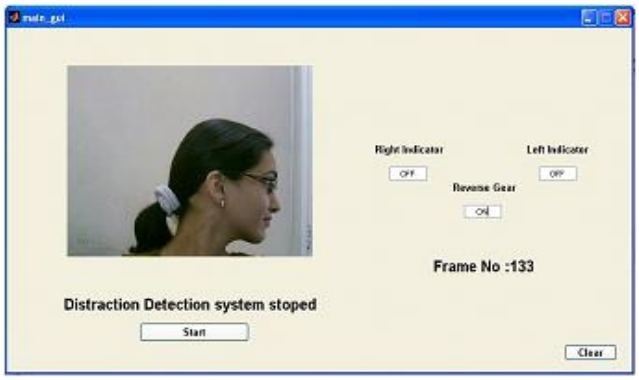
(c)

Figure 3: (a) Main GUI Window for Auditory Distraction, (b) Auditory Distraction is Detected, (c) Distraction Result for Different Frames & Mouth Area



(a) (b)

(c) (d)



(e)

Figure 4: (a) Main GUI Window for Visual Distraction, (b) Visual Distraction is Detected, (c) (d) (e) Distraction Detection System Stopped when Right Indicator, Left Indicator & Reverse Gear are Engaged

CONCLUSIONS

The proposed system detecting auditory, manual & visual distraction of driver by continuously monitoring mouth area & head pose. This non-intrusive approach to detecting driver distraction without interference in both daytime & nighttime as webcam having 6 LEDs for night vision, with brightness controller. However, there will be some false detection, where the results are not good when there is quick head-movement. So, future work will be done based on drivers quick head-movement and make it feasible to detect driver's distraction.

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