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HIT- HELLENIC INSTITUTE OF TRANSPORT

HELLENIC INSTITUTE OF TRANSPORTATION ENGINEERS

11th INTERNATIONAL CONGRESS on TRANSPORTATION RESEARCH

Clean and Accessible to All Multimodal Transport

Heraklion, Crete, September 20th - 22nd 2023

Impacts of automated driving vehicles on bus depot operation using naturalistic data

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Together with:

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The SHOW project

- 13 Project partners:
  - 70 partners from 13 EU-countries
- Duration of the project:
  - 48 months (January 2020 - January 2024)
- Framework Program:
  - Horizon 2020 - The EU Union Framework Programme for Research and Innovation - Mobility for Growth

show-project.eu

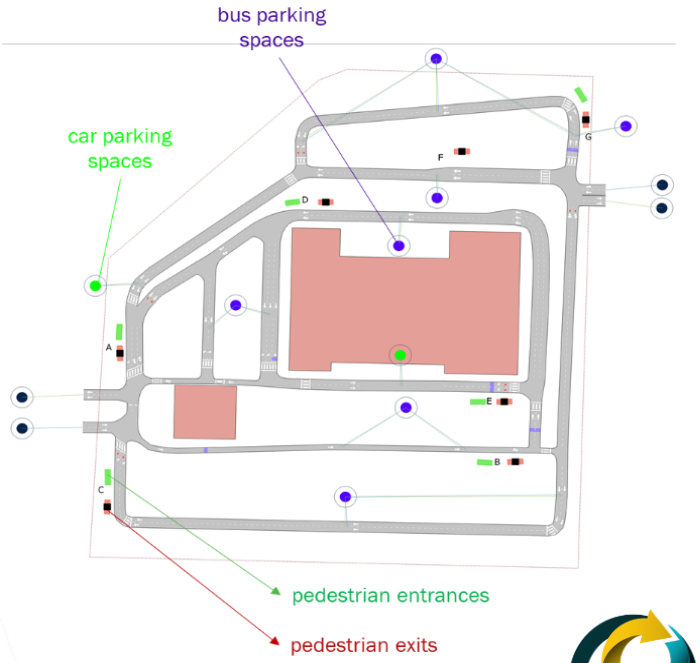
Introduction

- The SHOW project aims at developing shared automation operating models for worldwide adoption.
- During the project, real-life demonstrations are taking place in 20 cities across Europe to investigate the integration of Autonomous Vehicles (AVs) into various schemes.
- The present study aims to support this real AV deployment by investigating their impacts on road safety, traffic and the environment using field data.

Methodology

- One such demonstration site of the project is the Madrid site, which concerns a bus depot operations of the Carabanchel district and simulated in the Aimsun Next software.
- In order to provide impacts of AV operation that could not to be measured in reality, the microscopic simulation method was selected.
- The simulated network consisted of 30 nodes and 40 sections, vehicle O-D matrices of 11×11 centroids and a pedestrian O-D matrix with 6 entrances and 7 exits.

Carabanchel district
(Madrid, Spain)



aimsun.

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Field data integration

- The traffic simulation was performed using field data from the real-world operation, in which a fleet of up to five AVs was deployed.
- The fleet is mixed, composed of shuttles (mini-buses, and a 12 meter-long bus), and passenger cars (Renault Twizy) for people transport.
- The trajectory data of three types of AV (SAE level 4) operation were considered in the simulations:
  - a 12-meter bus (Irizar)
  - a mini bus (Gulliver)
  - a passenger car (Renault Twizy)

Electric bus – Irizar
SAE L4

Electric mini-bus – Gulliver
SAE L4

Electric car - Renault Twizy
SAE L4

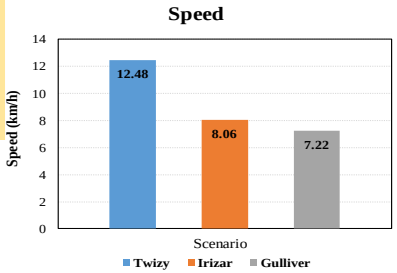
Simulated Scenarios

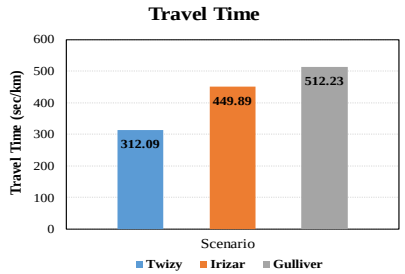
- Four scenarios were simulated:
  - three scenarios for each of the three AVs operation (Gulliver, Irizar and Renault Twizy)
  - a baseline scenario representing the existing network without the operation of AVs.
- The simulation time for all scenarios was 1 hour at a morning peak hour.
- For the automation scenarios, one route/round of each vehicle was completed during the 1-hour slot.

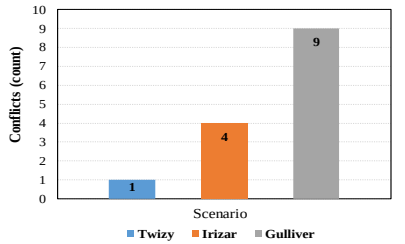
Results

- Renault Twizy presents the highest speed, lowest travel time and conflicts occurred, since it is a light-weighted vehicle compared to the others.
- All three AVs seem to increase network delay and travel time as well as decrease network speed, since AVs are slower than manually driven vehicles.
- All three AVs seem to increase traffic emissions more than the baseline conditions.
- Pedestrian speed, stop time and travel time seem to remain unaffected by the operation of AVs.

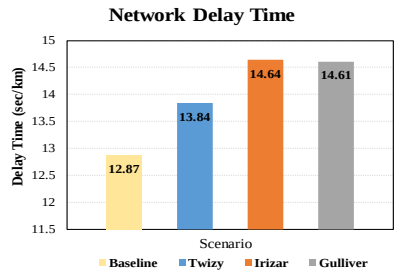
Vehicle Level:

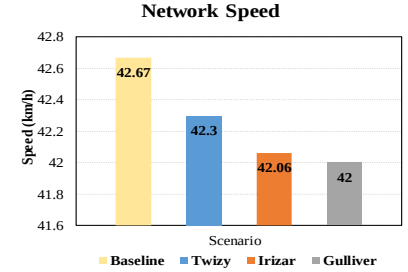


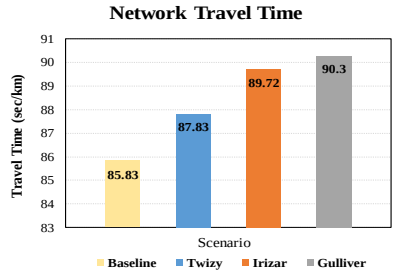


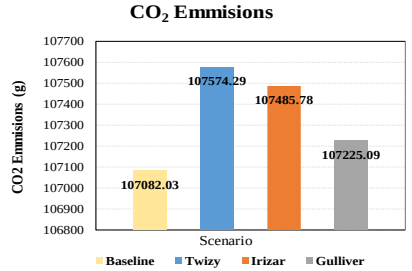


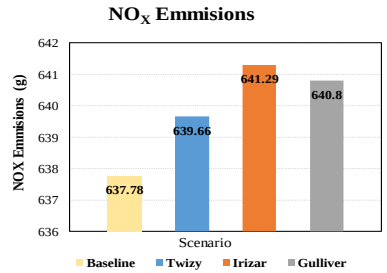
Network Level:

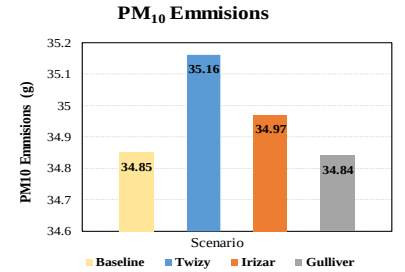




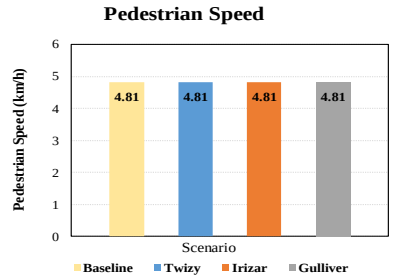


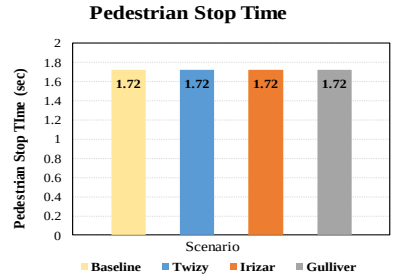


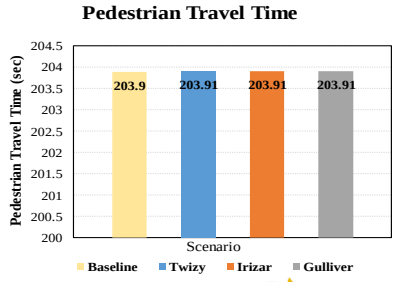




Pedestrian Level:







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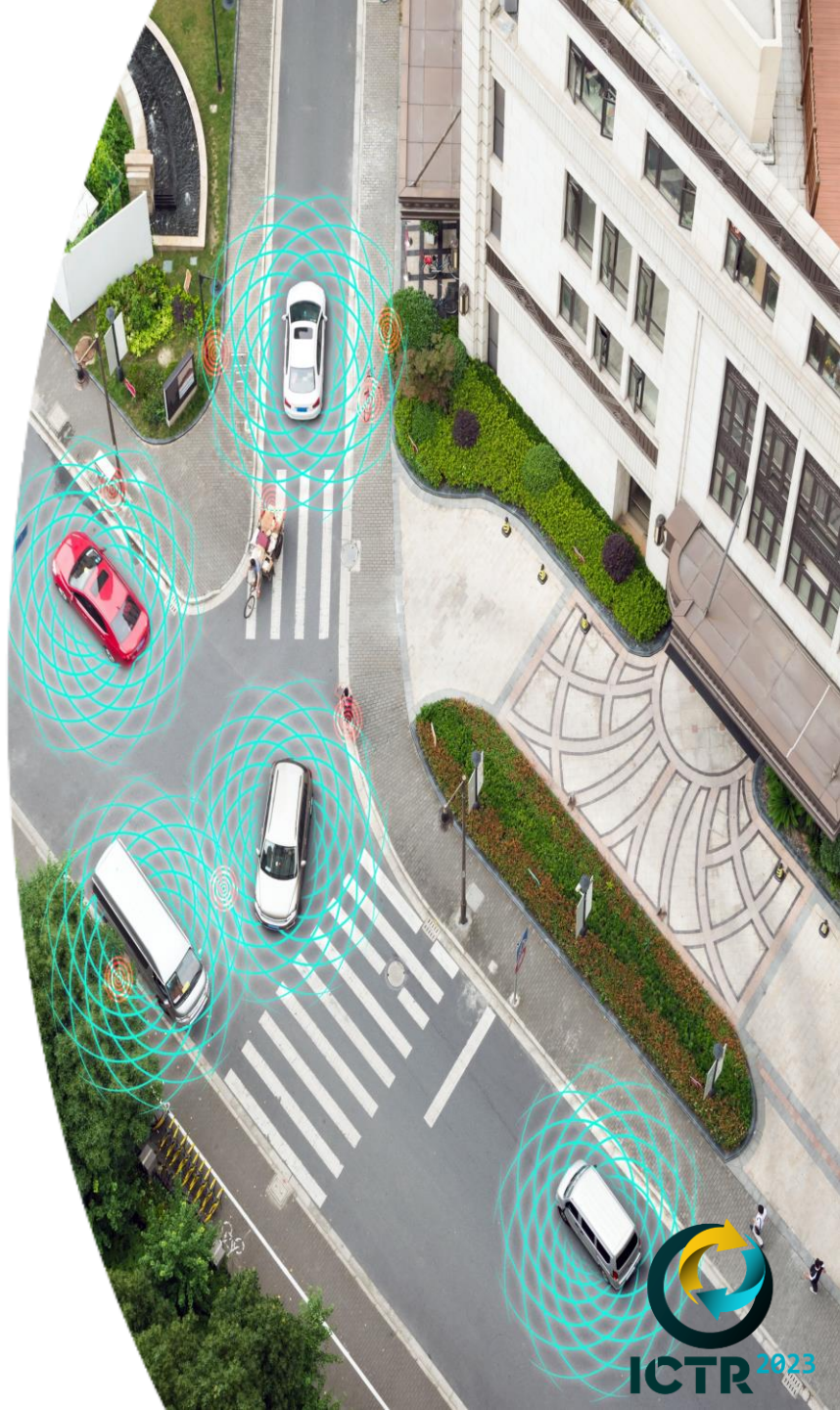
Conclusions

- Traffic simulation, as a solid approach, enables the assessment of potential alternatives before real-life interventions including the introduction of AV services and examines their interactions with human-driven vehicles as well as with pedestrians.
- The obtained results could guide stakeholders and practitioners as the examined scenarios included fundamental aspects for future traffic conditions.
- Findings can also help accelerate the deployment of autonomous vehicles and improve safety and reliability on the roads.



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