MITS6500 Capstone Project

Project Proposal

Version No: 15-03-2020

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Project Summary

Purpose
The purpose of this document is to get approval of our idea of implementation of underlaying technologies as a part of the final project work that justify the completion of the program – Masters in Information Technology.

Business and Policy Context
With increase in day to day vehicular traffic, the governments are trying their level best to ensure strict traffic laws for the safety of not just the drivers but everyone around them. The government has also introduced many laws for the manufacturers to ensure car safety and yet there is still much space left for improvement.
To compete in driver, passenger and pedestrian safety many car manufactures are going an extra mile. Few of their recent innovations include but not limited to, lane keep assist, pedestrian collision detection, automatic braking system. This opens a lot more room for us to enter and provide software aided services for them in the market. With the introduction of optimized fatigue detection module, our project can provide third party products to drivers, manufacturers or governments to ensure road safety.

Working Title for the Proposed Project
The working title for the project is the "Fatigue detection for driver using Computer Vision".

Objective(s)
The objective of the Fatigue detection for drivers using Computer Vision Project is to propose dro wsiness detection model with the physiological and behavioral measurements of the subject. Accor ding to that the study varies mainly on these two sectors.
Basic steps of the behavioral measurements are as follows,

- Study of behavioral techniques used to detect drowsiness.
- Video Acquisition.
- Extracting features to detect drowsiness.
- Monitoring features with time.
- Providing output based on the detected features.

Basic steps of the physiological measures are as follows,

- Study on physiological measures used to detect drowsiness.
- Selecting Heart Rate Variability analysis to detect drowsiness.
- Analyzing low frequency/high frequency of the ECG ratio for test samples.
- Selecting a suitable range of low frequency/high frequency for the implementation.

Project Complexity
Driver exhaustion is a significant variable in an expansive number of vehicle accidents. The frequency of road accidents in India is among the highest in the world. The Global Status Report on Road Safety published by the World Health Organization (WHO) identified the major causes of road accidents are due errors and carelessness of the driver. Less attention heads the driver to being distracted and the likelihood of street accident goes high. The sleeping sensation reduces the level of vigilante producing danger situations and increases the probability of an accident occurring. Drowsiness related accidents have all the earmarks of being more serious, because of the higher speeds involved distraction and the driver being not able to take any avoiding activity before the accident.

Computer vision is an interdisciplinary scientific field that deals with how computers can be made to gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do.
Understanding in this context means the transformation of visual images (the input of the retina) into descriptions of the world that can interface with other thought processes and elicit appropriate action. This image understanding can be seen as the disentangling of symbolic information from image data using models constructed with the aid of geometry, physics, statistics, and learning theory.
As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technological discipline, computer vision seeks to apply its theories and models for the construction of computer vision systems.

Potential Benefits
With the development of current software, our stakeholders are ready to deploy the module onto any manufacturer or government agency for the safety of public roads and intelligent driving. This module can be further enhanced and tweaked and can return concurrent maintenance and improving business.

Feasibility Statement
Our group comprises of individuals from required disciplines i.e. application development, software design, programming and electronics.

Recommendation
From a master's level of study, this project has been executed using Rasberry Pi but this time we want to develop a firmware which can be easily deployed on any platform.

Business Assessment

Situation Assessment and Problem Statement
From the statistics provided by the NSW Centre for Road Safety;
- Fatigue is one of the big three killers on NSW roads
- Fatigue-related crashes are twice as likely to be fatal - drivers who are asleep can't brake
- From 2013 to 2017, more people in NSW died in fatigue related crashes than drink driving crashes
- Being awake for about 17 hours has a similar effect on performance as a blood alcohol content (BAC) of 0.05

Proposed Scope

Scope Definition

Table 1: "Fatigue detection using Computer Vision" Proposed Scope

Element	Detail
Objective	
Outcome	A fatigue detection software.
Output	Detection module, integration module, Deployment module
Quality Criteria	The software should be optimised and should defer from current approach and can be easily deployed on any platform.
Customer(s)	The potential customers are car manufacturers, personal drivers, government agencies, ride share and fleet management companies.

Assumptions

The main assumptions are:

- All the team members are proficient in python
- The time allocated in the class will be sufficient for discussions.
- Drafted code can be easily shared among all the team members.
- All the team members are always on the same page of progress.

Constraints

The main constraints are:

- Dependence on ambient light
- Distance of camera from driver face
- Processor speed of hardware
- Use of spectacles
- Multiple face problem

Scope of Work

Initially different types of methods for measuring the drowsiness of the driver are discussed which includes Vehicle based measures, Physiological measures, Behavioral measures.
Using these methods an intelligence system can be developed which would alert the driver in case drowsy condition and prevent accidents. Advantages and dis advantages corresponding to each and every system will be explained. Depending on advantages and disadvantages the most suitable method is chosen and proposed. Then the approach for entire system development is explained using a flow chart which includes capturing the image in real time continuously, then dividing it in to frames. Then each frame is analyzed to find face first. If a face is detected, then then next task is

to locate the eyes. After the positive result of detecting eye the amount of closure of eye is determined and compared with the reference values for the drowsy state eye. If drowsy condition is found out, then driver is alarmed else repeatedly the loop of finding face and detecting drowsy condition is carried out.

Implementation Strategy

Theoretical base for designing the entire system is explained which includes Principal Component Analysis (PCA) and Eigen face approach. We know that the structure of face is complex and multidimensional. A face needs great calculating methods and techniques for recognizing it. In this our approach will be treating a face as a two dimensional structure and accordingly it should be recognized. Principal Component Analysis (PCA) is used for face recognition for this context. This idea involves the projection of face images onto that particular face space. Then we encode the variation or difference among the desired known faces. Eigen face decides and defines the face space. We represent these faces as eigen vectors. These vectors consist of all sets of faces. Cases of similarity with different features of our face appears like nose, Eyes, lips etc. The Eigen face approach uses the PCA for recognition of the images. The system performs by projecting preextracted face image onto a set of face space that represents significant variations among known face images. Eigen face approach in cludes Eigen Values and Eigen Vectors, Face Image Representation, Mean and Mean Centered Images, Covariance Matrix, Eigen Face Space.

The estimated resources that will be required to implement the proposed project are detailed in table.2 below.

Table <n>: <Project Title> Project Implementation Strategy

Element	Detail	Issues
Project Schedule	13 weeks	Possibility of extension in delivery due to the current pandemic covid-19
Budget Estimate	$100 approximately for the hardware	High resolution camera with good aperture may be expensive to get.
Other Resources	A computer hardware of minimum specification of a mac book	

Project Management Outline

Governance

Project Mentors:

- Dr. Mafruha Mowrin Hossain
- Dr. Mubashir Hussain

Key Risks and Issues

These major risks or issues will be investigated further should the project proceed:

- Compliance of the software with the government regulations
- Implementation of the software on multiple manufactured vehicles
- Deployment of software on multiple platforms
- The project should be completed in the given time.
- Extensions might be needed due to the COVID-19 pandemic.