S-EYE: DRIVER BEHAVIOUR ANALYSIS USING DEEP LEARNING

A PROJECT DESIGN REPORT

submitted by

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to the APJ Abdul Kalam Technological University
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Bachelor of Technology

in

Computer Science & Engineering

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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CERTIFICATE

This is to certify that the project design report entitled **'S-EYE: DRIVER BEHAVIOUR ANALYSIS USING DEEP LEARNING'** submitted by **ANJANA ANIL (TOC19CS016), ARATHI P KUMAR (TOC19CS018), LINA ANIL (TOC19CS038) and SEBA ABRAHAM (TOC19CS054)** during the seventh semester, is a bonafide record of the project work carried out by them in partial fulfillment of the requirements for the award of B.Tech degree in Computer Science & Engineering of the APJ Abdul Kalam Technological University, under our guidance and supervision, during the academic year 2022 - '23. This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

We, hereby declare that the project design report 'S-EYE: DRIVER BEHAVIOUR ANALYSIS USING DEEP LEARNING' submitted in partial fulfillment of the requirements for the award of degree of Bachelor of Technology in Computer Science & Engineering, of the APJ Abdul Kalam Technological University, Kerala, is a bonafide work done by us under the supervision of Mrs. Mima Manual, Assistant Professor, Dept.of CSE, Toc H Institute of Science and Technology. This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources. We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the Institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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PSO2: Successful Career and Entrepreneurship: Gain knowledge in diverse areas of Computer Science and experience an environment conducive in cultivating skills for successful career, entrepreneurship and higher studies.

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CO1: Model and solve real world problems by applying knowledge across domains (Apply).

CO2: Develop products, processes or technologies for sustainable and socially relevant applications. (Apply)

CO3: Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks. (Apply)

CO4: Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms. (Apply)

CO5: Identify technology/research gaps and propose innovative/creative solutions. (Analyze)

CO6: Organize and communicate technical and scientific findings effectively in written and oral forms. (Apply)

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ABSTRACT

An accident is an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury. Drivers easily get distracted by the activities happening around them such as texting, talking on a mobile phone, or talking to a neighboring person. All these activities take the driver´s attention away from the road which may lead to accidents and cause harm to the driver, pedestrians, and other vehicles on the road. Researchers have been working for more than a decade on designing driver inattention monitoring systems. As a result, several detection techniques for the detection of both drowsiness and distraction have been developed. Here we´re proposing S-EYE:- A system for Driver Behavior Analysis using Deep Learning. The purpose of the behavior analysis system in vehicles is to aid in the prevention of road accidents. This system will detect the early symptoms of drowsiness before the driver has fully lost all attentiveness by sending a notification to the drivers friends or acquaintance and it also identifies risky driving behavior and warn the driver that they are no longer capable of operating the vehicle safely. Insights into driving behavior can help automotive manufacturers to optimize design and production, manage quality,improve safety, and simplify maintenance. The system also includes a fleet analysis which will be send to the driver at the end of the day.This option will be beneficial to cab service providers, who can keep their records based on driver performance. A good first step in detecting driver distraction or inattention is to monitor the driver´s head pose and gaze direction which infers quite reliable information about driver distraction.The head pose and gaze direction of the driver can be measured by applying computer vision techniques properly. We aim at helping drivers for detecting their moments of distraction and warning them. We believe that aggregation of the outputs from the camera system would yield more robust and reliable decisions. The operation of our system is described in these steps: Data adjustment and standardization, identification of driving actions, examination of driver behavior, evaluation of trips, and assessment of driver performance.

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LIST OF ABBREVIATIONS

Abbreviation	Expansion
CNN	Convolutional Nueral Network
ITS	Intelligent Transport System
PVT	Psychomotor Vigilance Task
RNN	Recurrent Neural Network
PERCLOS	Percentage of Eyelid Closure Over Time
GPS	Global Positioning System
LSTM	Long Short-Term Memory
VGG	Visual Geometry Group

Chapter 1

INTRODUCTION

Road accidents are a major public health problem that result in millions of deaths every year worldwide. According to recent data, human factors are the predominant cause of these accidents, accounting for a staggering 90% of all injuries. The main causes of road accidents are speeding, drunk driving, drug use, and health issues. In addition, driver drowsiness and distraction are significant contributors, with distraction being a result of human error and drowsiness being a dangerous condition that impairs a driver's ability to operate a vehicle safely. In order to address this issue, there has been an increasing focus on the development of innovative technologies and techniques that can detect and prevent driver drowsiness and distraction. One of the most promising approaches is the use of Intelligent Transportation Systems (ITS), which are designed to improve public safety and reduce the number of road accidents. ITS technology uses a variety of sensors and cameras to monitor driver behavior and provide real-time feedback and alerts to help prevent accidents.

Driver fatigue and monotony, especially on rural roads, is another major factor contributing to road accidents. Fatigue reduces a driver's perception and decision-making ability, making it more difficult for them to control the vehicle. Research has shown that after one hour of driving, a driver is typically fatigued, and this risk is even higher in the afternoon, after lunch, and at midnight. Alcohol consumption, drug addiction, and the use of hypnotic medications can also lead to loss of consciousness, which can result in devastating accidents.In conclusion, road accidents are a major problem that result in millions of deaths every year. Human factors, such as speeding, drunk driving, drug use, and drowsiness and distraction, are the main causes of these accidents. To address this issue, innovative technologies and techniques are being developed to improve public safety and reduce the number of road accidents. Driver fatigue and monotony, as well as alcohol consumption and drug addiction, also play a major role in road accidents and must be addressed to prevent further casualties.

Driver fatigue and distraction are significant contributors to road accidents and are reported as the main cause of approximately 20% of crashes and 30% of fatal crashes in different countries. In single-vehicle accidents or those involving heavy vehicles, up to 50% of accidents have been linked to driver hypovigilance. To address this issue, the development of driver face monitoring systems has been proposed as a solution. Driver face monitoring systems are real-time systems that monitor the physical and mental state of a driver based on the processing of the driver's face images. The system can estimate the driver's state based on various factors, including eye closure, eyelid distance, blinking, gaze direction, yawning, and head rotation. If the system detects hypovigilance, such as drowsiness or distraction, it will emit an alarm to alert the driver. The major components of a driver face monitoring system include the imaging hardware, platform, and intelligent software.

Studies have shown that the implementation of driver face monitoring systems has the potential to reduce the number of crashes by 10% to 20%. This is because the system provides real-time feedback to the driver, alerting them of any signs of drowsiness or distraction and allowing them to take corrective action before an accident occurs. Furthermore, the driver face monitoring system can also help to identify any underlying medical conditions that may contribute to driver fatigue and distraction, allowing for appropriate medical treatment to be sought. Hence, driver fatigue and distraction are major contributors to road accidents, and the implementation of driver face monitoring systems has the potential to reduce the number of accidents by up to 20%. The system provides real-time feedback to the driver and helps to identify underlying medical conditions that may contribute to fatigue and distraction. By providing an extra layer of safety and protection for drivers, these systems have the potential to save lives and prevent accidents on our roads.

Researchers and scientists have been trying to find a way to precisely define and measure fatigue for years. Despite the advancements in physiology and psychology, there is still no universally accepted definition or criterion for fatigue [3]. However, some symptoms such as body temperature, electrical resistance of skin, eye movement, breathing rate, heart rate, and brain activity have been found to be related to fatigue [2] [3]. These symptoms can help us to determine the presence of fatigue. Eye closure detection is one of the most widely used methods to measure fatigue in driver face monitoring systems. This is because there is a close relationship between the response speed of a person to a visual stimulation (as measured by Psychomotor Vigilance Task or PVT) and the percentage of eyelid closure over time (PERCLOS). When a person is fatigued, the response speed to a visual stimulation decreases and the eyelid closure increases.

Measuring driver attention to the road is another challenge in the driver face monitoring system. The driver's attention can be partially estimated from the head and gaze direction.

However, simply looking towards the road does not necessarily mean that the driver is paying attention to it [3]. Previous studies have shown that driver inattention is a major cause of many accidents. To reduce accidents and improve public safety, the analysis of driver responsiveness has become an important area of investigation. Driver Behaviour Monitoring Systems are important for people who need continuous monitoring, which cannot be provided outside of hospitals. Automobile manufacturers are now paying attention to developing vehicles with IoT-enabled technology that includes services such as healthcare, accident prevention, vehicle safety, driver safety, driver and passenger comfort, vehicle monitoring, and more.

In conclusion, the main challenges in the driver face monitoring system are (1) “how to measure the fatigue?” and (2) “how to measure the concentration?”. Although there is no universally accepted definition for fatigue, researchers are finding ways to measure it by analyzing related symptoms [3]. Measuring driver attention is also challenging, as simply looking towards the road does not necessarily mean that the driver is paying attention to it. However, the development of Driver Behaviour Monitoring Systems is important for ensuring the safety and well-being of drivers and passengers on the road.

1.1 BACKGROUND

Driver behavior analysis systems have been gaining increasing attention and importance in recent years due to growing concerns about road safety and the number of traffic accidents caused by fatigued or distracted driving. This type of system aims to monitor and analyze the behavior of drivers while they are on the road and detect any signs of fatigue or distraction that may put the driver, passengers, or other road users at risk.

The development of driver behavior analysis systems is driven by various stakeholders in the automotive and transportation industry, including automobile manufacturers, government organizations, insurance companies, and fleet management organizations. These stakeholders recognize the need for a technology that can help reduce the number of traffic accidents caused by driver fatigue or distraction, and they are investing in research and development to make this a reality. The proposed system works by using various sensors and cameras to monitor the driver’s behavior and physiological responses. For example, the system may monitor the driver’s eye movements, heart rate, and skin resistance to detect signs of fatigue. It may also monitor the driver’s head and gaze direction to detect signs of distraction. If the system detects any signs of fatigue or distraction, it will trigger a warning alarm that can be turned off by the driver. If the driver does not react within a certain amount of time, the system will notify the driver's family or another designated target with an alert message.

One of the key features of the driver behavior analysis system is the time-series analytics that it provides. This analytics allows fleet managers and other stakeholders to evaluate the driving behavior of individual drivers and routes. This information can be used to identify areas where improvements can be made and to help drivers improve their driving behavior. The goal of this type of system is to reduce the number of traffic accidents and to improve road safety for everyone.

To increase the performance of existing driver behavior analysis systems, innovative and optimal solutions are necessary. The proposed system is designed to do just that, by using cutting-edge technology and advanced algorithms to detect signs of fatigue or distraction more accurately and with greater reliability. Ultimately, the goal of this type of system is to help reduce the number of traffic accidents and improve road safety, making our roads a safer place for everyone.

A few more aspects that can be added to the background of driver behavior analysis system are:

1. Technological advancements: The advancements in the field of computer vision, artificial intelligence, and machine learning have greatly influenced the development of driver behavior analysis systems. The use of cameras, sensors, and algorithms has made it possible to accurately monitor driver behavior in real-time.

2. Increasing road safety concerns: The increasing number of road accidents has led to a growing concern for road safety. Driver behavior analysis systems aim to address this issue by detecting and addressing the driving behaviors that contribute to accidents.

3. Government regulations: Many governments are implementing regulations and policies aimed at improving road safety. These regulations often require the use of driver behavior analysis systems in commercial vehicles, such as buses and trucks, to ensure the safety of passengers and other road users.

4. Insurance industry: The insurance industry has also shown interest in driver behavior analysis systems as it can help to reduce the number of accidents and, in turn, the cost of insurance claims. The use of these systems can also aid in determining the cause of an accident and assigning liability.

5. Fleet management: Driver behavior analysis systems are also commonly used in fleet management to monitor the driving behavior of commercial vehicle drivers. The use of these systems helps to improve the efficiency and safety of the fleet, which can have a significant impact on the bottom line of the business.

6. Ethical and privacy considerations: The use of driver behavior analysis systems raises several ethical and privacy concerns. The collection and use of personal data, such as facial expressions and eye movements, must be done in accordance with privacy laws and regulations.

Ultimately, driver behavior analysis systems play a crucial role in improving road safety and reducing the number of accidents. With the advancements in technology and growing concerns for road safety, the development and use of these systems is expected to continue to grow in the coming years.

1.2 RELEVANCE

The use of driver behavior analysis systems is becoming increasingly relevant as a means of reducing the number of road accidents caused by driver inattention and distraction. While technology has played a significant role in the automation of driving, it has also become a major source of driver distraction. The advent of smartphones and other digital devices has increased the risk of driver distraction, as these devices compete for the driver's attention while they are driving. Driver inattention and distraction have been identified as the leading causes of road accidents, and these incidents have become a major public health and safety concern. The use of driver behavior analysis systems can help to address these problems by detecting the signs of driver fatigue and distraction, and issuing timely warnings to the driver. The systems can also be used to monitor driver behavior and provide feedback to the driver on areas where improvement is needed. This information can be used by the driver to make necessary adjustments to their driving style, or to seek treatment if needed, thus improving their overall safety on the road.

In addition to reducing the number of road accidents, the use of driver behavior analysis systems also has significant financial benefits. By reducing the number of road accidents, the systems can save significant amounts of money in terms of insurance premiums, medical expenses, and legal costs. Additionally, the reduced number of road accidents can reduce the burden on the healthcare system and free up resources for other areas of need.

Furthermore, the use of driver behavior analysis systems has the potential to improve the overall efficiency of transportation systems. By monitoring driver behavior and performance, fleet management companies can optimize routes, reduce fuel consumption, and reduce wear and tear on vehicles, resulting in cost savings and increased operational efficiency. In conclusion, the use of driver behavior analysis systems is becoming increasingly important as a means of improving road safety and reducing the number of road accidents caused by driver inattention and distraction. The systems offer significant financial benefits, and have the potential to improve the overall efficiency of transportation systems. As technology continues to advance, it is likely that the use of these systems will become more widespread, leading to an even greater reduction in the number of road accidents and a corresponding improvement in road safety.

Driver inattention and distraction are the main causes of road accidents and these accidents often result in fatalities. To address this issue and reduce road accidents, the development of information systems to detect driver inattention and distraction has become essential. Currently, distraction detection systems for road vehicles are not widely available or are limited to detecting specific causes of driver inattention such as fatigue.

Despite the increasing automation of driving, the human driver will continue to play a significant role in supervising vehicle automation. A large number of road accidents are caused by driver fatigue and as a result, a system that can detect driver fatigue and issue a timely warning could help in preventing many accidents. By doing so, it will also help save money and reduce personal suffering.

The relevance of driver behavior analysis is paramount in ensuring road safety and reducing the number of road accidents. It is important to note that the development of these systems should keep pace with the increasing sophistication of vehicle assistance systems to accurately detect and address driver distraction and inattention. This will be a crucial step in enhancing road safety and reducing road accidents.

Relevance of driver behaviour analysis are:

1. Improved Road Safety: By detecting driver inattention, fatigue, and distraction, these systems can help reduce the number of road accidents and improve overall road safety. By providing real-time warnings and alerts, these systems can help prevent dangerous driving behavior and reduce the risk of collisions and other accidents.

2. Increased Productivity: By analyzing driver behavior, these systems can help identify

areas for improvement and help drivers develop better driving habits. This can lead to increased productivity, as drivers are able to drive more efficiently and safely.

3. Enhanced Fleet Management: In the case of fleet management, these systems can help optimize routes, reduce fuel consumption, and monitor driver behavior to ensure that company policies and regulations are being followed.

4. Reduced Costs: By reducing the number of road accidents and improving driver behavior, these systems can help reduce costs associated with insurance, vehicle maintenance, and other expenses.

5. Improved Driver Performance: These systems can also provide drivers with feedback on their performance, helping them to identify areas for improvement and make necessary changes. This can lead to improved driving habits and a reduction in dangerous driving behavior.

Overall, driver behavior analysis systems play a crucial role in promoting road safety and improving driver performance. By detecting and addressing inattention, fatigue, and distraction, these systems can help reduce the number of road accidents and improve overall driving habits.

Chapter 2

LITERATURE REVIEW

2.1 A SMARTPHONE-BASED DROWSINESS DETECTION AND WARNING SYSTEM FOR AUTOMOTIVE DRIVERS

Anirban Dasgupta , Member, IEEE, Daleef Rahman, and Aurobinda Routray

Publisher: IEEE

Year: 2019

This paper presents a smartphone-based system for the detection of drowsiness in automotive drivers. The proposed framework uses three-stage drowsiness detection. The front camera's images are used in the first stage to determine the percentage of eyelid closure (PERCLOS) using a modified eye state classification approach. The second step uses the voiced to the unvoiced ratio obtained from the speech data from the microphone, in the case PERCLOS crosses the threshold. A final verification stage is used as a touch response within a stipulated time to declare the driver as drowsy and subsequently raise an alarm. The device keeps track of periodic metrics events in a log file together with the related GPS locations.

2.1.1 ADVANTAGE

- Smartphones are widely available these days, thus like other solutions, a driver or automobile owner does not need to purchase additional hardware for the purpose.
- The smartphones are equipped with high fidelity sensors for image and speech data acquisition which does not require connection of external add-ons.

2.1.2 DISADVANTAGE

- It is difficult for the user to always fix the phone whenever they use the car.
- There is chance that people might not have smart phone with greater specifications.
- Large amount of data to be processed, hence reduced efficiency.

2.2 DRIVER FATIGUE DETECTION USING RECURRENT NEURAL NETWORKS

Younes Ed-doughmi,Najlae Idrissi

Publisher: ResearchGate

Year: 2019

Analyze driver drowsiness by applying a new recurrent neural network architecture to frame sequences of a driver. They used a public data set to train and validate the model and applied a recurrent neural network architecture called ”long short-term memory” to detect driver drowsiness. The idea of RNN is to use sequential information and execute the same task for each element of a sequence from where the name has recurred. RNN use memory to capture the state of events calculated in the past. Here the mobile application will use the phone's camera to capture a sequence of frames at a frequency of 5 frames a second. Through the drowsiness prediction model, computations will be performed in real-time. If the model predicts drowsiness, a visual and audio message will be run on the user's phone.

2.2.1 ADVANTAGE

- This architecture respond well to the sequential problem.
- The cutting of videos from the dataset was preferred to better extract sequences that reflect drowsiness and avoid sequences that can distort the learning results.

2.2.2 DISADVANTAGE

- Cases in which the driver is extremely drowsy but does not change posture cannot be detected.
- LSTM consume more memory and time.

2.3 MULTIMODAL SYSTEM FOR DRIVER DISTRACTION DETECTION AND ELIMINATION

Abdulrahman Abououf, Ibrahim Sobh, Mohammad Nasser Omar Alsaqa, Omar Elezabyand John F. W. Zaki

Publisher: IEEE

Year: 2022

In this research paper, a proposed hybrid approach is presented. The approach is based on deep learning to detect the driver's actions and eliminate the driver's distraction as a packed solution. The detection is performed by analyzing the driver's actions and his head pose. The elimination is by using voice commands that are based on trigger words, speech to text, and text classification models to access the car's functions such as the air-condition, radio, etc. The driver is monitored by two cameras. One of the cameras is fitted exactly in front of the driver to capture images of the face. It then sends the images to the head pose detection model. The other camera is placed in the passenger side on the front pillar. It captures images of the driver's full body. The images are sent to the action classification model. Additionally, a microphone is placed near the driver to capture his commands. It sends the commands to the speech recognition and command classification models. If the classification of the driver's action meant something dangerous, the device will play an alarm message to alert the driver of the behavior.

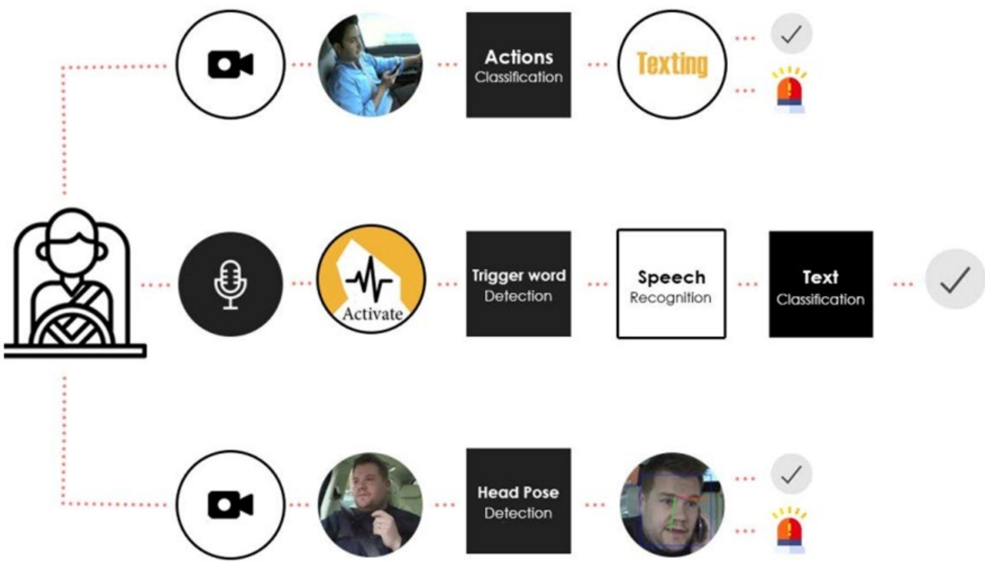

Figure 2.1: System components

2.3.1 ADVANTAGE

- The system provides full-time safety against different distractions by alarming the driver when a distraction is detected.
- The proposed software model and hardware deliver an affordable device for the automobile industry.

2.3.2 DISADVANTAGE

- There is no proper way to handle unrecognizable commands.Thus leads to unexpected behaviour of the system.
- Comparingly high inference time.

2.4 AUTOMATIC DRIVER DISTRACTION DETECTION USING DEEP CONVOLUTIONAL NEURAL NETWORK

Md. Uzzol Hossain, Md. Ataur Rahman, Md. Manowarul Islam, Arnisha Akhter ,Md. Ashraf Uddin, Bikash Kumar Paul
Publisher:ResearchGate
Year: 2022

This paper propose a system to tackle the issue of driver distraction, which is one of the leading causes of road accidents worldwide. They recognized the importance of monitoring and analyzing driver behavior during driving to detect distraction and reduce the number of road accidents. To detect various forms of distraction, such as using a cellphone, talking to others, eating, sleeping, or lack of concentration during driving, the authors proposed using machine learning and deep learning techniques. Specifically, they developed a Convolutional Neural Network (CNN) based method for detecting distracted drivers and identifying the cause of distraction [6].

They adopted four different CNN architectures for transfer learning, including CNN, VGG-16, ResNet50, and MobileNetV2. The proposed model was trained using a publicly available dataset containing images of ten different postures or conditions of a distracted driver. The performance of the model was evaluated using various performance metrics.

2.4.1 Convolutional Neural Network (CNN)

They have used a Convolutional Neural Network (CNN) as the basis for their proposed method to detect distracted drivers. The reason for choosing a CNN is due to its ability to effectively classify images and detect objects. The architecture of a CNN consists of three main layers: a convolutional layer, a pooling layer, and one or more fully connected layers [7]. The convolutional layer is responsible for detecting patterns and features in the input image through the use of filters. These filters are applied to the input image and generate feature maps, which are then passed onto the next layer. The pooling layer performs down-sampling of the feature maps to reduce the computational cost and preserve only the most important information.

Finally, the one or more fully connected layers make the predictions by taking the output from the pooling layer and making a decision based on the features learned by the previous layers. In the case of the authors' work, the CNN is used to detect distractions in drivers, such as talking, sleeping, or eating, by analyzing the driver's face and hand movements.

2.4.2 VGG-16

The VGG-16 is a Convolutional Neural Network (CNN) architecture that has gained popularity due to its standardized structure and efficiency in extracting features from images. It has a total of 16 convolutional layers, which is why it's named VGG-16. The convolutional layer of VGG-16 uses 3x3 filters with a stride of 1 and employs 2x2 max-pooling with a stride of two. This simple architecture with fewer hyperparameters has made VGG-16 a popular choice for transfer learning. In transfer learning, pre-trained models are fine-tuned on the target dataset to extract features that are specific to the task at hand. The pre-trained VGG-16 model is trained on a large image dataset and can be fine-tuned to suit the needs of different computer vision tasks. In conclusion, VGG-16 is a standard and reliable choice for extracting features from images for computer vision tasks.

2.4.3 ResNet50

ResNet50 is a convolutional neural network architecture that consists of 50 layers. It includes 48 Convolutional layers, one MaxPool layer, and one Average Pool layer. The structure of ResNet50 is designed to allow for stacking additional layers which makes it useful for image recognition. Unlike traditional classification architectures such as VGG-

16, ResNet-50 has shown to be faster and less computationally intensive. The direct linking of the input of the nth layer to the (n+x)th layer is a unique aspect of ResNet50, which contributes to its performance and computational efficiency.

2.4.4 MobileNet-v2

MobileNet-v2 is a deep convolutional neural network (CNN) with 53 layers. It is designed to be a powerful feature extractor that can detect and segment objects in an image. The network is built on an inverted residual structure, which involves adding residual connections between the bottleneck layers. The inverted residual structure helps in preserving the information from the earlier layers and allows for more efficient use of computational resources. Additionally, the MobileNet-v2 architecture is optimized for deployment on mobile devices, making it ideal for real-time object detection and classification tasks with limited computational resources.

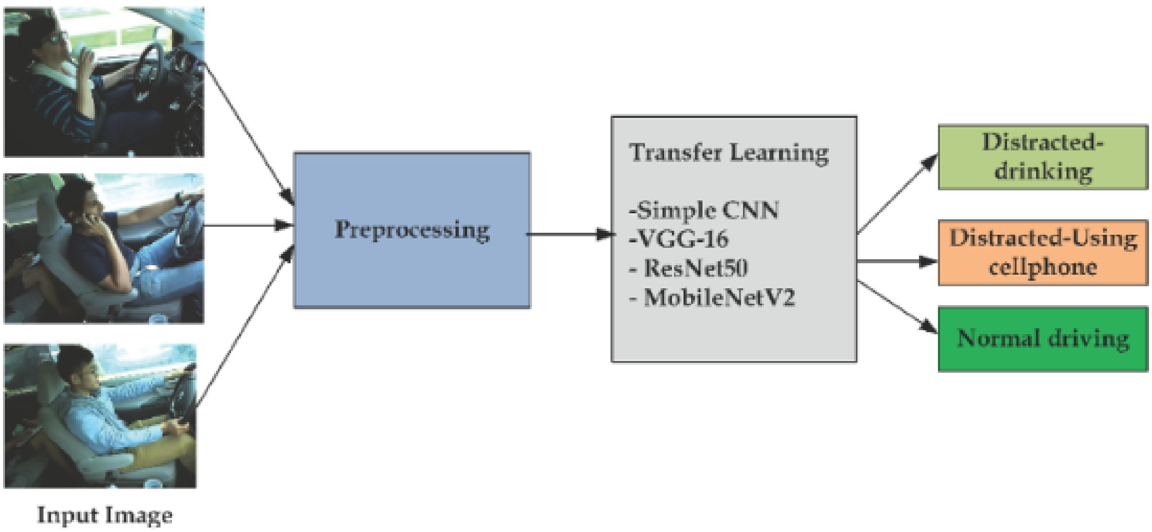

Figure 2.2: Proposed Schematic Diagram

It is found that the ResNet50 and MobileNetV2 models provided the highest accuracy, at 94.50% and 98.12% respectively. They concluded that their proposed model could be used to design real-time driver distraction detection systems, and they are planning to develop an Android application for real-time distraction detection in the future. The results showed that the pre-trained MobileNetV2 model had the best classification efficiency.

In summary, this paper have made a significant contribution to the field of driver behavior analysis by developing a CNN-based model for detecting distracted drivers and identifying the cause of distraction. The proposed model showed promising results and has the potential to be used in real-world applications to improve road safety and reduce the number of road accidents caused by driver distraction.

2.4.5 ADVANTAGE

- Dataset containing large number of images is used.
- Pre-trained MobileNetV2 model has the best classification efficiency and exhibits lower training loss.

2.4.6 DISADVANTAGE

- Fatigue detection is not performed.
- There is no warning system.

2.5 REAL TIME DRIVER'S MONITORING MOBILE APPLICATION THROUGH HEAD POSE,DROWSINESS AND ANGRY DETECTION

HamimahUjir, Ee Min Jee, Mohammad FarhaanIqbal, QanKhaiMun,IrwandiHipiny
Publisher: IEEE
Year: 2021
This project proposes a framework of using mobile devices and cloud services to monitor the driver's head pose, detect angry expression and drowsiness, and alerting them with audio feedback. With the help of a phone camera functionality, the driver's facial expression data can be collected then further analyzed via image processing under the Microsoft Azure platform. Whenever an angry or drowsy face is detected, pop-up alert messages and audio feedback will be given to the driver.

2.5.1 ADVANTAGE

- Reduces the number of cameras used behind the steering wheel,making the driving environment more comfortable.
- The benefit of this mobile app is it can remind drivers to drive calmly and safely .

2.5.2 DISADVANTAGE

- Processing can be difficult depending on the difference in the clarity of mobile camera used.

Chapter 3

PROBLEM IDENTIFICATION AND OBJECTIVES

3.1 SYSTEM STUDY

The issue of driver fatigue and distraction has been a major cause of traffic accidents for many years. As a result, on-board monitoring of driving behaviors has become an important aspect of advanced driver assistance systems (ADAS) for intelligent vehicles. In this paper, we aim to address this issue by presenting techniques to detect fatigue, drowsiness, and distracted driving behaviors through vision and machine learning approaches.

To detect fatigue driving, we use facial features to determine if the driver's eyes are open or closed, if they are yawning, and their head posture. A random forest algorithm is used to analyze the driving conditions and make predictions. On the other hand, to detect distraction, a convolutional neural network (CNN) is used to classify various distracted driving behaviors. Experiments were conducted on a PC and embedded hardware platform using a public dataset taken from kaggle for training and testing purposes. The results of the experiments indicate that our proposed method outperforms previous approaches in terms of accuracy and computation time.

The proposed system is designed to detect tired or distracted driving behaviors, provide real-time alerts to the driver in emergency situations, and send warning notifications to the intended target. If the system detects that the driver is drowsy or distracted, an alarm will be activated in the car which the driver must switch off. If the driver fails to do so within a set period of time, the system will conclude that the driver is unconscious and a notification will be sent to their relatives. In addition, the system provides analytics over time for every driver and route, helping to reduce the frequency of traffic collisions. The data collected over time can be used for fleet analysis, providing insights into the driving habits of each driver and helping to identify areas for improvement.

In summary, the proposed system offers a solution to the problem of driver fatigue and distraction, and helps to mitigate the number of road accidents. The use of machine learning and vision-based approaches provides a more accurate and efficient method for detecting these behaviors, leading to a safer driving experience for all.

3.2 PROBLEM DEFINITION

The proposed system is designed to detect and mitigate the number of road accidents caused by driver distraction or drowsiness. It uses a combination of real-time alerts and warning notifications to alert the driver of potentially dangerous driving conditions. The system is equipped with an alarm that is triggered when the driver is detected as distracted or drowsy. The alarm must be switched off by the driver, and if it is not turned off within a certain amount of time, the system will conclude that the driver is unconscious and send a notification to the driver's relatives. In addition to providing real-time warnings, the system also provides analytics to help monitor and improve driver behavior over time. It provides fleet analysis by tracking the behavior of individual drivers and the routes they drive. This information can be used to identify areas where improvement is needed and to implement targeted training programs to reduce the number of road accidents.

Overall, the proposed system is a valuable tool in the effort to improve road safety and reduce the number of accidents caused by driver distraction or drowsiness. It provides real-time warnings, analytics, and training programs to help drivers and fleets improve their behavior and reduce the risk of accidents.

3.3 OBJECTIVES OF THE PROJECT

The proposed approach in this paper aims to address the issue of fatigue and distraction during driving which are significant contributors to traffic accidents. The method aims to detect the driving behavior and conditions of the driver in real-time, and provide necessary alerts and warnings in emergency situations.

The system employs facial features to detect fatigue by analyzing the driver's eye movements, yawning and head posture. A random forest algorithm is used to analyze the driving conditions to determine if the driver is tired or not. For distraction detection, a convolutional neural network (CNN) is used to classify various distracted driving behaviors. In case the system detects that the driver is drowsy or distracted, an alarm will be activated inside the vehicle which must be turned off by the driver. If the driver fails to do so within the set period of time, the system will conclude that the driver is unconscious and a notification will be sent to the driver's family. This system offers better accuracy and computation time compared to previous methods. The system also provides fleet analysis by providing analytics over time for each driver and route. This helps in reducing the number of traffic accidents and provides insights on the driving habits and conditions of each driver. This information can be used to make necessary improvements to reduce the risk of accidents.

Thus, the proposed system aims to ensure the safety of the driver and other road users by detecting and mitigating the risk of fatigue and distraction during driving. The real-time alerts, warning notifications, and fleet analysis offered by the system will play a crucial role in reducing the number of traffic accidents and promoting safe driving habits.

Chapter 4

PROBLEM ANALYSIS AND DESIGN METHODOLOGY

Accidents are undesirable incidents that occur spontaneously and without warning and frequently cause harm or injury. The things going on around them, including texting, using a phone, or chatting with a neighbour, can easily divert drivers. All of these activities divert the driver's focus from the road, which increases the risk of accidents and harm other road users including pedestrians and other cars. Designing technologies to monitor driver inattention has been the focus of researchers for more than 10 years. As a result, numerous detection methods for both distraction and tiredness have been created. S-EYE is what we're suggesting here. - A deep learning-based system for driver behaviour analysis.

The proposed behaviour analysis system for cars is designed to help prevent traffic accidents. This technology can identify the first symptoms of intoxication before the driver lose complete awareness. It can also spot unsafe driving patterns and alert the driver that they are no longer capable of driving safely. Automotive manufacturers can improve design and production, regulate quality, increase safety, and make maintenance easier with the use of insights into driving behaviour. Driver is alerted when they are found to be distracted and their behaviour is identified. Additionally, when a medical emergency occurs, mobile push notifications are sent to the specified recipients.

4.1 MODULES PROPOSED

The proposed system uses a dashboard camera to monitor the driver's behavior and alert them if they appear to be distracted, fatigued, or drowsy. If the driver is unable to turn off the alarm, it could indicate that they are unconscious or fatigued, and a notification would be sent to the intended recipient. The system would also provide a fleet analysis report at the end of the day.

First, the dashboard camera captures video of the driver while driving. This video is then pre-processed to identify any potential distractions, fatigue, or drowsiness. The CNN algorithm is then used to classify the images based on the pre-processed models within the jetson nano.

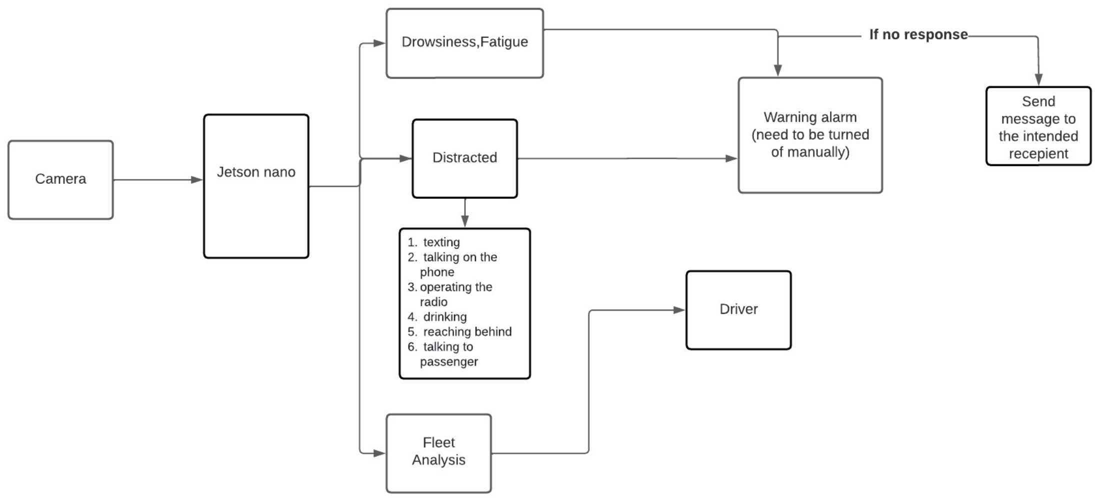

Figure 4.1: Block Diagram Of The Proposed System

Classification of images from the dashboard camera is done by convolutional neural network (CNN) algorithm. CNNs are a type of artificial neural network that are particularly well-suited for image classification tasks. They can learn to recognize patterns in images by analyzing the relationships between the pixels in the image and the associated label (e.g., ”distraction,” ”fatigue,” or ”drowsiness”).

To train the CNN a dataset of labeled images is provided. This dataset include a variety of images that represent the different categories(e.g., distraction, fatigue, drowsiness). Now this dataset can be used to train the CNN to recognize the patterns associated with each category.

Once the CNN is trained, you can use it to classify new images from the dashboard camera in real-time. If the CNN predicts that the driver is distracted, use an alarm to alert the driver. If the driver is unable to turn off the alarm, it indicates that the driver is unconscious or fatigued, and a notification would be sent to the intended recipient.

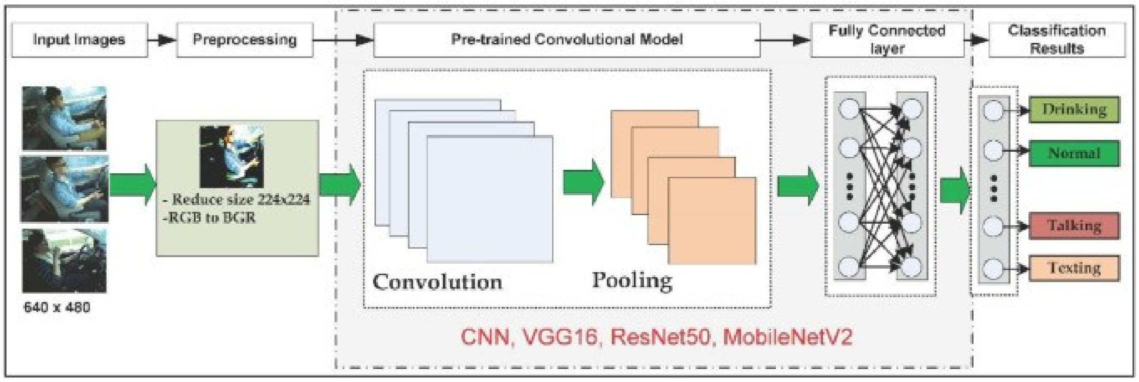

Figure 4.2: Convolutional Neural Network

Jetson Nano can be used to analyze driver behavior by utilizing machine learning algorithms to classify images captured by a camera into drowsy or distracted states. The camera can be mounted on the dashboard of a vehicle and can capture videos of the driver's face.

To classify the driver's state, the Jetson Nano can be trained on a dataset of images labeled as either drowsy or distracted. The machine learning algorithm can then analyze the features of the images, such as the position of the eyes, the amount of eye closure, and facial expressions, to determine the driver's state.

Once trained, Jetson Nano can continuously analyze the images extracted from the captured video by the camera and classify the driver's state in real-time. If the driver is classified as drowsy or distracted, an alert can be sent to the driver or the vehicle's systems can take action to prevent an accident, such as slowing down or pulling over.

If the driver is identified as being distracted, use an alarm to notify him which is need to be turned off manually. If the driver fails to turn off the alarm it indicates that the driver is unconscious or fatigued, then a mobile notifications will be sent to the intended recipient.

At the end of the day, the system also provide the driver with a fleet analysis report. This report could include informationS on the number of time the driver was distracted, fatigued, or drowsy, as well as any notifications that were sent out as a result.

System is designed into three modules:

1. Distraction Observation
2. Fatigue Detection
3. Fleet Management

4.1.1 Module 1: DISTRACTION OBSERVATION

Distraction detection is a technology that is designed to detect when a person is not fully focused on a task, such as driving a vehicle. This can be accomplished through the use of sensors and algorithms that analyze a person's behavior and surroundings to determine whether they are exhibiting signs of distraction. Some common types of distractions that distraction detection systems are designed to detect include texting, talking on the phone, eating, drinking, and fidgeting. These systems can be used to alert the person to their distraction and encourage them to refocus on their task, or they can be used to automatically take corrective action, such as slowing down a vehicle or issuing a warning.

To train any learning model, we need to input images that represent the status of any distracted driver like gossiping, sleeping, or eating during the driving.Here, the input dataset is the Distraction Detection Dataset, which is available on the Kaggle platform and contains the following classes like standard driving, texting, talking on the phone, using the radio, drinking, reaching behind, etc. Preprocessing the images is done before fitting them into the learning module to obtain accurate results. The CNNs are trained on raw images and can automatically extract high-level features from raw input features that are used for the detection, classification, and segmentation. These architectures apply a filter to an input image to generate a feature map that summarizes the presence of detected features. The pooling layer is responsible for reducing the size of the extracted vectors which minimize the computational energy. Finally, the fully connected layers. connects every neuron layer-wise. Here, backpropagation is applied to every iteration of training that make the system to learn. In this phase, the CNN identify each of the distracted behavior based on the learned experience of the previous phase. The dataset is split into Train and Test Set in 80%-20% proportion.The testing and training process is done.

When a distraction is identified, an alarm starts to sound, and the driver himself needs to deactivate the alarm. Otherwise it will be detected as a fatigue.

Figure 4.3: Sample Dataset For Distraction Observation

4.1.2 Module 2: FATIGUE DETECTION

Fatigue detection can be a useful tool in driver behavior analysis as it can help identify when a driver is exhibiting signs of fatigue, which can lead to dangerous driving behaviors such as drifting or falling asleep at the wheel.

To detect fatigue from images, machine learning algorithms can be used to analyze facial features such as eye position and blink rate, as well as body posture and facial expressions. These features can help indicate whether a driver is experiencing fatigue or drowsiness.

The module works in the following pattern. The input dataset for the Drowsiness detection on the Kaggle platform includes four classifications for classifying visuals into Open Eyes, Closed Eyes, Yawning or not, and hand gestures. The preprocessing is done as same as in distraction detection using CNN algorithm. CNN identify each of the drowsiness or fatigue behavior based on the learned experience of the previous phase. The dataset is split into Train and Test Set in 80%-20% proportion. The testing and training process is done.

As soon as a fatigue state is identified, the alarm will start to sound. The designated recipient will receive a mobile push message via cloud service that the driver is experiencing a medical emergency if the alarm continues to sound after a predetermined amount of time. This signals that the driver is drowsy or fatigued.

Figure 4.4: Sample Fatigue Detection

TESTING AND TRAINING

Input: Video samples

Output: Driver behaviour analysis

1. Import required libraries like numpy, cnn etc.. and load the dataset.
2. Process the image samples to video frames.
3. Extract features from the image frames.
4. Feed this to the CNN model and train the model.
5. Test the model using test dataset and analyse the result.

MODULE INTEGRATION

The Jetson Nano then receives the training modules. Through the camera interface, live video is captured.The preprocessed images from the input visuals are also transferred to the trained model.There will be a warning alarm activated if a distraction is found. Driver must manually turn it off. Alarm will be activated if a condition of weariness is found. A mobile push message with the driver's current position will be automatically delivered to the intended recipient as a warning if the driver does not answer within the allotted time period.

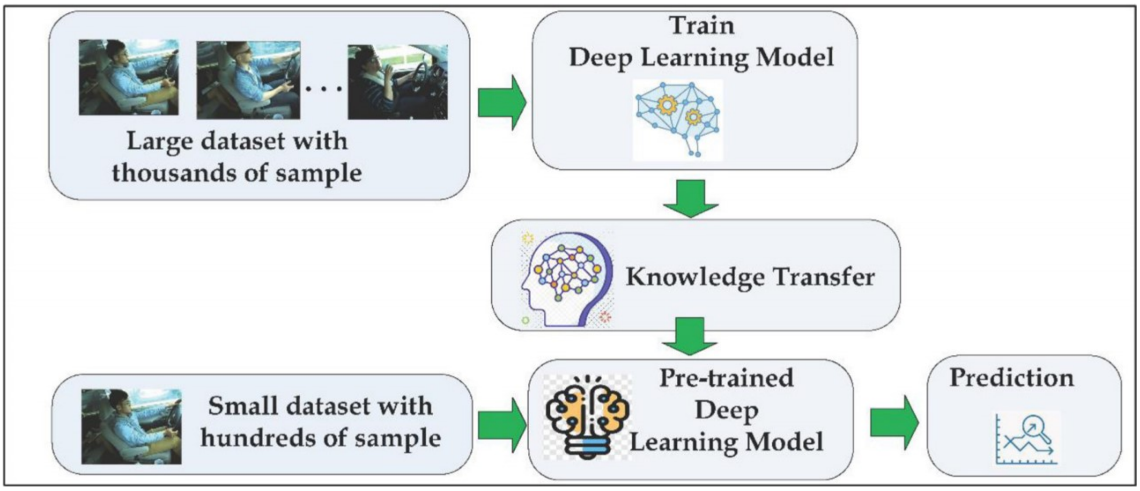

Figure 4.5: Transfer Learning

4.1.3 Module 3: FLEET MANAGEMENT

Fleet management is the management of a company's vehicle fleet. This includes the acquisition, maintenance, and disposal of vehicles, as well as the management of drivers. One aspect of fleet management is the analysis of driver behavior. This can be done by monitoring the performance of vehicles and drivers. By analyzing driver behavior, fleet managers can identify and address problems such as reckless driving, speeding, and excessive idling. This can help to reduce the risk of accidents and improve the efficiency of the fleet. It can also help to reduce fuel costs and vehicle wear and tear.

By analyzing driver behaviour, fleet managers can identify opportunities to optimize routes and schedules, which can help to improve productivity and reduce downtime. At the same time by monitoring the driver behaviour, fleet managers can identify and address any issues that may impact customer service, such as late deliveries or rude behaviour.Hence fleet management plays a crucial role in driver behaviour analysis by helping to ensure that vehicles and drivers are operating safely and efficiently, which can lead to a wide range of benefits for the organization.

In this system For driver fleet analysis, GPS data combined with the output of the distraction and fatigue detection system is used.Free Fleet Management Software is used to manage trip analysis and driver behaviour analysis.

4.2 FEASIBILITY STUDY

The feasibility of the project is analysis, in this phase and business proposal is put forth with a very general idea with, some cost estimates. During system analysis the feasibility study of the proposing system, is to be carried out. This is to ensures that the proposed system is not a, burden to the company. For feasibility analysis, the major requirements for the system, is essential. The 3 key considerations, involved in the feasibility analysis are: -

- Economical Feasibility
- Technical Feasibility
- Social Feasibility

i) ECONOMIC FEASIBILITY

The proposed model is economically feasible since the budget is low.

Table 4.1: Cost Analysis

Sl. No	Items	Cost
1	Jetson Nano Toolkit	Rs. 8740
2	Camera	Rs. 4399
3	Wires and other connection requirements	Rs. 150
4	Others	Rs.500
5	Total	Rs.13789

The overall budget is not so high ,hence economically feasible.

ii) TECHNICAL FEASIBILITY

The model can be created with the current technologies. This study is being done to evaluate the system's technical requirements, or technical feasibility. Any approach created must not impose a significant burden on the technical resources at hand. Technical issues include the proper image capture by the camera, the proper operation of the Jetson Nano, which is used to run machine learning models that can analyse data from cameras to detect and classify various types of driving behaviours, and issues with the alarm during distractions and mobile push notifications during medical emergencies. The technology will do this by mounting a webcam inside the car so that it can record the driver's front and side perspectives. Jetson Nano's installed CNN algorithm, which is trained using relevant datasets from Kaggle, is guaranteed to function properly. This can categorise the visuals to the appropriate modules as being distracting or worn out. In case of distraction, the appropriate alert is blown, and for medical situations, messages are sent through cloud to the intended recipients.

iii) SOCIAL FEASIBILITY

The social feasibility of drivers behavior analysis is generally high, as it has the potential to improve road safety and reduce the number of accidents and fatalities on the roads. This can be achieved through the use of technology such as dashboard cameras that can monitor and analyze a driver's behavior. The model provides fleet data of each driver which can be used for analysis of driving behaviour as well as for further studies in the domain . However, there are also potential concerns related to privacy and the use of personal data. Therefore, it is important to ensure that any technology or systems used for drivers behavior analysis are implemented in a transparent and ethical manner, with appropriate safeguards and consent in place.

Overall, the social feasibility of drivers behavior analysis is likely to depend on the specific context and circumstances in which it is applied. With proper safeguards and transparency, the proposed system make a positive impact on road safety and reduce the number of accidents and fatalities.

4.2.1 System Requirements

4.2.1.(i) Hardware Requirements

1. Jetson nano
2. Camera interface
3. GPS module

4.2.1.(ii) Software Requirements

1.Python
2. Keras
3. Tensorflow
4. Ubuntu
5. Cloud service

4.2.1.(iii) Datasets Identified

The module is tested and trained using Kaggle datasets.

1.For Distraction

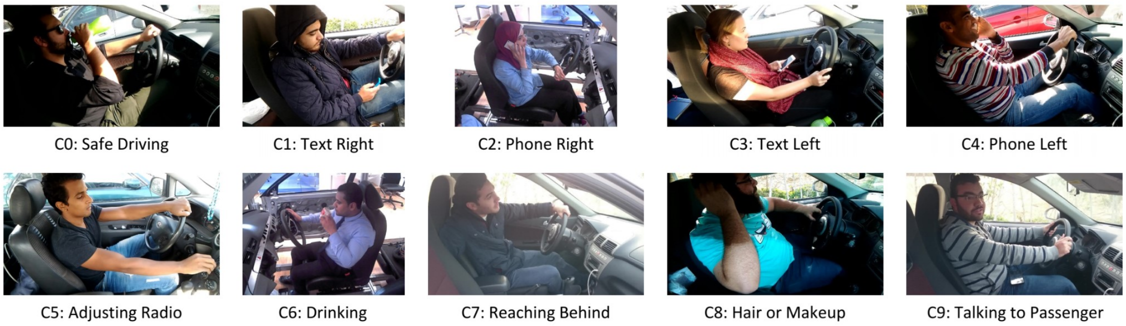

Figure 4.6: Sample dataset for Distraction Detection

2. For Fatigue

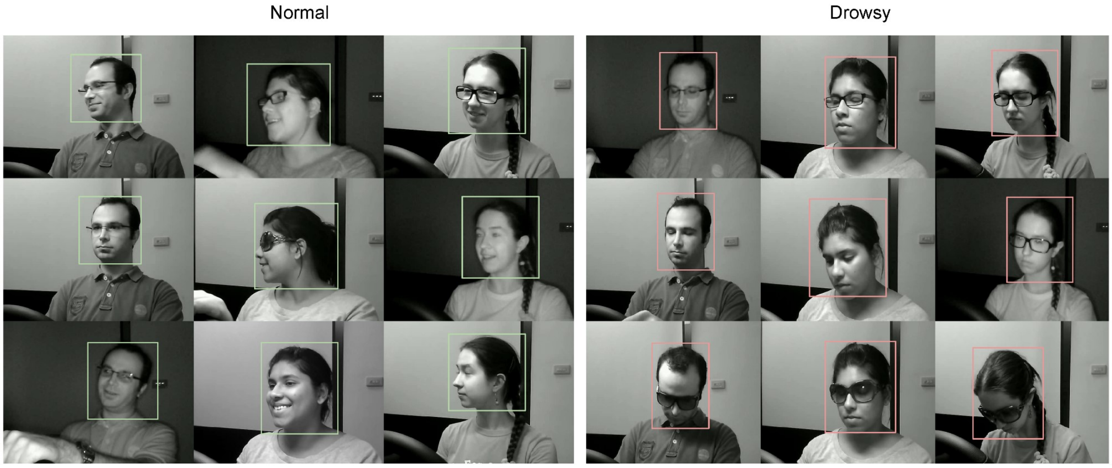

Figure 4.7: Sample dataset for Fatigue Detection

Chapter 5

PROJECT PLANNING AND SCHEDULING

TASK IDENTIFICATION

1. Data collection

2. Behaviour analysis:

   (a) Drowsiness/fatigue detection

   (b) Distraction detection

3. Alarm System

4. Location tracking using GPS.

5. Cloud service

6. Emergency notification should be send to intended recipient if required.

7. Fleet analysis

5.1 PROJECT PLAN

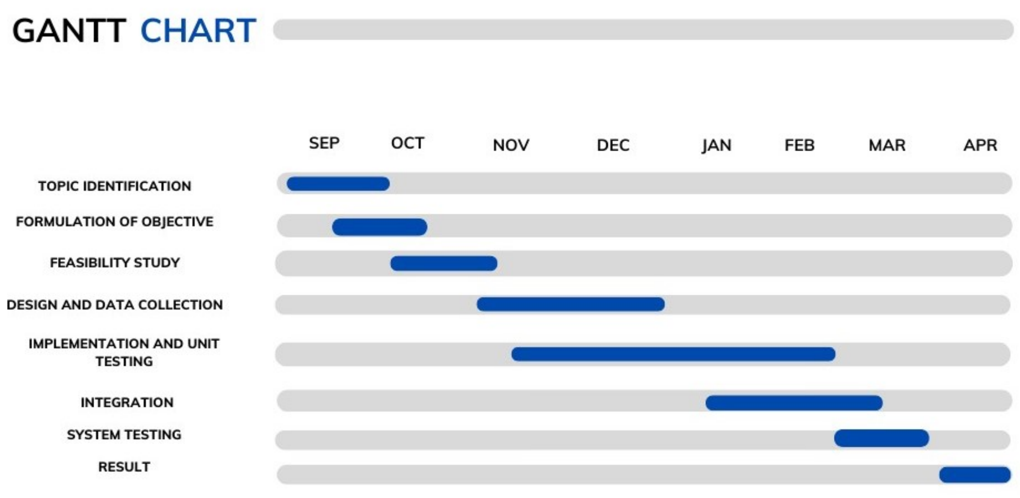

Figure 5.1: Gantt Chart

5.2 DETAILED BUDGET

Table 5.1: Budget Proposal

Sl. No	Items	Cost
1	Jetson Nano Toolkit	Rs. 8740
2	Camera	Rs. 4399
3	Wires and other connection requirements	Rs. 150
4	Others	Rs.500
5	Total	Rs.13789

5.3 TASK ALLOCATION

Table 5.2: Resource-wise Task Allocation

Sl. No	Task	Allocated Resource
1	Hardware Components	ARATHI P KUMAR
2	Training and Testing part	ANJANA ANIL,LINA ANIL,SEBA ABRAHAM
3	Cloud Storage Maintenance and related works	ANJANA ANIL, ARATHI P KUMAR
4	Maintenance and updations	ANJANA ANIL,ARATHI P KUMAR LINA ANIL,SEBA ABRAHAM

Chapter 6

CONCLUSION

The paper presents a new system aimed at detecting and monitoring driver drowsiness, fatigue, and distraction while driving. The system is based on advanced technologies such as computer vision and deep learning, and is referred to as S-EYE.

The main objective of the system is to help prevent traffic accidents by alerting the driver when he/she shows signs of drowsiness, fatigue, or distraction. The system will also notify the driver's friends or acquaintances when the driver is no longer capable of driving safely. Furthermore, automobile manufacturers can use the insights gained from the system's analysis of driving behavior to improve design and production, manage quality, increase safety, and make maintenance easier.

The system employs Convolutional Neural Network (CNN) algorithms for facial detection and related tasks, such as face tracking and eye state analysis. The proposed algorithm has been shown to be robust and accurate even in varying light conditions, background changes, and facial orientation. The system's short training phase makes it adaptive and efficient for use by different individuals with varying face and eyelid behaviors.

Experiments conducted on the existing systems have shown that it is capable of accurately detecting the symptoms of driver fatigue and distraction. The system has also been observed to estimate driver fatigue and distraction very well by subjective evaluation. The system also includes a fleet analysis component that is sent to the driver at the end of each day. This feature will be particularly useful for cab companies.

In conclusion, the proposed system is a promising solution for detecting and preventing drowsiness, fatigue, and distraction while driving, and can help reduce the number of traffic accidents.

Chapter 7

SCOPE OF FUTURE STUDY

The future scope for further study on driver behavior analysis involves several important aspects. Firstly, there is room for improvement in terms of adjusting the zoom or direction of the camera during operation. This could be achieved by automating the process of zooming in on the eyes once they are localized, which would improve the accuracy of the system.

Another area of future study is to integrate the driver behavior analysis system with healthcare facilities. Instead of just sending notifications to the relatives of the driver, the system could be enhanced to send notifications to the nearest health center by accessing the driver's current location. This would provide a more immediate response in case of an emergency.

In terms of usability, the proposed system could be turned into an android application that would offer a better user experience. This could be done to reduce the cost of hardware and increase accessibility. Additionally, the drowsiness detection system could be made more accurate by incorporating other parameters such as the state of the car, detecting foreign substances on the face, etc.

In the future, with the increasing automation of vehicles, if the system detects the driver as drowsy or fatigued, the car could be switched to an autonomous mode. This would ensure the safety of the driver and other road users and prevent traffic accidents.

Therefore, the future scope for further study on driver behavior analysis includes the integration of the system with healthcare facilities, the development of an android application, and the improvement of the drowsiness detection system through the incorporation of additional parameters. Additionally, the system could be integrated with autonomous vehicles to ensure road safety.

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