Title: Safe Driving System using STM32 & Raspberry Pi

1: Introduction

- **Project Name:** Safe Driving System
- **Objective:** To enhance road safety by monitoring driver behavior and environmental conditions using STM32 and Raspberry Pi.
- **Key Features:** Alcohol detection, drowsiness monitoring, speed tracking, obstacle detection, and emergency alerts.

2: Motivation

- **Why is this system needed?**
    - Rising cases of accidents due to drunk and drowsy driving.
    - Lack of real-time monitoring solutions in budget-friendly vehicles.
    - Importance of driver assistance systems in modern transportation.

3: System Architecture

- **STM32 Microcontroller**: Handles real-time sensor data processing.
- **Raspberry Pi**: Performs image processing and AI-based drowsiness detection.
- **Sensors Used:**
    - MQ3 Gas Sensor (Alcohol Detection)
    - Camera Module (Drowsiness Detection)
    - GPS Module (Speed Monitoring)
    - Ultrasonic Sensor (Obstacle Detection)
    - Accelerometer/Gyroscope (Crash Detection)

Slide 4: Working Mechanism

1. **Driver Starts the Car** → System initializes all sensors.
2. **Alcohol Detection** → If alcohol is detected, ignition is disabled.
3. **Drowsiness Detection** → If signs of drowsiness are detected, an alarm is triggered.
4. **Speed & Obstacle Monitoring** → Alerts issued for overspeeding or obstacles ahead.

5. **Emergency Alerts** → In case of a crash, an alert is sent to emergency contacts.

5: Hardware Components

- **STM32 Microcontroller**: Low-power, efficient sensor interfacing.
- **Raspberry Pi**: High-speed processing for AI-based tasks.
- **Camera Module**: Used for eye-tracking and drowsiness detection.
- **MQ3 Alcohol Sensor**: Detects alcohol in breath samples.
- **GPS Module**: Tracks vehicle speed and location.
- **Ultrasonic Sensor**: Detects obstacles in front of the vehicle.
- **GSM/Wi-Fi Module**: Sends emergency alerts.

6: Software & Algorithm

- **STM32 Code (Embedded C)**: Processes sensor data in real time.
- **Raspberry Pi Code (Python, OpenCV, AI)**:
    - Face & Eye Detection using OpenCV.
    - Machine Learning for drowsiness detection.
    - Communication with STM32 via UART/SPI.
- **Alert System:**
    - If any unsafe condition is detected, the system triggers alerts and logs data.

7: Real-World Applications

- **Fleet Management**: Monitors commercial drivers for safety.
- **Personal Vehicle Safety**: Prevents unsafe driving behavior.
- **Smart Cars Integration**: Can be integrated into ADAS (Advanced Driver Assistance Systems).
- **Public Transport Monitoring**: Ensures safety in buses, taxis, and transport services.

8: Challenges & Solutions

- **Sensor Accuracy:** Calibration of MQ3 and camera-based detection to reduce false positives.
- **Real-time Processing:** Optimizing STM32 and Raspberry Pi communication for fast response.
- **Environmental Factors:** Addressing lighting and weather conditions affecting drowsiness detection.

- **Power Management:** Ensuring low-power consumption for embedded devices.

9: Future Enhancements

- **AI-based Voice Alerts**: Provides real-time voice warnings to drivers.
- **Cloud-Based Data Storage**: Logs driver behavior for analysis.
- **Improved Image Processing**: Enhanced accuracy using deep learning models.
- **IoT Integration**: Real-time monitoring through a mobile app.

10: Conclusion

- **Summary:** The Safe Driving System is a cost-effective, real-time solution for preventing road accidents.
- **Key Benefits:** Reduces drunk and drowsy driving incidents, improves driver awareness, and enhances road safety.
- **Future Scope:** Can be integrated into autonomous driving systems and smart vehicle solutions.
