Inferring Aggressive Driving Behavior from Smartphone Data - Smartphone's sensors meet Inception

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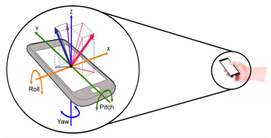
Motivation

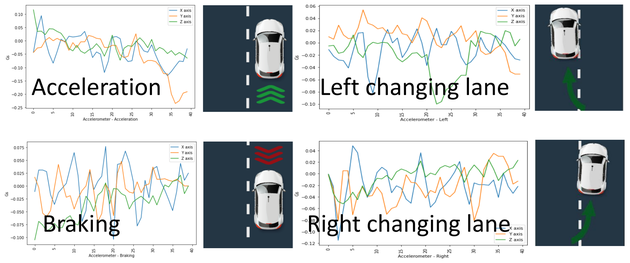
The World Health Organization estimates that "*Every year approximately 1.35 million people die and between 20 to 50 million people suffer injuries as a result of road traffic crashes*" [1].

More than a half of the fatal accidents that occurred between 2003 and 2007 (just in the U.S.) were related to aggressive driving behavior [2].

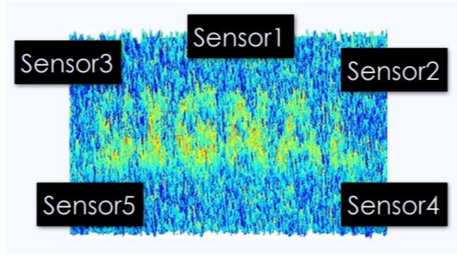
This study aims to exploit driving data collected by drivers' smartphones to classify risky decisions



Accelerometer, Gyroscope, Magnetometer, GPS, Camera

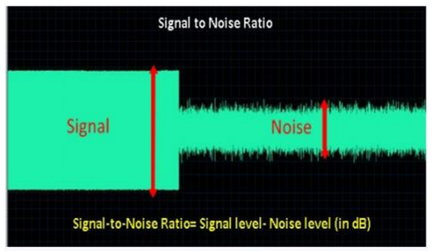


Problem Statement



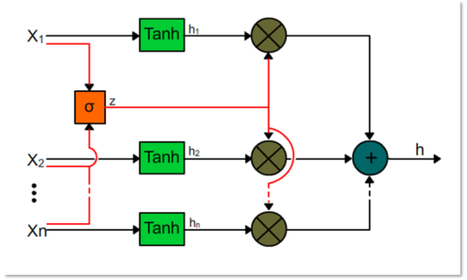
When we add more data sources, the classification becomes challenging!

Problem Statement

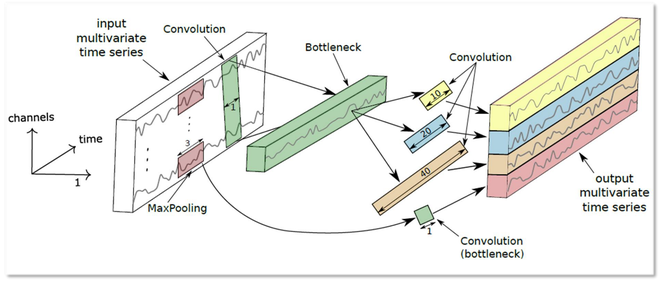


The signal-to-noise ratio is commonly low

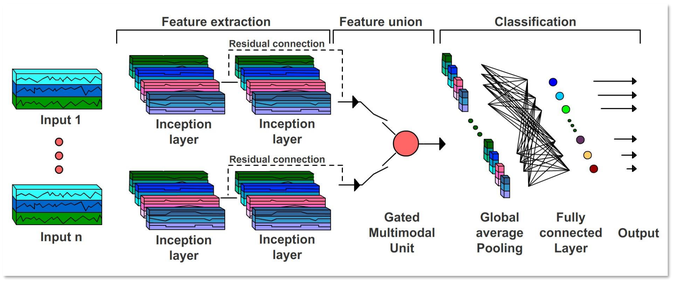
Proposed Solution



Combination of information from different modalities [3]



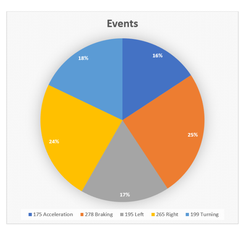
Abstraction of the original data [4]



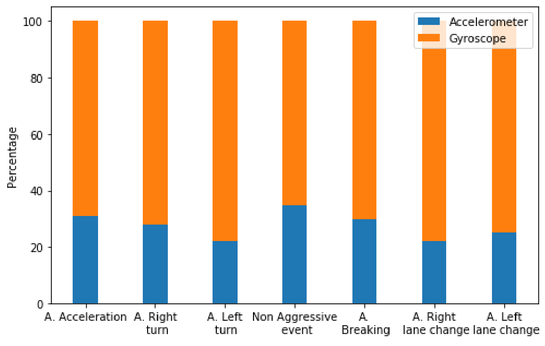
Proposed model with two inceptions layers and a Gated multimodal unit.

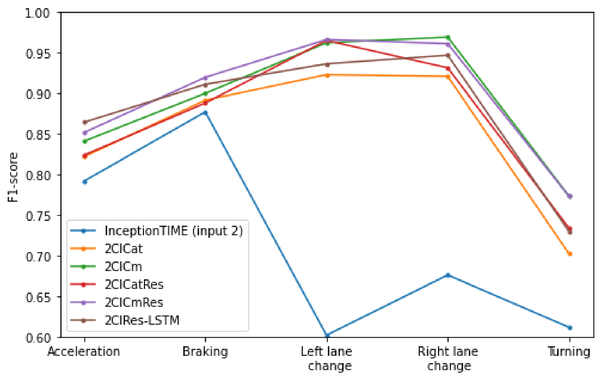
Results

When this model receives Accelerometer and Gyroscope data as input it learns to weight how much importance it needs to pay to each data source

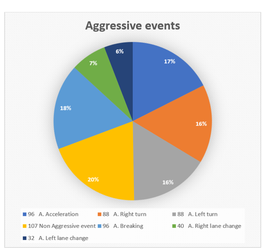


Dataset 1





Comparison of different models on several driving maneuvers



Dataset 2

Conclusion

We can conclude that the models that abstract each of the inputs individually are useful for those problems with multiple data sources, especially when the data sources do not contain relevant information for all classes. In turn, the use of GMU can improve the general classification.

References: [1] World Health Organization, "Road traffic injuries." World Health Organization, Feb-2020.
[2] American Automobile Association Foundation, "Aggressive Driving : Research Update," Washington DC, 2009.
[3] J. Arevalo, T. Solorio, M. Montes, and F. González, "Gated Multimodal Units for Information Fusion," 2017.
[4] H. Ismail Fawaz et al., "InceptionTime: Finding AlexNet for Time Series Classification." 2019.

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