An ANN Model for Detecting Secondary Tasks from Driving Behavior Attributes

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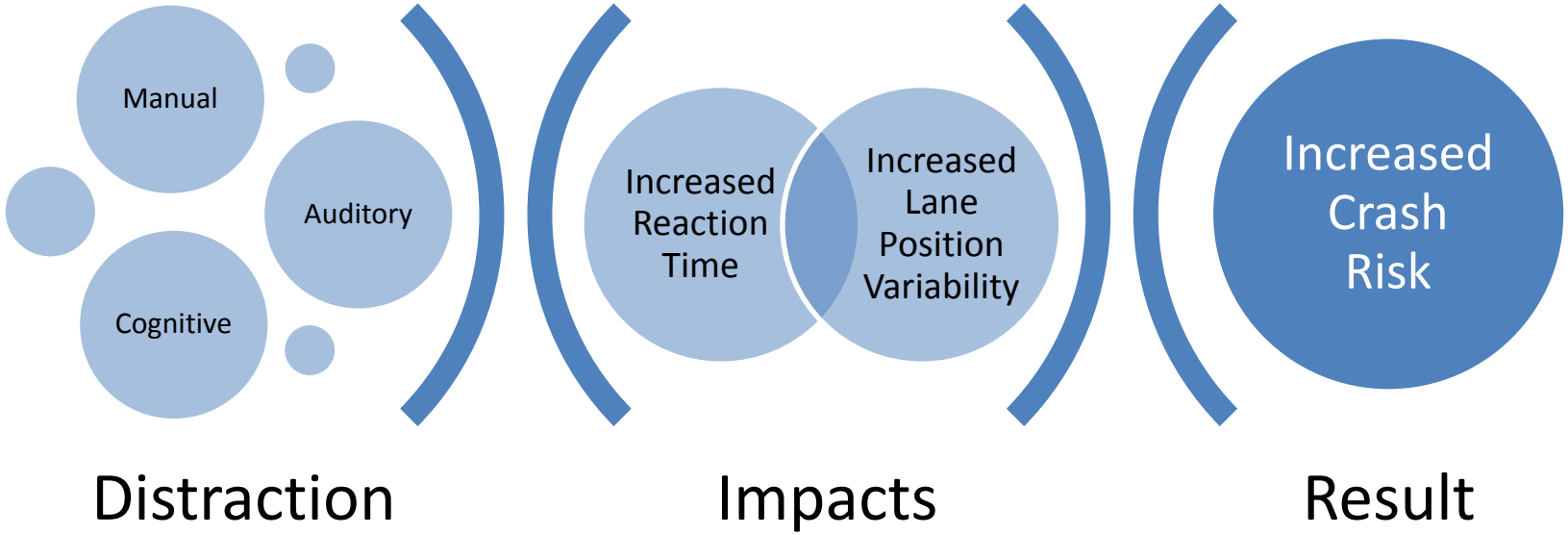
Outline

- Introduction
- Motivation and Objectives
- Methodology
- Results and Analysis
- Findings
- Acknowledgements

Introduction

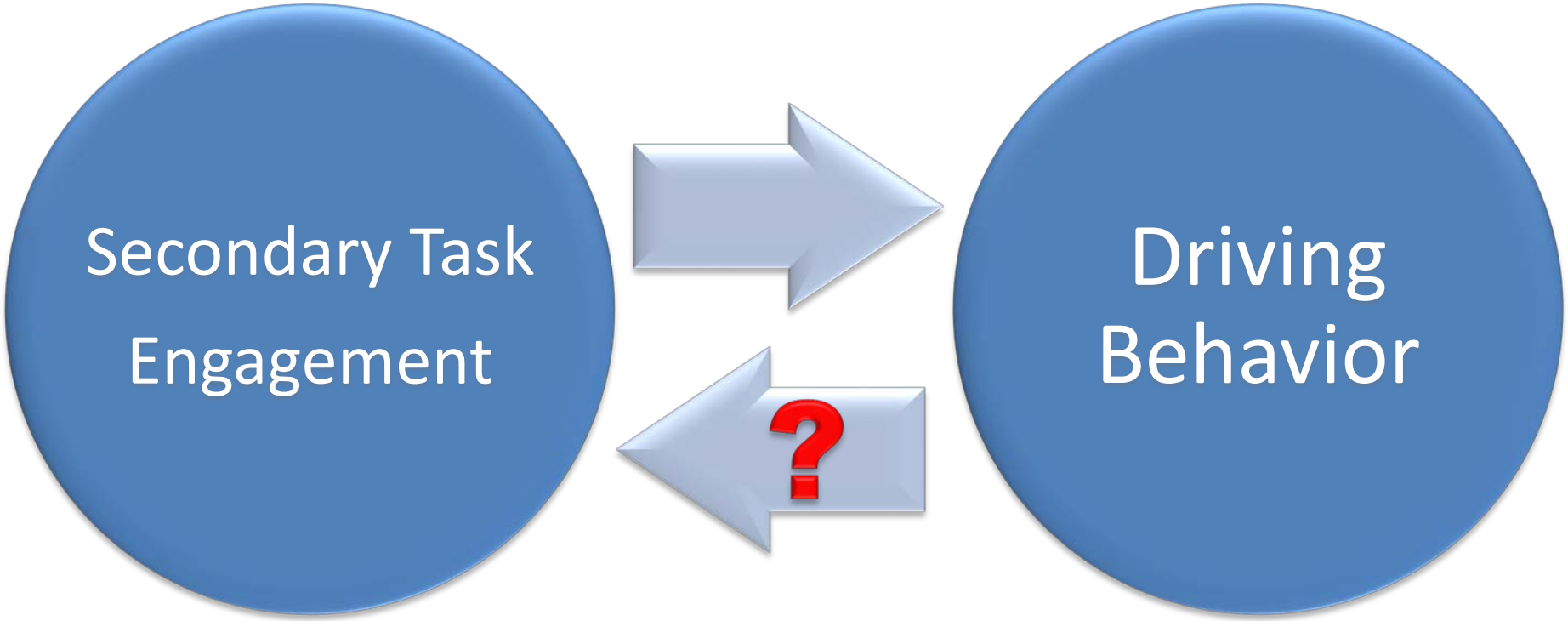
- **Distracted driving is any activity that could divert a person's attention away from the primary task of driving.**
  - Manual ***(eating, adjusting entertainment systems, grooming)***
  - Auditory/Visual ***(crying baby, passenger conversation, rubber-necking)***
  - Cognitive ***(using cell phone, navigation system, reading)***

Introduction



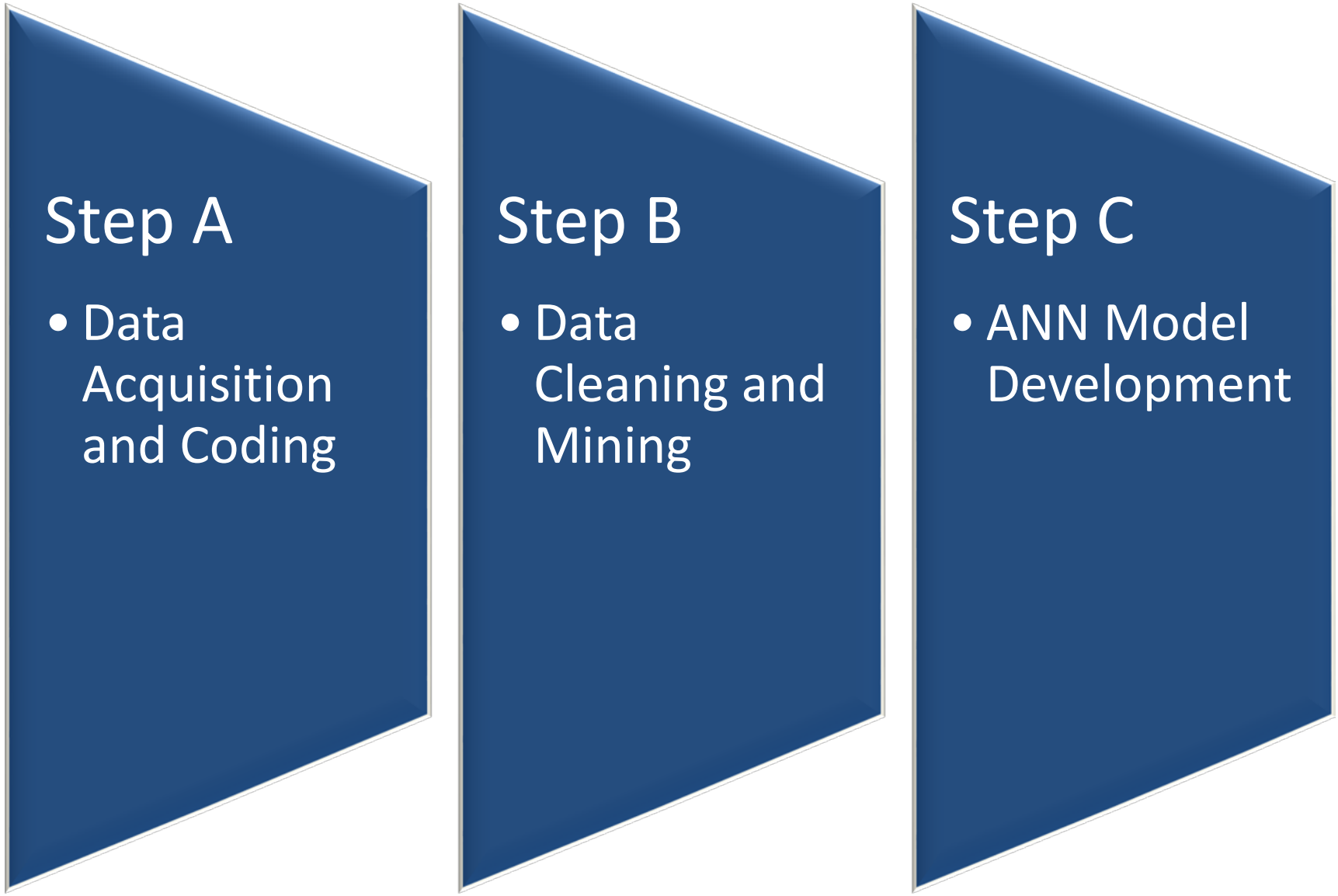
- **Raises the crash risk to at least 2 times higher than it is during normal driving - 51.93% of the time while driving [Dingus et al. 2016]**
- **Increased headway between vehicles unnecessarily and reducing the operational efficiency**

Motivation & Objectives



- **Detect secondary task engagement from driving behavior?**
- **Artificial Neural Networks (ANN)**
  - **Cellphone talking/listening**
  - **Cellphone texting/dialing with a hand-held device**
  - **Interaction with adjacent seat passenger**

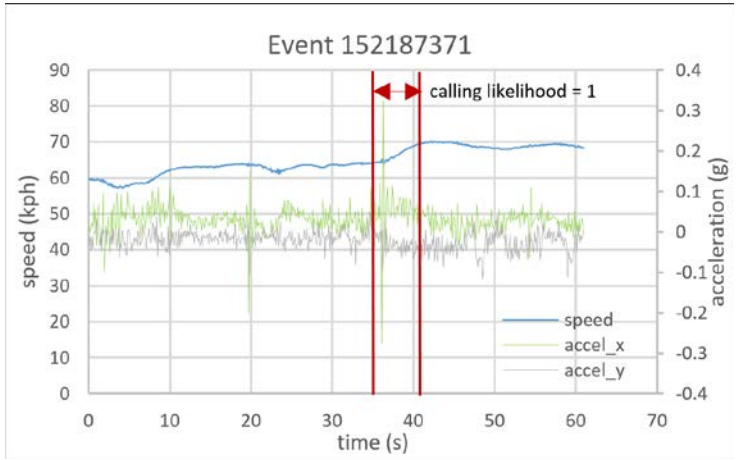
Methodology

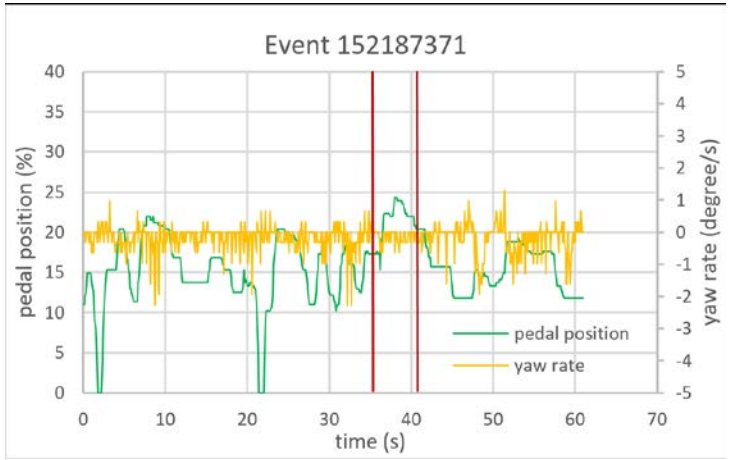


Data Acquisition and Coding

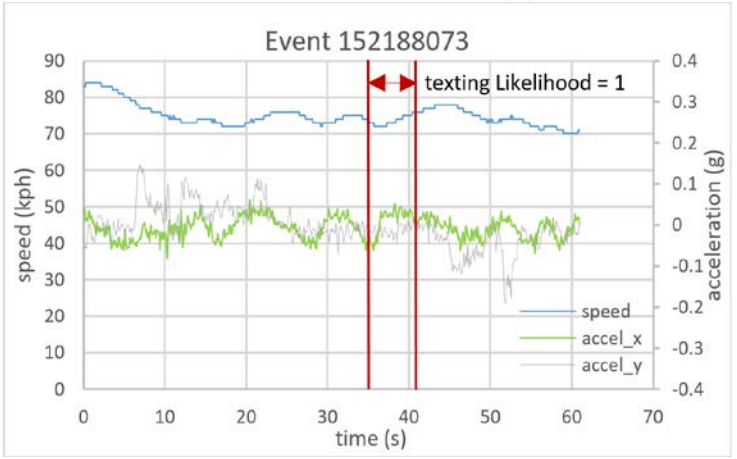
- Florida: 50 events for each secondary task
- Time series records for the five performance attributes
  - Speed, longitudinal acceleration, lateral acceleration, throttle position, and yaw rate
- Over a period of nearly one minute with a resolution of 0.1 seconds
- Starting and ending times of each secondary task that lasted around 6 seconds
- Data coding
  - 1 = from the beginning to the end of each secondary task
  - 0 = no secondary task

Data Acquisition and Coding



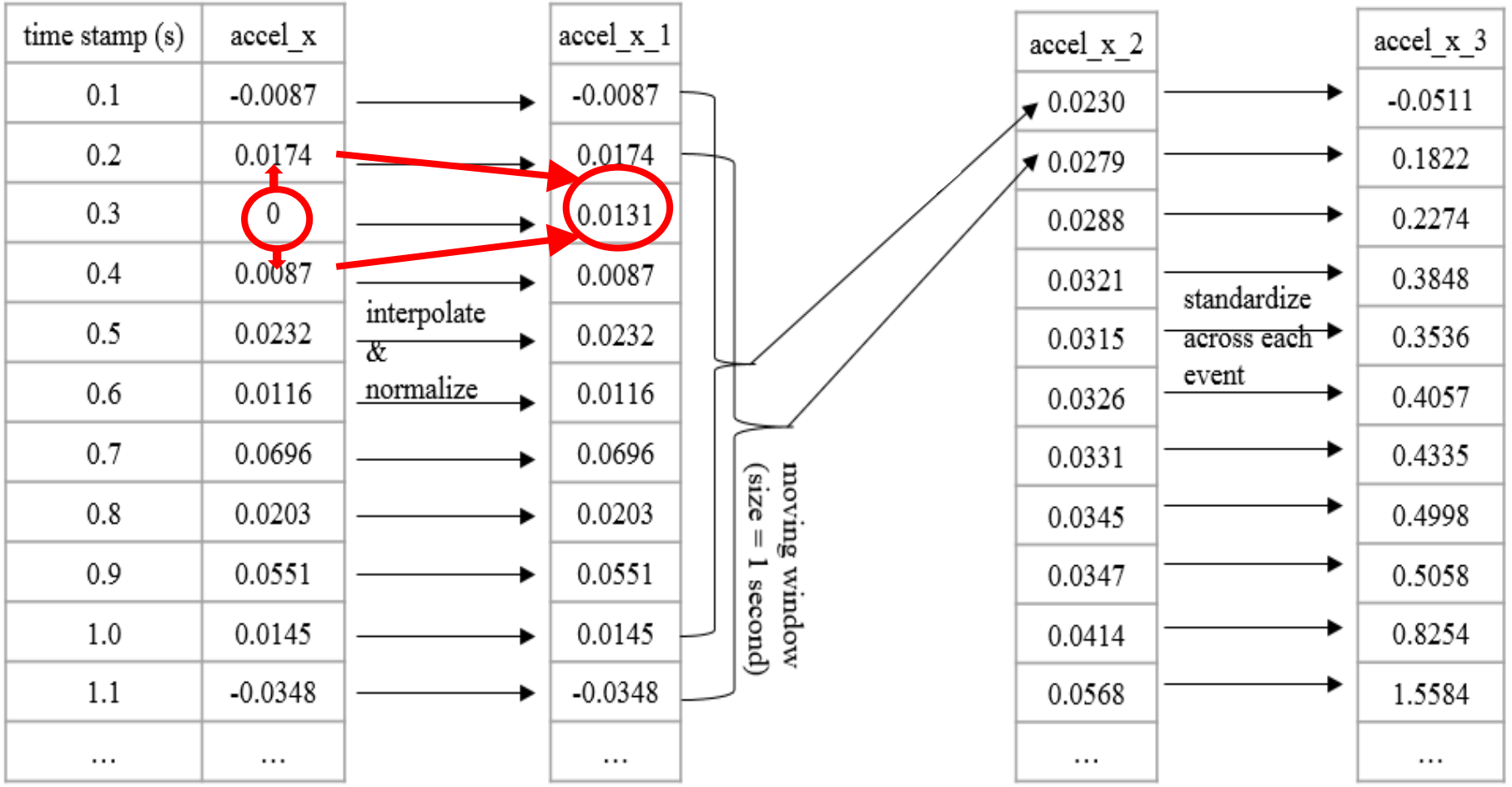


(a) Time series data for Calling event



(b) Time series data for Texting event

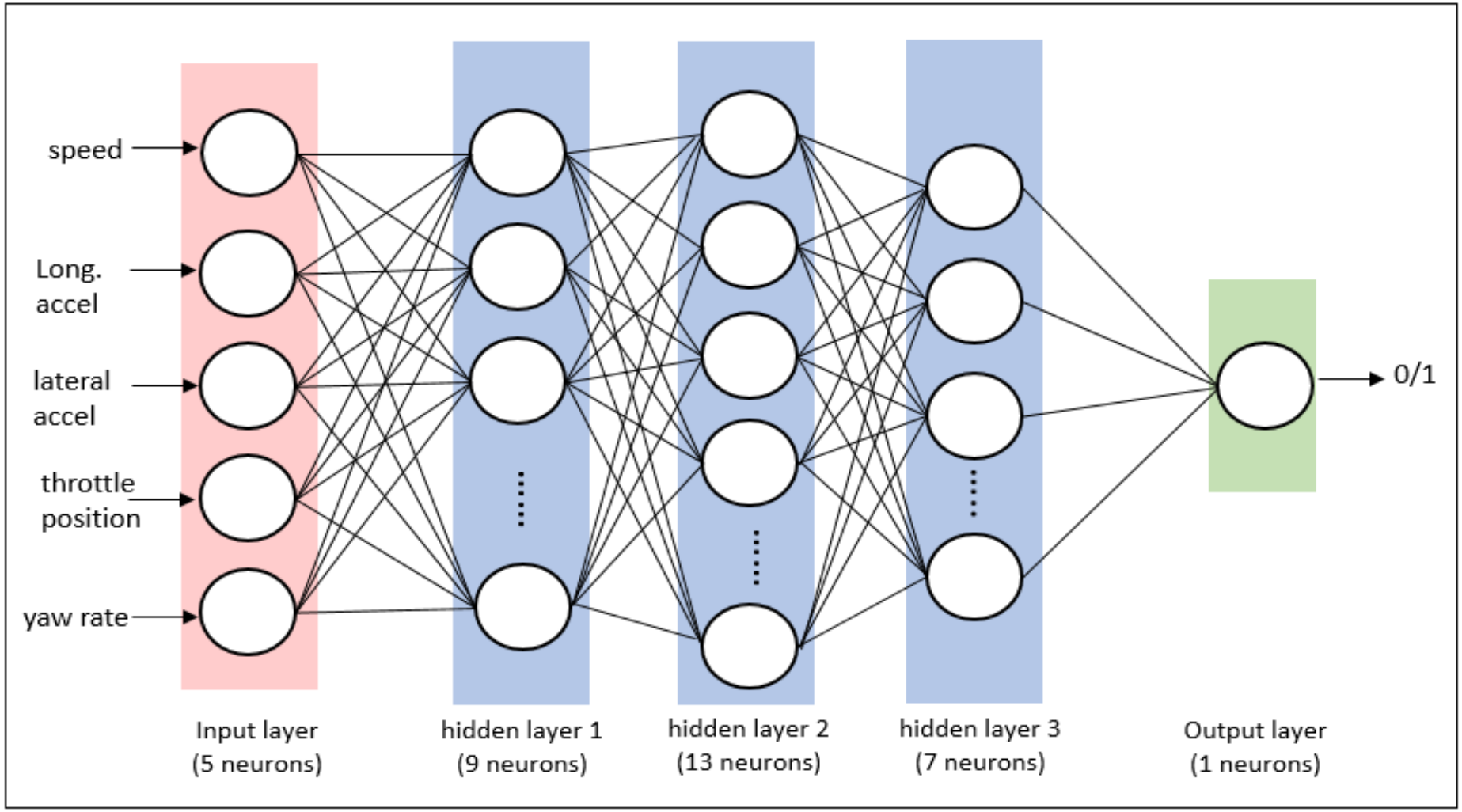
Data Cleaning and Mining



Neural Network Model Development

- **Three binary ANN models were developed individually for each type of secondary task**
- **Supervised feed-forward network with backward propagation (FFBP)**
- **Data divided into 70%+15%+15%**

Neural Network Model Development

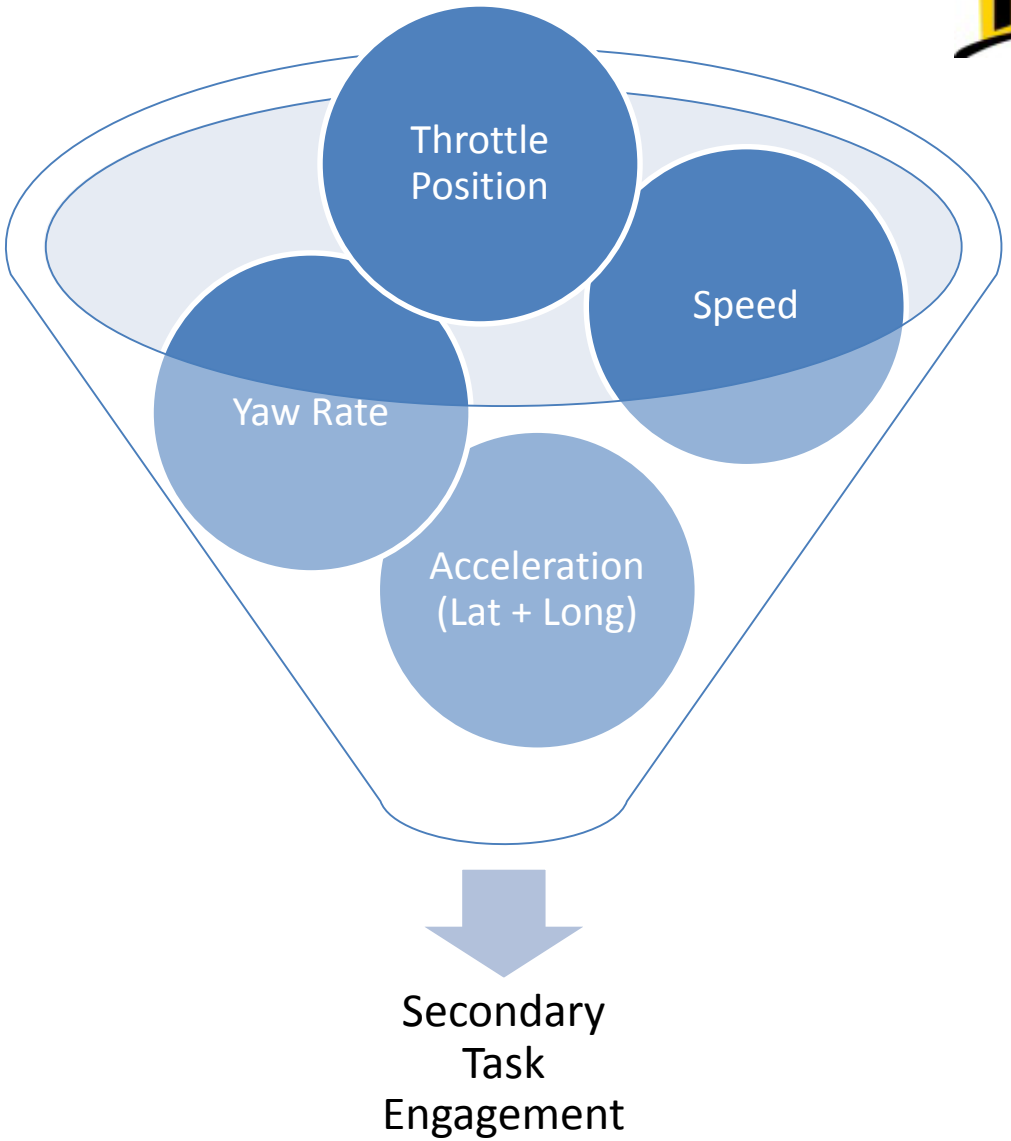


Results

Dataset	Model	Correlation Coefficient	Sensitivity	Specificity	False Detections	Failed Detections
Training	Calling	0.99	98.2%	100%	1.8%	0.0%
	Texting	0.98	99.7%	100%	0.3%	0.0%
	Passenger Interaction	0.99	98.9%	100%	1.1%	0.0%
Validation	Calling	0.99	96.3%	99.9%	3.7%	0.1%
	Texting	0.95	95.6%	99.9%	4.4%	0.1%
	Passenger Interaction	0.94	95.2%	99.7%	4.8%	0.3%
Testing	Calling	0.99	98.8%	99.9%	1.2%	0.1%
	Texting	0.95	92.8%	99.6%	7.2%	0.4%
	Passenger Interaction	0.97	97.4%	99.7%	2.6%	0.3%
Overall	Calling	0.99	98.0%	100%	2.0%	0.0%
	Texting	0.97	98.1%	99.9%	1.9%	0.1%
	Passenger Interaction	0.98	98.1%	99.9%	1.9%	0.1%

Findings

- **Hypothesis**
- **Likelihood of drivers' secondary task engagement can be detected**
- **Performing diagnostics during accident investigation to resolve legal disputes**



Acknowledgements

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THANK YOU

"Whoever does not thank people, does not thank God."