

# Video Competition: Solving Smart Mobility Problems Using Bio-inspired Techniques

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## I. TOOLS AND ASSETS

This video was made using Open Source tools such as Ubuntu, Kdenlive, Audacity, Gimp, LibreOffice, and the traffic microsimulator SUMO. Graphic resources were obtained from OpenStreetMap, Google Earth, Bing Maps, and Pixabay. Finally, sound effects were downloaded from Free Sound Clips. The selected soundtrack is Chill Police by Anttis Instrumentals. The rest of pictures and sounds were created by the authors. Link: <https://youtu.be/ssE0RDitQvY>

## II. A.I. TECHNIQUE

We have chosen our epiGenetic Algorithm (epiGA) [5] as an A.I. technique to optimize our Yellow Swarm architecture [3], [4], [6] to obtain the optimal time slots for each sign and LED panel with the aim of reducing travel times, greenhouse gas emissions, and fuel consumption in the city of Malaga (Spain).

Yellow Swarm suggests possible detours to vehicles by showing different cyclical indications to drivers using LED panels. It has two stages: The Offline stage in which the system is configured, and the Online stage in which drivers are informed about the suggested detours. In the Offline stage, our epiGA analyzes different scenarios (traffic distributions) of our case studies, using the SUMO traffic simulator [1] which is controlled by the TraCI module [7], in order to implement the decisions that drivers make during their journey. The urban maps used to build the case studies have been imported from OpenStreetMap [2] so that we can test our system in realistic city districts, including traffic lights, roundabouts, etc. The training carried out in this phase results in the configuration of the LED panels to be used in the next stage.

In the Online stage, the LED panels show the different detour options to drivers depending on the time slots calculated in the previous stage, using the Panel Manager. The possible signs are: go straight on, turn left, and turn right. However, their availability depends on the type of junction the vehicles are approaching, i.e. the possible detour options, and the street where the panel is placed. The first sign is visible during a previously calculated time interval, after that the next sign in the sequence will be presented to the drivers. Once the cycle has finished it again starts with the first sign of the sequence.

By using this strategy, Yellow Swarm is able to prevent possible traffic jams in the city as well as improve the use

of most of the available secondary streets. Furthermore, as it uses LED panels, no personal devices (GPS navigators, mobile phones, etc.) are needed. Yellow Swarm also promotes road safety as drivers do not have to lose eye contact with the street while driving.

The epiGenetic Algorithm (epiGA) [5] consists of a set of strategies, based on evolutionary computation, inspired in nature, especially in epigenetics, with the aim of solving complex combinatorial problems. DNA and histones are collapsed to form nucleosomes, and this affects the gene replication during reproduction, while the epigenetic mechanisms modify the gene expression through methylation. We use this bio-inspired model to build the operators of our algorithm.

## III. NARRATIVE RESOURCES

The video was intended to be understood by everyone, so general concepts were presented and at the end of it, a set of references are given in order to provide more technical information. The first part is meant to present the road traffic in the city and its negative consequences as a real world problem to be solved, then our smart mobility solution (Yellow Swarm) is explained. After that, the A.I. technique (epiGenetic Algorithm) takes over to answer one research question: How the Yellow Swarms time slots can be optimally calculated? Finally, the improvements achieved, i.e. shorter travel times, less emissions and fuel consumption, are shown in a bar graph.

## IV. DISCUSSION

We have used several sound effects, animations, and transitions to make the video more dynamic and keep the viewers engaged. Our goal here is to present our smart mobility solution in which an A.I. technique is used to make it effective and efficient. Viewers should be able to understand our proposal and learn how new algorithms inspired in nature can be used to improve their lives. Additionally, it may be useful to show that Artificial Intelligence is not *Skynet*, i.e. that it is not here to end with humans, but to help us.

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