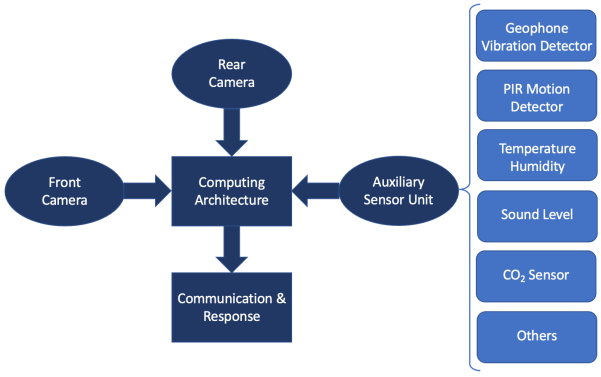
ZeteoTech

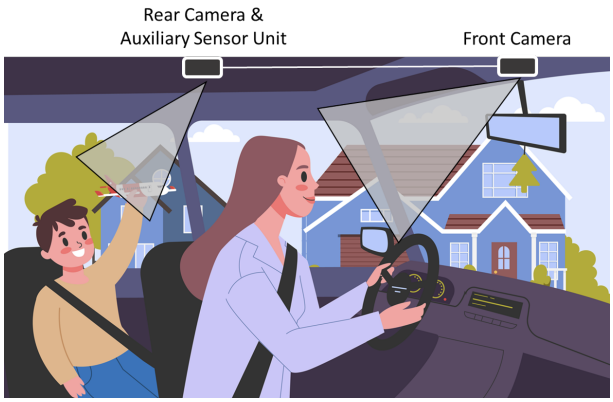
In-Vehicle Occupant Detection System

Overview

Vehicle-related tragedies are often the result of preventable behaviors like drowsy driving, distracted driving, and leaving children unattended in cars. These actions have dramatic consequences, causing nearly 50 children per year to die in hot cars, and thousands of people to die from drowsy and distracted driving. Given the avoidable nature of these incidents, the U.S. Department of Transportation is funding the development of Zeteo Tech's In-Vehicle Occupant Detection System, capable of monitoring the interior of a passenger vehicle and responding to potentially dangerous situations. Our approach combines a front camera module to focus on driver and passenger behavior, and a rear camera module and array of environmental sensors to detect unattended children or pets in the rear seats. This information about the passenger safety status is processed by an intelligent algorithm, which assesses the situation and responds with alarms or countermeasures as appropriate.



In-Vehicle Occupant Detection System design architecture.

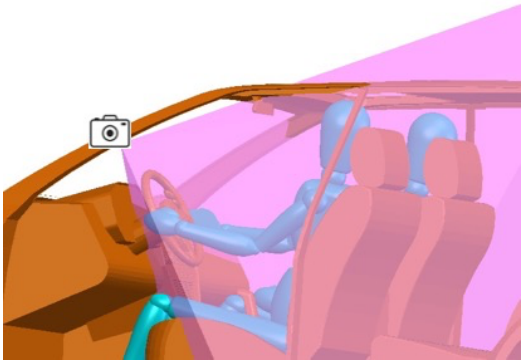


In-Vehicle Occupant Detection System concept.

Detection Capabilities

- ◊ Occupant(s) presence
- ◊ Presence of unattended children
- ◊ Proper interior settings for safe driving position
- ◊ Seat belt (non)-use, misuse
- ◊ Occupants in unsafe positions i.e., leg on dash
- ◊ Drowsy drivers
- ◊ Distracted drivers

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA



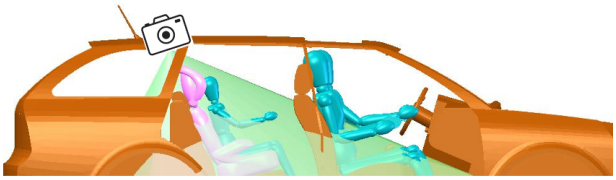
Computer model of front camera module.

Front Camera Module

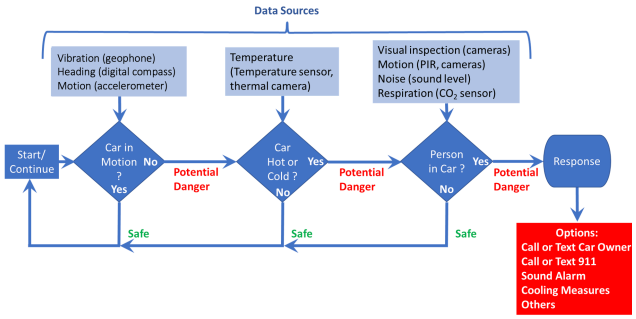
The front camera module consists of an IR-illuminated camera with automatically switchable LEDs. When the photodiode on the camera detects that the environment is dark, a 24-piece IR LED board turns on automatically, providing night vision capabilities. The camera is mounted as shown on the left. Video footage is used in conjunction with state-of-the-art machine learning techniques to identify drowsy driving, distracted driving, seatbelt compliance, and unsafe passenger seating positions.

Rear Camera Module

The rear camera module consists of a FLIR Lepton Thermal Imager. The camera is mounted as shown on the right. The Lepton is smaller than a dime and a fraction of the cost of traditional IR cameras. Another benefit is that thermal images are intrinsically anonymized, so no personally identifiable information is ever acquired. Neural networks analyze these thermal images to identify the presence of a child or pet.



Computer model of rear camera module.



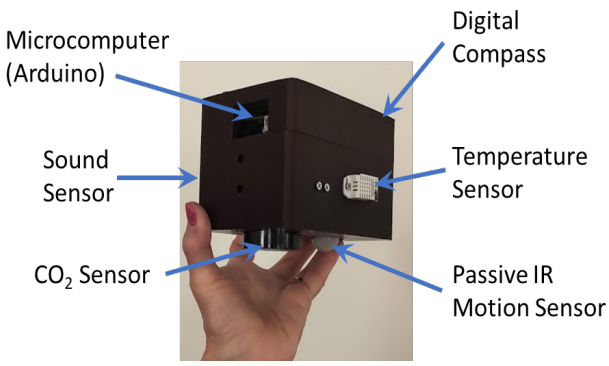
Flow chart outlining an occupant detection algorithm fed by the sensor network.

Auxiliary Sensor Unit

Zeteo Tech has identified several key parameters for its sensor system— temperature and relative humidity, motion within the vehicle, motion of the vehicle, sound levels within the vehicle, and carbon dioxide (CO_2) concentration in the passenger compartment. The CO_2 sensor is especially critical as a rise in CO_2 concentration will ***always*** be present if a human (or pet) is occupying an enclosed space. In order to maintain an exceedingly low false alarm rate, Zeteo Tech's In-Vehicle Occupant Detection System utilizes multiple orthogonal sensor modalities to provide independent data streams about vehicle occupancy at as low cost and low power draw as possible. The front and rear camera modules and the auxiliary sensor unit can all operate on a single board computer, such as NVIDIA's Jetson Nano.

Applications

- ◊ School and public transit buses
- ◊ Self-driving and assisted-driving vehicles
- ◊ Aftermarket personal-use vehicles



Early-stage prototype of sensor system.

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