Research Field And Department	Department of Systems Engineering and Automation
Supervisor	Raúl Fernández Matellán
Title of the Work	Synthetic & Private Data for Driver Monitoring

Objective:

We want to create "fake but useful" data for driver-monitoring research. You'll learn to:

- Clean real recordings (physiology + images).
- Train generative models that produce realistic new samples.
- Test whether those samples actually help models perform better.
- Check that privacy is protected (the synthetic data shouldn't reveal real people).

Abstract:

Privacy restrictions and the limited availability of public datasets hinder progress in Driver Monitoring Systems (DMS) for conditional autonomy. This project investigates generative AI models to (1) augment existing datasets with realistic, task-relevant samples and (2) anonymize data to improve shareability. We cast the problem as a min–max trade-off: maximize utility (downstream model performance when trained on synthetic, real, or mixed data) while minimizing re-identification risk (ensuring synthetic samples are meaningfully different from their real sources). Using a provided two-modal dataset—physiological signals (EDA, PPG, HR) and driver images—we will train multiple generators and directly compare utility and privacy outcomes.

Main Tasks to Carry Out:

- Clean/normalize data (EDA/PPG/HR signals and driver images) and align metadata.
- Create subject-wise train/validation/test splits to avoid identity leakage.
- Implement generative AI algorithm generators for both modalities.
- Generate synthetic samples that mirror labels, lengths, and resolutions of the real data.
- Train models on real vs. synthetic vs. mixed data and compare performance.
- Assess re-identification risk (embedding + nearest-neighbor or classifier tests) and iteratively adjust generation settings until utility increases while re-ID risk remains low.

References/Bibliography if required

A preliminary bibliography is included; an expanded reference list will be supplied at the beginning of their stage.

https://youtu.be/fbLgFrlTnGU?si=YTfhPhuA-fI0_rm3
https://youtu.be/RAa55G-oEuk?si=L1ShZh0m9vzw7aqF
https://youtu.be/HIusawrGBN4?si=TdpVl_sIYVEX9P9X
https://dl.acm.org/doi/abs/10.1145/3422622