VitaSense
Unattended Child Detection

Seminar "Forgotten Child in the Car"
MIROS, 13\textsuperscript{th} July 2018

More than 25 years of innovation—
and we are just getting started!
About IEE

- Founded in 1989 and headquartered in Luxembourg

- Pioneer and global leader in automotive safety sensing systems for occupant detection and classification

- Proven reliability with installations in over 300 mio vehicles

- First to market with capacitive Hands-Off Detection sensor for ADAS

- Global player with local presence and ~3600 employees
Contents

- In-vehicle Heat Stroke
  - Statistics and Root Causes

- VitaSense
  - Background Information
  - Functional Principles

- NCAP Incentives and Rule-making Trends
In-vehicle Heat Stroke

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You would never forget her in the car, would you?
Heat Stroke Deaths of Children in Cars

Heat stroke vs. airbag related fatalities in U.S.

USA:
- In the 1990’s about 120 children died due to airbags, and advanced airbags were mandated.
- Since 1998 about 750 children have died from heat stroke in the U.S. alone, on average 37 per year

Rest of the world:
- Many known incidents, but there is no systematic monitoring.

1) KidsAndCars.org national database & noheatstroke.org 2) NHTSA: DOT HS 811 114 - January 2009
Circumstances and Age of Victims

- People can forget their children in cars
  - When daily routine distracts them
  - When misunderstandings occur
  - When the children are out of sight
- Children can climb into unlocked cars (age 3+)
- Some children are intentionally left, as people are unaware of the risk
- The interior temperature of a vehicle can reach a critical level in 15 minutes
- Heat strokes happen to small children much faster than to adults

![Pie chart showing the age distribution of victims of vehicular heat stroke](chart.png)

It is important to detect small (and often sleeping) children!
Heat Stroke Deaths of Infants < 1 y.o. in Cars

Comparing infant heat strokes to crash fatalities

- Infant heat stroke fatalities are significant compared to car crash fatalities

1) noheatstroke.org  2) NHTSA: FARS database
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System background

- VitaSense detects occupants based on their movements or breathing, even when they are sleeping.

- VitaSense uses well-known 24 GHz low-power radio technology similar to burglar alarms and automatic doors.

- Sleeping children are characterized by a low level of periodic motion, with a certain repetition rate.

- VitaSense is mounted invisibly behind the head liner.
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Enabling cars to save the children

OEM - Vehicle
Warning and preventive actions

IEE - VitaSense
Detection of unattended child

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Fast reaction is vital

- It does not take long for parents to be far away from a vehicle
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Robust decision making

- Detection of all occupants
  - Sleeping newborns
  - Other children, adults, pets
  - Independent from CRS

- Robust decision making
  - Independent of air currents
  - Compatible with CRS sun shades and winter clothing
  - Distinguish breathing motions from background noise
  - Robust against false positives

- Vehicle based integration - direct communication to vehicle (e.g. LIN)
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Advantages of low-power radio technology

- 2D Camera
  - Needs direct field of view
  - Does not work with sun shades in direct line of sight

- Infrared imaging
  - Can not differentiate between warm objects and living occupants

- Ultrasonic motion detection
  - Can not detect sleeping newborn
  - Can react on moving of air currents
    - Risk of false positives

⇒ Low-power radio technology can overcome all these disadvantages
Algorithm functionality

- Selection is dependent on the level of motion observed:
  - Low level of motion ⇒ no action taken
  - Medium level of motion ⇒ Data analyzed for presence of a periodic motion ⇒ qualification of presence
  - High level of motion ⇒ qualification of presence after a few seconds

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How it works

- Algorithm functionality
  - Selection is dependent on the level of motion observed:
    - Low level of motion ⇒ no action taken
    - Medium level of motion ⇒ Data analyzed for presence of a periodic motion ⇒ qualification of presence
    - High level of motion ⇒ qualification of presence after a few seconds
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Simulating “worst case” occupants: The IEE live dummy

- Important to have a test tool as newborns are not easily available for frequent testing
- Build-up of “live dummy”:
  - Newborn-sized baby doll
  - Integrated bladder in the abdomen to simulate breathing

Complete test setup

Reference baby signal

IEE “live dummy”
VitaSense

Non-harmful low-power emission

- VitaSense has a significantly lower level of transmitted power than other devices
  - A typical cell phone transmits power between 500 and 1000 mW
  - VitaSense transmits only 4 mW – and only for a short period of time

- The level of absorbed power per human body mass is significantly lower for VitaSense than e.g. for mobile phones
  - Limit according WHO: \(\text{SAR}^{1)}_{\text{max}} = 2.0\text{W/kg}\)
  - Mobile phone: \(\text{SAR} \approx 0.1\text{W/kg} \ldots 1.6\text{W/kg}\)
  - VitaSense: \(\text{SAR} \approx 0.005\text{W/kg}\)

1) \(\text{SAR}: \text{Specific Absorption Rate}\)
NCAP incentives, Rule-making trends and public awareness

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NCAP Incentives

- "Child Presence Detection" – Function to be awarded in future NCAP roadmaps

- Euro NCAP 2025 Roadmap
  - "From 2022, a reward is given to Child Presence Detection, which can detect a child left alone in a car and alert the owner and/or the emergency services, to avoid heatstroke fatalities."
  - 4 points available within "Vehicle based assessment" under "Child safety"

- ASEAN NCAP: listed as Roadmap 2021-2025 topic
U.S. “HOT CARS” Act

- In September 2017, the “HOT CARS” Act was passed in the U.S. House of Representatives.
- The “HOT CARS” Act requests the U.S. Department of Transportation (i.e. NHTSA) to issue a final rule within two years, requiring vehicles to be equipped with an alarm system that alerts the driver.
Unattended Child Detection

Public awareness

- IEE presented papers at several conferences, e.g. the 25th ESV conference in Washington, the Ircobi Conference in Belgium, “Kids in Cars” in Munich

- IEE has won awards for VitaSense: CLEPA Innovation Award and FEDIL Innovation Award

Press coverage

- Press awareness is increasing around the world
- Recent Examples:
  - USA: NBC Nightly News, New York Times
  - Korea: MTN news
Summary

- Heat stroke deaths of children in cars are a global issue
  - Detection of sleeping infants is important

- IEE’s VitaSense is tailored for the detection of unattended children
  - Detects occupants based on motion, even newborns when they are sleeping
  - Car infrastructure is important to ensure warning and preventive actions

- NCAP and regulatory activities
  - Euro NCAP & ASEAN NCAP Roadmaps include “Child Presence Detection”
  - “HOT CARS” Act was passed in the U.S. House of Representatives
Thank you for your attention

You can see our VitaSense film at:
https://www.youtube.com/watch?v=1qJRDcaDb-U

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