TED UNIVERSITY

CMPE 491

Project Specifications

Project Name: Drive Safe-Off

Team Members

Gökçe BEKAR

Rabia Esra ŞENDUR

Rumeysa OMAY

Oğuzhan Uğur SARISAKALOĞLU

Supervisor

Venera ADANOVA

Jury Members

Aslı GENÇTAV

Orkunt SABUNCU

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1.Introduction

Accidents caused by sleepy drivers have become a major problem for society. Studies done so far show that there is a strong relationship between drowsiness and accidents. European Road Safety Observatory states that: "A person who drives after being awake for 17 hours has a risk of crashing equivalent to being at the 0.05 blood alcohol level (i.e. twice the normal risk)." Therefore, systems showing the driver's sleepiness level in vehicles gained speed in line with these facts.

In order to reduce the accidents caused by drowsiness, it was decided to develop software using image processing as a solution. The remainder of the report is as follows. In the description section, why the project is needed, the reasons for the need, and the function of the project will be mentioned. In the Constraint section, the difficulties we may encounter during the construction process of the project are mentioned. In the Professional and Ethical Issues section, the issues to be considered and followed by our teammates in the project are explained, and in the Requirements part, what should happen in a software project is mentioned.

1.1 Description

Drowsy driving has become the leading cause of accidents around the world. An estimated 21 percent of fatal accidents, 13 percent of accidents with serious injuries, and 6 percent of all accidents involve a drowsy driver.Determining the drowsiness as the cause of an accident is also extremely difficult at that time, as there are no tests that can be performed on the drive. Therefore, the best way to reduce or mitigate these types of accidents is to have the driver checked for drowsiness in the moment. The most accurate way to measure driver drowsiness is to monitor physiological signals such as heart rate, skin conductivity, and brain activity. However, such measurements require wires or equipment to be connected to the driver's body, which can cause discomfort and distraction.

Another commonly used technique is to study behaviors that could indicate that the driver is drowsy. The most popular approach is to use image processing to detect physical changes in a sleepy driver, including drooping eyelids, drooping of the head, and yawning. The methods used to detect drowsiness are as follows. There are various methodologies to determine the drowsiness of the driver.

Methodologies To Determine The Drowsiness Of The Driver

Behavioral methods

This method is based on detecting certain behavior exhibited by a driver in a drowsy state. Features such as continuous blinking or prolonged closure of the eye, shaking of the head or frequent yawning can be shown as evidence for drowsiness in this method.

Subjective methods

Physiologically, people needs to combat the fatigue of the human system. Human systems differ individually in challenging in this combat. By measuring these described their level of sleepiness, which is clearly a subjective assessment of their perception of drowsiness

Physiological methods

Physiological measurements relate with driver fatigue. Following physiological signals to detect drowsiness: electrocardiogram (ECG): heart rate can be easily determined by the ECG signal, electroencephalogram (EEG), Electrooculogram (EOG). To detect drowsiness using EEG, EOG and ECG alone, and combining their modalities to improve the performance of the drowsiness detection system. Difficulties (Cons): Providing and applying technologies

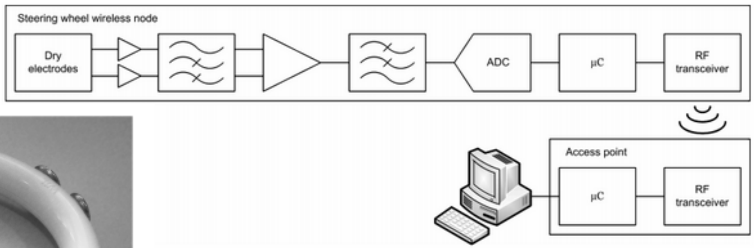

Fig. 1. Block diagram of the presented system.

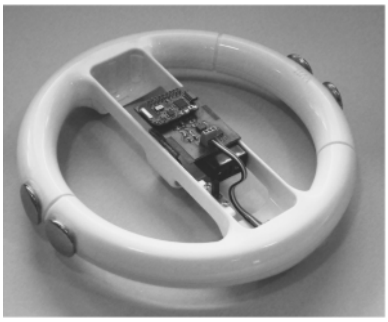

Fig. 2. Steering wheel wireless node prototype.

of sensor devices are challenging. (Even if Elon inputted the chip on a pig's brain now.)

Vehicle-based methods

One method of understanding the causes of drowsy driving accidents can be based on subjective evidence such as police crash reports and self-written reports by the driver after the incident. The results from the reports show that the behavior of the driver and behavior of the vehicles during these events generally exhibits characteristics such as higher speed with little or no breaking, a sleep-deprived driver losing concentration and drifting off the road or the crash occurs on a high-speed road.

Summary of Our Approach

In this project, we use behavioral methods which are shown below:

These techniques measure drivers' drowsiness thanks to behavioral parameters such as eye blinking, head position, yawning, etc.

1.2 Constraints

Some of the constraints faced by the system include:

- **Camera Motion**: Poor road conditions or a harsh and fast driving style can cause unwanted vibrations. Since these vibrations will be transferred to the camera, the images may be distorted. As a result, the performance and accuracy of the system may decrease.

- **Position Of the Camera:** For the computer vision algorithms to work, the camera must be at a certain distance and at a certain angle. Otherwise it will not be possible to get the desired result.

- **Lightning Condition:** Constant and sharp changes in light affect the performance of computer vision algorithms adversely. As a consequence of this, the accuracy of the system can be significantly affected.

- **Power:** There will be a limited power source so the solution needs to be designed so that it can operate properly on limited power requirements.

· **Hardware & Software Limitations:** Mobile devices usually have one or two processor cores. This reduces the working memory compared to desktop computers. All this significantly reduces energy consumption. However,considering the system we will establish, it poses a big obstacle. In addition, the second option is to use a Raspberry pi board and Raspberry pi camera module.Although accessing is very easy with Python and OpenCV, the fact that the raspberry camera module is as expensive as the raspberry pi card is a big limitation. Also, since they are fragile and sensitive equipment, purchasing a case for the Raspberry Pi board and camera housing for the Raspberry Pi camera module will increase the cost. Furthermore, when we consider that this technology will be used in the car, the necessity of having a power supply for Raspberry Pi is an important constraint. On the other hand, the field of computer vision and digital image processing interrupts the ai frameworks such as deep learning. If we consider touching these technologies in the future parts, we can adapt our approach with AI compute modules.

· **Testing the software:** Due to the difficulties that can be encountered in using hardware, an alternative way to test the software must be found.

These problems are as follows:
A suitable camera may not be found, even if there is a camera, testing may not be performed in the vehicle. For this reason, the videos on the internet that show the behavior of the drivers while driving will be used and the software will be tested in this way.

1.3 Professional and Ethical Issues

Honesty is the best policy.
—English proverb, pre-1600

Developers have been achieving things that are monitoring the reflection of the real world for years, and for all that time solution maker developers faced ethical challenges as well as opportunities for their monitoring facilities. Our purpose in our state of the art approach is solving this dilemma that occurs when receiving and exploring the visual data is recorded in the entire driving session. In this way, we have to assess our responsibility to our customers and must explain the limitations and uncertainties to users.

Providing guidance is an essential behavior of being honest developers to people. We must report the risks that treat the ethics of the people to the user from the beginning. In this way, these declarations can be categorized by two: individuals and the community governance side that need to be investigating rules of rule makers such as KVKK. Currently, planning to use frameworks of solution comes with application issues.:

- Identity theft

Identity theft is a process of stealing another individual’s identity for various malicious purposes, such as obtaining various benefits in the name of another person. The personal data that is targeted by theft can be credit cards, passports and driver’s licenses. For example, data we process can store sensitive personal information.

- Discrimination

- Espionage
- Malicious Attacks

The exclusive features of - in car - drowsiness detection systems may be the networked, data-driven response capabilities through smart components and integrated IoT devices. Such a system built up with relative framework can be guide us

As the stack of issues listed above the living product can be faced with extraordinary scenarios such as psychological harm that appears when feeling monitored. As a result, we examine the feedback, usages, etc.

When we consider it professionally, releasing the product as an open source software can lead to tension between users obeying their ethics and product.

2. Requirements

There are some requirements the system must meet in order to prevent traffic accidents efficiently. The requirements decided at the beginning of the project are stated below. During the project process these requirements can change, new requirements can be added, and changes in requirements will be noted in the next reports. Requirements are examined under two headings:

2.1 Functional Requirements

- The system should be able to process images while driving.
- The system will warn when the drowsiness exceeds a certain value.
- The system must be able to calculate the yawning time.
- The system should be able to calculate the amount of blinking and how long it was off.
- The system must be able to calculate the time for head movement the driver does other than looking at the road.

2.2 Non-Functional Requirements

Performance / Response Time: A device that is unable to detect drowsiness and warn the driver inefficiently can have severe consequences. The response time of the device should be fast and the alert should be effective enough to make the driver sober up.

Reliability: The system should identify drowsiness correctly so that it can serve its function as a driver safety promotion device. The system defect rate shall be less than 1 failure per 1000 hours of operation.

Availability: The system should always be ready for use (7/24).

Maintainability: The system shall not be shut down for maintenance more than once in a 24-hour period.

Economical: There are existing solutions to this problem available today, but for broad implementation, the successful ones are typically too costly.

Usability: The use of the device should be as simple as possible. People who are not trained to use the system will be able to use the product.

Security: The driver's personal information shall not be accessed or reached by anyone.

Accessibility: The system shall be accessible to a wide range of driver as well as the prevalence of driver's license.

Efficiency: The system restart cycle must execute completely in less than 60 seconds.The system should deliver a notification in 1 second or less.

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