Digital Image Processing

Literature Review Presentation

Aditya Misra
169105017

Maheeka Kaistha
169105101

Mehil Shah
169105105

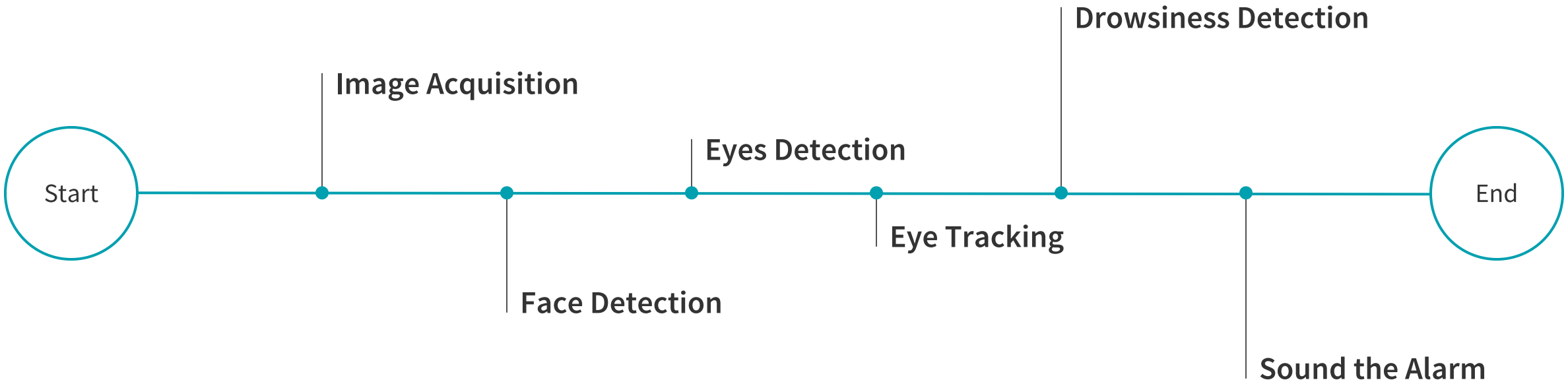
Introduction to the Problem

1

Problem Statement

- Sleepiness during driving is a major cause for roadaccidents. Most people thought that drunken driving is the serious cause of accidents and unaware of drowsy driving which is just fatal.
- It also deteriorates vigilance, concentration and alertness so that the ability to perform different consciousness-based activities (such as driving) is impaired, decreases awareness,reduces judgment and increases the risk of crashing.
- The cause of a fatal crash where drowsy driving is involved is nearly impossible to determine with certainty.
- However, the investigators tell that there are a number of clues at a crash scene that shows the person fell asleep at the wheel. For example, accidents due to drowsy driving occurs usually in vehicles where the driver is alone and the injuries seems to be serious or fatal, especially during nights the drivers drive under stress on highways and as a result, they mostly lose control over the vehicle and become the victims of accidents.

General Architecture of Drive Drowsiness Detection



A situation-adaptive lanekeeping support system: Overview of the SAFELANE approach.

A.Amditis, M.Bimpas, G.Thomaidis, M.Tsogas, M.Netto, S.Mammar, A.Beutner, T.Wirthgen, S.Zipser, A.Etemad, M. Da Lio and R.Cicilloni

- This paper addressed the development of system that is able to deal with large set of different traffic situations. System is structured on model-based approach with use of vehicle-side technologies, the model consists of 3 layers : Perception Layer, Decision Layer, Action Layer.
- Perception Layer consists of sensor system and image processing. The input comes from camera that are monitoring the road in front of the vehicle, further supplemented by radar data, vehical controller area network data, digital road maps and precise GPS.
- Action Layer comprises all system reaction in critical lane-departure situations and involves all the control of acoustic or/and haptic warning actuators, as well as an active steering actuator.
- Decision Layer determines the current overall situation using a situational model with respect to the driver's state, actual driver maneuver, the environment, lane, street condition. Based on the parameters, it determines the output to be sent to the actuator system.

Vision–based method for detecting driver drowsiness and distraction in driver monitoring system

Jaeik Jo, Ho Gi Jung, Kang Ryoung, Jaihie Kim

- This paper presents a driver-monitoring systems that contains both drowsiness detection method and distraction detection methods.
- Drowsiness involves a driver closing his eyes because of fatigue, and distraction involves a driver not paying sufficient to the road despite the presence of obstacles or people.
- In this approach, eye-detection algorithm is designed which combines adaptive boosting and adaptive template matching.
- The algorithm consists of face-detection, head-orientation-estimation, eye-detection, eye-state-detection, drowsiness and distraction-detection steps.
- Distraction and Drowsiness are determined from head-pose of the driver.
- Driver Drowsiness level is measured as PERCLOS, Percentage of Eye Closure Time during a Time Interval. Similarly, Distraction Level is measured as PERLOOK, which is the percentage of time spent not looking ahead during a certain time interval.

A Survey on Driver's Drowsiness Detection Techniques

Jay D Fuletra, Dulari Bosamiya

1

There are 3 techniques used by researchers to detect drowsiness.

- Image Processing Based Techniques
- ANN based Techniques
- Electroencephalograph Based Techniques

2

Image Processing Techniques :

- Template Matching Technique : In this technique, one can use various states of eye for some particular time, then system will ring the alarm. These method is easy to implement, as machine has templates of both open and closed eyes.
- Eye Blinking Based Technique : Here, the rate of eye blinking and eye closure duration is measured to detect driver's drowsiness. In this system, the positions of irises and eye states are monitored to estimate blinking frequency and eye close duration. We can use data, to sound the alarm.
- Yawning Based Techniques : Using various face detection and mouth tracking techniques, we can detect yawns, when user yawns for more than 5/10 times, we can sound the alarm.

A Survey on Driver’s Drowsiness Detection Techniques

Jay D Fuletra, Dulari Bosamiya

1 ANN Based Techniques

- In this technique, we use neurons to detect driver's drowsiness.
- People in this fatigue exhibit certain visual behaviors that are easily observable from changes in facial features such as eyes, head and face.
- Visual behaviors that reflect person's level of fatigue include eyelid movement, gaze, head movement and facial expression.
- Using these visual cues, we can construct a ANN, testing of samples is done and researchers have obtained an accuracy of 96%.

2 EECG Based Techniques

- In this technique, electrode helmets are to be worn by the drivers, while driving.
- This helmet has electrode sensors, which are placed at correct places and that helps us obtain data from the brain.
- Researchers have used characteristic of EEG Signal in Drowsy Driving Detection.
- A method based on Power Spectrum Analysis and FastICA algorithm was proposed to determining the fatigue degree.
- EEG Signals were recorded in sober and drowsy states. According to these signals and real time data, we can sound the alarm.

A Survey of Drowsiness Detection System for Drivers

Dr. V.K.Kadam, A.A.Shirsath

Step-by-Step Process

The various steps involved in this process are Image Acquisition, Image Preprocessing, Feature Extraction, Classification, Signal to Controller, Controller Action and Result.

Image Acquisition

- In the image acquisition stage, image is acquired and various methods are applied to the image to perform various tasks.
- Main aim of this process, is to have a source of input that operates within controlled and measured guidelines.

Image Preprocessing

- This is done to increase the reliability of optical inspection, and increase or decrease image details for faster and smoother evaluation process.
- Example of Filters are Normalization, Edge Filters, Focus.

Feature Extraction

- Various features such as Pixel Level Features, Local Features, Global Features, Domain Level Features are extracted from the processed image.
- These can be grouped into high level features and low level features, low level are obtained from image and high level are dependent on low level features.

A Survey of Drowsiness Detection System for Drivers

Dr. V.K.Kadam, A.A.Shirsath

Classification

- Driver Drowsiness Detection System using Image Processing Techniques with Neural Network is implemented.
- It is based on Facial Image Analysis, the real time data is obtained by video camera which is installed on the dashboard in front of the driver.
- A neural network based algorithm is proposed to determine the level of fatigue, by measuring eye opening and closing, and warns the drive accordingly.

Microcontroller

- After the classification, results are sent to hardware. MATLAB sends serial command to hardware, whether the driver is drowsy or not.
- According to the signal sent to hardware, the user is warned by alarm/buzzer.

Result

- Result can also be sent in form of SOS, if the GSM Module is configured in the system.

Drowsiness Detection for Drivers Using Computer Vision

C.Murukesh, Preethi Padmanabhan

- **System Architecture**
  1. Hardware - Intel i3 Processor
  2. Operating System - Linux
  3. Middleware - OpenCV
  4. Application - Drowsiness Detection

- **Process**
  - Camera
  - Frame Acquisition
  - Face Detection
  - Eye Detection
  - Eye Tracking
  - Blink Rate
  - Warning and Display

Drowsiness Detection for Drivers Using Computer Vision

C.Murukesh, Preethi Padmanabhan

- Various smoothening filters like averaging are applied to preprocess the image.
- Face Detection is done using Viola Jones Based Haar Classifiers - multi-level cascade filters are used for face detection i.e 2 or 3 times, input is taken, and even if one of the time, the answer is negative, it discards the image.
- Using the Haar Classifiers, feature points are analyzed and pixel values are determined from the passed image. These pixel values are the locations of eyes.
- Eye Closure Evaluation : When eyes are detected, eyelid states are initialized, eye state is set.
- When Driver is drowsy, amplitude of eyes decreases and the frequency increases significantly. State of the Eyelid is changed
- Whenever drowsiness is detected, the system displays a alert and sounds a alarm.

Driver Fatigue Detection: A Survey + A Survey Paper On Drowsiness Detection & Alarm System for Drivers

R.C. Coetzer, G.P. Hancke + Prakash Choudhary, Rahul Sharma, Gautam Singh, Smarjeet Das

- **Driver fatigue detection technique classified into techniques that monitor the driver directly and techniques that monitor the behavior of the vehicle.**

- **Direct monitoring of Driver**
  - EEG : recording of electrical activity along the scalp as a result of firing neurons within the brain. Done by defining alpha, beta, delta and theta waves which are calculated as mean and std. deviation. Increases in a driver's delta and theta waves and decreasing beta wave activity indicate fatigue using and algorithm and classif fatigue into 4 levels. Quite accurate but intrusiv and uncomfortable.
  - Eyelid Movement : Device called near-IR illuminator is used which consists of ringed LED which define bright and dark pupil ring which o subtracting give a binary image and eyes can be

Driver Fatigue Detection: A Survey + A Survey Paper On Drowsiness Detection & Alarm System for Drivers

R.C. Coetzer, G.P. Hancke + Prakash Choudhary, Rahul Sharma, Gautam Singh, Smarjeet Das

- ## Analysis
  - Eye Gaze Analysis : 3 stage tracking algorithm is used and a 6 parameter mapping function is defined to find relative position between pupil and glint. If narrow; fatigue. Non-intrusive but not very practical as requires motionless head.
  - Face Orientation Analysis : 2D face tracking is used to find distance between eyes to locate face and define initial parameters. 3D facial pose estimation done using Kalman's filter to predict head movement. Calculates number of head tilts; greater the head tilts, more the fatigue.
  - Facial Expression : Gabor's wavelet used to

- ## Driving Perfomance
  - Steering angle analysis
  - Artificial Vision for Lateral Position Analysis : System RALPH- rapidly adapting lateral position handler

- ## Using ANN
  - Detecting and using neurons; visual behaviours monitored related to fatigue and alarming driver. Image captured > Preprocessing Image > Using neurons for detection > Producing result and taking measures

Driver drowsiness detection with eyelid related parameters by Support Vector Machine

Hu Shuyan , Zheng Gangtie

- **Support Vector Machine (SVM) is a machine learning algorithm for data classification and pattern recognition.**

- **Analysis**
  - Karolinska drowsiness score (KDS) is a method to score the drivers' drowsiness level and is developed for the quantification of sleepiness in ''active" situations. It is based mainly on EEG and EOG recordings. Subjective ratings of sleepiness are also obtained using a modified version of Karolinska Sleepiness Scale (KSS) which consists of a nine-point scale.
  - From EOG data, eyelid movement features needed for SVM are extracted. The first stage is to identify eye blinks from EOG data using an algorithm with which the position parameters o the validated blink are acquired.

Driver Drowsiness Detection Using Face Expression Recognition

By Mohammad Amin Assari , Mohammad Rahmati

- **In this system, sequence of images is acquired by the proposed hardware and are injected as input to the system which consists of four steps: face detection, facial component extraction, facial components tracking, and drowsiness detection.**

- **Process**
  - Facial detection : The background subtraction method is used to detect face region in the image which will repeat until the correct detection and reliable face is found in the image.
  - Extraction : Horizontal projection is used to determine eyebrow and eye region and template matching to determine region of mouth. At the end of this phase, a reference template for each of the facial components is extracted.

Driver Drowsiness Detection Using Face Expression Recognition

By Mohammad Amin Assari , Mohammad Rahmati

- **Process**
  - Tracking : The reference template is used for tracking each facial components. The stage output will produce a new region for each facial component.
  - Drowsiness Detection : Eyes, eyebrows and mouth are focused on to detect drowsiness.

- **Conclusion : Hardware is based on infrared light provides benefits such as simplicity of used methods, independent from environment lighting conditions. The results indicate that the system in the presence of glasses or beard and mustache will produce appropriate response, too.**

Efficient Driver Fatigue Detection and Alerting System

Miss. Kanchan Manohar Sontakke

- **Kalman method, it is a linear system estimation algorithm. In fatigue detection eye motion has the highly nonlinear so standard Kalman filter is no longer favorable. To solve these problems ZHANGs used a nonlinear unscented Kalman filter for fatigue detection but it require IR-sensitive camera.**

- **Algorithm for Face Detection**
  - Face detection and tracking are important in many computer vision applications including activity recognition. Face detection done through an image or video. There are various methods for face detection, artificial neural network method, template matching method, Voila and Jones algorithm , AdaBoost face detection algorithm.
  - Image Input : We click images from camera which is situated in front of driver. Then we extract one by one Images. We will compare these images with previous images.

Efficient Driver Fatigue Detection and Alerting System

Miss. Kanchan Manohar Sontakke

- **Algorithm for Face Detection**
  - Surf Feature Detection algorithm : First of all we detect the feature from eyes is useful for finding and tracking of face. It decides whether eyes are closed or opened.
  - After extracting the feature points in image we track the face and eye movements if eyelids are 80% closed then the driver drowsiness detected.

Development of Drowsiness Detection System

Hiroshi Ueno, Masayuki Kaneda,Masataka Tsukino

- Preprocessing: The preprocessing operations include the binarization of a facial image to increase the processing speed and conserve memory capacity, and noise removal.
- Face width detection : The maximum width of the driver's face must be detected in order to determine the lateral positions of the areas in which the eyes are present.
- Detection of vertical eye positions: Each vertical eye position is detected independently within an area demarcated by the center line of the face, which is found from the face width, and straight lines running through the right and left outer edges of the face.
- Eyeball tracking : A function for tracking the positions of the eyeballs is an important capability for achieving high-speed processing because it eliminates the need to process every frame in order to detect each eye position from the entire facial image.

Development of Drowsiness Detection System

Hiroshi Ueno, Masayuki Kaneda,Masataka Tsukino

- **Judgment of whether eyes are open/closed**
  - A window is defined on the basis of the Feret's diameter of the eyes.
- **Method of judging alertness level**
  - As the level of alertness drops, rapid blinking gives way to the appearance of long intervals when the eyes are closed, which provides a basis for detecting drowsiness.

Drowsy Driver Warning System Using Image Processing

Singh Himani Parmar,Mehul Yadav,Priyanka Brijbhan Jajal

- **The proposed method is built in four stages and it is applied to the colored images with any background.**
  - Localization of Face
  - Localization of the Eyes
  - Tracking the eyes in the subsequent frames.
  - Detection of failure in tracking.
- **Location of Eyes: A raster scan algorithm is used for the exact location of the eyes and extracts that vertical location of eyes.**
- **Tracking of the eyes: We track the eye by looking for the darkest pixel in the predicted region. In order to recover from tracking errors, we make sure that none of the geometrical constraints are violated.**
- **Detection of Drowsiness: As the driver becomes more fatigued, we expect the eye-blinks to last longer. We count the number of consecutive frames that the eyes are closed in order to decide the condition of the driver.**

Real Time Driver's Drowsiness Detection System based on Eye Conditions

Asad Ullah, Sameed Ahmed, Lubna Siddiqui, Naibha Faisal

- **Each face detected is stored for half a second to crop the image in order to detect the eye. Our proposed algorithm CropEye is used for eye detection. CropEye algorithm divides the face horizontally into two segments i.e. upper segment and a lower segment.**

- **The eyes extracted are now categorized in two parts through vertical calibration -the left eye and the right eye.**

- **Check whether eye is open or closed**
  - A graph is plotted which calculates the intensity distance in the eye separately through the eye lashes and eye brow and check the state of an eye on this intensity distance. If distance is large, eye is close and when distance is less, eye is open.

Real Time Driver's Drowsiness Detection System based on Eye Conditions

Asad Ullah, Sameed Ahmed, Lubna Siddiqui, Naibha Faisal

- **Need of algorithm**
  - Sometimes the eyes were not detected individually, at times any black spot in an image was identified as eyes. Thus it was concluded that even while being one of the most frequently used algorithm for face detection, these algorithms were not able to gather the results we wanted for our calculations.

Thank You!