Title Of The Paper

Real-Time Air Pollution Exposure and Vehicle Emissions Estimation Using IoT, GNSS Measurements and Web-Based Simulation Models.

Paper Link

https://ieeexplore.ieee.org/document/8690622

1. Summary

1.1. Hypothesis

This paper addresses the growing concern over increasing urban air pollution levels and its impact on public health.The paper proposes a solution using new information and communication technology to create an in-vehicle Internet of Things (IoT) device. This device provides real-time feedback to the driver on their emissions and exposure during trips.

1.2. Contribution

The authors have introduced a dedicated IoT device alongside a mobile application to enhance real-time visual feedback for drivers. The IoT device improves feedback by employing dedicated displays and automatically detecting the beginning of a trip through its sensor. To ensure affordability and widespread adoption, the authors have utilized existing smartphone features like the Global Navigation Satellite System (GNSS) sensor and internet connection through a dedicated application instead of embedding these components directly in the IoT device.

1.3. Methodology

The models, developed in Matlab/Simulink, are integrated into a Java server, accessible through web services, including the smartphone application. These models estimate instantaneous pollutant emissions, encompassing NOx, exhaust Particulate Matter (PM) in mass and number, non-exhaust Particulate Matter (from brakes and tires), CO, and CO2. The outputs dynamically inform the driver through LEDs indicators and enable post-trip analysis in the smartphone application. The GNSS sensor initiates a longitudinal dynamic vehicle model, calculating power requirements at the wheel, and a sub-model for converting wheel velocity and power to engine speed and torque.

1.4.Conclusion

This paper introduces an innovative solution for providing real-time information to drivers regarding both air quality exposure and pollutant emissions.The software-based approach not only informs individual drivers but also offers cities an opportunity to enhance existing emissions-related traffic restriction systems by considering real-world emissions. Although this was the current phase of the application, the

subsequent phases include gathering user feedback and evaluating system efficiency using Portable Emissions Measurement Systems (PEMS).

2. Limitations

2.1. First Limitation

This architecture did not account for the exact rules of control strategies for each Original Equipment Manufacturer (OEM) and each model, as well as the impact of aging, tampering, and poor maintenance.

2.2. Second Limitation

The architecture lacks in evaluating system efficiency by using Portable Emissions Measurement Systems to improve the user experience.

3. Synthesis

Further refinement of simulation models to improve accuracy, especially in estimating pollutant emissions for different vehicle types, driving conditions, and environmental factors. Also, the integration of additional sensors or data sources to capture more comprehensive information, such as weather conditions, road quality, and traffic patterns, for a more realistic understanding of the driving environment's impact on emissions. By Integrating machine learning algorithms to adaptively adjust recommendations based on individual driving styles and conditions.