



E-Bike and sustainable mobility as a means of preventing cardiovascular and metabolic diseases in the presence of pollutants in the air

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Background

Recently, we have been witnessing a revolution in urban transportation thanks to the development of policies of green mobility. Cities have started to invest considerable resources in green vehicles and, specifically, on e-bikes. An increase in the use of e-bikes is important since it may help meet the WHO guidelines on physical activity requirements, which consists of at least 150 minutes per week of moderate-intensity activity or 75 minutes of vigorous-intensity activity. Moderate to vigorous physical exercise, among others, requires increased lung ventilation. However, outdoor air pollution is one of the biggest problems in our modern cities, and exposure to atmospheric pollutants (e.g., PM_{2.5} and PM₁₀) is harmful to health and should be avoided or, at the very least, minimized.

Objectives

The aim of the PhD project is to develop a real-time system for the optimization of the level of assistive e-cycling in the presence of air pollutants. The system will use the live data from a heart rate monitor and an air pollutant measuring device to modulate the intensity of the e-bike's assistance and obtain a trade-off between a moderate level of physical exercise and exposure to air pollutants.

Methodologies

In the first part of the project, we will estimate the correlation between heart rate and oxygen consumption in young and old individuals. This information will be used to model the metabolic effort during the use of the e-bike on urban and extra-urban routes. In the second part of the project, a real-time system for the automatic control of the level of assistive cycling will be developed. In this phase, a single-board computer able to interact with the e-bike assistive system, the pollutant probe, and the heart rate monitor will be programmed.

In the last phase, several tests will be performed to verify the validity of the developed system. Specifically, subjects will be asked to ride the e-bike with and without the developed system. The tested subjects will wear masks to quantify the effective level of pollutants inhaled. Additionally, the metabolic effort will be estimated through the analysis of the heart rate monitor.



FIGURE 1. IN PHOTO: THE USE OF THE METABOLIMETER WITH THE CYCLE ERGOMETER AND THE USE OF AN E-BIKE IN A

Expected Results and Impact

In general, we expect that the developed system will decrease the amount of inhaled pollutants, maintaining a moderate level of physical exercise.