Drivers Drowsiness Detection

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Introduction

Driver drowsiness is a critical safety concern, contributing to 35-45% of global traffic accidents. Fatigue-related incidents account for approximately 1.3 million deaths and 20-50 million injuries annually. Factors like insufficient sleep, prolonged driving hours, and environmental monotony exacerbate the issue. This project leverages AI technologies to detect drowsiness through eye tracking and yawning detection, providing early warnings to prevent accidents.

Objectives

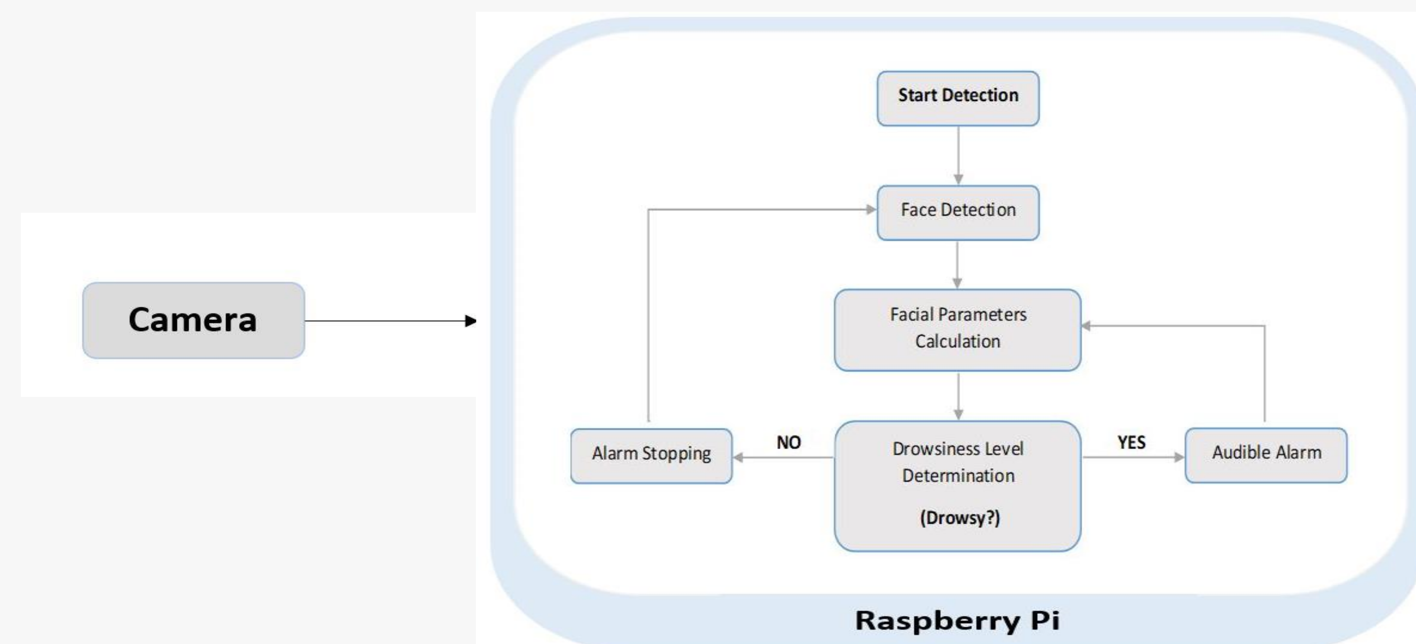
1. **Real-time Monitoring:** Develop a system to continuously monitor driver alertness.
2. **Enhanced Safety:** Use artificial intelligence to detect fatigue and distractions accurately.
3. **Accident Reduction:** Mitigate the frequency and severity of road accidents.
4. **Awareness:** Promote responsible driving practices through real-time feedback.

Methodology

1. Detection Approach: Utilize Convolutional Neural Networks (CNN) classify driver eye states (open or closed) and detect signs of drowsiness.
2. **Technological Stack:**
   1. **Hardware:** Raspberry Pi 4, Pi Camera, buzzer for alerts.
   2. **Software:**
      1. Python for coding.
      2. TensorFlow and OpenCV for image processing.
      3. Media Pipe for real-time facial landmark detection.
3. **Dataset:**

The Yawn-Eye Dataset (labeled as either "open" or "closed") from Kaggle.
Images were preprocessed to 32x32 pixels for consistency.

System Design



1. **Data Collection:**
   A Raspberry Pi camera captures real-time video of the driver's face.
2. **Processing Pipeline:**
   1. Video frames are analyzed using CNN for eye state classification.
   2. Media Pipe detects yawning and head tilt indicators.
   3. A logic system integrates data to determine drowsiness.
3. **Output:**
   Alerts (audible) are issued via a buzzer connected to the Raspberry Pi.

Results

- **Model Accuracy:** Achieved 99% test accuracy on the dataset.
- **Performance Metrics:**
  - Precision: High detection reliability for drowsy states.
  - Recall: Minimal false negatives for alert accuracy.
  - F1-Score: Balanced measure of precision and recall effectiveness.

Practical Performance:

- Lighting Conditions: Robust under varying lighting conditions.
- **Adaptability for Women Wearing Niqab:** The system effectively detects drowsiness even when the driver's face is partially covered by a niqab. By focusing on eye movements as the primary indicator, the model ensures high accuracy without relying on full facial visibility.
- **Reliability for Drivers Wearing Glasses:** It demonstrates the ability to overcome visual obstructions, maintaining precise detection of eye states (open or closed). This ensures consistent and reliable performance across diverse scenarios without requiring specific design adjustments for glasses.

Limitations and Future Work

- **Limitations:**
  - Sensitivity to extreme lighting and face angles.
  - Raspberry Pi processing constraints limit frame rates.
- **Future Enhancements:**
  - Integration of advanced CNN and YOLO techniques for greater robustness.
  - Improved deployment on other platforms and vehicles.

Impact

1. **Improved Safety:** Timely detection of fatigue prevents accidents and saves lives.
2. **Awareness Campaigns:** System serves as a tool to promote safe driving habits.
3. **Policy Contribution:** Provides data to refine road safety standards and laws.

References

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Ahammed, Md. Tanvir, et al., Real-Time Driver Drowsiness Detection using Deep Learning, IJACSA, 2021.