Towards In-Cabin Monitoring: A Preliminary Study on Sensors Data Collection and Analysis

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Motivation

- **Driver loss of attention** due to **sleepiness** or **distraction** is a world-wide problem that leads to a high number of deaths every year.
- Several methods for monitoring the driver's state have been proposed over the years, based on the way of driving (behavior on the steering wheel), camera-based, and physiological data analysis.

In this paper proposes:
- A preliminary idea on multiple sensors data collection and analysis.
- The obtained preliminary experimental results.

State of the art

Sleep onset prediction can be performed measuring:
- Heart Rate (HR), which describes the contractions of the heart per minute
- Heart Rate Variability (HRV), which represents the change in time intervals between adjacent heartbeats
- Respiration Rate (RR), which is the number of breaths a person takes per minute

Physiological parameters (HR, HRV, RR) can be measured resorting to commercial devices like:

Wearable devices

Contactless devices

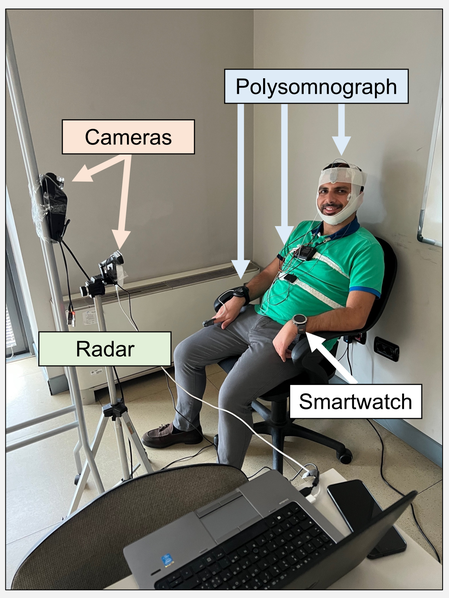
Distraction detection can be performed resorting to camera-based sensors which, alongside to computer vision techniques can measure eye and face gazing or detect the usage of not-allowed objects, like mobile phones.

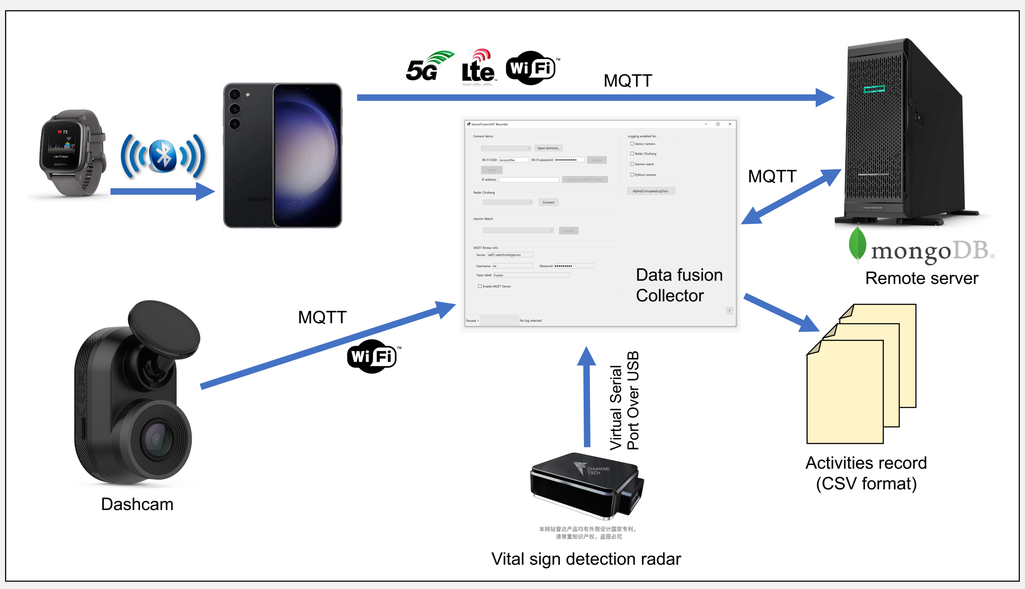
Dashcam

Proposed Approach

In this first stage, we conducted some experiments (Maintenance Wakefulness Tests) involving 16 volunteers, 5 females and 11 males, age range 25-30 to verify the sensitivity and accuracy of the data fusion algorithm.

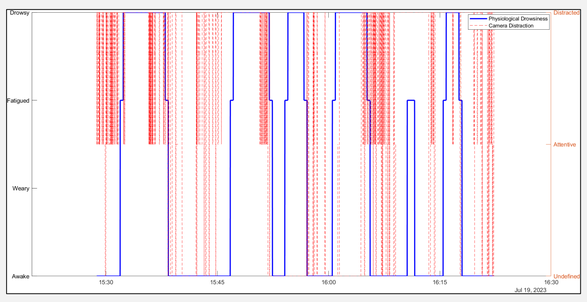
Each test lasted about 1.5 h and involved the usage of a **polysomnograph**, a clinical-grade instrument that can provide state-of-the-art data to medical doctors who can determine the exact sleep onset times.





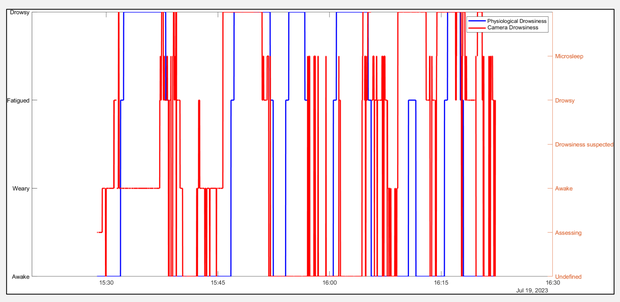
The architecture of the data fusion system

Experimental Results



Comparison between **physiological-based drowsiness** detection and **camera-based attention** detection.

It can be observed that a complete understanding of the passenger's status requires additional information about distraction.



Comparison between physiological-based and camera-based detected **drowsiness level**.

The physiological-based method indicates potential alarms for the passenger minutes earlier than the camera-based method.

Conclusion

In this paper, a significant array of sensors was utilized, each capable of operating independently and improving performance by leveraging information from other devices.

The results section examined a specific real-life scenario involving a combination of a camera and a wearable device.

This integrated system provided a comprehensive understanding of the driver's status in terms of both drowsiness and attention levels.

The future direction of this research involves the development of a real-time sensor fusion algorithm to effectively synthesize data from all sensors simultaneously.