**KIRINYAGA UNIVERSITY**

**SCHOOL OF PURE AND APPLIED SCIENCES**

**DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY**

**PROJECT TITLE**

**DRIVER DROWSINESS DETECTION SYSTEM**

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**Submitted On:** APRIL 8

# DECLARATION

I do hereby declare without any reasonable doubt that the work presented in this project proposal is my original work and it has not been presented before to the Faculty of Science, pure and applied sciences ,Kirinyaga University

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**CONFIRMATION BY THE SUPERVISOR**

This project has been submitted with my approval as the university supervisor.

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# 

# ABSTRACT

In recent years, driver fatigue is one of the major causes of vehicle accidents in the world. Driver fatigue often becomes a direct cause of many traffic accidents. Therefore, there is a need to develop systems that will detect and notify a driver of her/his psychophysical condition which could significantly reduce the number of fatigue-related car accidents. Driver Drowsiness Detection System will be developed using a non-intrusive machine vision based concepts. The system will use a small monochrome security camera that will point directly towards the driver’s face and monitor the driver’s eyes in order to detect fatigue. In such a case when fatigue is detected, a warning signal is issued to alert the driver. This report describes how to find the eyes, and also how to determine if the eyes are open or closed. The system will deal with information obtained for the binary version of the image to find the edges of the face, which narrows the area of where the eyes may exist. Once the face area is found, the eyes are found by computing the horizontal averages in the area. Taking into account the knowledge that eye regions in the face present great intensity changes, the eyes are located by finding the significant intensity changes in the face. Once the eyes are located, measuring the distances between the intensity changes in the eye area determine whether the eyes are open or closed. A large distance corresponds to eye closure. If the eyes are found closed for 5 consecutive frames, the system will draw a conclusion that the driver is falling asleep and will issue a warning signal. The system will also be able to detect when the eyes cannot be found, and will work under reasonable lighting conditions. So it is very important to detect the drowsiness of the driver to save life and property.

Table of Contents

[DECLARATION ii](#_Toc121258755)

[ACKNOWLEDGEMENT iii](#_Toc121258756)

[ABSTRACT iv](#_Toc121258757)

[CHAPTER ONE 1](#_Toc121258758)

[INTRODUCTION 1](#_Toc121258759)

[1.1 Background of the study 1](#_Toc121258760)

[1.2 Statement of the problem 3](#_Toc121258761)

[1.3 Proposed system 3](#_Toc121258762)

[1.31 Sensing Phase 3](#_Toc121258763)

[1.3.2 Detection Phase 4](#_Toc121258764)

[1.3.3 Correction Phase 4](#_Toc121258765)

[1.4 Objectives 4](#_Toc121258766)

[1.4.1 General objective 4](#_Toc121258767)

[1.4.2 Specific objectives 4](#_Toc121258768)

[1.5 Research questions 5](#_Toc121258769)

[1.6 Justification 5](#_Toc121258770)

[1.6 Scope 6](#_Toc121258771)

[1.6 Assumptions 6](#_Toc121258772)

[1.8 Limitations 6](#_Toc121258773)

[CHAPTER TWO 7](#_Toc121258774)

[LITERATURE REVIEW 7](#_Toc121258775)

[2.1 Introduction 7](#_Toc121258776)

[2.2 System requirements 8](#_Toc121258777)

[2.2.1 Software requirements 8](#_Toc121258778)

[2.2.2 Hardware requirements 9](#_Toc121258779)

[2.3 Current Driver Drowsiness Detection and warning technologies 9](#_Toc121258780)

[2.3.1 Head- Nodding Technology 9](#_Toc121258781)

[2.3.2 Roadway Designs 9](#_Toc121258782)

[2.3.3 Lane Departure warning systems 9](#_Toc121258783)

[2.3.4 Collision Avoidance warning 10](#_Toc121258784)

[2.4 Video Image Processing 10](#_Toc121258785)

[2.4.1 Face Detection Algorithms 11](#_Toc121258786)

[2.4.1.1 Viola–Jones Algorithm 11](#_Toc121258787)

[2.4.2 Eye Detection Algorithms 12](#_Toc121258788)

[2.4.3 Eye State Detection 13](#_Toc121258789)

[2.5 Indicators of Drowsiness 13](#_Toc121258790)

[2.6 Eye data Acquisition 14](#_Toc121258791)

[2.6.1 INFRA RED sensors 14](#_Toc121258792)

[2.6.2 Camera sensors 15](#_Toc121258793)

[2.7 Specific Cases of Drowsiness Detection Systems 15](#_Toc121258794)

[2.7.1 Pro-Active Drowsiness management system 15](#_Toc121258795)

[2.7.2 Volvo driver alert control 16](#_Toc121258796)

[2.7.3 Eye check 16](#_Toc121258797)

[2.7.4 Drowsiness warning system 16](#_Toc121258798)

[2.8 Summary 16](#_Toc121258799)

[CHAPTER THREE 18](#_Toc121258800)

[RESEARCH METHODOLOGY 18](#_Toc121258801)

[3.1 Introduction 18](#_Toc121258802)

[3.2 Methods of collecting data 18](#_Toc121258803)

[3.2.1 Primary collection method 18](#_Toc121258804)

[3.2.1.1 Observation 18](#_Toc121258805)

[3.2.1.2 Interview 18](#_Toc121258806)

[3.2.1.3 Questionnaires 18](#_Toc121258807)

[3.2.2 Secondary collection method 18](#_Toc121258808)

[3.3 Targeted Population 19](#_Toc121258809)

[3.4 System design 19](#_Toc121258810)

[3.4.1 Context diagram 20](#_Toc121258811)

[3.4.2 Data flow diagram 20](#_Toc121258812)

[CHAPTER FOUR 22](#_Toc121258813)

[SYSTEM DESIGN AND IMPLEMENTATION 22](#_Toc121258814)

[4.1 Introduction 22](#_Toc121258815)

[4.2 Findings 22](#_Toc121258816)

[4.2.1 Open eye detection 22](#_Toc121258817)

[4.2.2 Closed eye detection 22](#_Toc121258818)

[4.2.3 Alarm generation 23](#_Toc121258819)

[CHAPTER FIVE 24](#_Toc121258820)

[CONCLUSION AND RECOMMENDATION 24](#_Toc121258821)

[5.1 INTRODUCTION 24](#_Toc121258822)

[5.2 Conclusion 24](#_Toc121258823)

[5.3 Recommendations 24](#_Toc121258824)

[5.4 Future work 25](#_Toc121258825)

[APPENDICES 25](#_Toc121258826)

[Appendix 1: Sample Questionnaire 25](#_Toc121258827)

[Appendix 2: Budget 26](#_Toc121258828)

[Appendix 3: Schedule and Gantt chart 28](#_Toc121258829)

[2.1 Schedule 28](#_Toc121258830)

[2.2 Gantt chart 28](#_Toc121258831)

[REFERENCES 29](#_Toc121258832)

# CHAPTER ONE

## INTRODUCTION

Drowsy driving poses a significant threat to road safety, contributing to a substantial number of accidents and fatalities worldwide. The detrimental effects of fatigue on a driver's alertness and reaction time underscore the need for innovative solutions to address this pressing issue. In response to this challenge, the proposed project seeks to develop an advanced Driver Drowsy Detection System, utilizing cutting-edge technologies in computer vision, machine learning, and real-time data processing.

### 1.1 Background of the study

Passenger safety has been a major concern to all societies in any country in the world. Thousands lose their lives daily and many more lose their livelihood because of paralysis caused by accidents. On average traffic, road accidents in the world claim 13 million lives and cause 20 to 50 million disabilities annually (Manyara, 2013). It is approximated that road accidents account for more than 23% of all injury deaths worldwide. These statistics are projected to rise to be the third killer by 2026 (Manyara, 2013) ahead of HIV/AIDS, respiratory infections and wars (Nantulya V.M, 2009).The continuous rise in road accidents attributed to drowsy driving emphasizes the critical need for effective drowsiness detection systems. Traditional approaches often fall short in providing timely and accurate alerts, necessitating the development of a more sophisticated and adaptive solution. This project aims to tackle the limitations of existing systems by implementing a comprehensive drowsy detection mechanism capable of analyzing facial features, eye movements, and other vital indicators to proactively identify signs of driver fatigue.

### 1.2 Statement of the problem

In the 21st century, driver drowsiness has continued to be a major challenge contributing to a large number of accidents on our roads. In Kenya, driver drowsiness especially among long distance truck drivers, public service vehicles drivers and private vehicle drivers is a major concern. This continues despite the government putting in place several measures to address the problem; measures including regulation of the public vehicle travel time, increasing the number of drivers for buses that travel at night, use of alcohol blows to detect drunk drivers among many others.

Providing Drowsiness Detection System among drivers has not been achieved making it difficult to enforce relevant legislations. A few systems are available in the market however; they are expensive making them a reserve for a few who can afford the cost of the current vehicles fitted with search technologies. There is hence great need to provide a Driver Drowsiness Detection System that are affordable to the many who are low income earners and also public service vehicles to help address the many accidents associated with drowsiness.

### 1.3 Proposed system

There are several different algorithms and methods for eye tracking, and monitoring. Most of them in some way relate to features of the eye (typically reflections from the eye) within a video image of the driver. The original aim of this project was to use the retinal reflection as a means to finding the eyes on the face, and then using the absence of this reflection as a way of detecting when the eyes are closed. Applying this algorithm on consecutive video frames may aid in the calculation of eye closure period. Eye closure period for drowsy drivers are longer than normal blinking. It is also very little longer time could result in severe crash. So we will warn the driver as soon as closed eye is detected.

#### 1.31 Sensing Phase

Eye Camera is used for sensing the eyes of the driver. Alcohol sensor is used for sensing the presence of alcohol content in the driver’s breath. The accelerometer present on the vehicle suspension unit senses the downward acceleration of the vehicle toward the road humps and pits.

#### 1.3.2 Detection Phase

The analysis of information from the sensors and camera are done to deduce the driver’s current driving behavior style. The open/closed state of eyes is deduced by means of image processing techniques using computer vision. The image processing techniques are performed inside PC.

#### 1.3.3 Correction Phase

This phase is responsible for doing the corrective actions required for that particular detected abnormal behavior. The corrective actions include in-vehicle alarms, turning of the engine and GSM communication with the authorities. The corrective measures vary according to the behavior detected. Corrections for drowsiness include in- vehicle alarms and its repetition turns the engine off. Drunken behavior is rectified by in-vehicle alarms, if not GSM communication with the authorities are done. Reckless measures include in-vehicle alarms and repetition will turn off the engine certain issues related to the low cost implementation of the proposed system with all its functionalities include the data fusion from different sensors and the image processing techniques. Also the addition of more sensors and algorithms to improve the accuracy and perfection of the system will be a challenge in front of this work.

### 1.4 Objectives

#### 1.4.1 General objective

To develop an intelligent driver drowsy detection system that utilizes computer vision and machine learning algorithm to accurately detect and analyze signs of drowsiness in facial images hence road safety by providing timely alerts to drivers.

#### 1.4.2 Specific objective

* Develop an intelligent system capable of accurately detecting signs of drowsiness in real-time.
* Design and integrate an effective alert mechanism to prompt drivers when signs of drowsiness are identified.

### 1.6 Justification

The drowsiness detection system to be developed will be one of the best systems that will help to predict drowsiness levels among drivers in order to reduce associated losses. If the driver is drowsy the system will detect it faster through face detection and eye detection and alerts the driver of his drowsiness.

The system will also help to reduce road accidents associated with drowsiness in the country. Most of the accidents caused in Kenya occur though roads thus having this system will be of importance to the country by reducing the number of road accidents.

The system that will be developed will also be able to accurately detect a face from an image. It will contain a small monochrome camera that will point directly to the face and divide the face into small frames from the image it contained.

The system with the small monochrome camera will also be able to detect the eyes of the driver. By doing so the small monochrome camera will point directly to the eyes of the driver and detect whether the eyes are closed or opened, if the eyes are closed then the system will detect that the driver’s eyes are drowsy.

The system will also be able to provide a warning to the driver if drowsiness is detected. The system will be developed in such a way that it warns the driver when he or she becomes drowsy while driving and the system detects the drowsiness.

It will also be able to alert the driver on the detection of the drowsiness by using a buzzer or alarm.

The system will also be able to reduce loss of income and increased dependency ratio due to accidents. Due to accidents in the country there has been an increase in dependency ratio and high loss of income maybe due to loss of sight or one being paralyzed on both legs that he or she can’t walk to the place of work thus having high dependency ratio. The system will be developed to reduce and solve the above problems.

### 1.6 Scope

The Driver Drowsiness Detection System will be developed in a period of about three months of time. This study aims at collecting the drowsiness symptoms from the driver’s face through analysis of the driver’s eye state. The system will be used in the transport sector specifically the road transport where it will be used in the vehicles. This will be achieved through processing video images obtained through a sensing technology.

The outcome of the video will be used to determine the drowsiness levels and then provide a warning to the driver if he or she is drowsy. The system will be used in vehicles to detect drowsiness in the driver’s eyes and issue a warning to the driver thus helping in reducing the number of road accidents.

### 1.6 Assumptions

It is assumed that the project will run in conjunction with the code.

It is also assumed that every one will install the service in their cars.

### 1.8 Limitations

The system can be operated by learned personnel.

# CHAPTER TWO

## LITERATURE REVIEW

### 2.1 Introduction

Drowsiness detection poses a big challenge to researchers. In both manual and automatic approaches, researchers highly depend on the symptoms of drowsiness in order to predict a drowsy driver. Manual approaches are however very difficult and totally undependable to prevent traffic road accidents. Manuals approaches are based on the human perception of the situation. Mainly the police use this manual technique to explain that an accident resulted from drowsiness. Several characteristics including: no alcohol in the blood of the driver during accident, vehicle run off the road or at the back of another, no signs of breaking, vehicle has no mechanical defects, good weather with clear visibility and even the police officer at the ground suspects drowsiness to be the cause can be pointers of drowsiness related accidents.

The above techniques however cannot be used in traffic road accident prevention. In order to prevent an accident resulting from drowsiness a method for detecting and measuring drowsiness need to be developed. This will make it possible to warn the driver, slow the vehicle or even halt the vehicle if the driving situation demands. Automatic detection of driver’s drowsiness is critical for all this to be achieved. From research, several techniques have been developed, all these techniques attempt to measure the level of driver vigilance and alert him or her of an insecure driving condition (Abhi R. Varma 2012).

Drowsiness detection can generally be divided into the following classes. According to Abhi R. Varma (2012), they include: sensing of physiological characteristics, sensing of driver operation, sensing of vehicle response and monitoring the driver response. To achieve the best result human physiological centered techniques are preferred (Abhi R. Varma 2012). In this, both intrusive and non-intrusive techniques can be adopted. However, intrusive techniques such measuring of physiological change like brain wave, heart rate and body temperature may provide most accurate results. They are however not realistic as they involve implanting of sensing electrodes on the driver’s body an act that is annoying and distractive to the driver. Increased perspiration during long driving hours result in sweating which might also interfere with the performance of the implanted gadgets, hence reducing the accuracy of the data they obtain.

Non-intrusive techniques are most suited for real world driving conditions, through use of non-intrusive data collection techniques to obtain physical measures such as sagging posture, learning of the driver’s head, open or closed state of the eyes, blink duration, blink frequency, saccade frequency has gained popularity among many researchers.

This is because of non-interference with normal state of the drives as they operate without even the knowledge of the driver.

Other non-intrusive techniques involve measuring driver operation and vehicle behavior; they can be achieved through measuring vehicles lateral displacement, braking and acceleration patterns, vehicle speed, steering wheel movements and lateral accelerations (Abhi R. Varma 2012). In this drowsiness interferes with the driver alertness and vigilance leading to changes in both his driving behavior and the vehicle behavior. Being able to establish and measure this changes one can be able to predict a drowsy driver. This system however may provide a very short time span to correct the situation before a crash occurs. However, they have been successful combined with other techniques by different manufactures to develop drowsiness detection systems.

Finally, driver response can continually be monitored by frequently requesting the driver to send a response to the system to indicate his or her alertness. An audio or visual sign can be provided to driver periodically, to indicate his or her alertness the driver can respond to the sign, if the driver fails to respond within a specified time the frequency of the sign can be increased and later provide an alarm or alert of the driver’s state. This method however is monotonous, boring and tiresome to the drivers; frequent false alarm may be annoying to drivers making them ignore even when the situation is genuine.

### 2.3 Current Driver Drowsiness Detection and warning technologies

#### 2.3.1 Head- Nodding Technology

When a driver is drowsy and gets sleepy hide muscles relax, hence he or she starts nodding. This symptom can be used to detect drowsiness. The approach however should be used to detect the onset of sleep as head-nodding phenomenon manifests as the last cue before micro-sleep or complete sleep occurs. Although this system appears to be efficient in detecting the onset of sleep the driver might as well drive unsafely leading to accident before he even manifests the head-nodding to trigger an alert as the system warns the driver too late into the drowsiness curve. The system may also trigger false alarms as the driver may make movements that are not indicators of drowsiness resulting in false alarms. This might be annoying to drivers hence they may ignore genuine warning (Jennifer F.may, 2009).

#### 2.3.2 Roadway Designs

Roads can be designed to monitor weaving and alerting drivers when they drive off roads through use of rumble strips that produce a loud noise and vibrations within the car when a driver crosses or drives along the strip. This technology is advantageous as it is available to all drivers. These technologies highly reduce the amount of run off the road crashes (Jennifer F.may, 2009).

#### 2.3.3 Lane Departure warning systems

These systems depend on the feed from a camera that monitor the road ahead and establishes the lane boundaries; in the event that a driver veers of the lanes without using, the turn signal an alarm sounds is produced. Lane departure has been can be implemented using different with technologies such as sidetrack (AssistWaretechnology, 2005), Auto view and many others being adopted by different automotive manufacturers. These systems however do not predict the drowsiness but senses the reputations of drowsiness. (Jennifer F.may, 2009).

*Disadvantage*

1. The driver may experience false alert, which are annoying and may make him or her ignore future genuine alerts.

2. When dealing with unmarked roads or rural road it will be difficult for the system to detect and warn the driver.

#### 2.3.4 Collision Avoidance warning

These systems are commonly integrated in high end vehicles to provide warning to drivers of eminent crushes, majorly these systems attempts to reduce severity of a crash. These systems can measure the time of crush, sense when another vehicle or obstacle comes close to a vehicle reducing the collision velocity and minimizing to collision. The systems provide auditory tones and visual icon displays.

### 2.4 Video Image Processing

Vision based real time driver drowsiness systems have been proposed and developed by different institutions; most of the systems are based on eye tracking, head tracking and other facial features that manifest in drowsy drivers. This has been highly motivated by the advancement in video image processing algorithms.The ability of correctly detecting a human face from a video stream and the demand for high quality and reliable data for intelligent solutions that can be provided through image processing is a major drive towards adoption of vision based systems. Through use of image processing algorithms the regions of interest which are the eyes can be located and analysis done to determine their state (closed or open). This is treated as a classification problem or pattern recognition problem in which supervised learning plays key role. In the first step, a classifier is first trained to classify an image as either a face or non-face. Once a face is detected, another classifier is trained to detect the region of interest in our case the eyes.

#### 2.4.1 Face Detection Algorithms

When driving on the roads in order to detect the state of the driver using facial feature analysis, we will need to detect the face of the driver. Different techniques are in use in order to achieve this. Algorithms such as Viola-jones, Gabor features extraction and classification using support vector machine. (Kristopher Reese, 2011)

##### 2.4.1.1 Viola–Jones Algorithm

Viola-jones approach is a very common approach for object detection. The algorithm is a machine learning approach for object detection that emphasizes on rapid result generation and high object detection rates with figures of up to 99% detection being registered by different researchers (Kristopher Reese, 2011); the method uses integral images as the image detection structure that guarantees speed in detection. The features are calculated by taking the sum of pixels within multiple rectangular areas. Several adjustments have been made by different researcher to the initial algorithm to enhance its robustness (R. Lien hart and J. Maydt, 2002). Extensions such has addition of Ada boost algorithm allows training of classifiers to detect integral images of the face and those of the background and increase the speed of the detection. A cascade classifier is the used to speed up the detection process; this is by avoiding areas that are most unlikely to be regions of interest and concentrating on highly likely regions.

Gabor Features Extraction is another is feature based approach, Gabor wavelets transformation is run against images and feature points are extracted to make a feature vector. The feature vector is that passed through a trained support vector machine or artificial neural network for classification process (Kristopher Reese, 2011).

Zeng (2010) proposed another approach for detecting faces in thermal spectrum. This approach uses projection profiles Analysis algorithm. In the approach, region glowing segmentation is used to separate the areas of interest from the background noises. This approach has highly been adopted in medical imaging in areas with radiography and magnetic resonance imaging being the center stage. The approach works by segmenting the image into 2 segments, the background and regions of interest. The background is treated as the region with the lowest pixel intensity, which is the region with lowest thermal emissions.

Other methods have been proposed such has principle component analysis, fisher faces, face recognition using Line Edge and Bayesian methods cui (2007) however; viola jones remains the algorithm of choice due to the speed and high detection rates.

#### 2.4.2 Eye Detection Algorithms

Kanade-Lucas-Tomas feature Tracker Algorithm is one of the algorithms that are used to track and recognize facial features. The algorithm has been provided as open source code by the Stanford vision Laboratory. This approach makes use of spatial intensity information to direct the search for the position that yield the best match. The technique has been improved by tracking features that are wanted in subsequent frames (Kanade, 1991).

SIFT (scale-invariant feature transform) and SURF (speed up Robust Feature), are other algorithms that are used in object detection. With SIFT being proposed by Lowe in 2004 (P M Panchal, 2013) and SURF presented by Herbert Bay in 2006. They are both excellent in mapping facial features in templates to target images, with the SURF being several times faster than the SIFT. However, the two are highly sensitive to very small changes in illumination. An attempt to overcome this challenge via use of histogram equalization and histogram fitting has yielded little success as this result to very slow algorithms (Eric Chu n.d.).

Hough Transformation is the other approach that is used to extract eye features; this technique detects regular curves like lines, circles and ellipse hidden in large amount of data, during processing large number of lines pass through any given point. The Hough transform determined which of this line pass through a circle or an ellipse in an image. With the eye pupils, being a circle and having the ability to determine the size of the eye pupils we can easily detect the location of the eye, different images will be detected in different locations of the image and by establishing the distance between two pupils we can easily eliminate the associated errors (storkey, 2005). The performance of this algorithm is however affected by the quality of images obtained (Wallace Hung, 2006). Viola and jones object detection Algorithm is one of the easiest algorithms and has a high performance when it comes to object detection (Wallace Hung, 2006). The algorithm is based on key feature detection using haar features that are grouped into 3 different categories: 4-rectangle features, 3-rectangle features, 2 rectangle features. Through use integral images, the speed of the execution is increased making the approach ideal for systems that have low processing resources. A classifier is then used to extract the required features from the many obtained, using the concept of Ada Boosting where weaker classifiers help to narrow down to stronger patterns the performance of the algorithm is enhanced (Wallace Hung, 2006).

#### 2.4.3 Eye State Detection

Detection of the eye state (closed/open) is very important in order to be able to detect the changes of the driver eye, which is a key drowsiness indicator. Different approaches have been proposed to address the problem of blink detection. The average duration of an eye blink is 0.5 to 0.6 seconds with a frequency varying from once every 3 seconds up to several a tenth of a second (Mehdy Bohol n.d.). The blink rate can be affected by several external stimuli like fatigue.

Different algorithm have been used to detect the blinks in an eye with template matching being one of them, according to Betke (2005) on online database is developed that contains several images of the eyes indifferent states. The real-time images obtained from the cameras are developed into a template that is correlated with the images in the database. A correlation threshold that indicates an open eye is established. Blinks are detected using a time that is triggered each time the correlation scores falls below the set threshold. A correlation score that lies between -1 and 1 indicate the similarity levels with scores close to 0 indicating low similarity and score close to 1 indicate a close match to the open eye template. The approach is insensitive to changes in ambient lighting conditions. The approach however requires an extensive amount of computation (Haripriya D, 2014).

(Mehdy Bohol n.d.) In his work on computer vision syndrome prevention using real time accurate blink detection proposed a much faster and easier approach of detecting blink. In his work, he uses integral images in differential images of two adjacent frames to detect the intensity difference that is an indicator of blink.

In his work, he describes a blink to being two big dots of changes with the same size and within a defined distance. To determine the change in deferential images a score is computed. When a blink occurs, there are some changes on the eye position that can be seen in the threshold differential image at the same time there is nearly no change in the other face regions, or the regions near the eye (Mehdy Bohol n.d.). This information is used to detect the blink.

### 2.5 Indicators of Drowsiness

Drowsy persons exhibit certain visual behaviors, which can be observed from changes in the facial features such as eye, mouth, head and face (Dhaval Pimplaskar, 2013). Studies have indicated that the eyelid activities are highly related to the levels of intention, alertness, vigilance and needs (Dhaval Pimplaskar, 2013). The eye blink frequency is believed to increase beyond normal rate for a drowsy person. Eye closure duration is also used to detect drowsiness; a drowsy person manifest micro sleeps that last between 3 to 4 second (Abhi R. Varma, 2012). The percentage eyelid closure (PERCLOS) or proportion of time in a minute that the eye is 80% closed has highly been adopted and proven a reliable measure of drowsiness. It measures the percentage of the eyelid closure over the pupil over time and reflects the slow eye movements that are used to predict the drowsiness levels. This method was introduced in 1994 by Wierwille and coworkers as an alert measure. This method later became accepted standard measure for alertness and it was adopted by the United States transportation Department. According to (Udo Trutschel ,2011) in their work, they argue that this approach perform better that other measure such as eye blind measure , head movement and even EEG which is a direct measure that is influenced by Cortical and to some degree also by sub-cortical activities.

PERCLOS a parameter used to widely monitor the drowsiness of a driver; it is defined as the proposition of frames in which the driver’s eyes are closed over a certain period.

The average eye closure and opening speed (AECS) is another a drowsiness indicator based on the eyelid analysis, when a person is drowsy, the eyes closes/opens slowly due to either tiredness of muscles or slower cognitive processing (Dhaval Pimplaskar, 2013).

Eye closure duration (ECD) is defined as the mean duration of clusters over a certain period, where a cluster is set of continuous frames in which the eyes are closed.

To detect the driver level of alertness, individual eye closure duration and eye closure speed are analyzed (Yang, 2002). In their systems percentage eyelid closure (PERCLOS) and average eye closure speed (AECS) at particular time instance are computed over a fixed time interval of 30s. The average eye closure/opening speed is computed as arithmetic average of all eye closure speed is computed over the same period. To increase the accuracy and robustness of their system the average running rate is computed using the current data and data at the previous time instances.

### 2.6 Eye data Acquisition

#### 2.6.1 INFRA RED sensors

Imaging in the infrared spectrum can be used to detect the eye and provide the status of the eye. In this approaches both the physiological and optical properties’ of the eye are used. The eye pupil reflects an infrared beam and depending on the amount of reflectance, a decision is made on the state of the eye. An open eye has a higher reflecting ability than a closed eye (Mohamad Hoseyan sigari, 2013).

#### 2.6.2 Camera sensors

In this, an image is captured using a charged- couple device (CCD) or Complementary metal–oxide–semiconductor (CMOS) imaging technologies. The captured image is then processed using machine vision algorithms to extract regions of interest. Through extracting and analysis of the eye region features a researcher is able to detect the eye and given regions of interest. This approach assumes that the eye is darker that the face skin (Mohamad Hoseyan sigari, 2013).

### 2.7 Specific Cases of Drowsiness Detection Systems

#### 2.7.1 Pro-Active Drowsiness management system

This is a product developed by ARRB, it tailored to detect drowsiness in mining industry and commercial vehicles, and the system is a stimulus- reaction device that measures the reaction time to the stimuli. The system establishes a baseline performance measure for each operator and test against this measure throughout the work shift. The system has the ability to detect reduction in alertness levels in real time and allow intervention strategies to counter the impact of working drowsy. The system presents an audio and light stimulus every 7 to 10 minutes, slow reaction to the alerts triggers more frequent testing and if the reaction levels are extremely slow an alarm is triggered in the cab and an alert sent to the dispatcher. This system has very positive feedback from operators however it is very expensive costing $9000 per machine on a yearly lease. (Caterpillar, 2008)

*Disadvantages*

1. It is expensive

2. It requires manually acquisition of the driver data and sleep patterns

3. The system can raise false alerts which are annoying to the users

4. Requires a lot of training to obtain the correct sleeping patterns of the users

#### 2.7.2 Volvo driver alert control

Volvo uses a camera mounted on the rear view mirror to analyze the road markings together along with combination of inputs from steering wheel movements and use of accelerator and brake pedals to determine drowsiness.

A set of 5 bars appear on the dash board to indicate the level of alertness, when the bars diminish to two an alarm is raised and a written warning provided requesting the driver to take a break. The alarm provided is a gentle sound that will not scare the driver leading to abrupt reaction that may cause an accident. This system has been fitted into several Volvo make to reduce crushes. This package however comes at a cost of $2100

#### 2.7.3 Eye check

This is a product by MCJ INC. It is based on measuring the pupil reaction to light flashes. At first, the eye is allowed to adapt to dark for 30 seconds and the initial pupil diameter is measured, after a brief flash of light, the device measures reflex amplitude, rate of constrictions, final pupil diameter and the time to minimum diameter. The system is applied widely even in the police departments. It is however also expensive costing $ 8,000 (Caterpillar, 2008).

#### 2.7.4 Drowsiness warning system

A device based on stimulus reaction, it checks the operator’s alertness using visual signals, and it provides random signals with their frequency increasing with slower reaction time. If no response is provided the system produces audible alarm sound until the operator resets the system. It can be used in wide area ranging from transportation, mining, agriculture and construction. This system is relatively cheap costing $ 1300.

### 2.8 Summary

Several other systems are available but either their use is limited to a certain field or their cost is high with prices extending up to $16,000 making it difficult to acquire. In low income economies government policies are less regulating when it comes to the kind of vehicles imported, in most of this economies safety is always traded for affordability hence manufactures do not equip vehicles meant for search regions with advanced technologies. On the contrary high end economies vehicle safety is very important; governments dictate the kind of safety features to be available in automobiles before they are allowed in these countries. Users are also very concerned about their safety hence willing to pay an extra cost for vehicle with advanced security features.

With this facts, there is growing need to develop safety systems that are cheap and affordable to the many in low income economies. From the symptoms associated with drowsiness and other factors that result in poor driving practices, a warning system can be developed to prevent the possible resulting crushes; the system will have a mechanism of detecting drowsiness/ drowsiness in the driver’s eyes and providing a corrective mechanism. The corrective mechanism will be aimed at concentrating the attention and alertness of the driver to the task.

# CHAPTER THREE

## RESEARCH METHODOLOGY

### 3.1 Introduction

This is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge.

After careful consideration, the agile methodology is the appropriate methodology for its adaptability, iterative aproach and emphasis on customer feedback. Agile aligns well with the dynamic nature of this project , allowing for continuos improvement and flexibility in response to evolving requirements.

AGILE DEVELOPMENT FRAMEWORK

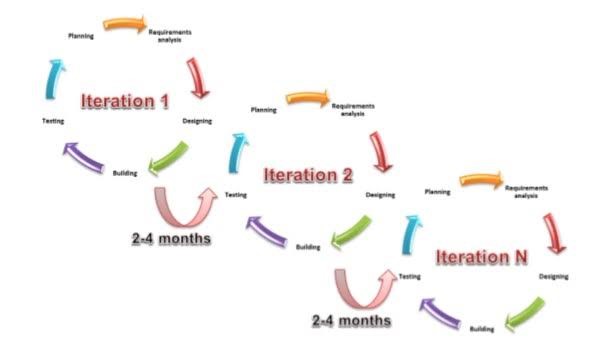


Figure 1Agile Development framework

Characteristics of Agile Software Development

Light Weighted methodology.

Small to medium sized teams.

Vague and/or changing requirements.

Vague and/or changing techniques.

Simple design.

Minimal system into production.

Agile Software Development comprises of set of methods and practices based on the values and principles expressed in the Agile Manifesto. The following are the values and principles in the Manifesto: -

1. Individuals and interactions - In Agile development, self-organization and motivation are important, as are interactions like co-location and pair programming.

2.Working software - Demo working software is considered the best means of communication with the customers to understand their requirements, instead of just depending on documentation.

3. Customer collaboration - As the requirements cannot be gathered completely in the beginning of the project due to various factors, continuous customer interaction is very important to get proper product requirements.

4.Responding to change-Agile Development is focused on quick responses to change and continuous development.

Agile Scrum Methodology

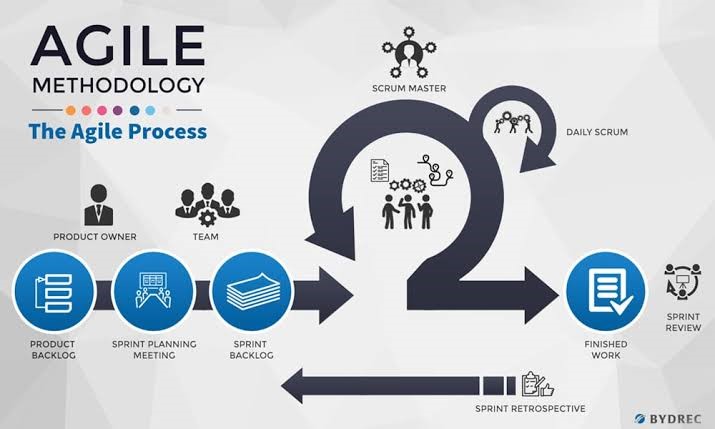


Figure 2Agile Scrum methodology

Scrum is an agile project management methodology or framework used primarily for software development projects with the goal of delivering new software capability. It is capable of managing and controlling iterative and incremental projects

It has set of guidelines and principles on how to develop high quality apps and faster

1.User involvement is imperative.

2.The team should be able to make decisions.

3.Fixed time scale with changing requirements.

4.Requirements are highly considered.

5. Development of small iterations.

6. Products should be delivered quickly.

7. Completion of features before moving to the next.

By using this framework, it is possible to manage resources, add functionality rapidly,deliver early working, enhances flexibility to the developer and is also suitable for changing requirement.

Agile is based on the adaptive software development methods, whereas the traditional SDLC models like the waterfall model is based on a predictive approach. Predictive teams in the traditional SDLC models usually work with detailed planning and have a complete forecast of th exact tasks and features to be delivered in the next few months or during the product life cycle.

Predictive methods entirely depend on the requirement analysis and planning done in the beginnig of cycle. Any changes to be incorporated go througha strict change control management and prioritization.

Agile uses an adaptive approach where there is no detailed planning and there is clarity on future tasks only in respect of what features need to be developed. Tere is feature driven development and the team adapts to the changing product requirements dynamically.The product is tested very frequently, through the release iterations,minimizing the risk of any major faiures in future.

Customer Interaction is the backbone of this agile methodology,and open communication with minimum documentation are the typical features of agile development environment.The agile teams work in close collaboration with each other and are most often located in the same geographical location.

### 3.2 Methods of collecting data

#### 3.2.1 Primary collection method

Primary data means original data that has been collected specially for the purpose in mind. It means someone collected the data from the original source first hand.

##### 3.2.1.1 Observation

Observation is a systematic data collection approach. Researchers use all of their senses to examine people in natural settings or naturally occurring situations. Observation of a field setting involves: prolonged engagement in a setting or social situation.

##### 3.2.1.2 Interview

Interview is a direct face-to-face attempt to obtain reliable and valid measures in the form of verbal responses from one or more respondents. It is a conversation in which the roles of the interviewer and the respondent change continually. Interviewing is one of the most common methods of collecting information from individuals. There are various types of interviews that are used to collect data. These include structured, semi-structured and unstructured interviews.

##### 3.2.1.3 Questionnaires

A questionnaire is a research instrument consisting of a series of questions (or other types of prompts) for the purpose of gathering information from respondents.

#### 3.2.2 Secondary collection method

A researcher can obtain secondary data from various sources. Secondary data may either be published data or unpublished data. Published data are available in:

1. Technical and trade journals
2. Publications of government
3. Statistical or historical documents
4. Reports of various businesses, banks etc.
5. Public records
6. Reports prepared by research scholars, universities, economists, etc. in different fields.

Unpublished data may be found in letters, diaries, unpublished biographies or work. Before using secondary data; it may be checked for the following characteristics:

1. Suitability of data – The object, scope and nature of the original enquiry must be studies then carefully scrutinize the data for suitability.
2. Adequacy – The data is considered inadequate if the level of accuracy achieved in data is found inadequate or if they are related to an area which may be either narrower or wide than the area of the present enquiry.
3. Reliability of data – Who collected data? From what source? Which methods? Time? Possibility of bias? Accuracy?

### 3.3 Targeted Population

The system targets the drivers of the vehicles especially the ones who gets drowsy or dizzy as they drive through the roads. The system will check the driver’s face by using a small monochrome camera that points directly to the eyes to detect whether they are open or closed and then warns the driver of his or her drowsiness by an alarm. The system will be developed in such a way that it detects both the face and the eyes through image acquisition with the help of the camera where the image will be divided into frames. The processing will target to detect the drivers face from the video stream; once the face is detected, the region of interest that is the eyes will then be located from the facial features. The system will help the transport sector in reducing the number of accidents that usually happen on roads leading to loss of many lives.

# CHAPTER FOUR

## SYSTEM DESIGN

### 4.1 Introduction

This chapter is very important as it entails the screenshots of the developed system. It describes step by step right from detection of a closed eye and detection of an open eye and issuing of an alarm when eyes are detected to be closed.

### 4.2 System requirements

#### 4.2.1 Software requirements

* Windows XP,7,8,10
* Anaconda environment with spider ++
* Python 3.6 environment
* Python libraries OpenCV (eye and face detection), Keras (to build our classification model), Tensorflow (Keras uses Tensorflow as backend) and Pygame (to play sound)

#### 4.2.2 Hardware requirements

* Hard Disk: 20 GB (minimum recommended)
* Monitor: 11” inch DISPLAY or more
* Keyboard: 108 key normal
* Camera
* RAM: 1 GB (minimum recommended)

#### 4.2 Context diagram

This is a diagram that shows the general overview of the project, it describes the way external entities interact with the system.

Drivers Face

Detection

Dividing into frames Face localization

Eye state determination

Camera

**Image acquisition**

Alarm

**Processing**

**Analysis**

Eye detection

Find eye landmarks extract eye landmarks

Figure 1 context diagram

#### 4.3 Data flow diagram

It describes the system data flow from the users to the administration that is the final user stage of the system. More generally, a data flow diagram is used for the visualization of data processing.

Driver

I image acquisition

Dividing to

Frames

Camera

Processing Analysis Face

Face localization detection

Morphological

Eye

Find eye landmarks processes

Crop

eye region

Extract eye Convert to gray scale Eye

Landmarks Detection

Eye state closed/open

Determination

Drowsiness detection

Alarm

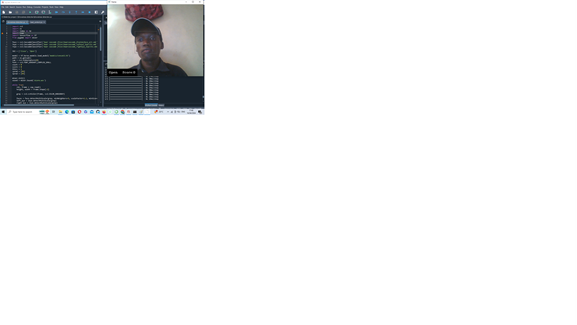
Analysis of data Analysis Alert

Actuating signal decision Gener

**4.4 Output design**

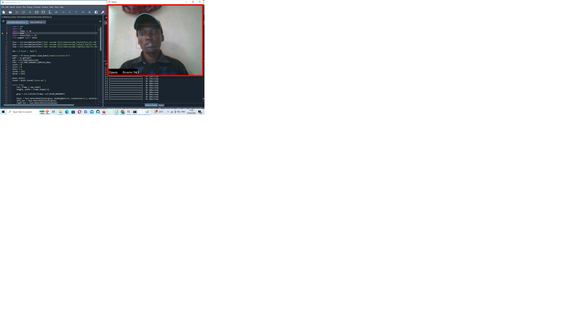
***4.4.1 Open eye detection***

Open cv is used to detect the face and haar cascade classifier to detect the eyes and a CNN model to predict the status.



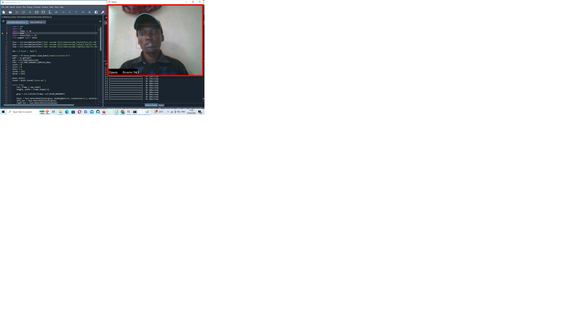
***4.4.2 Closed eye detection***

Open cv is used to detect the face and haar cascade classifier to detect the eyes and a CNN model to predict the status.



***4.4.3 Alarm generation***

Here if a threshold is defined for example if a score becomes greater than 15, that means that the person’s eyes have been closed for a long period of time then the system will actuate the signal and beep the alarm to indicate drowsiness as shown below.



**CHAPTER FIVE**

**SYSTEM TESTING AND IMPLEMENTATION**

**5.1 Introduction**

In this chapter, we delve into the implementation details of the Driver Drowsy Detection System (DDDS) and the testing strategies employed to ensure its effectiveness and reliability.

**5.2 Unit Testing**

Unit testing is a crucial aspect of software development, where individual components or units of the system are tested in isolation. In the context of DDDS, each module, such as image processing algorithms, drowsiness detection logic, and alert generation, undergoes rigorous unit testing to validate its functionality.

**5.3 Integration Testing**

Integration testing focuses on testing the interactions between different modules or components of the system. In DDDS, integration testing ensures seamless communication between modules and verifies that they function correctly when integrated. This includes testing how image processing results feed into drowsiness detection algorithms and how alerts are triggered based on detected drowsiness.

**5.4 System Testing**

System testing evaluates the system as a whole to ensure that it meets the specified requirements and functions as intended in a real-world environment. For DDDS, system testing involves simulating various driving scenarios and monitoring the system's performance under different conditions, such as varying lighting conditions, driver positions, and levels of drowsiness.

**5.5 Database Testing**

Database testing is essential for verifying the integrity, reliability, and performance of the database used by the DDDS. This includes testing data retrieval, storage, and manipulation operations to ensure accurate and efficient handling of driver-related information and alert history.

**5.6 Implementation Requirements**

The implementation of DDDS requires adherence to specific requirements, including hardware specifications, software dependencies, and compatibility with existing vehicle systems. This section outlines the necessary hardware components, such as cameras and processing units, as well as software dependencies, such as OpenCV, TensorFlow, and Pygame.

**5.7 Coding Tools**

DDDS implementation utilizes various coding tools and frameworks to streamline development and ensure code quality. This includes IDEs (Integrated Development Environments) such as PyCharm or Visual Studio Code, version control systems like Git, and testing frameworks such as pytest for automated testing.

**5.8 Chapter Conclusion**

In conclusion, the implementation and testing phases are crucial stages in the development lifecycle of the Driver Drowsy Detection System. By ensuring robust implementation and thorough testing, we aim to deliver a reliable and effective solution that enhances road safety and reduces the risk of accidents caused by driver drowsiness.

**CHAPTER SIX**

**CONCLUSION AND RECOMMENDATION**

**6.1 INTRODUCTION**

This chapter is very important as it entails any recommendation to be done to the system. It describes also any other information or implementation to be done to the system.

**6.2 Conclusion**

This project details the great potential that OpenCV, Haar cascade classifier and CNN model has. To conquer most of the world problem human, perceive the world through vision, in a similar way adequate cheap technology is available for manipulating images to enable machines interact with their environment through vision. Through this, machine will be able to solve many problems.

The system provides a cheap drowsiness detection method hence providing a solution to millions of Kenyans who are losing their lives and livelihoods in the hand of drowsy drivers both in the public service transport, track driving and in low income private vehicle owners. Through collaboration with various government agencies, the technology can be used in enforcing the other rules that are found in the Kenyan constitution on fatigue driving. This system demonstrates the great potential that lies in the advancements made in face and eye detection technologies and increased computing power on different board.

**6.3 Recommendations**

In order to advance the performance of the system and incorporate more drowsiness measure parameter, more powerful embedded devices such as FPGA fitted with microcontroller, and more powerful cameras with higher frame rates can be adopted, however the devices in question will be a little more expensive.

To enhance control and more driver situation monitoring a transmission module can be incorporated to transmit the driver state details in real-time to the relevant authorities. To increase the performance of the system at night or in places with low illumination levels an active method of video capture can be adopted e.g. infra-red camera over the visible light dependent cameras.

**6.4 Future work**

Our model is designed for detection of drowsy state of eye and give an alert signal or warning maybe in the form of audio or any other means. But the response of the driver after being warned may not be sufficient enough to stop causing the accident meaning that, if the driver is slow in responding towards the warning signal then an accident may occur. Hence to avoid this, in future we can design and fit a motor driven system and synchronize it with the warning signal so that the vehicle will slow down after getting the warning signal automatically.

In future, the research should be extended to cover more complex user behaviors in front of the camera that indicate drowsiness in drivers, lastly it will be of great benefit to advancement in research in this area if a test database is developed to help young researchers test their works.

**APPENDICES**

**Appendix 1: Budget**

|  |  |  |  |
| --- | --- | --- | --- |
| **EXPENSES** | **UNIT** | **COST PER UNIT**  **(**Ksh**)** | **TOTAL COST**  **(**Ksh) |
| **Travel** | | | |
| Fare to Nairobi | 2 | 450 | 900 |
| Food(day) | 5 | 200 | 1,000 |
| **Equipment** | | | |
| Cell Phone | 1 | 3,000 | 3,000 |
| Laptop | 1 | 25,000 | 25,000 |
| Mobile Data Modem | 1 | 1,500 | 1,500 |
| Camera | 1 | 4,500 | 4,500 |
| **Materials** | | | |
| Pen, Marker pen, Book, Paper, File, Pins | 1 | 300 | 300 |
| Airtime for phone calls | 20 | 20 | 400 |
| Mobile Internet Services(monthly) | 100mbs | 20 | 2,000 |
| **Publication And Dissemination.** | | | |
| Printing | 30pages | 10 | 300 |
| Binding | 1 | 50 | 50 |
| **Total Expenses Ksh. 38, 950** | | | |

**Table 1: Budget**

**Appendix 2: Schedule and Gantt chart**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NO** | **Activity** | **September** | **October** | | **November** | | **December** | **January** | | **February** | | **March** | | **April** |
| **1** | **Presenting the Topic** |  |  | |  | |  |  | |  | |  | |  |
| **2** | **Introduction** |  |  |  |  | |  |  | |  | |  | |  |
| **3** | **Problem statement** |  |  |  |  | |  |  | |  | |  | |  |
| **4** | **Objectives** |  |  | |  |  |  |  | |  | |  | |  |
| **5** | **Literature Review** |  |  | |  |  |  |  | |  | |  | |  |
| **6** | **Methodology** |  |  | |  |  |  |  | |  | |  | |  |
| **10** | **Printing and Binding** |  |  | |  | |  |  | |  | |  | |  |
| **11** | **presentation of the Proposal** |  |  | |  | |  |  |  |  | |  | |  |
| **12** | **System Design** |  | |  | |  |  |  | |  |  |  | |  |
|  | **Implementation /Data analysis** |  | |  | |  |  |  | |  |  |  |  |  |
|  | **System Launch** |  | |  | |  |  |  | |  | |  |  |  |
|  | **Documentation** |  | |  | |  |  |  | |  | |  | |  |

appenix 3 source code

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