CIVITAS FORUM 2016

CIVITAS ANNUAL CONFERENCE | 28-30 SEPTEMBER | GDYNIA

An Electric Scooter Sharing System for Urban Mobility

CIVITAS FORUM 2016

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Gdynia, Poland

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Introduction

- **City of Dubrovnik's public road transport**
  - Dense traffic (cars, public transport buses, tourist buses, etc.)
  - Insufficiency of parking spots
  - Air and noise pollution by conventional vehicles
  - Narrow city roads, hilly roads (up to 10% slope), warm climate conditions
  - Habits towards use of scooters for personal city transport
- **Main solutions towards sustainable urban transport**
  - e-buses in city public transport (INTERREG project SOLEZ)
  - e-scooter sharing system (GreenGo Project)
  - Low emission zones and e-cars
  - Smart parking (SOLEZ)
- **GreenGo project**
  - A fleet of 100 e-scooters with 16 charging stations
  - Fully-automated e-scooter sharing system
  - Integrated into public bus transport system incl. intermodality option

City of Dubrovnik

Famous historical and tourist city; ‘Pearl of Adriatic’

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GreenGo Dubrovnik: e-scooter sharing system

- 100 e-scooters, P_n < 4 kW (B-category driver's licence), zero emission and no noise polution
- 16 AC charging stations
- GPS/GPRS tracking and CAN powertrain data tracking
- User friendly
- Integrated into public bus system
- On-line reservation (through app)
- Automatic billing
- Open for citizens and guests (tourists)

GreenGo DUBROVNIK

Supported by
Environmental Protection and Energy Efficiency Fund

Existing e-scooter sharing solutions

Barcelona

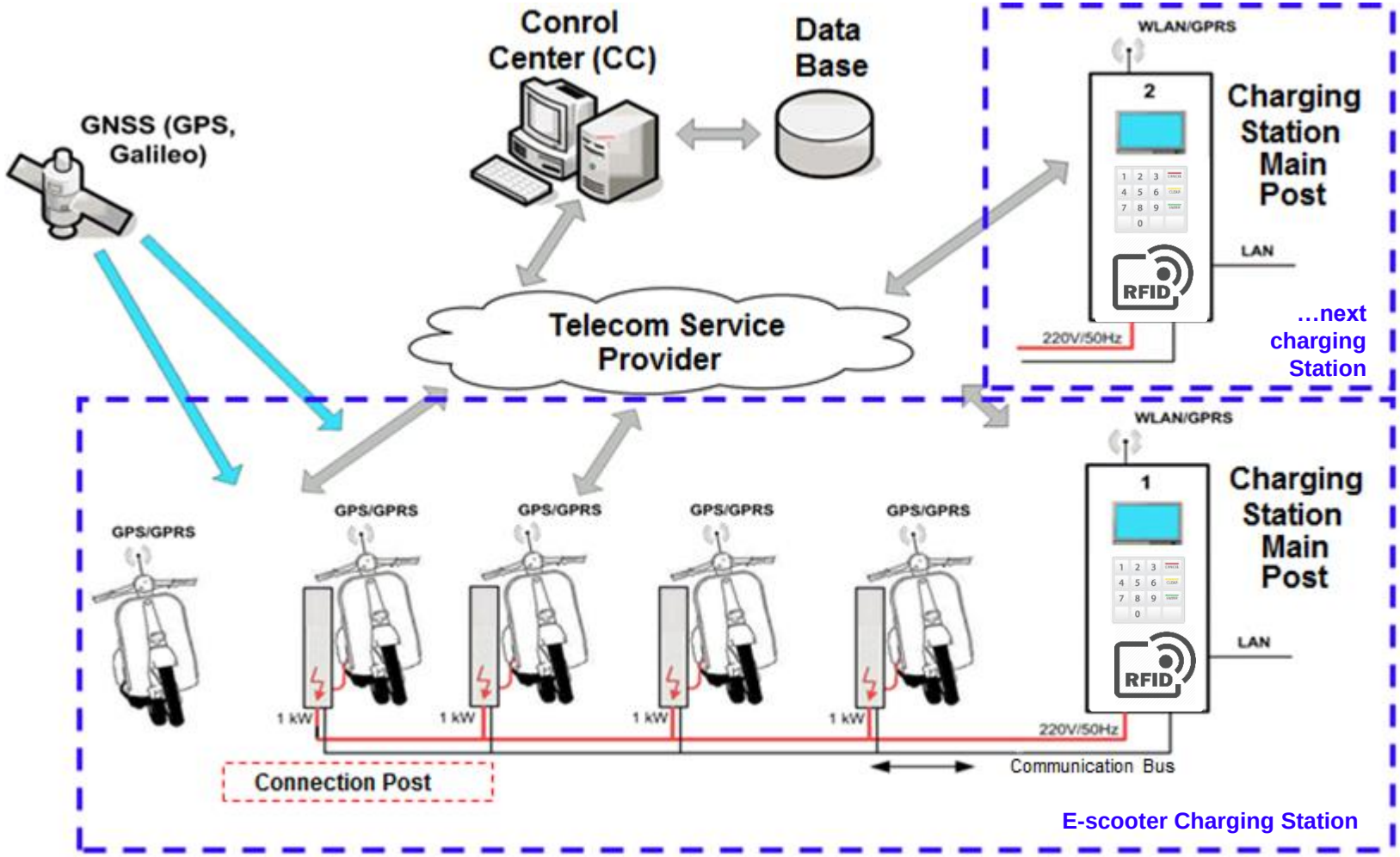
1. https://www.youtube.com/watch?v=zt6abZN3UI4
2. https://www.youtube.com/watch?v=A2ZDSskjK4w

Paris

1. https://www.youtube.com/watch?v=Y9JIGkoRHms
2. https://www.youtube.com/watch?v=BH_t10fLry0

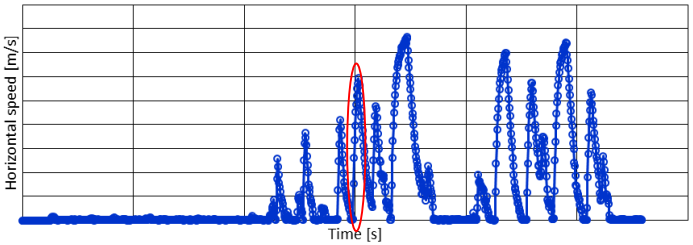
Not appropriate in the view of City of Dubrovnik's authorities, because the city is small and can be covered by charging stations, and because of significant logistics requirements/issues with such system (battery swapping system, irregular parking)

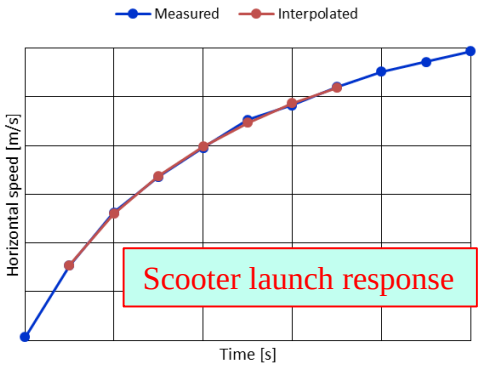
Concept of proposed sharing system



E-scooter tests

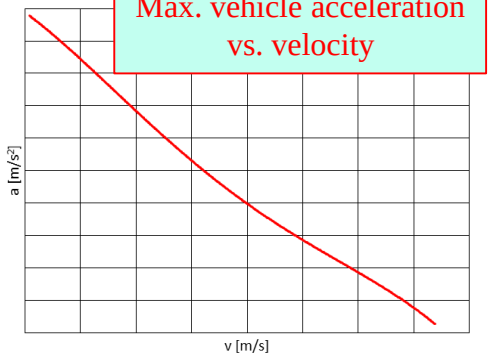
Repeating scooter launch tests under full throttle



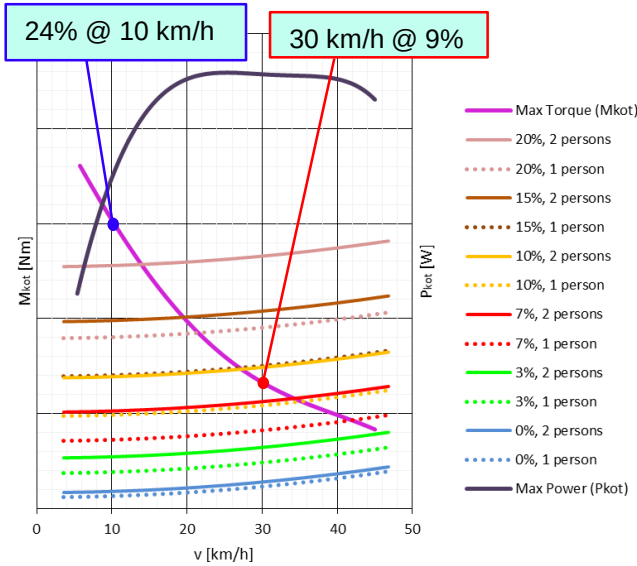


Scooter launch response

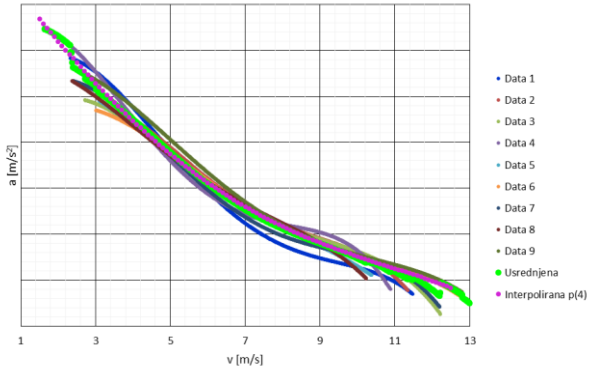
Max. vehicle acceleration vs. velocity



Conventional scooter Piaggio FLY 50 2T



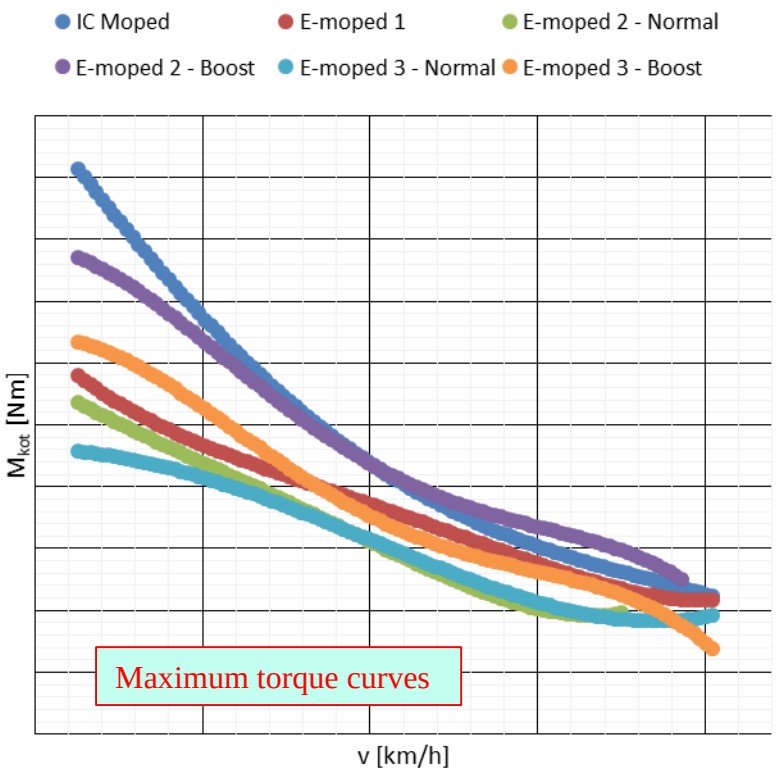
Max. torque and road load curves



Max. acceleration vs. velocity for repeating launch tests

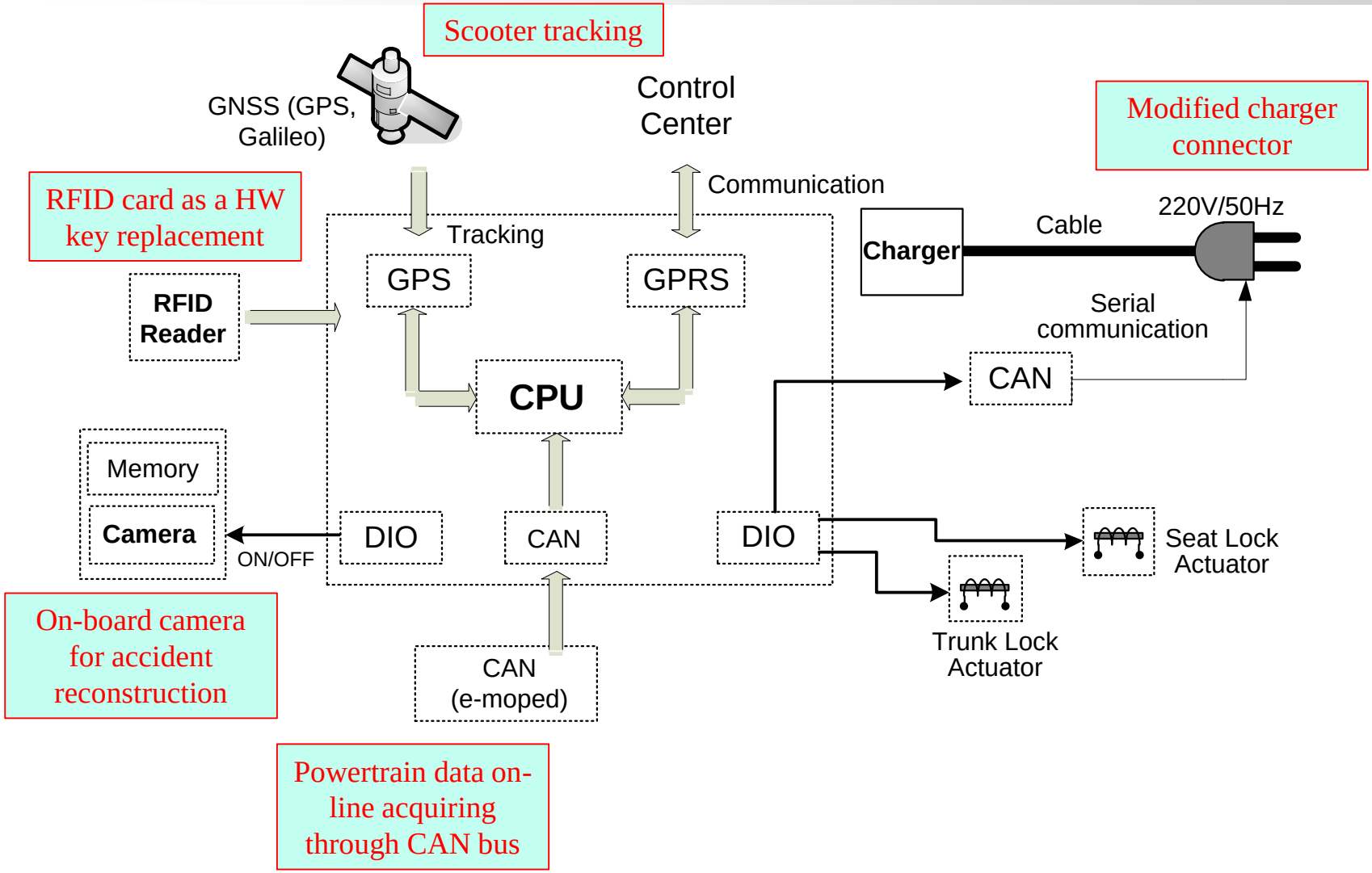
E-scooter tests (cntn'd)

- One of three e-scooters (when set in the boost mode) approaches maximum torque curve of the conventional scooter
- Maximum torque is significantly reduced in the normal (eco) mode
- Note: The e-scooters typically have a larger motor e-motor torque capacity, and they can be tuned by producer for higher torque (at the expense faster battery aging)
- Two scooters with Li-Ion batteries have a good range of approx. 60 km for a city-like driving pattern



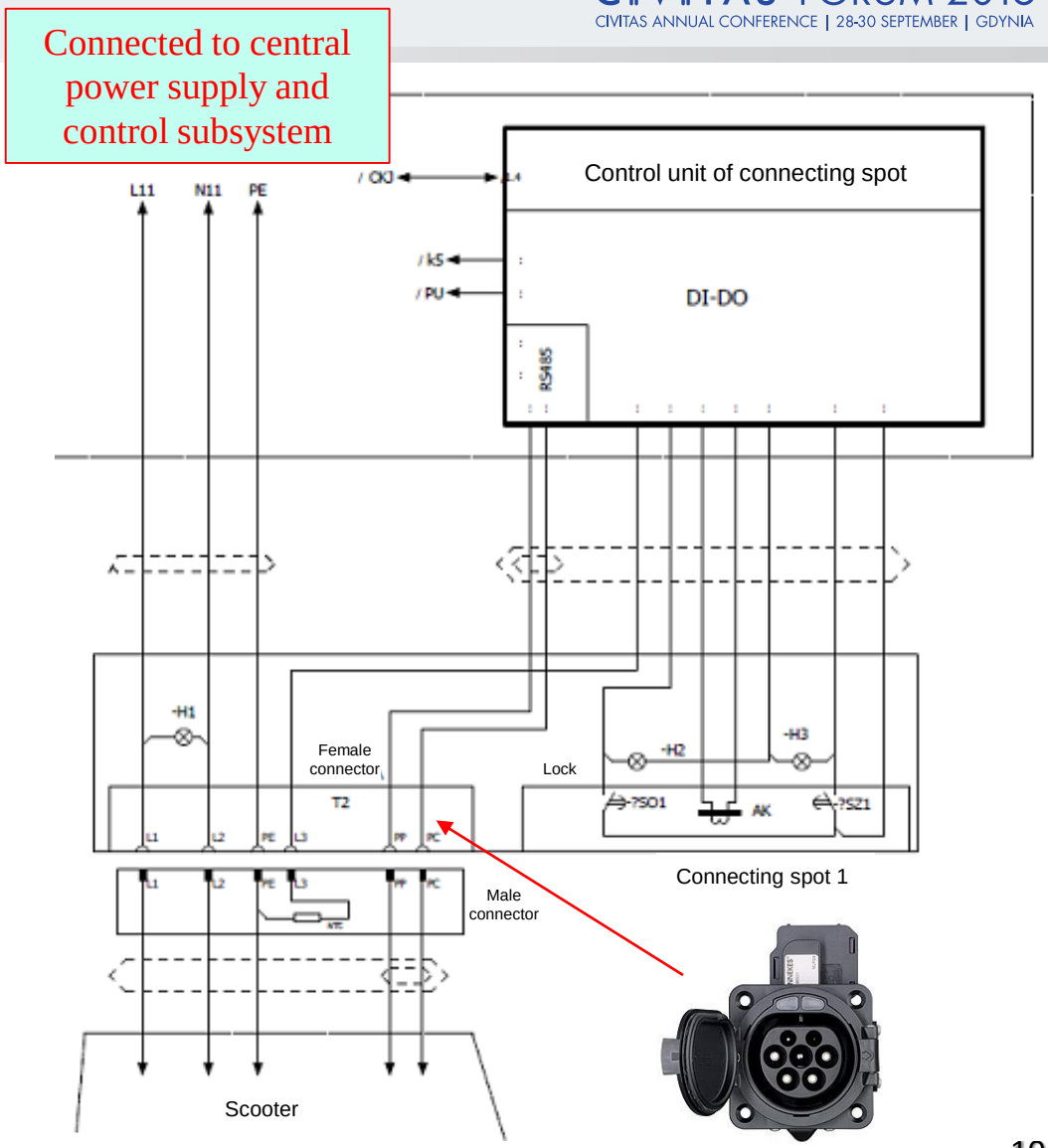
Range	E 1	E 2	E 3
Effective range (range in E1 cycle) [km]	21.7 (34)	62.7	62.5

Additional electronic module on scooter



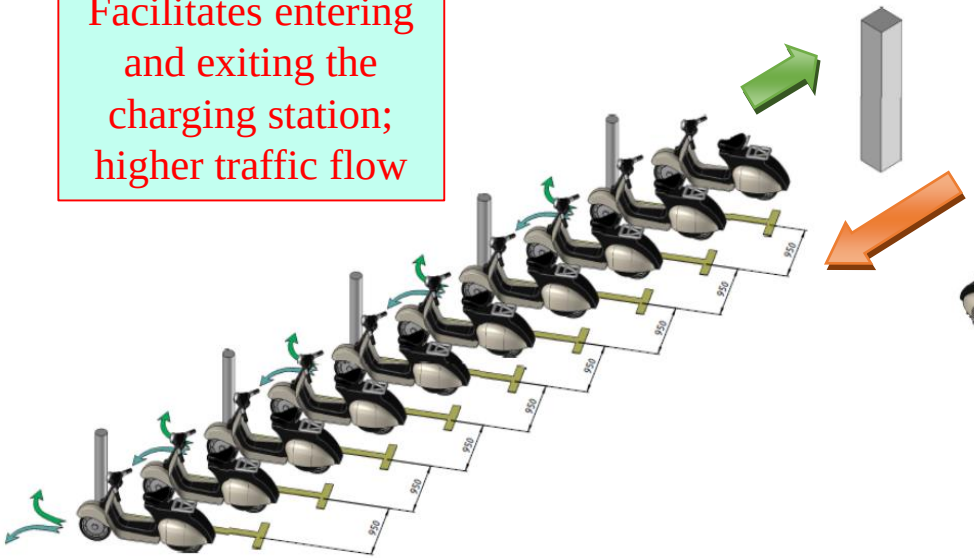
Charging station – connection spot

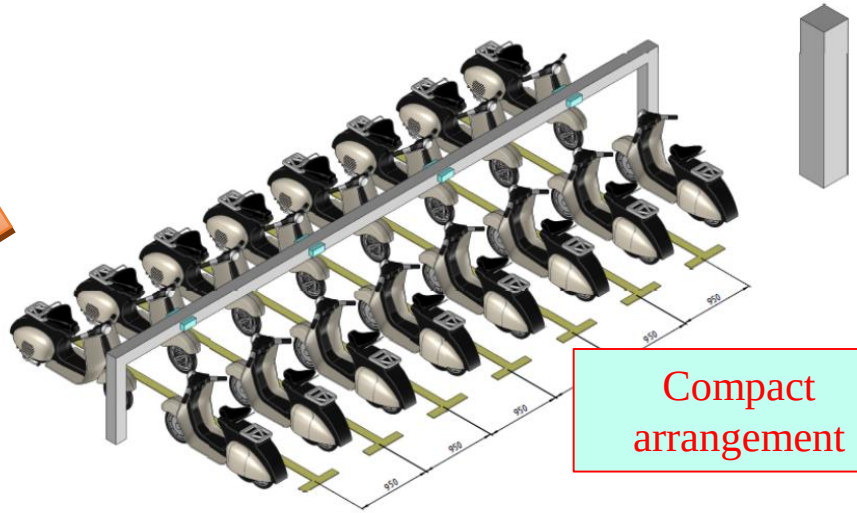
- The original schuko connector on scooter can be replaced by an automotive connector to provide safety function through proxy pin and NTC resistor (charging only when connector is plugged in and high-temperature monitoring)
- The connector can be of Type 2 with a locker option (see figure), or an other (simpler) type
- There can be communication between scooter and charging station through a CAN bus line, in order to monitor the charging process



Possible layouts of charging station

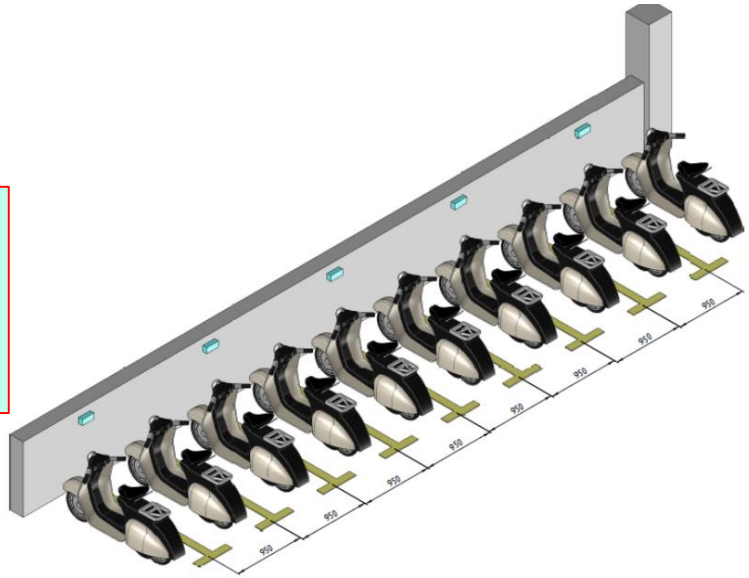
Facilitates entering and exiting the charging station; higher traffic flow





Compact arrangement

Convenient for spots along walls & hill-sides



User check-in/check-out at charging station

Issued by city bus operator

Check-in

- Authentication (RFID card, PIN)
- Scooter number is displayed (unplugged scooters are preferred if battery SoC is high enough)
- Connector and seat lockers open
- User plugs in the RFID card on a scooter slot
- User takes helmet
- User disconnects charging cable and puts it in seat compartment
- User drives the scooter
- In the case of stop, user takes the RFID card (disables the scooter)

Check-out

- Authentication (RFID card)
- Free charging spot is displayed
- Connector and seat lockers open
- User parks and plugs-in scooter
- Connector is locked automatically
- User returns helmet into seat compartment
- User takes RFID card from scooter to complete check-out process
- Charging process starts

Cell phone app functionality

- The app communicates with the sharing system control center
- The app enables the user to:
  - Log in the system
  - Check available scooters
  - Find the nearest ch. stations
  - Reserve a scooter
  - Enter required range to filter avaialble scooters based on their SoC
  - Use navigation when driving
  - On-line check of user's account and re-payment
- The app can also serve to:
  - Ceck in/out (instead of RFID c.)
  - User registration

Note: The use of app makes the system closer to open-patform system, because the user can leave scooter at any designated parking spot, while another user can ckeck-in through app ad take the scooter

Concluding remarks

- A e-scooter sharing system including charging stations and a control center has been proposed with the target application in the City of Dubrovnik.
- The proposed e-scooter sharing system will represent a zero-emission alternative to the current conventional city bus transport, and from the user's perspective (registration, payment etc.) it will be an integral part of the bus transport system.
- It will be fully automated in terms of charging requirements, easy to handle, safe and fun to use.
- In its initial variant the system can be used based on RFID card (and PIN), and it can be readily expanded towards using a cell phone app to facilitate user registration, scooter reservation, check in/out, account check, payment etc.
- The system of 100 scooters and 16 charging stations is planned to be developed and installed by the summer of 2017.

Thank you!

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