

Year 10 - Proposed Project

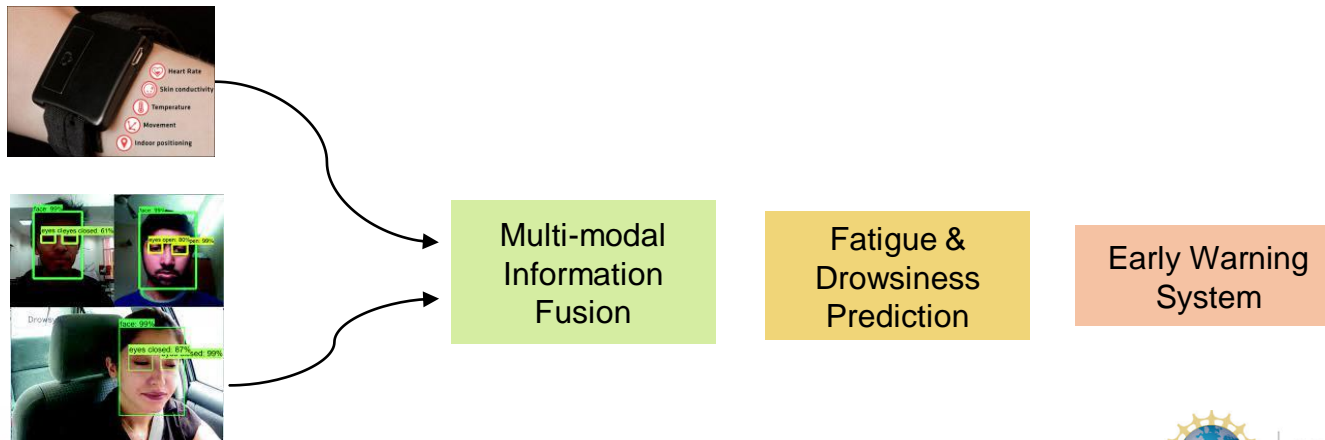
- ▶ 10a.005.UL_TAU - Improving Drowsiness and Fatigue Prediction with Multi-modal Sensing and Deep Learning

Project Team

Role	Name	Email	University or Company
PI(s)	Raju Gottumukkala	raju.gottumukkala@Louisiana.edu	University of Louisiana at Lafayette
Co-PI(s)	Moncef Gabbouj		
Researcher(s)	Satya Katragadda Raviteja Bhupatiraju		
Graduate Student(s)	Majid Hosseini		
Project Mentor(s)	Iftikar Ahmad (TietoEvry) Matti Vakkuri (Haltian)		

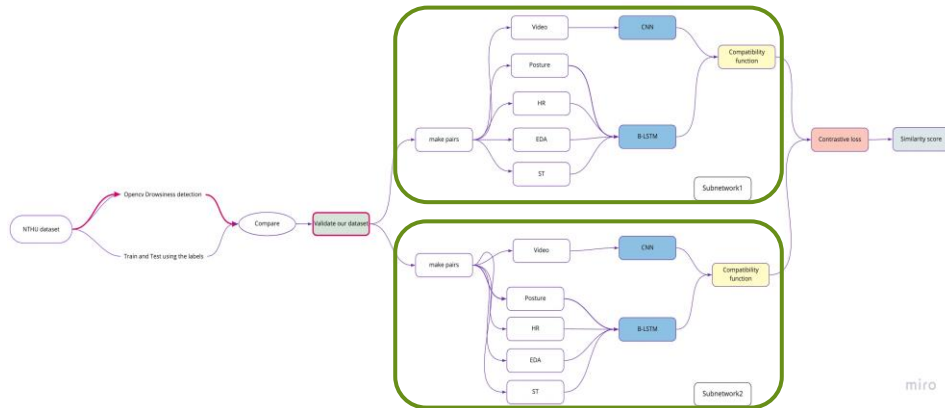
Project Goals & Novelty of Approach

- ▶ **GOAL:** Improve driver safety with multi-modal recognition of driver fatigue and drowsiness
- ▶ **Key-Features:**
 - Improve the performance of driver fatigue and drowsiness detection (using a combination of video and biometric signals)
 - Early warning system (compared to using video based)
- ▶ **Novelty:**
 - Integration of physiological signals and video
 - Multi-modal intelligence [representation learning + information fusion]

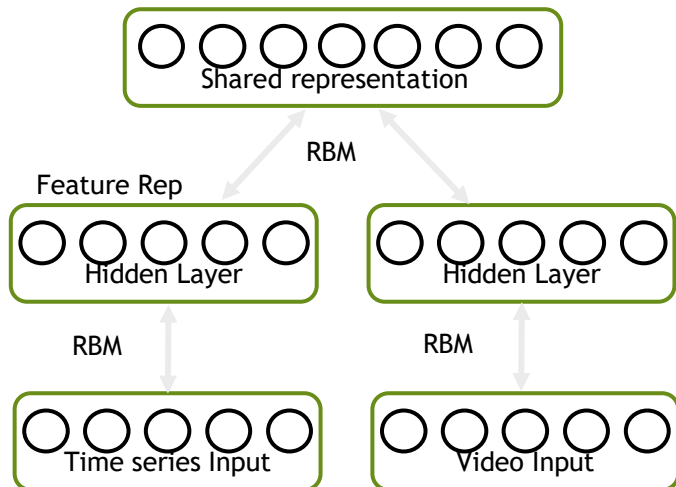


Improving drowsiness detection

Siamese networks:



Multimodal Shared representation learning:



Proposed driving simulator

Sensors:

Empatica E4: EDA, HR, Skin temperature, Accelerometer

Video cameras(3): face detection, pose detection, IR

Grip force sensor: Steering wheel with sensors(angle force and grip force)

Smart Rubber Soft: Vision seat pressure detection sensors

Signals:

Facial images

3D IR Facial images

Posture images

Electrodermal activity

Heart rate

Skin temperature

Pressure (driver's sitting position)

Steering wheel grip force

Accelerometer data (driver's behavior)



Benefits to IAB

- ▶ Improves driver safety through more reliable warning system [similar to braking assistance, lane assistance, blind spot warning, etc.)
 - ▶ Minimize accidents
 - ▶ Improve driver safety

Project Accomplishments

Deliverables/Steps	Status	Completion Date
Investigate existing open datasets for driver fatigue and drowsiness detection	Completed	12/20/2021
Investigate methods to integrate physiological signals and video features [RL + Information fusion]	Completed	12/20/2021
Conduct tests to collect drowsiness detection (independent of driving)	IRB and ethical review submission in progress	03/30/2022
Implementation of prototype for real-time location tracking and localization	In progress	07/30/2022
Write technical report	Has not started	07/30/2022

Research Results

- ▶ Drowsiness detection of the drivers using video is an important step towards drivers' safety but not sufficient due to inability to detect drowsiness ahead of time.
- ▶ Using Biometric signals is a way to predict the drowsiness; however, it is not fully addressed and using solely biometric feedbacks is not accurate enough to detect drowsiness.
- ▶ Conventional machine learning models are unable to find strong correlations between biometric feedback signals and drowsiness.
- ▶ Although controlled lab setting data is accurate, in the wild settings are more preferable to investigate due to their stochasticity of different scenarios that completely covers every aspect of the research. However, there are a lot of noises and partial data loose in the real-world investigations. Moreover, Conventional machine learning models are clumsy in presence of noise or when a signal is partially missing. So, a need for new multimodal representation learning model is felt in this regard.
- ▶ There is no available multimodal drowsiness detection data using video-biometric feedbacks and drivers behavior data to fully investigate driver's drowsiness.

Next Steps/Deliverables & Timeline

Next Steps/Deliverables	Start Date	Completion Date
Multimodal drowsiness detection using Video and biometric feedbacks	02/01/2022	05/02/2022
Multimodal Drowsiness prediction architecture	05/01/2022	06/01/2022
Draft of publicly available dataset for drivers' drowsiness detection	05/15/2022	07/01/2022

NOTES:

Questions?