# Real-Time Anomaly Detection from Dashcam footage on Raspberry-pi

Real-Time Video-Based Anomaly Detection Using Computer Vision on Raspberry Pi

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The Problem

Passive Recording

Traditional dashcams only record video without analyzing or interpreting events in real time.
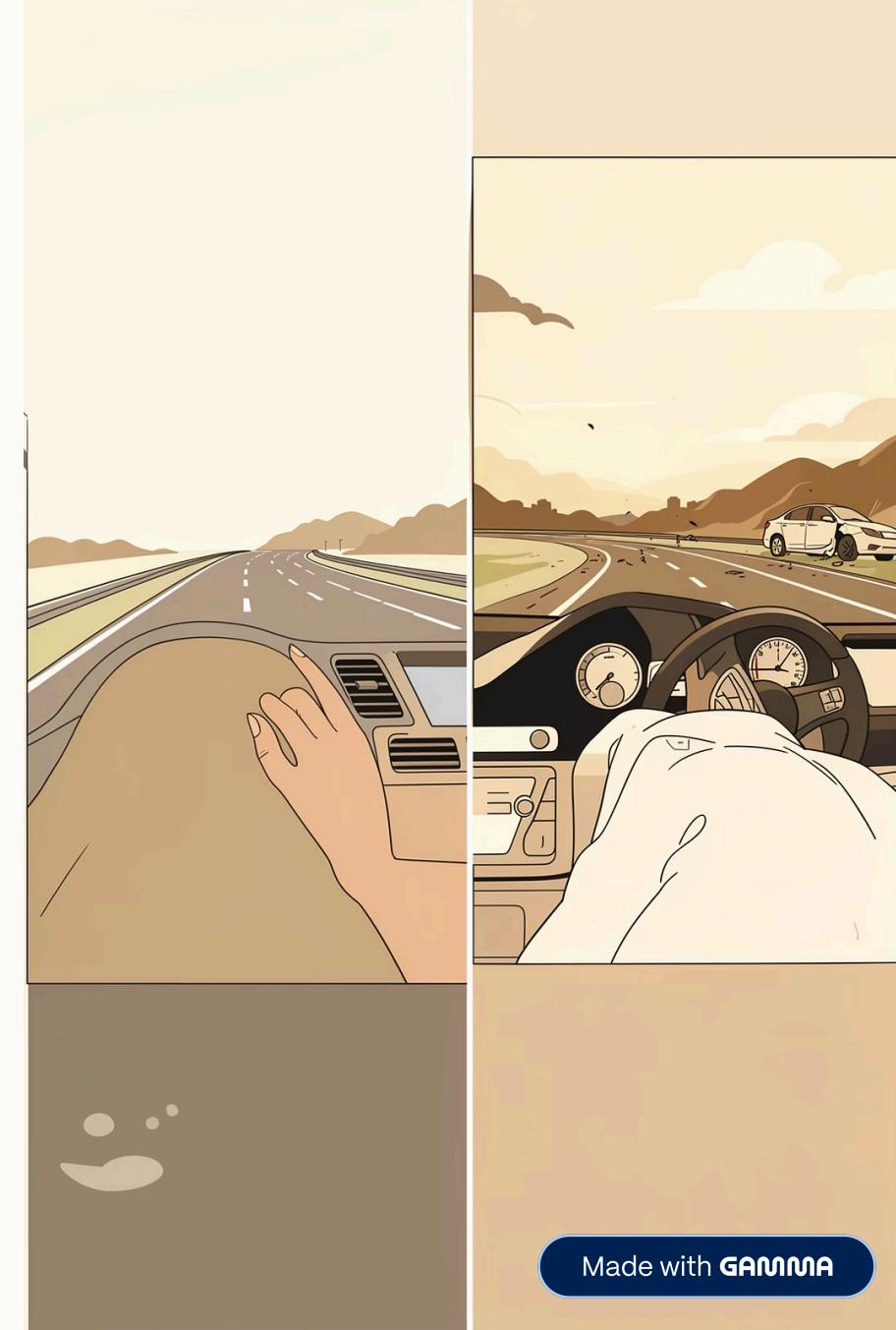
After-the-Fact Detection

Accident detection usually occurs after the event, limiting preventive action.

Cost Barrier

Advanced ADAS systems are expensive and require hardware-intensive setups.

Project Overview

System Capabilities
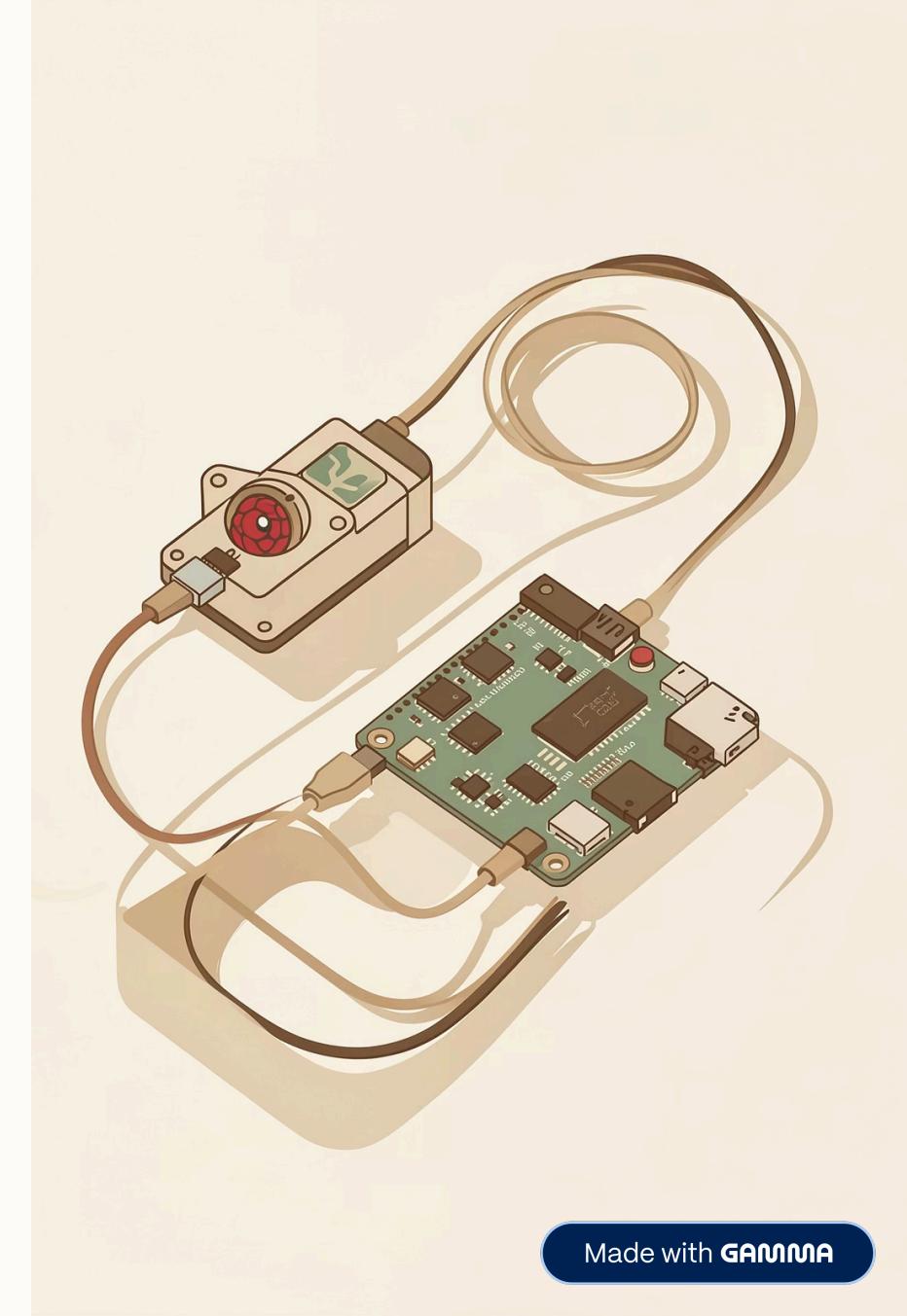
This project implements a real-time computer vision system on Raspberry Pi that captures live dashcam video and processes frames continuously using Python and OpenCV.

A lightweight CNN-based object detection model is used to analyze road scenes, track object behavior across frames, and identify abnormal events such as sudden object appearance or irregular motion patterns.

Key Innovation

Hybrid anomaly detection logic analyzes both motion patterns and object presence, generating real-time visual alerts when unsafe situations are detected.

Instead of simple video recording, the system actively interprets visual data in real time and generates alerts when unusual or unsafe situations are detected, making it suitable for low-cost embedded road safety monitoring.
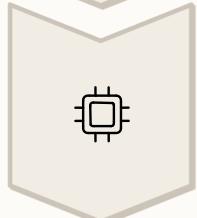
System Architecture

Camera Input

Dashcam continuously streams video frames
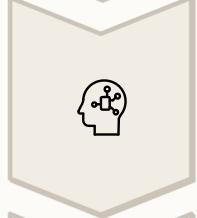
Frame Processing

OpenCV captures and preprocesses frames in Python
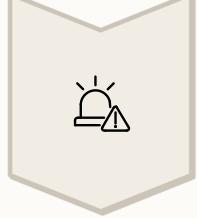
Motion Analysis

Optical flow detects motion patterns between frames

Object Detection

CNN identifies objects using TensorFlow Lite

Anomaly Alert

If an Object reaches an unsafe distance threshold, Hybrid logic triggers visual warnings on screen

Hardware Platform

## Raspberry Pi Specifications
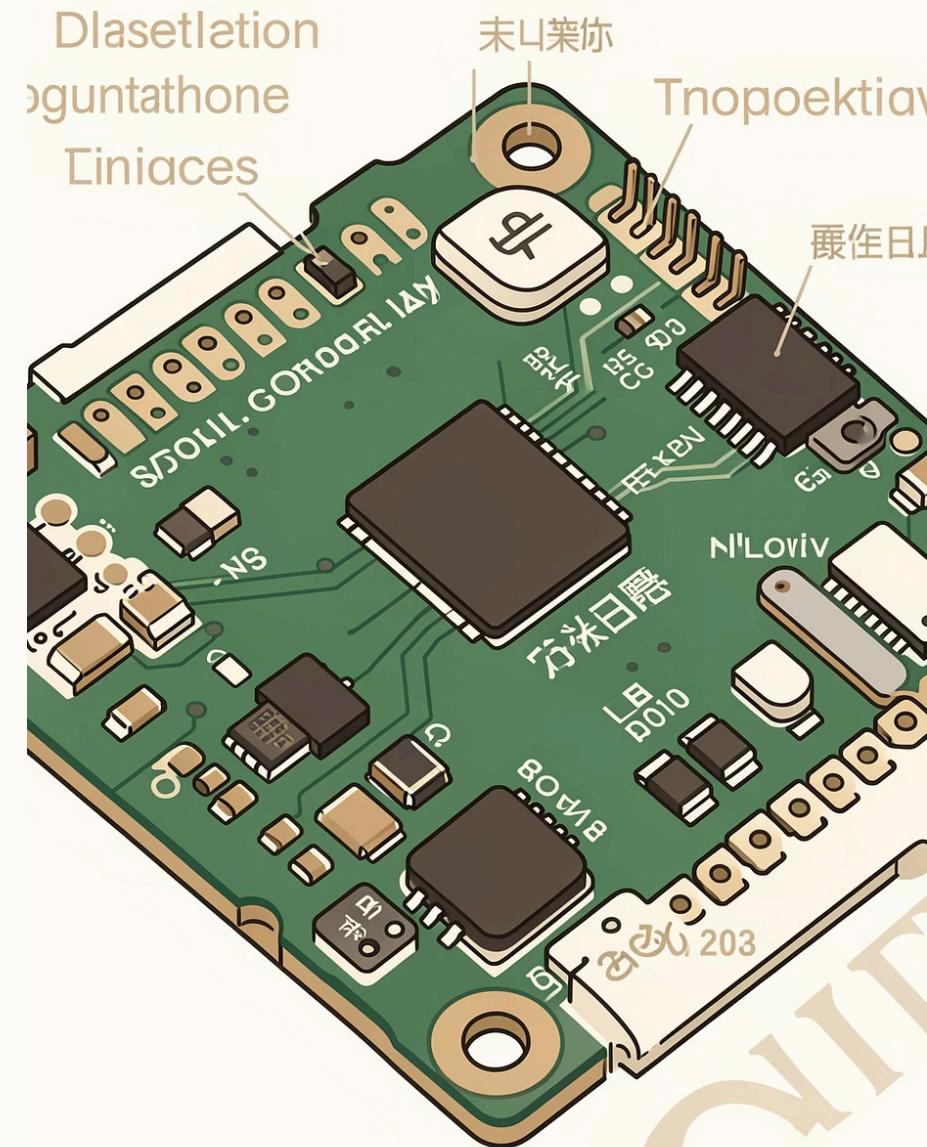
- Broadcom ARM Cortex-A series processor
- ARMv8 64-bit architecture
- ~1.5 GHz quad-core CPU
- 2GB/4GB RAM depending on model

Why Raspberry Pi?

- Supports Python and OpenCV
- Compatible with TensorFlow Lite
- Suitable for real-time edge AI applications
- Low power and cost-effective
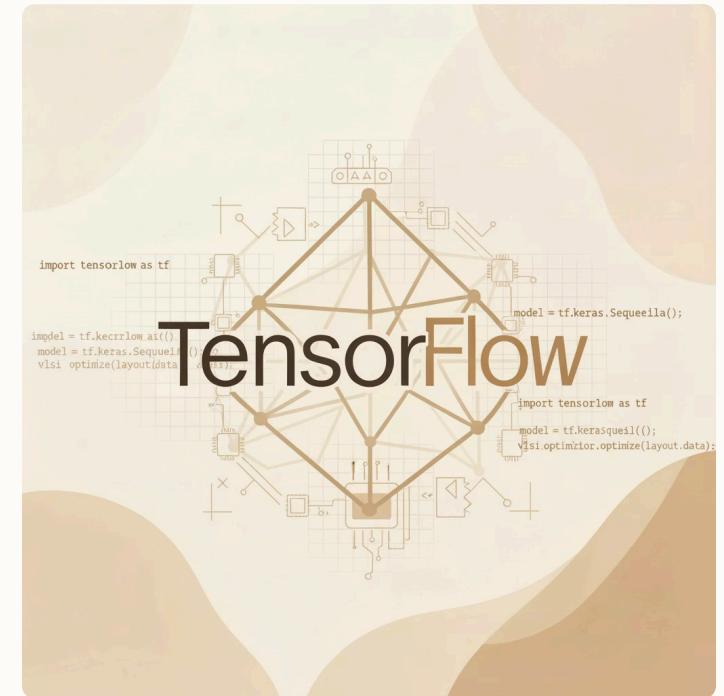
Camera Module

Dashcam camera connected to Raspberry-pi provides continuous live video input
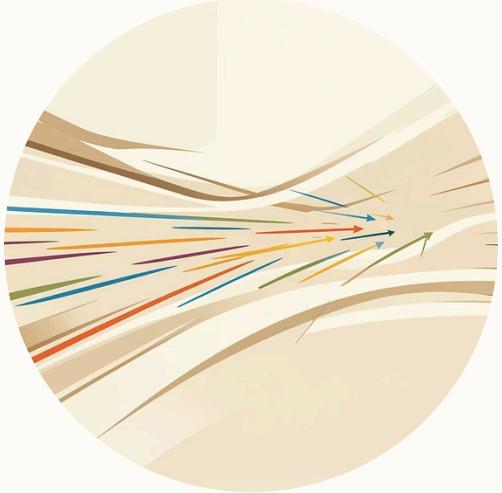
Edge AI Implementation

- Real-time video frames captured from dashcam
- Frame processing and analysis performed on Raspberry Pi
- Computer vision implemented using Python and OpenCV
- Distance estimation based on object size and motion across frames
- Anomaly detected when object crosses predefined distance threshold
- Visual warning displayed on screen and audio alert generated
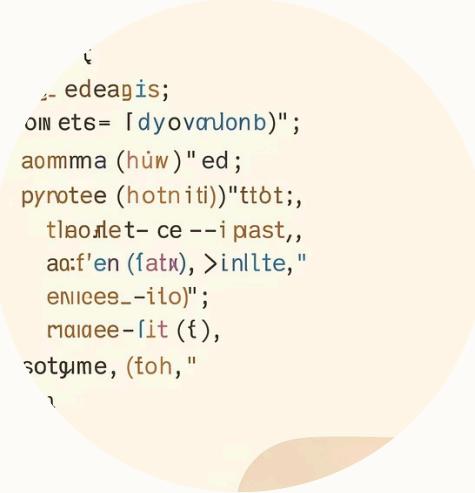
Core Detection Techniques

Optical Flow (Farneback)

Detects sudden or approaching motion between frames
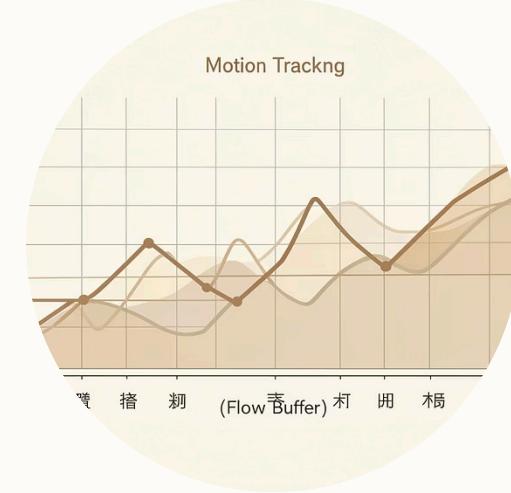
flow = cv2.calcOpticalFlowFarneback(prev_gray, gray, ...) mag, _ = cv2.cartToPolar(flow[...,0], flow[...,1]) flow_mean = np.mean(mag)

Object Detection (TensorFlow Lite)

Lightweight convolutional neural network identifies objects and provides spatial context.

interpreter = tf.lite.Interpreter(model_path="model.tflite") interpreter.invoke()
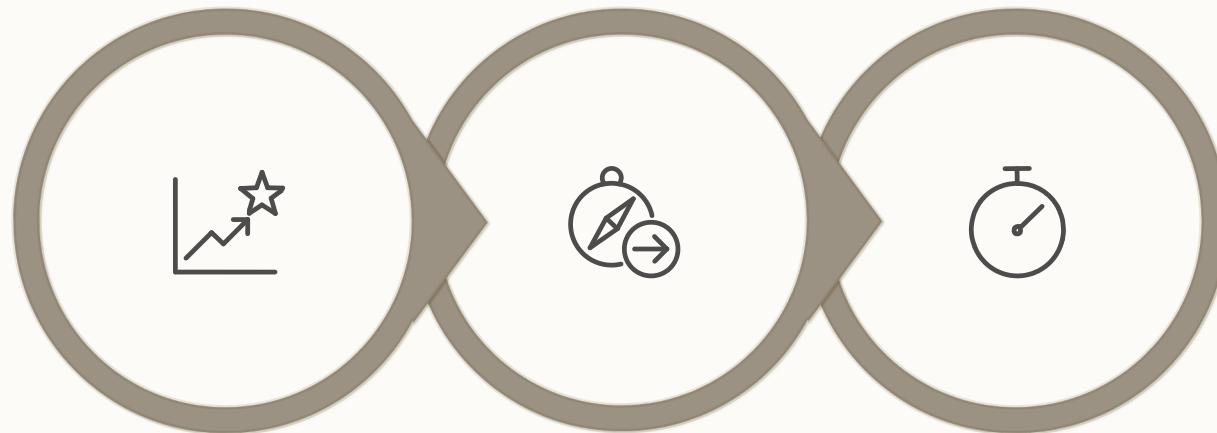
Temporal Motion Tracking

Maintains motion history to avoid false alarms

flow_buffer = deque(maxlen=40) motion = abs(flow_mean - np.mean(flow_buffer))

Made with GAMMA

Hybrid Anomaly Logic
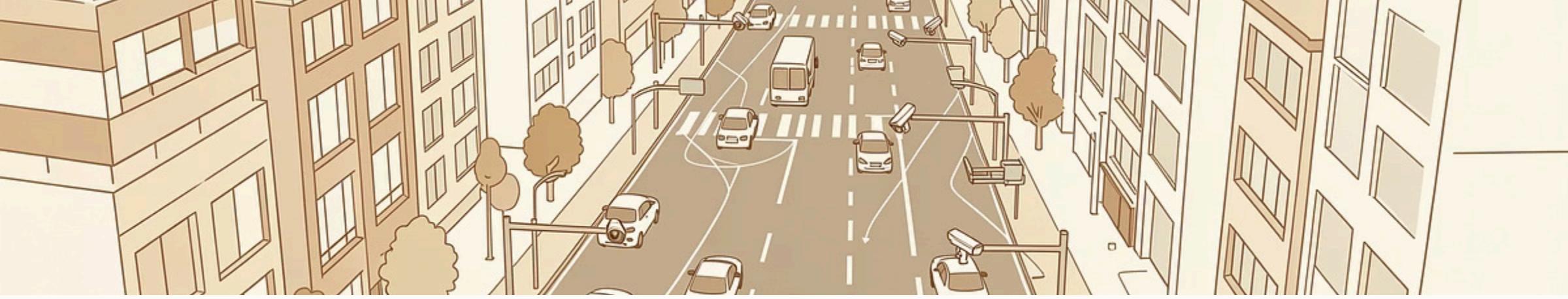
Motion Exceeded

Object Confirmed

Persistence Check

An anomaly is detected when significant optical flow motion is observed, valid objects are detected by the AI model, and the condition persists across consecutive frames. This hybrid decision logic improves reliability and minimizes false positives.

Results & Applications

Performance Achieved
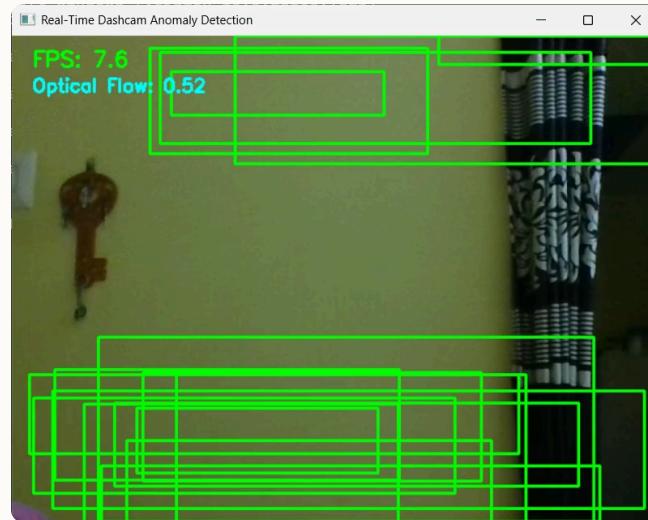
- Real-time anomaly detection
- Stable live video processing
- Works under varying conditions
- Embedded deployment ready

Application Areas
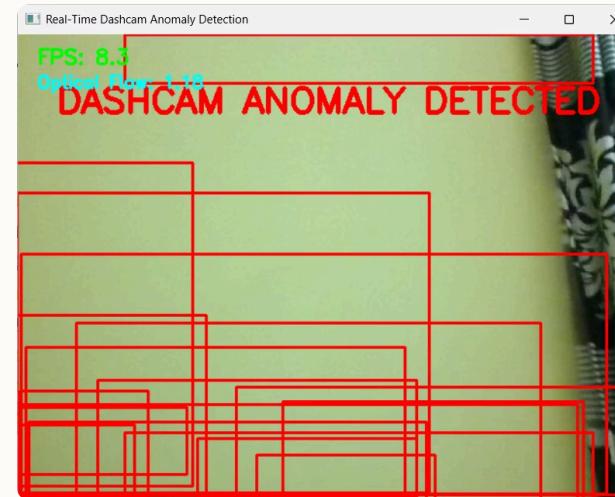
- Smart dashcam systems
- Accident monitoring
- Traffic surveillance
- Intelligent transportation

Performance Snapshot

Real-Time Dashcam Anomaly Detection   *Dashcam anomaly detected*

Conclusion & Future Scope

Project Success

This project demonstrates that real-time video-based anomaly detection can be implemented on low-cost edge devices such as Raspberry Pi, enabling practical deployment for road safety monitoring.

Future Enhancements

- Distance-based collision detection
- Audio warning alerts
- Object classification
- Sensor fusion with IMU and radar
- Hardware accelerator integration

Thank You!

For your attention and support in our project on real-time anomaly detection.