Micro sleep Detection Technique

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Abstract- **In recent years, driver drowsiness has been one of the major causes of road accidents and can lead to severe physical injuries and deaths. On-road driver's fatigue and drowsiness are contributing more than 30% of reported road accidents [1]. Statistics indicate the need for a reliable driver drowsiness detection system which could alert the driver before a mishap happens. Driver drowsiness can be estimated by monitoring vehicle-based measures, behavioral measures and physiological measures. The physiological measure includes eye-blinks, yawning, nodding of heads. The Blink and micro-sleep detection mechanisms are implemented by monitoring EAR. EAR is calculated by calculating Euclidean distance between measured eye coordinates. Blinks and drowsiness levels are displayed on the monitor screen with a micro-sleep detection audio warning.**

Index terms- **EAR, micro-sleep, Drowsiness**

I. INTRODUCTION

A. MICRO-SLEEP

A micro-sleep may be a temporary episode of sleep or sleepiness which can last for a fraction of a second or up to thirty seconds wherever a private fails to retort to some impulsive sensory input and becomes unconscious. Often, folks that expertise micro-sleep don't even notice that it's happening. Not obtaining enough sleep, that for many adults means that between seven and 9 hours an evening, will cause sleep deprivation and therefore the expertise of micro-sleep.

The brain can lose in a struggle between sleep and wakefulness. Within the battle to remain awake, typically your brain loses. A study revealed within the journal Neuroimage [2] investigated micro-sleep by keeping a gaggle of volunteers awake for twenty-two hours. The volunteers were then placed in a very dark functional magnetic resonance imaging machine and asked to not nod off. The brain scanner detected once they nodded off sporadically, and checked out what was happening in their brains. Throughout these bursts of micro-sleep, there was reduced activity within the neural structure, an area of the brain concerned in regulation sleep. Interestingly, there as conjointly exaggerated activity in brain regions chargeable for sensory process and taking note -- functions that area unit, of course, essential to wakefulness. this means that elements of the brain area unit in "waking" mode whereas alternative areas briefly succumb to the urge to sleep.

B. MICRO-SLEEP AND DRIVING ACCIDENTS

Micro-sleep may be a scarily common divisor in drowsy driving accidents. Maybe the foremost distressful facet of micro-sleep episodes is that they are common at the wheel, and that they will result in accidents. in keeping with the U.K. road safety charity Brake[3], forty five of men and twenty two of girls surveyed admitted to micro-sleeping whereas driving.

Shift workers driving home after night shifts are at a high risk for crashes caused by micro-sleep. A small study published in December [4]found that night shift workers are significantly more likely to have a crash when they're coming off a shift as compared to when they're fully rested, largely due to micro-sleep.

An alarming study conducted in 2012 [5] found that many of these accidents could have been prevented if drivers got off the road at the early signs of drowsiness. The findings showed that many people continue driving drowsily even after they experience micro-sleep episodes.

II. RELATED WORKS

There area unit presently some ways to find micro-sleeps; but, there's a scarcity of accord on the most effective thanks to determine and classify micro-sleeps. the only ways to find these events appear to be through psychological tests, speech tests, and behavioural tests (e.g. yawn check and eye-video test). a lot of advanced and pricy ways in which to

find micro-sleeps embrace graphical record, fMRI, EOG, and PSG tied to numerous computer code platforms. Once multiple tests area unit employed in parallel, the detection of micro-sleeps presumably can become a lot of correct.

A. Polysomnography (PSG)

Polysomnography (PSG), a sort of sleep study is a multi-parametric test employed in the study of sleep and as a diagnostic tool in sleep drugs. The take a look at result's referred to as a polysomnogram, conjointly abbreviated PSG. TypeI polysomnography, a sleep study performed nightlong whereas being unendingly monitored by a documented engineer, could be a comprehensive recording of the biophysiological changes that occur throughout sleep. it's typically performed at nighttime, once the majority sleep, although some labs will accommodate shift employees different people|and folks} with circadian rhythm sleep disorders and do the take a look at at other times of the day. The PSG monitors several body functions, including brain activity (EEG), eye movements (EOG), muscle activity or skeletal muscle activation (EMG), and heart rhythm (ECG), throughout sleep. A polysomnogram can generally record a minimum of twelve channels requiring a minimum of twenty-two wire attachments to the patient. These channels vary in each workplace and should be tailored to satisfy the doctor's requests. there's a minimum of 3 channels for the graph, one or 2 live flow of air, one or 2 ar for chin tonicity, one or additional for leg movements, 2 for eye movements (EOG), one or 2 for vital sign and rhythm, one for gas saturation, and one every for the belts, that live chest wall movement and higher wall movement.

B. Electroencephalography (EEG)

EEG is one in all the most diagnostic tests for brain disorder. Graphical record records the brain's spontaneous electrical activity over a brief amount of your time, sometimes 20–40 minutes [6]. it's a check that detects electrical activity within the brain exploitation tiny, metal discs (electrodes) connected to your scalp. Routinely, graphical record is employed in clinical circumstances to work out changes in brain activity that may be helpful in diagnosis brain disorders, particularly brain disorder or another seizure disorder. Associate in Nursing

graphical record may additionally be useful for diagnosis or treating the subsequent disorders:

- Brain tumor
- Brain damage from head injury
- Brain dysfunction that can have a variety of causes (encephalopathy)
- Inflammation of the brain (encephalitis)
- Stroke
- Sleep disorders

Micro-sleeps have EEG shift to slower frequencies (from alpha to theta waves).The electroencephalogram (EEG) is a recording of the electrical activity of the brain from the scalp. The recorded waveforms reflect the cortical electrical activity.

Signal intensity: EEG activity is quite small, measured in microvolts (mV).
Signal frequency: the main frequencies of the human EEG waves are:

Delta: encompasses a frequency of three cycles/second or below. It tends to be the very best in amplitude and also the slowest waves. it's traditional because the dominant rhythm in infants up to 1 year and bit by bit three and four of sleep. it's going to occur focally with neural structure lesions and generally distribution with diffuse lesions, metabolic brain disease abnormalcy or deep sheet lesions. it's sometimes most outstanding frontally in adults (e.g. FIRDA - Frontal Intermittent chantlike Delta) and posteriorly in kids e.g. OIRDA - os Intermittent chantlike Delta).

Theta: features a frequency of three.5 to 7.5 cycle and is classed as "slow" activity. it's dead traditional in youngsters up to thirteen years and in sleep however abnormal in awake adults. It may be seen as a manifestation of focal neural structure lesions; it also can be seen within the generalized distribution in diffuse disorders like metabolic neurological disease or some instances of abnormal condition.

Alpha: encompasses a frequency between seven.and thirteen Hertz. it's sometimes best seen within the posterior regions of the top on either side, being higher in amplitude on the dominant aspect. It seems

once closing the eyes and restful, and disappears once gap the eyes or alerting by any mechanism (thinking, calculating). it's the foremost rhythm seen in traditional relaxed adults. it's gift throughout most of life, particularly when the thirteenth year.

Beta: Beta activity could be a "fast" activity. it's a frequency of fourteen and larger Hz. it's typically seen on each side in symmetrical distribution and is most evident frontally. it's accentuated by sedative-hypnotic drug medicine particularly the benzodiazepines and also the barbiturates. it should be absent or reduced in areas of plant tissue injury. it's typically thought to be a traditional rhythm. it's the dominant rhythm in patients World Health Organization square measure alert or anxious or have their eyes open.

C. Functional magnetic resonance imaging (fMRI)
A purposeful neuroimaging procedure imaging technology that measures brain activity by detection associated changes in blood flow (detects what regions of brain square measure active throughout micro-sleep events) [8].
This technique depends on the actual fact that cerebral blood flow and somatic cell activation square measure coupled. once a neighborhood of the brain is in use, blood flow to it region additionally will increase. the first kind of functional magnetic resonance imaging uses the blood-oxygen-level-dependent (BOLD) distinction,[9] discovered by Seiji Ogawa in 1990. this can be a kind of specialised brain and body scan wont to map neural activity in the brain or spinal cord of humans or different animals by imaging the amendment in blood flow (hemodynamic response) associated with energy use by brain cells.
In fMRI, the most aim is to search out that a part of the brain are in sleep throughout micro-sleep. Hence, the brain and its blood flow are consciously monitored throughout micro-sleep. throughout micro-sleep the expected behavior is that a neighborhood of the brain won't receive a lot of blood than atomic number 8 like different components.

D. Mouth yawning test
Yawning detection check is performed in 2 main steps: within the opening move, we tend to observe the yawn part within the face freelance of the mouth location. This part is largely gap|the outlet} within the mouth because the results of wide mouth opening. Within the second step, the mouth location has verified the validity of the detected part [11]. Once skin segmentation, the most important hole placed within the face is chosen because the candidate for a yawning mouth. This hole is really associated with a non-skin space within the face that may be associated with eyes, mouth or open mouth. It is assumed that the open mouth are the most important of the 3 in a very yawning state. during this means a candidate for yawning mouth is found. we'll then use the data from the detected mouth to verify the detected yawning mouth. The versification criteria area unit the amount of pixels placed within the yawning mouth with relation to the amount of mouth pixels additionally because the relative location of the open mouth with relation to the lips.

III SYSTEM DESIGN

A. Objective of research
Driver in-alertness is important resulting in sleep deprivation or sleep disorders and is an important factor in the increasing number of accidents on today's roads.
The main objective of this research is to minimize the road accident that occurs due to micro-sleep.
The micro-sleep detection technique should be a fast and precise one to detect the micro-sleep faster and it should alert the person/ driver as soon microsleep has been detected.

B. Problem definition
Designing a system to sight a micro-sleep and awaking the person/ driver could be a difficult task. The system ought to sight the micro-sleep of a person/ driver in period eventualities, here the system ought to be an ideal one to sight the micro-sleep. However, detection a micro-sleep could facilitate to avoid wasting a person's life from accident or death.
Here during this paper, the detection of micro-sleep is finished by detection the attention blinks, the projected rule is predicated on live watching of EAR (Eye side Ratio) by application of Image process. HD live video is rotten in continues frames and facial-landmarks are detected victimization pre-trained Neural Network-based Dlib functions.

EAR is calculated by shrewd geometer distance between measured eye coordinates. Blink and micro-sleep detection mechanisms enforced by watching EAR against a threshold worth. Blinks associate somnolence levels detected with an audio warning.

C.   Disadvantages
• The micro-sleep detection using eyeblinks is not accurate in night or in dim light.
• The detection is not possible when a driver or a person wearing sunglasses or spectacles. The sunglasses or coolers act as a obstacle to detect the micro-sleep.
• If the person's eye lids distance is too close then the system may calculate the coordinates in a wrong way.

D.Stages involved in micro-sleep detection
The micro-sleep detection technique has its own design stages. The stages have their own significant process. The steps are,
1.   Detection stage
2.   Tracking stage
3.   Warning stage
4.   Alerting stage

E.   Detection stage
The detection consists of various process in it. The processes that involved are,
1.   Camera initialization
2.   Video to frame conversion
3.   Pixmap conversion
4.   Dlib predictor file loading
5.   Processing of images for facial landmark detection
In the detection stage, the monitoring set up will be done and the necessary library will be installed. Through the video, the frame will be set and those frame will be taken to the processing through dlib and then facial landmark will be detected.

1. Camera initialization
In-camera initialization, do use the system's web camera. The first stage of the project the usage of the system's web camera will be easy for testing and also for any alteration purposes. Use python code for integrating the system's web camera with my project.

2. Video to frame conversion

Integrating the system's camera with my project, the next stage is that have to make frame conversion. In frame conversion, the face of the person/ driver will be detected using the frame. The frame is the set of pixels that are captured inside the video.
The frame conversion has been done using the OpenCV. OpenCV comes with many powerful video editing functions. Take a video as input and break the video into the frame by frame and save those frames. Now, a number of operations can be performed on these frames. Like reversing the video file or crop the video etc. For playing video in reverse mode, need only to store the frames in a list and iterate reverse in the list of frames. Use the reverse method of the list for reversing the order of frames in the list.

3.Pixmap conversion
QImage is designed and optimized for I/O, and for direct pel access and manipulation, while QPixmap is designed and optimized for showing pictures on the screen. QBitmap is solely a convenience category that inherits QPixmap, guaranteeing a depth of one. The isQBitmap() operate returns true if a QPixmap object is de facto a ikon, otherwise returns false. Finally, the QPicture class may be a paint device that records and replays QPainter commands.
QPixmap provides many ways in which of reading a picture file: The file will be loaded once constructing the QPixmap object, or by exploitation the load() or loadFromData() functions presently. once loading a picture, the file name will either check with associate degree actual file on disk or to at least one of the application's embedded resources. See The Qt Resource System overview for details on a way to infix pictures and different resource files with the application's possible. merely decision the save() operate to avoid wasting a QPixmap object.

4. Dlib predictor file loading
Facial landmarks area unit accustomed localize and represent salient regions of the face, such as:
a.   Eyes
b.   Eyebrows
c.   Nose
d.   Mouth
e.   Jawline
Facial landmarks are with success applied to face alignment, head create estimation, face swapping, blink detection and far additional. police

investigation facial landmarks is a subset of the shape prediction problem.

Detecting facial landmarks is thus a 2 step process:

Step #1: Localize the face within the image.

Step #2: Detect the key facial structures on the face ROI.

Face detection (Step #1) is achieved in an exceedingly range of how. OpenCV's inbuilt Haar cascades. Step #2: police investigation key facial structures within the face region. There area unit a spread of facial landmark-detectors, however all strategies basically attempt to localize and label the subsequent facial regions. The facial landmark detector enclosed within the dlib library is AN implementation of the one unit of time Face Alignment with AN Ensemble of Regression Trees paper by Kazemi and Sullivan (2014). the tip result's a facial landmark detector which will be used to detect facial landmarks in real-time with high quality predictions. The pre-trained facial landmark detector within the dlib library is employed to estimate the situation of 68 (x, y)-coordinates that map to facial structures on the face.
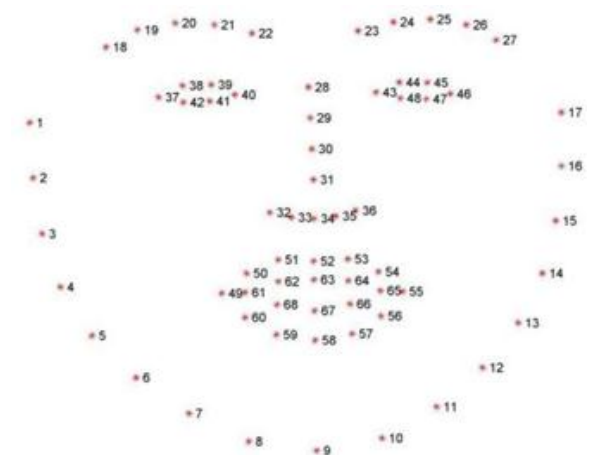

Figure 3.2 The indexes of the 68 coordinates can be visualized on the image

5. Processing of images for facial landmark detection
Face landmark detection is that the method of finding points of interest in a picture of a personality's face. it's recently seen ascent within the laptop vision community as a result of it's several compelling applications. As an example, the power to notice feeling through facial gestures, estimating gaze direction, dynamic facial look (face swap), augmenting faces with graphics of virtual characters. To attain this, the landmark detector should realize dozens of points on the face, like corners of the mouth, corners of eyes, the silhouette of the jaws, and lots of additional. several algorithms were developed and enforced in OpenCV. To run the face mark detector, a pre-trained model is needed. though coaching the detector model is actually doable with the arthropod genus provided in OpenCV, some pre-trained models square measure offered for transfer. One such model is obtained and provided by the contributor of the algorithmic program implementation to OpenCV.

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F. Tracking stage
In the trailing stage concerned in trailing the video and also the facial landmarks. The eye blinks area unit presently monitored. the space between eyelids is monitored victimization the attention ratio.

$$EAR \ (Eye \ facet \ Ratio) = \frac{|p2 - p6| + |p3 - p5|}{a \ pair \ of \ |p1 - p4|}$$

Where p1, …, p6 area unit 2nd facial landmark locations. The dividend of this equation computes the space between the vertical eye landmarks whereas the divisor computes the space between horizontal eye landmarks, weight the divisor fittingly since there's just one set of horizontal points however 2 sets of vertical points. the attention ratio is around constant whereas the attention is open, however can apace fall to zero once a blink is going down. once the person/ driver blinks the attention ratio decreases dramatically, approaching zero. the attention ratio is

constant, then apace drops near to zero, then will increase once more, indicating one blink has taken place.

The EAR varies whereas blinking it ranges from one to zero. The frequent drop of the EAR implies that the person/ driver is asleep. This must be caterpillar-tracked and also the person must be alerted.

G Warning Stage

The warning stage is the next stage of the tracking stage. Once there is the frequent drop of the EAR the person/ driver has to be altered, this was been done during the warning stage. The blink detection and the count of the blinks are the input of this stage.

The blinks are been tracked using a graph. When there is a blink then the peak is downwards and there are continuous peaks which don't goes up and it ranges downwards. The duration of the continuous peak downwards ranges more than the normal peaks. In this stage, observe that the person is in micro-sleep/sleep. The warning has to be made to the person/ driver in this downwards peak. This is the most significant phase of sending input to the alert stage. The input will be the eye has been blinking than the usual or the eye has been closed for a longer time.

H Alert stage

The alert stage is the next stage of the warning stage when the warning stage attains the micro-sleep stage then the person/ drivers have to be alerted. The alert has been done using audio. The input for this phase will be coming from the warning stage. The input will be the frequent blinks than the usual or the eye has been closed for a longer time. The eye has been closed for a long time indicates that the person/ driver is in the sleep state and the frequent blinks refer that the person/ driver is in the micro-sleep state. The audio may help the person to wake up from his microsleep. The initial phase has the audio the next process of alerting will be done using a vibrator. The audio may act as an alarm for the person in micro-sleep. The audio as alarm should make the person in sleep to get scared of , it the audio makes them to scare then it may lead to the accident. Hence, the alarm should be in the way it should wake up the person and not to scare them To play the sound there is a library called play sound, which will be used for playing sound as an alarm.
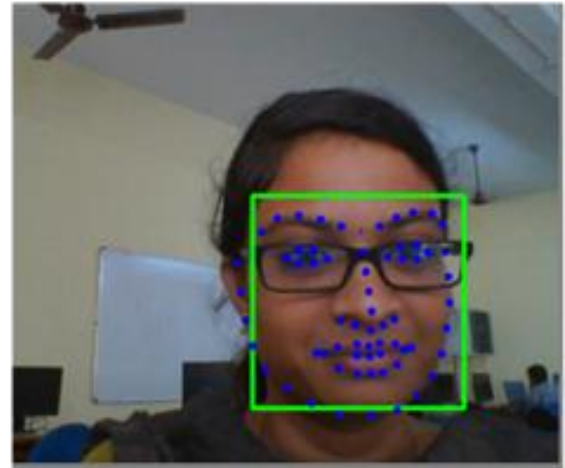
IV RESULT

Figure: 4.1 The facial coordinates plots.

Finally, as a result, the facial frame had been located and the facial coordinates also plotted.

After, plotting EAR will be calculated. If there are any frequent blinking of the eye then the alarm goes on.

V CONCLUSION

This project is constructed to discover the micro-sleep with innate reflex as its major focus victimization OpenCV, Python, and Dlib opensource Libraries by activity EAR. The primary step in building a blink detector is to perform facial landmark detection to localize the eyes in an exceedingly given frame from a video stream. Once the attention ratio calculated, the rule will threshold it to see if a person/ driver is blinking the attention ratio can stay just about constant once the eyes area unit open so can chop-chop approach zero throughout a blink, then increase once more because the eye opens. The length of the blink any provides associate estimation of micro-sleep. to form our blink detector additional sturdy to those challenges any following enhancements are often enforced by the mix of the temporal-based feature vector and SVM classifier helps scale back false-positive blink detections and improves the general accuracy of the blink detector.

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