UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Driver Drowsiness Detection

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PROJECT PROPOSAL SUBMITTED TO THE DEPARTMENT OF ICT INPARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A DIPLOMA IN COMPUTER SCIENCE

i. Declaration

We, Group 40, hereby declare that this proposal report titled "Driver Drowsiness Detection” is our original work and has never been submitted for any course at any other institution. The content in this report is based on our research and analysis conducted as Group 40.

ii. Approval

This is to certify that this proposal report titled "Driver Drowsiness Detection" has been done by group members in the names of GROUP 40 and has been examined and approved for submission.

Supervisor's Name and Signature:
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iii. List of acronyms

ACRONYM	MEANING
CNN	Convolutional Neural Network
EAR	Eye Aspect Ratio
DMS	Driver Monitoring System
ADAS	Advanced Driver Assistance System

Contents

1. CHAPTER ONE: INTRODUCTION

1.1 Introduction

The state of the driver of being extremely tired or sleepy through the operation of the vehicle is called driver drowsiness. Different factors caused this state such as alcohol, lack of sleep, and the side effect of some medication. The drowsiness of drivers is a serious safety lead to accidents or fatalities on external and internal roads. The increased number of road accidents resulted from drowsy driving. A special smart, reliable, and accurate system, Using Python language 3.6 for Windows, will be designed to build an alert system for drivers in detecting drowsiness driver.

1.2 Background

Drowsy driving is a significant contributor to road accidents globally. Fatigue, alcohol, and drug use impair a driver's ability to remain alert, react quickly, and make sound judgments, leading to catastrophic outcomes. The World Health Organization (WHO) identifies fatigue as one of the major risk factors in traffic accidents, particularly on highways.

Existing solutions, such as monitoring vehicle behavior or intrusive physiological monitoring systems, are often expensive, inefficient, or limited in real-time applications. With advancements in computer vision and machine learning, non-intrusive systems using video-based monitoring have shown promise for detecting drowsy behavior.

This study proposes developing a driver drowsiness detection system that employs the Viola-Jones algorithm for face and eye detection and a Support Vector Machine (SVM) classifier to differentiate between drowsy and non-drowsy states. By integrating this system into a mobile application or laptop interface, it will provide real-time monitoring and alert mechanisms, reducing the likelihood of fatigue-related accidents.

1.3 Statement of the Problem

Driver fatigue and drowsiness significantly contribute to road accidents, resulting in injuries, loss of lives, and economic costs. Existing detection systems are often costly, computationally intensive, or ineffective under varying environmental conditions, such as lighting and head orientation. Additionally, many of these systems are theoretical or survey-based, lacking practical real-world applications.

There is a pressing need for an affordable, efficient, and scalable drowsiness detection system that operates in real-time, identifies signs of fatigue accurately, and promptly alerts drivers to prevent accidents.

1.3 General Objective

To develop a real-time driver drowsiness detection system using the Viola-Jones algorithm and an alert mechanism to enhance road safety and reduce fatigue-related accidents.

1.3.1 Specific Objectives

- To detect driver drowsiness using the Viola-Jones algorithm for face and eye detection.
- To classify drowsy and non-drowsy states using a Support Vector Machine (SVM) classifier.
- To design a system capable of generating real-time alerts when drowsy behavior is detected.
- To evaluate the system under diverse environmental conditions, including lighting and head orientations.

1.4 Scope of the study

1.4.1 Geographical Scope

The system will initially be tested in a controlled environment simulating real-world driving conditions and later evaluated in moving vehicles under diverse conditions.

1.4.2 Timeframe

The development of the system will span four months, encompassing data collection, system design, algorithm development, testing, and refinement.

1.4.3 Technological Scope

The proposed system will utilize:

- **Viola-Jones Algorithm**: For face and eye detection.
- **Support Vector Machine (SVM)**: For classifying drowsy and non-drowsy states.
- **Mobile and Laptop Integration**: To ensure portability and ease of deployment in vehicles.
- **Alert Mechanism**: An audible alarm system to notify drivers of detected drowsiness.

1.5 Significance

- **For Road Safety**:
  This system will reduce the risk of fatigue-related accidents, contributing to safer roads and fewer fatalities.
- **For Drivers**:
  Drivers will benefit from a real-time, non-intrusive monitoring tool, promoting alertness and preventing accidents.
- **For Technology Advancement**:
  This project will showcase the practical application of machine learning and computer vision, paving the way for further research and innovation in driver assistance systems.

1.6 Justification.

The proposed system addresses a critical gap in road safety by offering an affordable and practical solution to detect driver drowsiness in real-time. Its use of efficient algorithms like Viola-Jones and SVM ensures the system is lightweight and deployable in resource-constrained environments, such as vehicles without advanced in-car technologies.

Furthermore, the system aligns with global efforts to reduce traffic fatalities and injuries, contributing to the United Nations' Sustainable Development Goal 3.6, which targets halving the number of global deaths and injuries from road traffic accidents.

2. CHAPTER TWO: LITERATURE REVIEW

2.1 introduction

The research on driver drowsiness contributed significantly to improving the safety of external and internal roads to increase safety and reduce or prevent all drowsy driving risks. These researchers try to identify the warning signs that cause driver drowsiness. This information is used in developing a different technology for detecting and preventing driver drowsiness such as physiological sensors, steering behavior analysis, and eye-tracking systems. Such technologies alert the drowsy driver through becoming incapacitated, to take control vehicle. The benefit of this is to reduce accidents number and save people's lives. With the increasing of road accidents number caused by drowsy driving has become a driver drowsiness detection system very important field in transportation safety. Through the availability of digital cameras, it has been increasing the amount of archived recorded videos around the world and it became an effectively growing processing of these video data.

2.2 Related works

Different studies have been conducted to develop and evaluate several techniques in detecting driver drowsiness. The most popular technique is using electromyogram (EMG), electroencephalogram (EEG), and electrocardiogram (ECG) signals in monitoring the driver's muscle activity, brainwaves, and heart rate respectively. Dong and colleagues (2015) introduced a study that used EEG signals in detecting driver [2] drossiness, with an accuracy of 94%.

Lee and colleagues (2017) introduce a study that used a combination of ECG, EEG signals in detecting driver drowsiness, with an accuracy of 98%. Chakraborty (2019) used the data of eye tracking in the detection of driver's drowsiness with an accuracy of 85%.

Wu and colleagues (2021) applied facial expression analysis in the detection of driver's drowsiness with an accuracy of 87%. Different machine language algorithms have been used in the detection of driver's drowsiness by using data pattern recognition and deciding the accurate predictions. Malik (2019) applied a support vector machine (SVM) classifier in the detection of driver's drowsiness with an accuracy of 92%.

Vishwakarma used a process called object tracking of the saved video in his survey [5]. M. Zhang [6] used extensive hardware sensors in detecting. But C. Anil used the generalizability of models in enhancing the detection of drowsy by increasing the dataset size [7]. M. Jafari introduced a new technology for enhancing the accuracy of system detection [8]. M. Aljasim suggested an expensive experiment detection method [9]. A. M. Leeuwenberg used more complex algorithms that used more variables and increased the tested samples [10].

The accuracy of the previous works is low in more time and most of these papers are surveys, that why it prepared a real-world practical system to protect people from the high numbers of accents. The real-world, low-cost cost with larger data sets proposed system is reliable and robust and is used in different scenarios like Viola-Jones algorithm, face eye region detecting and extracting from the smart camera's images. After evaluation of the proposed system, it will be expected to have a high accuracy. This system is more practical and it is easy to use in manufacturing different vehicles.

2.3 Comparative Evaluation

System	Accuracy	Cost	Real-time Suitability
CNN-based	High	High	Medium
EAR-based	Medium	Medium	Medium
Viola-Jones	Medium	Low	High

Table 2 shows comparisons among existing systems

The proposed system will leverage the Viola-Jones algorithm to achieve a balance between accuracy, cost, and real-time performance.

3. CHAPTER THREE: METHODOLOGY

3.1 Overview

The proposed system will be developed in multiple steps, as illustrated in Figure 1 (to be included).

1. **Input Data**: The system will utilize input videos and images as a dataset to analyze the driver's physiological signals, such as eye movement and facial expressions. These inputs will form the basis for identifying signs of driver drowsiness.
2. **Face Detection and Eye Region Extraction**: The system will preprocess the input data to identify and extract relevant features, such as eye blinking, which will serve as critical indicators of drowsiness. The Viola-Jones algorithm will be employed to detect objects in the videos or images, focusing specifically on facial features like the eyes. This step will be crucial for ensuring the accuracy and reliability of the detection process.
3. **Classification**: The extracted features will be passed to a Support Vector Machine (SVM) classifier. This supervised learning algorithm will be designed to distinguish between drowsy and non-drowsy drivers. The SVM classifier will analyze patterns in the input features to make accurate classifications.
4. **Alert Mechanism**: When the system detects drowsiness, it will activate an audible alarm to notify the driver. This notification will serve as a preventive measure, prompting the driver to stop driving and thus reducing the risk of accidents.

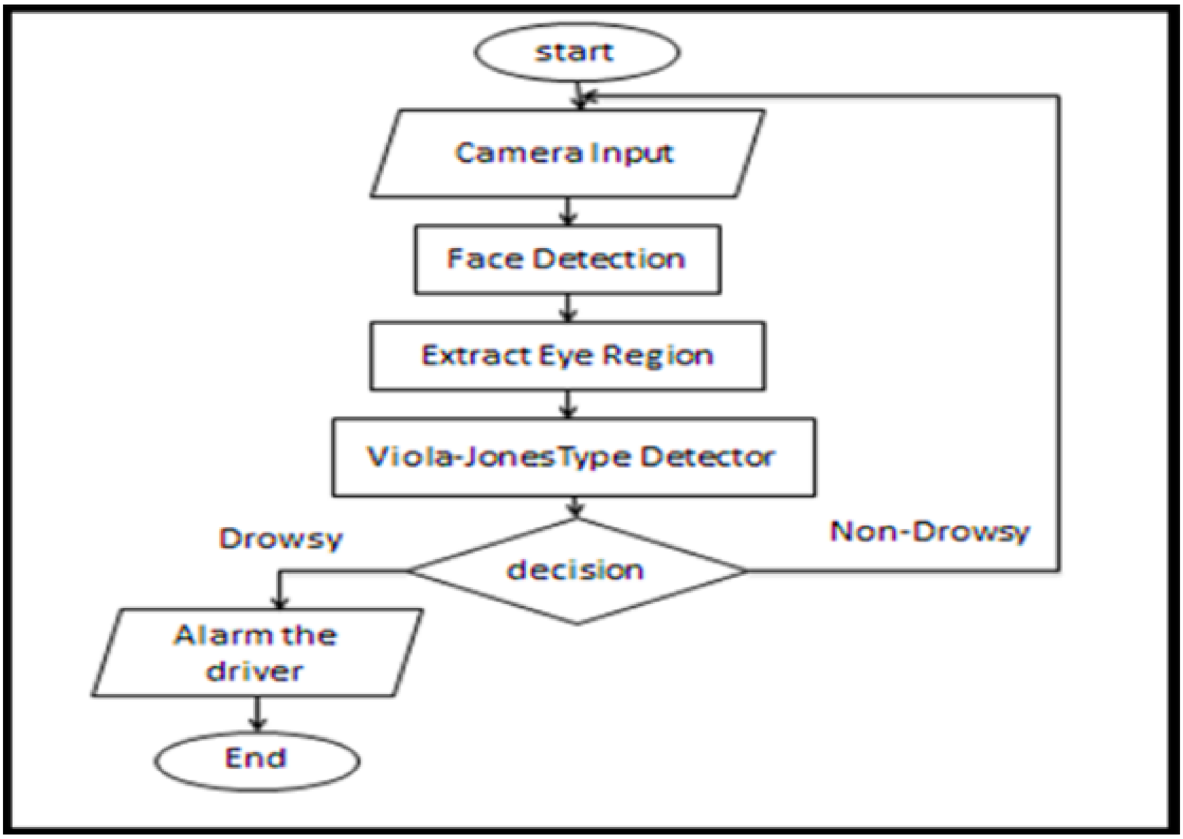

Figure 1 shows flow diagram for the system

3.2 Dataset and Preprocessing.

3.2.1 Dataset selection

The proposed system will rely on publicly available datasets, such as the **Closed Eyes in the Wild** and similar datasets from platforms like Kaggle. These datasets contain labeled images and videos capturing diverse facial expressions, eye states (open, closed), and other physiological signals relevant for detecting drowsiness. Key considerations for selecting the dataset include:

- **Variety**: Inclusion of images and videos representing various genders, ages, lighting conditions, and facial orientations to enhance the system's robustness.
- **Relevance**: Clear labels for eye states (open, closed) and other drowsiness indicators such as yawning.
- **Volume**: Sufficient data volume to train and test the system effectively while ensuring generalizability.

3.2.2 Data preprocessing

To ensure optimal performance, the selected dataset will undergo preprocessing, which includes:

1. **Grayscale Conversion**: All images and video frames will be converted to grayscale to reduce computational complexity and enhance processing speed.
2. **Resizing**: Images and frames will be resized to a uniform resolution to ensure compatibility with the Viola-Jones algorithm and the SVM classifier.
3. **Noise Reduction**: Techniques such as Gaussian blurring will be applied to reduce noise in the images, ensuring that only relevant features are processed.
4. **Data Augmentation**: To increase the dataset's diversity and robustness, data augmentation techniques such as rotation, flipping, and brightness adjustments will be applied. This will help simulate various real-world conditions like different lighting and head orientations.
5. **Feature Extraction**: Relevant features, including eye regions and facial landmarks, will be extracted to prepare the data for classification. The Viola-Jones algorithm will be used to detect and isolate these features effectively.
6. **Dataset Splitting**: The pre-processed dataset will be split into training, validation, and testing subsets (e.g., 70%, 20%, 10%, respectively) to evaluate the system's performance accurately.

This selection and preprocessing pipeline will ensure the dataset is optimized for training the SVM classifier and validating the overall system's performance. The focus will remain on achieving high accuracy in detecting drowsy drivers under various conditions.

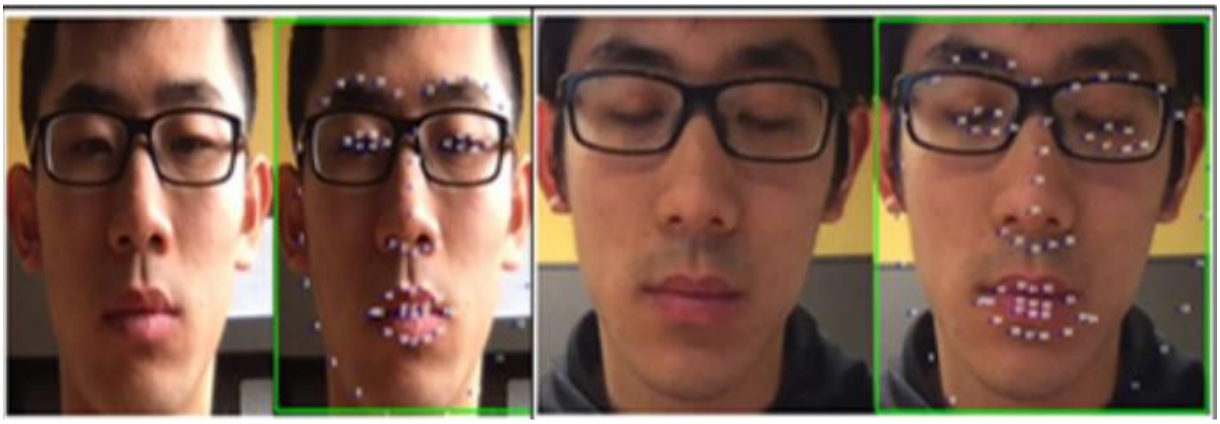

Figure 2 shows feature extraction of some images

3.3 System Development

3.3.1 Face and Eye Detection

Viola-Jones algorithm. This is the most algorithms popular today in object detection for digital videos and images. This algorithm applies a series of image classifications [14], [15]. At first, this algorithm will convert each image into (" Haar-like features) a series of rectangular sub-images. This algorithm used Haar-like features; Figure 2.0 represents these features. These sub-images a binary image that have different highlights in brightness between adjacent pixels. This algorithm is used to determine and detect the features of the object. Like detection of eyes in the face image, which is very high real-time framework training.

There are three ideas that used in this algorithm for face detection:

1. Integral Image: This idea represents an image where each pixel value represents the sum of all the above pixels and the left of it. This idea is very useful for quickly computing all sum values of pixels in any rectangle region of the image.

2. The classifier AdaBoost: This is an algorithm used in classification tasks. It is work combining different weak classifiers to form a strong one. It has multiple iterations; each one assigns higher weights to misclassified samples and trains a new one to get the final classifier from the weighted sum of all weak classifiers.

3. Attentional cascade structure: This is an algorithm in computer vision used for object detection. The idea of this algorithm is to break down the problem of object detection to a sequence of smaller sub-problems that are solved by a special detector. Each detector is applied to a small region of an image to form a successful detector in object detection.

The Viola-Jones used features of rectangles instead of pixels in face detection. Generally, the details of the eyes and face are detected by this algorithm automatically. The eye motion is estimated by the differences in optical flow intensity frame after frame, to decide if the eyes are covered or not by eyelids. This algorithm is used in a wide range of applications because of the speed and accuracy in detecting objects, especially faces.

3.3.2 Feature Classification:

Extracted features (eye closure, yawning) will be passed to an SVM classifier.

Support Vector Machine Algorithm. Support Vector Machines (SVM) is a supervised machine learning algorithm that is used in classification of Driver Drowsiness Detection to identify drowsy or non-drowsy drivers depending on all based features. After this classification, a sound will generate to alarm and prevent the driver from accidents caused by drowsy driving. SVM is used in regression analysis. In the context of the proposed system, the SVM will be trained on different of dataset-labelled examples. Each example has a set of extracted features from a driver's face. The most important features are head pose, eye closure duration, and all other factors of drowsiness indication. The goal of SVM is creating the best boundary line for segregating the space of n-dimensional into classes. To easily put the new data in the correct group. The hyperplane of the SVM algorithm called for the best decision boundary created by choosing the maximum points or vectors. These points are called support vectors. Figure 3 shows two different groups that are classified by using a hyperplane. The model of drowsy or non-drowsy drivers is created using the SVM algorithm by training this model using a lot of images of the driver with drowsy and non-drowsy by learning different features of them. So the SVM algorithm will create a boundary between these features (support vectors) to simplify the decision of classification between drowsy and non-drowsy.

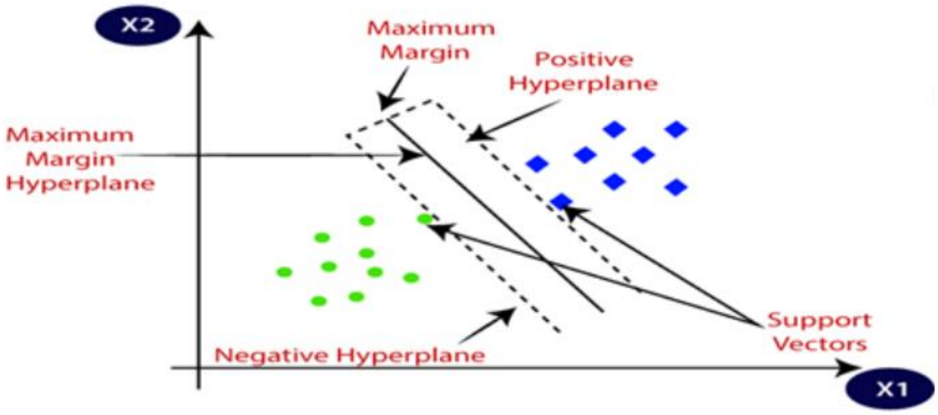

Figure 3 shows hyperplane for SVM classifier

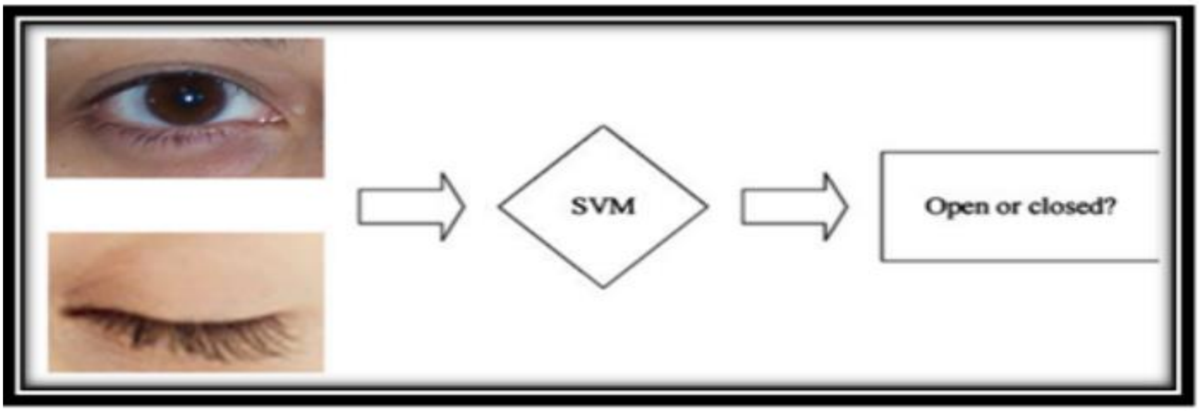

Figure 4 shows image fed to the classifier

3.4 Real-Time Alert Mechanism:

- An alarm system will be integrated to trigger an audible notification if drowsiness is detected.
- Customizable thresholds for eye closure duration and yawning frequency will be implemented to adapt to individual driver behavior.

3.5 Integration into Application

Platform Selection:

- The trained model will be integrated into a **mobile application** or **laptop camera-based system**, making it portable and easy to deploy in vehicles.
- **Mobile Application**: Suitable for smartphones mounted in vehicles, using their built-in cameras.
- **Laptop Camera**: Ideal for vehicles equipped with laptops or tablets for operational use.

The application will process live video streams from the camera, detecting drowsiness in real time.

4. CONCLUSION

This proposal outlines the development of a new tool designed as a preventive strategy for vehicle drivers to mitigate risks associated with alcohol consumption, drug use, and lack of sleep. The system aims to enhance road safety by building a monitoring system capable of detecting drowsiness. It will differentiate between drowsy and non-drowsy states and generate an alarm sound when prolonged eye closure is detected.

The system will utilize a combination of advanced algorithms and materials to achieve accurate and reliable drowsiness detection. The Viola-Jones detection algorithm will be employed to detect the driver’s face and eye regions, forming the foundation for feature extraction. Additionally, a Support Vector Machine (SVM) classifier will be used for classifying drivers into drowsy or non-drowsy categories based on extracted features, providing a supervised learning approach for accurate classification.

Previous works in this domain often suffered from low accuracy and prolonged response times, many of which were theoretical or survey-based studies. This proposal seeks to address these gaps by implementing a practical, real-world solution aimed at reducing the alarming number of road accidents caused by drowsy driving.

The proposed system will integrate an alert mechanism that activates when signs of fatigue or drowsiness are detected. High-quality 16-megapixel smart cameras will be utilized to capture videos and images, ensuring the clarity and precision required to monitor driver behavior effectively. By leveraging these technologies, the system aims to safeguard drivers and passengers, contributing to significant advancements in road safety.

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6. APPENDICES

Appendix I: Timeframe

Activities	Timeline
Literature Review	Week 1–2
Data Collection	Week 3–4
System Design	Week 5–6
Algorithm Development	Week 7–10
Testing and Refinement	Week 11–12

Appendix II: Budget

Item	Cost (ugshs)
Dataset Acquisition	**150,000/=**
Software and Tools	**500,000/=**
Internet Bundles	**100,000/=**
Miscellaneous	**100,000/=**
Total	**850,000/=**