

# Video analytic solutions for active safety, security and comfort

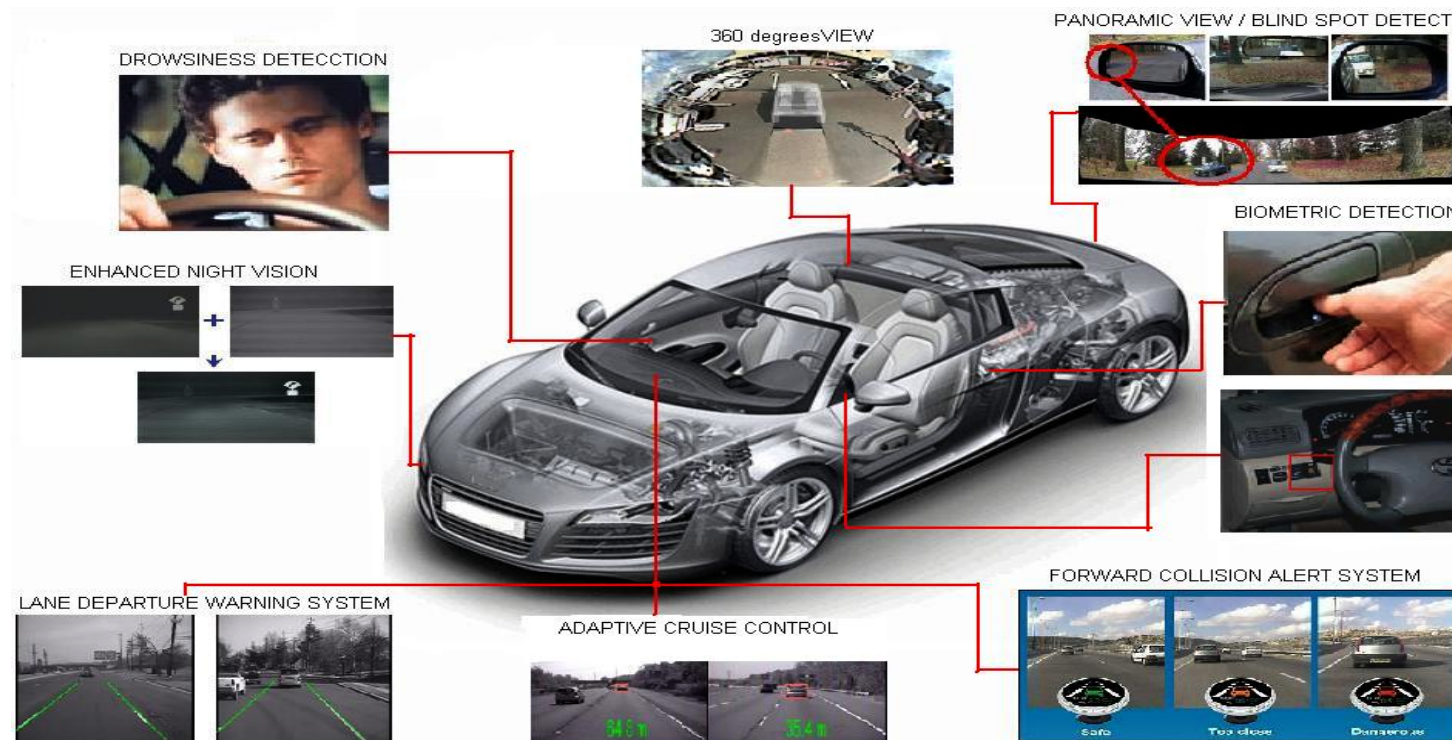
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## Overview and Agenda

- *This presentation outlines a low-cost, integrated driver-assistance solution based on visual captures. Active safety is addressed in multiple ways: recognizing driver's mood, detecting the drowsiness and alertness level, enhancing night vision, monitoring and keeping the lane, noticing the road signs and providing necessary alerts accordingly, and activating emergency controls. It includes adaptation to custom settings in case of multiple drivers using a single vehicle with an integrated security system.*
  - Vision based systems in the vehicle
  - Biometric Security systems
  - Drowsiness detection
  - Integrated solution for security and driver assistance
  - Lane departure warning system
  - Road sign detection
  - Adaptation to situation and driver response
  - Way forward – Vision based solutions

## Vision based systems overview



- Biometric Security systems – Finger print, Face recognition, Iris recognition
- Drowsiness detection – based on eye blink rate captured through camera
- Lane departure warning system - Enhances safety
- Forward collision alert – Using stereo/mono camera
- Adaptive Cruise control – Uses camera to measure target vehicle range and relative velocity
- Panoramic – Enhanced vision to assist the driver
- Night vision - Using Infra Red (IR) camera and Head Up Display (HUD)

# Overview

## ■ Active safety

- Majority of road accidents can be prevented by an extra second of warning time
- These systems provide that extra second of warning time to the driver and reduce the accidents
- Lane Departure, Forward collision detection, Drowsiness alert fall under Active safety category

## ■ Driver Assistance Systems

- Systems like Panoramic View , Blind Spot Monitor, Night vision provides assistance to drivers
- Reduces driver's stress
- Adaptive cruise control , Auto pilot provides additional comfort to the drivers

## ■ Access control

- Reorganization of driver to provide Anti theft mechanism for vehicles and provides personalized settings like AC control, Audio settings etc

## ■ Current regulation – status of compliance

- Implementation of few of these Active Safety applications (Blind spot monitor) may be forced by automotive statutory bodies/ legislation
- US Consumer Top 10 wish list applications in new cars includes Adaptive Cruise Control (38% respondents) and Lane Departure Warning (36%)
- US fleet operators interest in adding these Active Safety and Driver Assistance solutions in vehicles is VERY HIGH.

## ■ Vision Based Systems Definition

- Camera based systems - Image processing capabilities from Video capture and exploitation to analysis and communication — all in real time
- Vision and infrared processing technologies enable increased road/terrain awareness, and the detection, recognition and tracking of objects such as people and vehicles

# Biometric Security Systems



## Finger Print Scanning

- Uses dedicated fingerprint scanner as input device
- Can be integrated with door access control as well as immobilizer



## Face Recognition

- Facial feature analysis
- Skin texture analysis
- Affected by orientation
- Affected by facial expression



## Iris recognition

- Iris pattern is unique to an individual
- Pattern does not vary based on environmental conditions/states
- Reliable and accurate biometric security system

## Drowsiness Detection System (DDS)

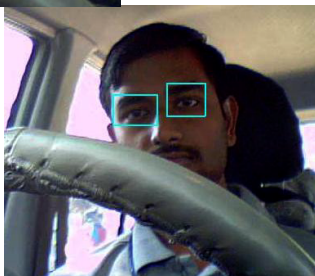
Active safety system to avoid fatal accidents due to drowsy driving.

- Vision computation system, which analyzes live images of the driver.
- Algorithms detect face, eyes and monitors eyes blinking rate.
- Determines driver drowsiness condition by measuring the eye blinking rate..
- Alerts by monitoring other vehicle parameters along with.



### Face detection

- Neural network,
- Projection function,
- Principal components,
- Independent components
- Skin color based methods.



### Eye detection

- Bright Pupil
- Dark pupil
- Combined method



# Integrated Driver Drowsiness Alert and Biometrics

## Problem 1

- Studies show that, after just four hours of non-stop driving, drivers' reaction times can be up to 50 percent slower.
- So the risk of an accident doubles during this time.
- The risk increases more than eight-fold after just six hours of non-stop driving!
- Around 30% of the total road accidents have as primary or secondary cause the driver fatigue



## Problem 2

- According to FBI's 2006 theft statistic, a motor vehicle is stolen in the United States every 26.4 second. A total of 1.2 million motor vehicles were reported stolen. In UK, 1.5 million vehicle-related thefts were recorded in between 2007 to 2008
- All the conventional security systems have one common feature – key, password
- Any one who possess key, remote or password can steal the vehicle easily



## Problem 3

- High Cost solutions consists of sensors, expensive cameras - Not fully explored segment,

## Solution

- Camera Based drowsiness detection and alert to reduce these accidents – Drowsiness Alert.
- Camera based Face detection, recognition and finger print - Biometrics/Bio Security
- Integrated solution shares same hardware resources and cost effective

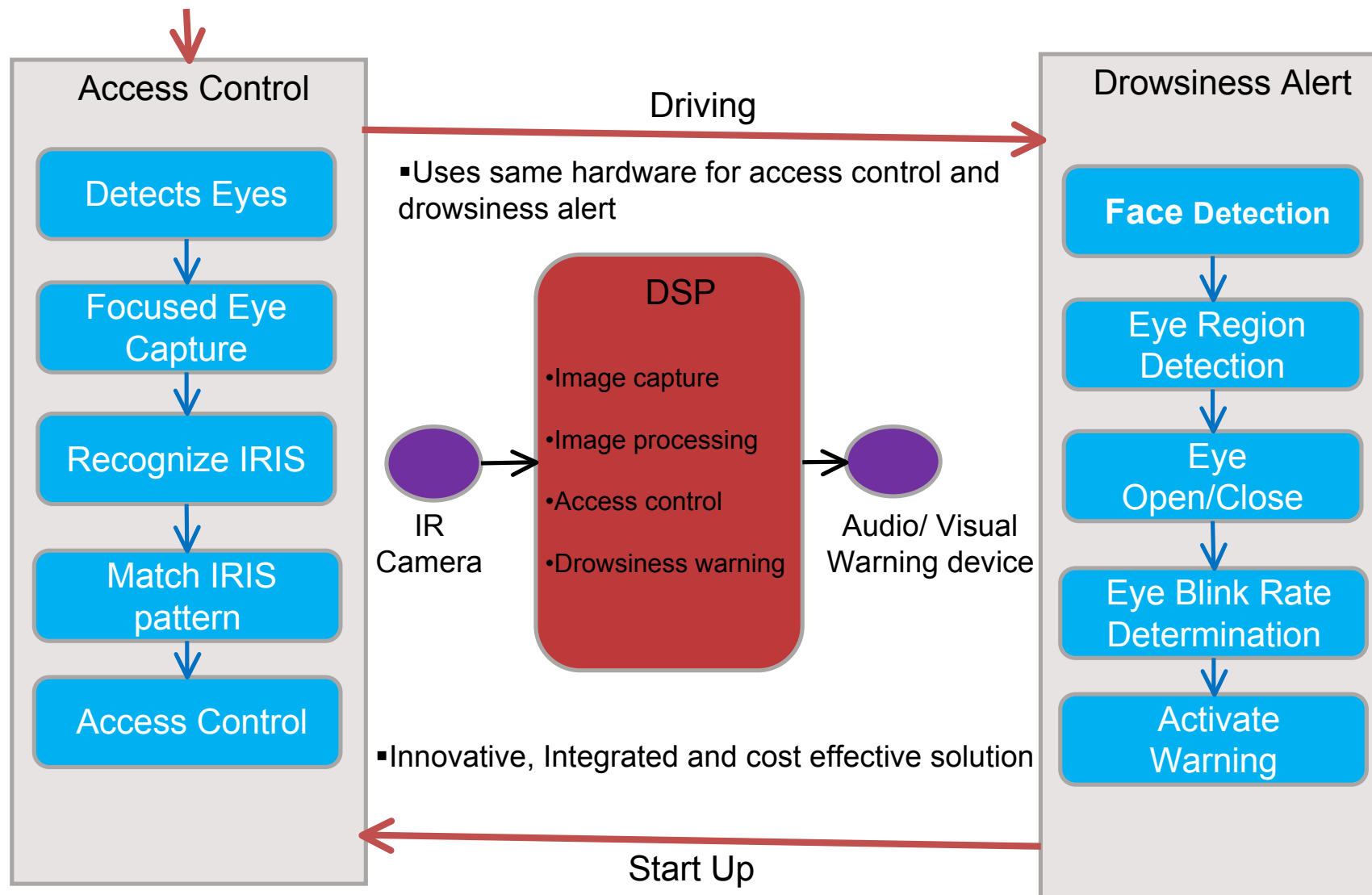


Integrated Low cost  
Multipurpose solution



2 -In- a -box  
Drowsiness detection + Biometric

## Integrated Solution with Biometrics and Drowsiness Alert



# Lane Departure Warning System



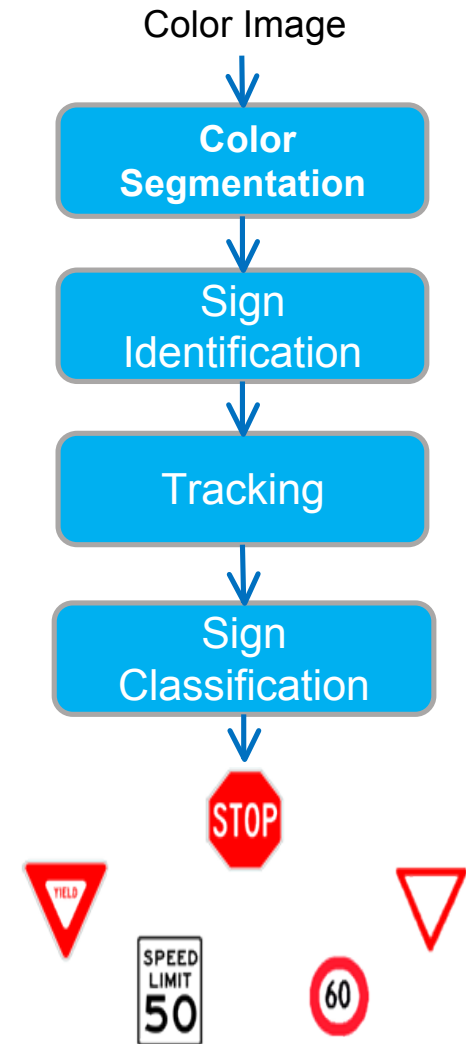
## Lane Departure Warning System

- Single Camera System, Works on variety of Lane Markers and curved roads
- warns driver about un-intentional lane changes

- ◆ Active Safety system – helps to prevent fatalities due to single vehicle roadway departure, lane change/merge departure
- ◆ Unintentional crosses – Alerts the driver when driver crosses a road lane marking or the edge of the rural roadways in the absence of markings, due to inattention, drowsiness or distraction
- ◆ Monitors and detect the lane markings (White, Broken white and yellow markings) on a highway and alongside many types of roadways
- ◆ Driver assistance in different environmental conditions such as, heavy rain, fog, Night, Tunnels, Multiple Lane Traffic, Missing Markings and Tailgating

## Traffic Sign Recognition

- Real time vision system to detect and recognize traffic signs.
  - Uses a small camera mounted on the rear-view mirror that monitors the road ahead.
  - Assist the driver in recognizing the traffic sign and avoids missing the sign.
  - Inform the driver to follow mandatory signs and warns the driver on potential hazards.
- 
- Features
    - Predicts the location of the sign by tracking and focus the camera for a closer view.
    - Signs are recognized and the information is read using template matching.



## Adaptation to the situation and driver response

- Uses multiple media to give advice/caution/warning to the driver
- Adapt to the driver response to situation and alert to suit to the requirements of young/old drivers

### Driver Feedback

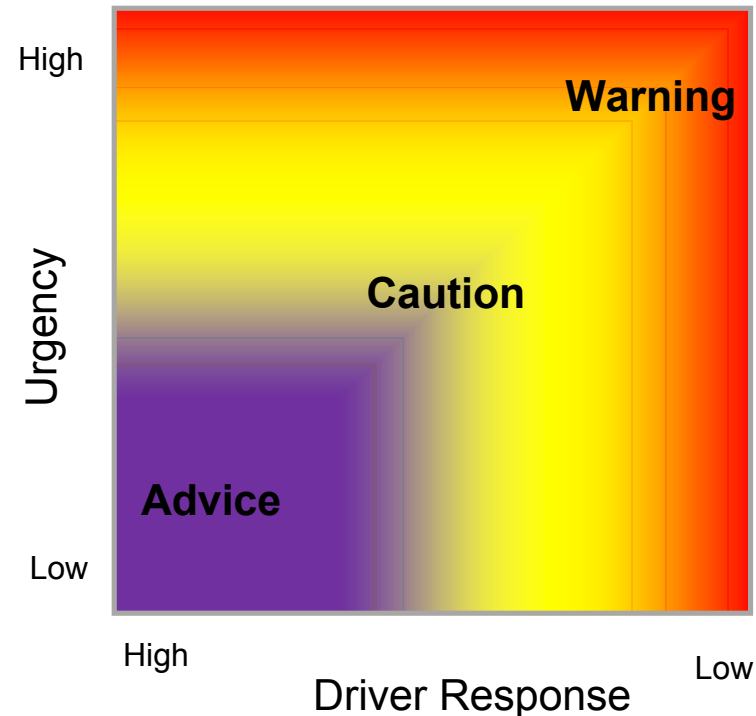
Audio alert

Visual Alert

Haptic – vibration of seat belt/steering column

### Control

Mitigation by Braking

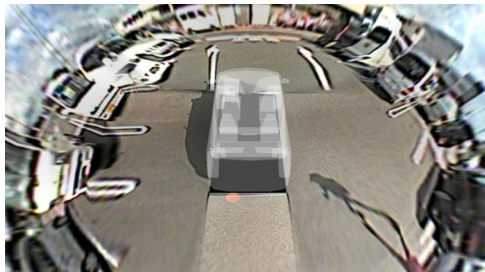


# Way forward – Vision based Solutions



## Panoramic Vision

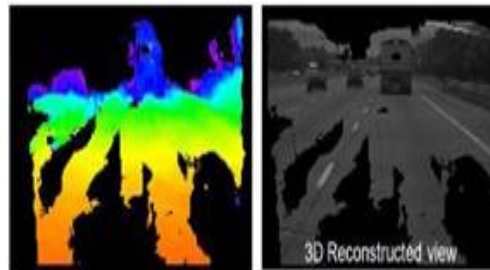
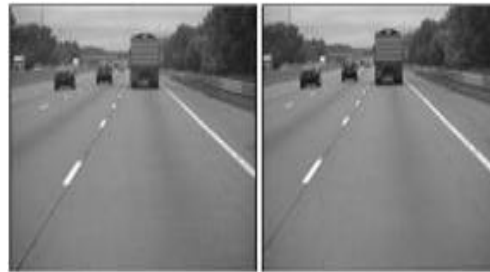
- 180 Degree Rear View mirror.
- Eliminates danger of objects hidden in blind spot.



## 360 degree Vision

- 4 camera captures images in 4 different directions.
- Computes virtual image of the 360 degree views – useful for Parking

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## Forward Collision Alert (FCA) system

- FCA system shall issue alerts to “object of interest” on straight and curved road to a minimum distance of 10 meters with closing velocity from 0-45 MPH
- The FCA system shall not respond to the “never before seen moving” - Stationary : signs, mailboxes, lamp posts, guardrails, overhead objects, bridges, etc.



## Enhanced Night Vision

- Uses visible and IR camera
- Fusing visible and IR images in real-time
- Visible image shows other vehicles, blinker, break lights, lane markings signs
- IR image shows other vehicles, persons and animals, road beyond headlights

# Thank you !

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