**CIS 4930 – Mobile Networks: Paper Review**

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**April 10, 2020**

Paper Title: *Wireless AI in Smart Car: How Smart a Car Can Be?*

Link: <https://ieeexplore.ieee.org/document/9025048?denied=>

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Summary:

This paper starts off by describing the topic of the research and the main problems that it is trying to propose a solution for. It lists out the popularity of mobile vehicles and how over 1 billion people own a car. The paper first mentions relevant information about vehicles and introduces many conflicts that come with the use of cars like safety and pollution issues. After thoroughly describing the issues, the paper explains how current solutions to issues like falling asleep while driving, children being left alone in cars, distraction while driving, and many more involve physical sensors to monitor human vitals. The current solutions however lack efficiency because the sensors need to be in direct line of sight of the driver and passengers, which leads to privacy issues.

Finally, after setting the groundwork for why a new solution must be made, the paper proposes the idea of wireless AI through the use of radio biometrics in cars. All of the challenges that face the proposal are addressed and explained in great detail. The solution solves issues that physical sensors face because the wireless radio biometrics can detect passenger vitals through objects, meaning they do not have to be in direct line of sight of the passengers. Also, passenger vital signs and children left alone in the car are monitored though breathing rate and number of detected passengers.

Strengths:

The paper does a great job explaining the reasons why physical sensors lack efficiency due to the need of direct line of sight to passengers. The wi-fi based in-car sensing system can perceive the environment even when there are obstructions in the way. The distinguishing solution to such a challenge was nicely highlighted and explained in a way that any reader would be able to understand how and why their proposed solution appears to be better than current solutions.

The paper also exceeds in extending the areas in which their proposed solution covers. Information regarding passenger privacy, driver authentication, and life-saving capabilities are all mentioned and explained. Specifically, abilities of the proposed wireless AI driver authenticator allow for potentially life-saving capabilities (determining if a child is left behind in a car alone).

Weaknesses:

The paper falls short when explaining how the wireless AI is going to measure vital signs and attention while driving. While breathing is explained as a primary source of data, it mentions that other factors are measured and compared but fails to list out specifically what they are.

Additionally, the paper includes extra information that might cause readers to lose focus on the solution being proposed. Environmental issues of driving cars are mentioned in the paper but never addressed when describing its proposed solution.

Improvement:

One area of improvement if I were to do this study again, I would test how many vital signs that can be monitored with the radio biometrics. The paper only mentions that breathing rate can be measured with the radio biometrics, however I would try to see how far the data collection and measurements could reach.

Additionally, machine learning is used when there are changes to the environment within the car. However, the paper only explains how it uses machine learning by referencing the machine learning model but does not explain the process further. There is a figure that describes how the grouping appears, but the image does not explain how the model works in detail.

Lastly, the proposed wireless AI primarily tackles the issues involving vehicle safety, such as distractions, sleep, and children being left in the car. The paper mentioned that vehicle issues also involve environmental conflicts, so I would try to extend the wireless AI to address some environmental issues as well. One way I would think this is possible is through adjusting throttle of the driver to not be as sensitive (similar to switching a car to eco mode) and use the machine learning technique to find the best throttle usage while driving for every owner of the car. Although this might be a stretch, it would help somewhat with environmental issues with regards to gas consumption and emissions.

Exam Question:

Q: How is driver identification and vital information measured with the wireless AI solution?

A: Radio biometrics is defined as the pattern of a human body when it has been introduced to a wireless propagation environment. Through machine learning, the wireless AI will be able to determine the unique wireless propagation patterns that each driver has due to the effect that certain biological tissues (skin condition, water mass, etc.) has on electromagnetic waves.