IMPAIRMENT DETECTION - NADS DRIIVE DRIVER IMPAIRMENT DETECTION RESEARCH

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SAE INTERNATIONAL

THE NATIONAL ADVANCED DRIVING SIMULATOR
THE UNIVERSITY OF IOWA

Objective of the DrIIVE Research

Develop and evaluate a system of algorithms to identify signatures of alcohol-impaired, drowsy, and distracted driving; and

Assess potential countermeasures for drowsy driving lane departures

Evaluate an initial proof of concept for the use of this system in the development of safety technologies such as driver feedback displays for drowsiness

- Collect a new distracted driving dataset;
- Develop a specialized algorithms for alcohol, drowsiness and distraction; and
- Evaluate an initial proof of concept for the use of this system in the development of safety technologies such as driver feedback displays for drowsiness

Past Research Efforts

Impairment Monitoring to Promote Avoidance of Crashes using Technology (IMPACT)

- Focused on detecting impairment from alcohol using vehicle measures
- Algorithms used vehicle data to distinguish between drivers above and below the US legal limit (0.08% BAC)

Distraction Detection and Mitigation

- Focused on visual measures for detecting driver distraction
- Examined visual and cognitive distraction.
  - Eyes off road time
  - Gaze concentration

Advanced Countermeasures for Multiple Impairment

- Overnight drives after being up all day
- Can you predict drowsy driving before it results in a lane departure.
- Determine if alcohol based algorithms can detect impairment from drowsiness

Phase II Plan

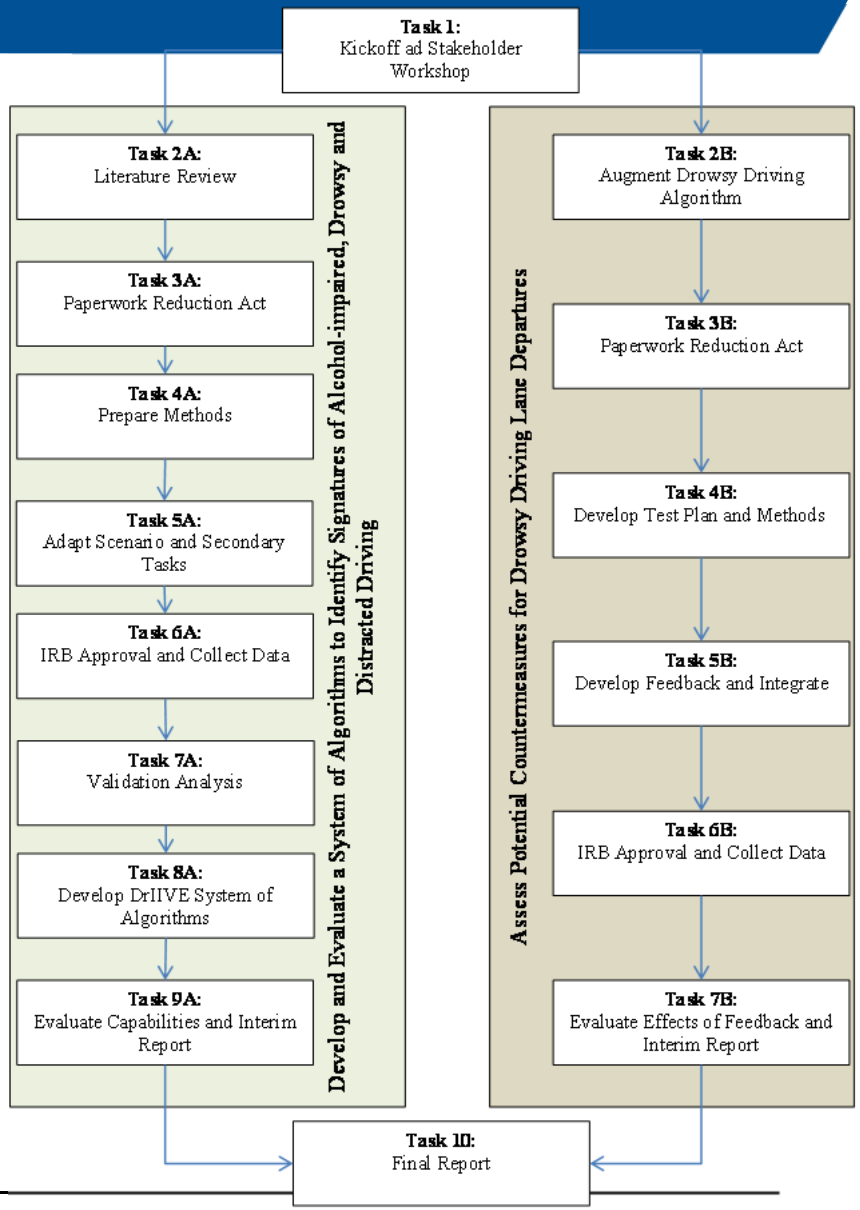
Develop Overall Structure

Refine Drowsiness Detection Algorithm

Collect Additional Distracted Driving Data

Develop Vehicle-Based Distraction Algorithm

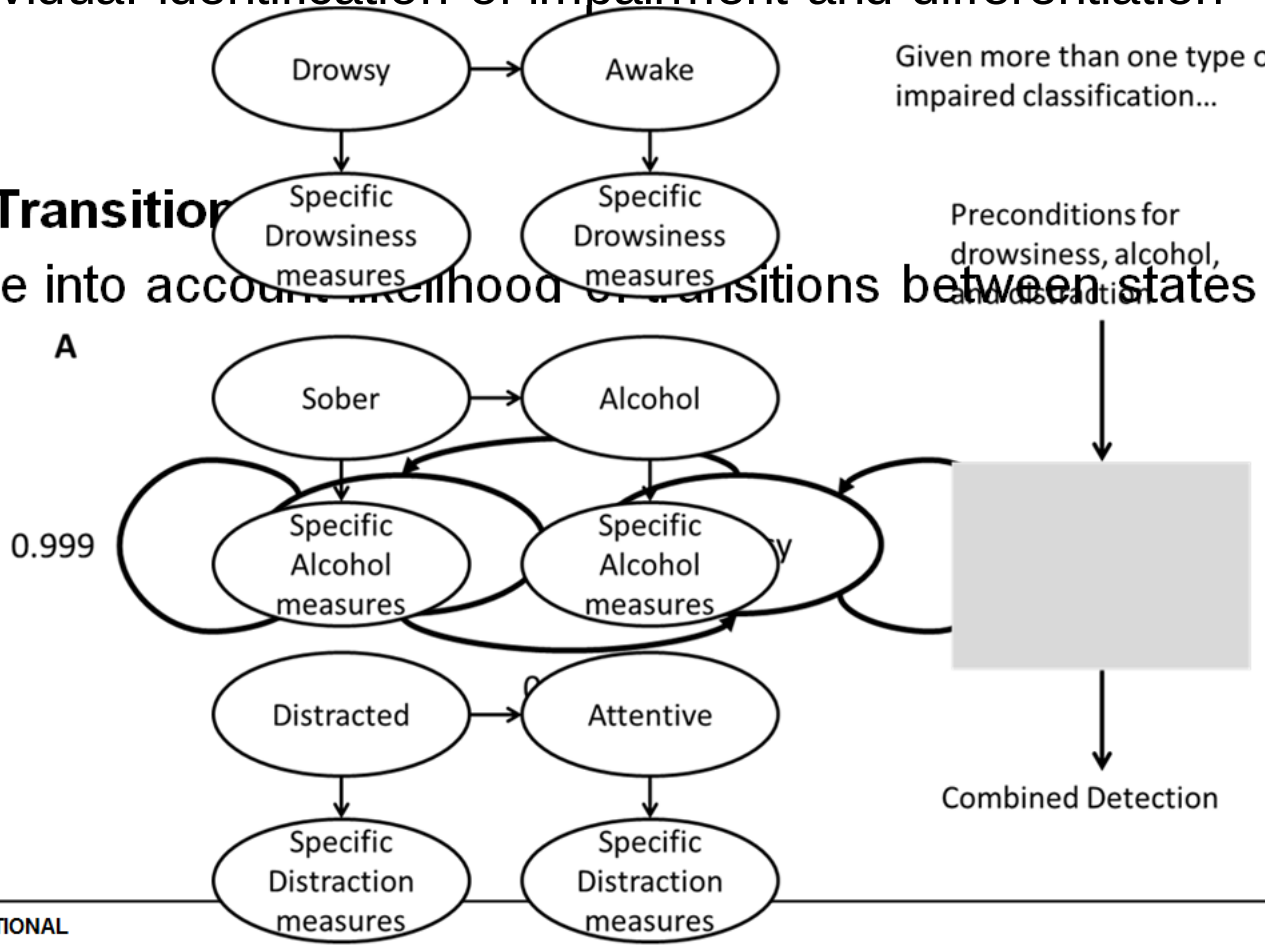
Test Combined System



Overall Structure

Many different ways to think about classifying type of impairment.

- Simultaneous differentiation and identification
- Individual identification of impairment and differentiation



State Transitio

- Take into accou likelihood of transitions between states

Drowsiness Detection Algorithm

Random Forest Models in a Hidden Markov Models Framework

- Use time series data over a minute length window

Model	Composition
A	consecutive steering wheel samples, aggregated each second (54 in 60 seconds)
B	Statistics on detrended steer, detrended steer rate, detrended steer energy, detrended steer rate energy (min,max,mean,median,sd)
C	Statistics on throttle, brake (min,max,mean,median,sd)
D	Statistics on TLC (min, sd), SDLP (sd), lane departure period (max)
E	Statistics on Seeing Machines PERCLOS and NADS PERCLOS (min,max,mean,median,sd)
F	Seeing Machines PERCLOS

- RF Performance (AUC)
  - Model A -> 0.69
  - Model B -> 0.61
  - Model C-> 0.74
  - Model D -> 0.72
  - Model E -> 0.67
- HMM Performance (AUC)
  - Models A,B -> 0.84
  - Models A,C -> 0.83
  - Models B,C-> 0.87

Data Collected to Support Detection Algorithms

Distraction Data

- Collect distraction data that is not forced paced
  - Menu selection task (visual manual)
  - Text reading (visual only)

- Data across three driving environment (urban, interstate, rural)

Distraction Detection Algorithm

Starting this process with existing data from prior studies

In preliminary stages of laying out the approach to distraction while waiting to collect new data

Will use both forced paced (old) and self paced (new) data

The Hidden Markov Framework will be adapted to distraction data

Outcomes

- Report on
  - DrIIVE System
    - Prototype system for detecting and differentiating between types of Inattention and Impairment
    - Algorithm considerations and integration issues
  - Drowsiness Mitigation
    - Approaches to mitigating drowsiness
    - Real-time algorithm integration issues
    - Evaluation considerations
- Recommendations for future work

Timeline- Where are we at

Waiting on approval from OMB under the PRA

- Collect distraction data February and April.
- Collect drowsiness mitigation in April—May
- Report in Quarter 4 FY14 or Quarter 1 FY15

Questions or Follow-up

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