

Applus⁺
IDIADA



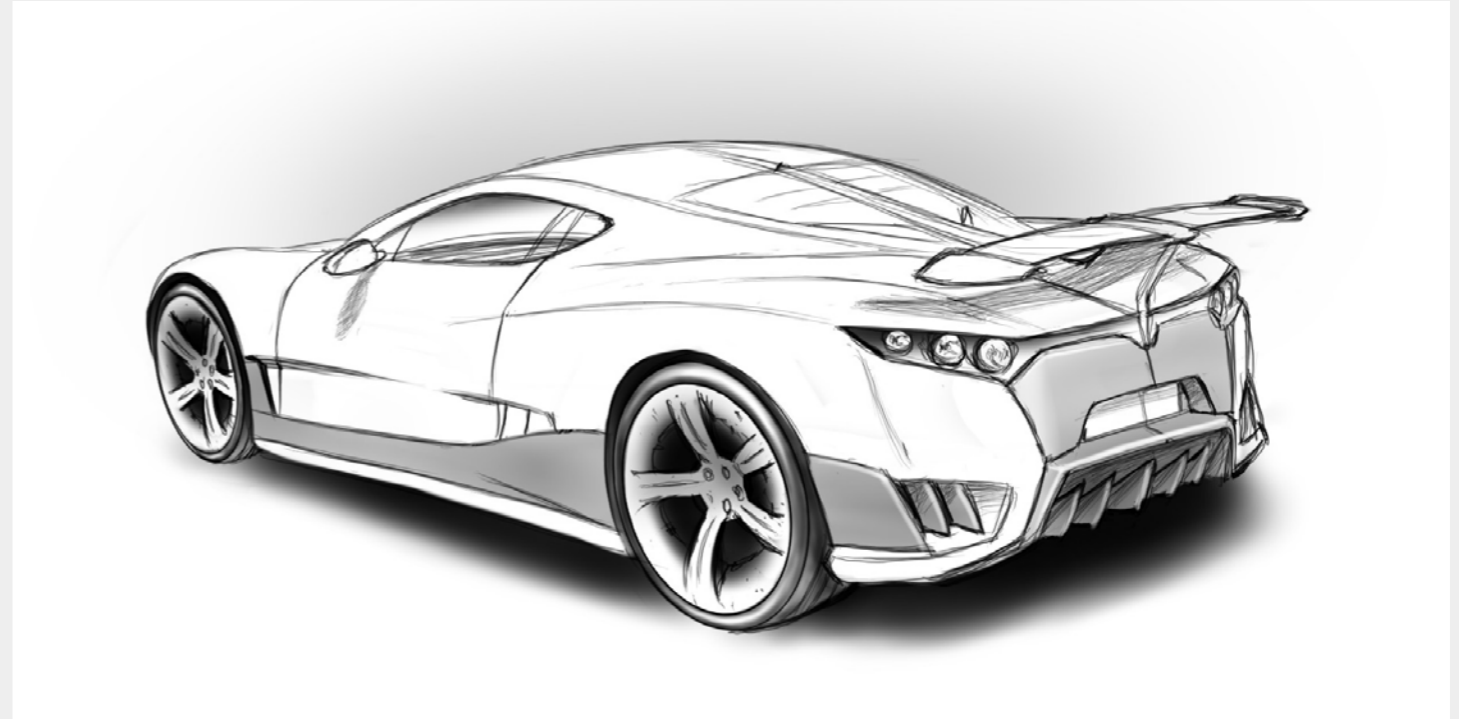
Development led by vehicle functionalities



In September 2012 Applus IDIADA was chosen by the European Commission to develop an electric high-performance sports car, comparable to or even better than sports cars with conventional engines. The vehicle should also incorporate the latest technologies in electric powertrain, active safety and communication systems.

The prototype should help overcome the current technological and social barriers of electric cars and promote acceptance of electric vehicle technology by the public and the mass introduction of this type of vehicle into our society.

The result is the **VOLAR-e**



SPECIFICATIONS

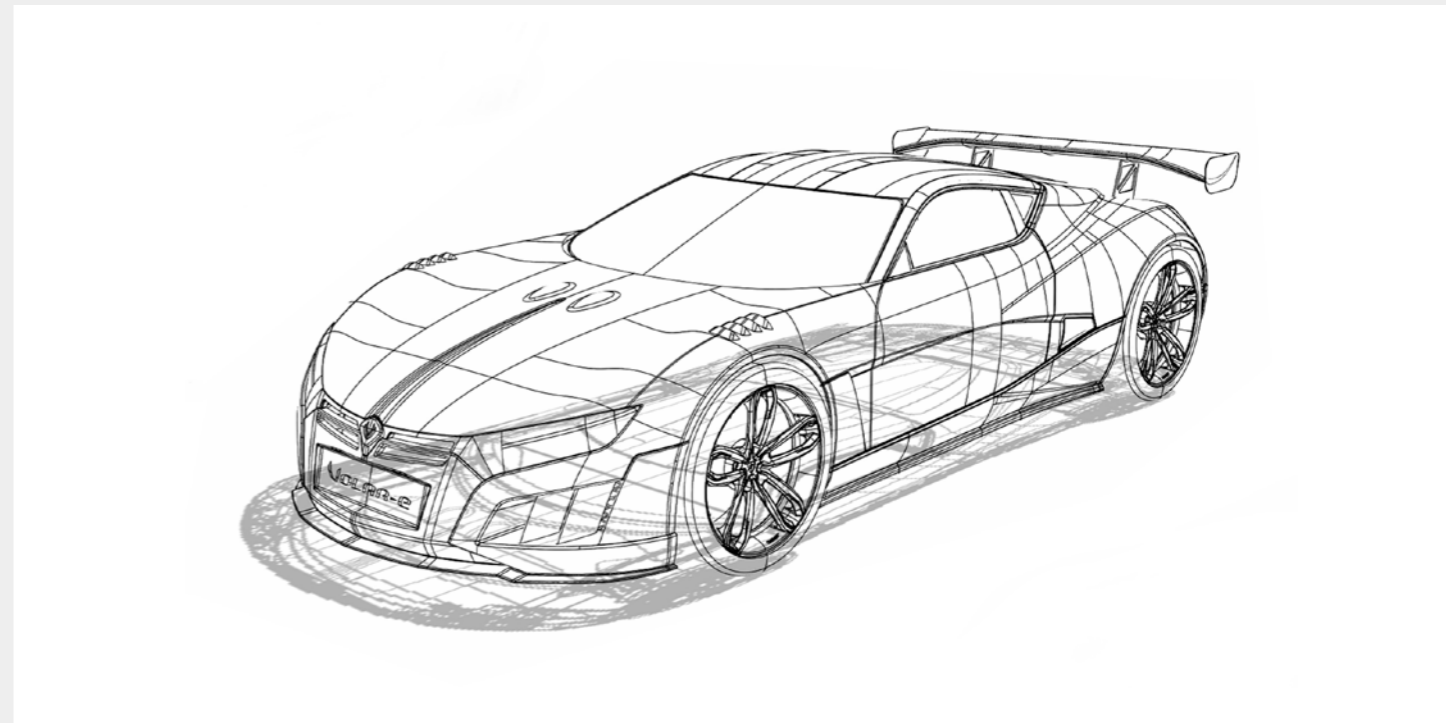
Motor	4 electric motors
Vehicle category	Supercar
Body	Carbon fibre
Chassis	Tubular Cr-Mo steel
Wheelbase (mm)	2770
Front/rear track (mm)	1540/1534
Maximum power (kW/CV)	800/1000
Maximum torque per wheel (Nm)	1000
Maximum speed (km/h)	300
Traction	4WD

Brakes	Regenerative braking / Carbon-Ceramic
Weight	1700 kg
Driving modes	4
Front suspension	Independent height and stiffness adjustable
Rear suspension	Independent height and stiffness adjustable
Front tyres	245/35R20
Rear tyres	295/30R20
Traction control	Applus IDIADA's ITORQ
Charging	Fast charging 15 min.

STYLING & SURFACING

Using the basis of an existing prototype, styling sketches were made for a new bodywork to give it a completely fresh look of a racing car, bearing in mind from the outset technical feasibility and aerodynamics considerations.

These sketches were then transformed into three-dimensional virtual surfaces, respecting both the aesthetics while at the same time the complex constructive constraints and the framework within. Afterwards, the virtual surface model went on to become the source data to mill the moulds from which the carbon fiber panels were built.

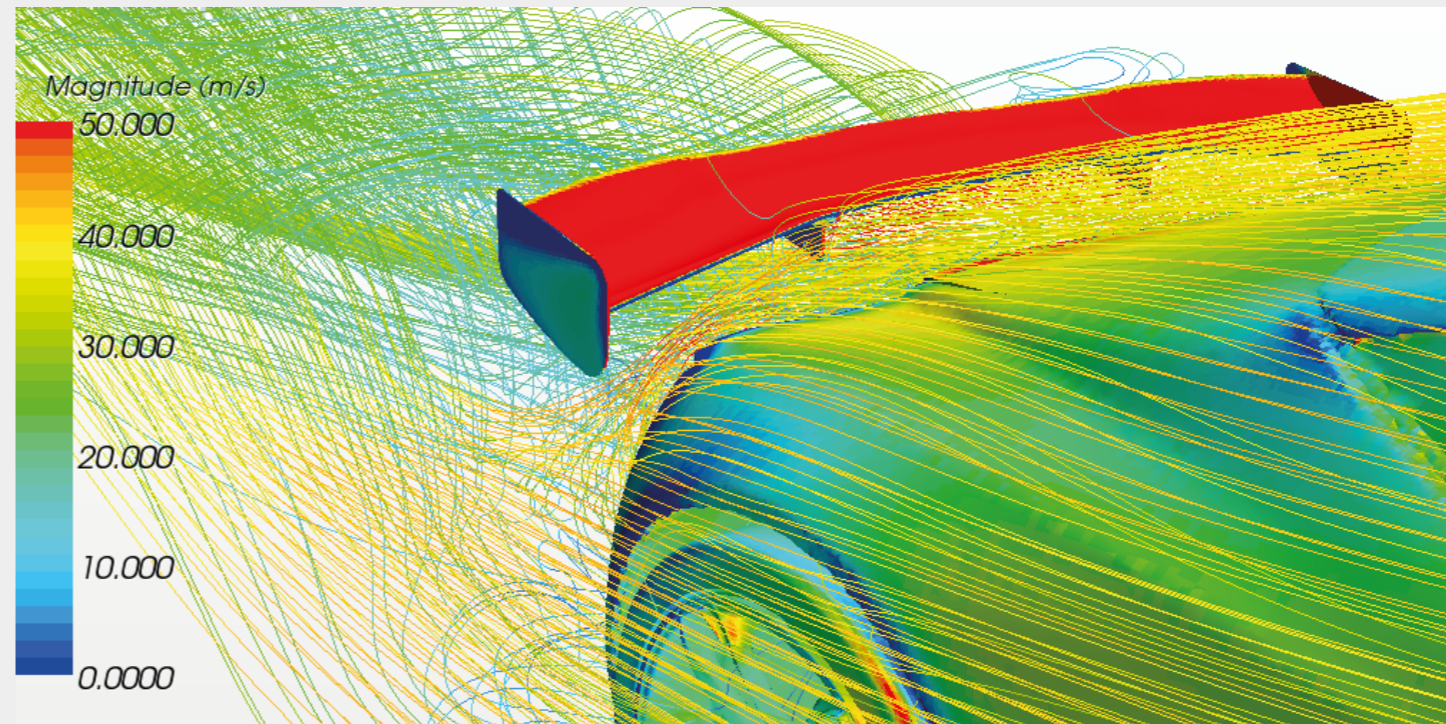


AERODYNAMICS

Applus IDIADA's aerodynamics experts provided continuous guidance to the design team in order to maximize the aerodynamic down force whilst minimizing the aerodynamic drag.

The aerodynamics analysis was focused on the front bumper, including the grill and splitter and the rear end including the main spoiler and diffuser.

The style concepts were continuously assessed by means of CFD simulation. That study was carried out in open road configuration and with realistic models, including complete under-hood and detailed axles.



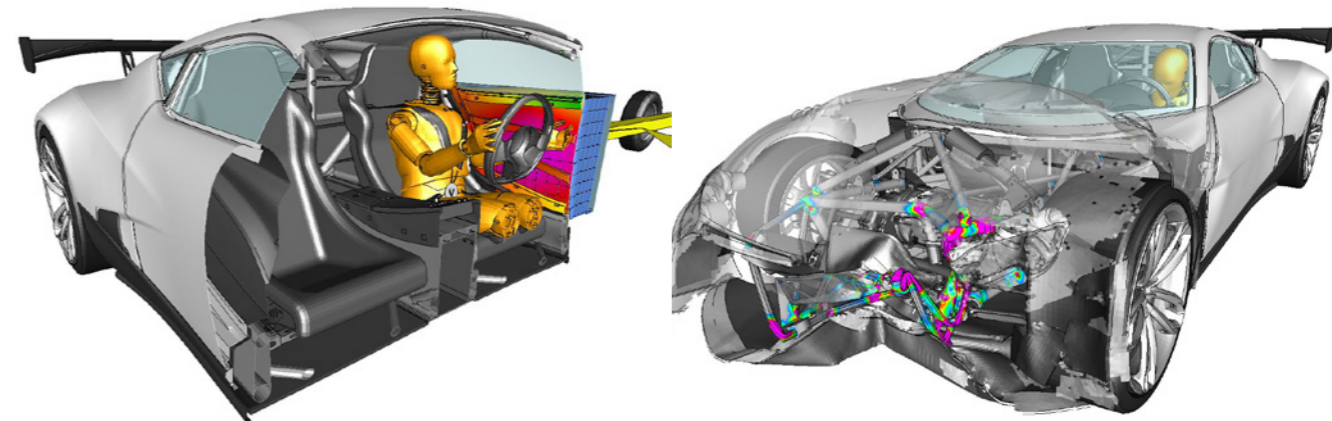
OCCUPANT PROTECTION

The target was to meet UN ECE regulations regarding occupant protection in impact simulations through structural design.

The bodywork of the *VOLAR-e* mainly consists of a chrome molybdenum alloy. This material provides for low intrusion values during impacts and a high torsional stiffness.

The *VOLAR-e* contains many structural components made of lightweight materials, such as aluminum battery carriers and a carbon-kevlar composite floor. The application of these innovative materials forms one of the core challenges in the structural development, together with the rather uncommon global vehicle architecture.

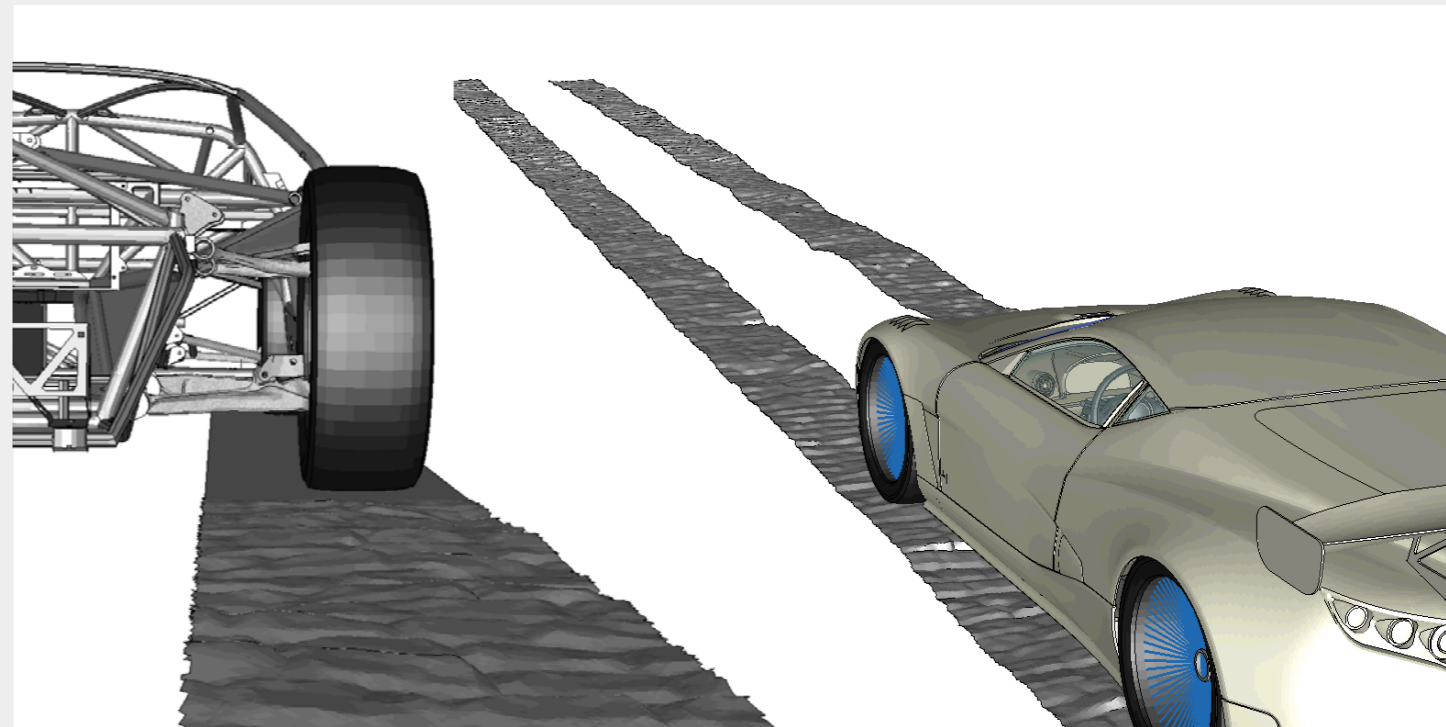
The simulations performed showed an excellent crashworthiness performance.



FATIGUE

The challenge was to estimate with exactitude the cyclic loading and the stress histories for each of the components of the vehicle rolling on a fatigue road, thus allowing us to perform durability analysis with good accuracy.

The keys to achieve our goals included a 3D scanning of one of Applus IDIADA's fatigue tracks, the modeling of the whole vehicle and a CAE methodology based on the integration of implicit and explicit codes.



RANGE ESTIMATOR

The range estimator project for the *Volar-e* focused on:

- Improvements of the state-of-charge calculation considering important influence factors like ambient temperature, battery life and discharge profiles
- Refinements of the energy consumption prediction considering different traffic conditions, driver behavior and route topology with GPS data

As a result the prediction is far more precise and could be visualized in an intuitive way on the HMI screen.

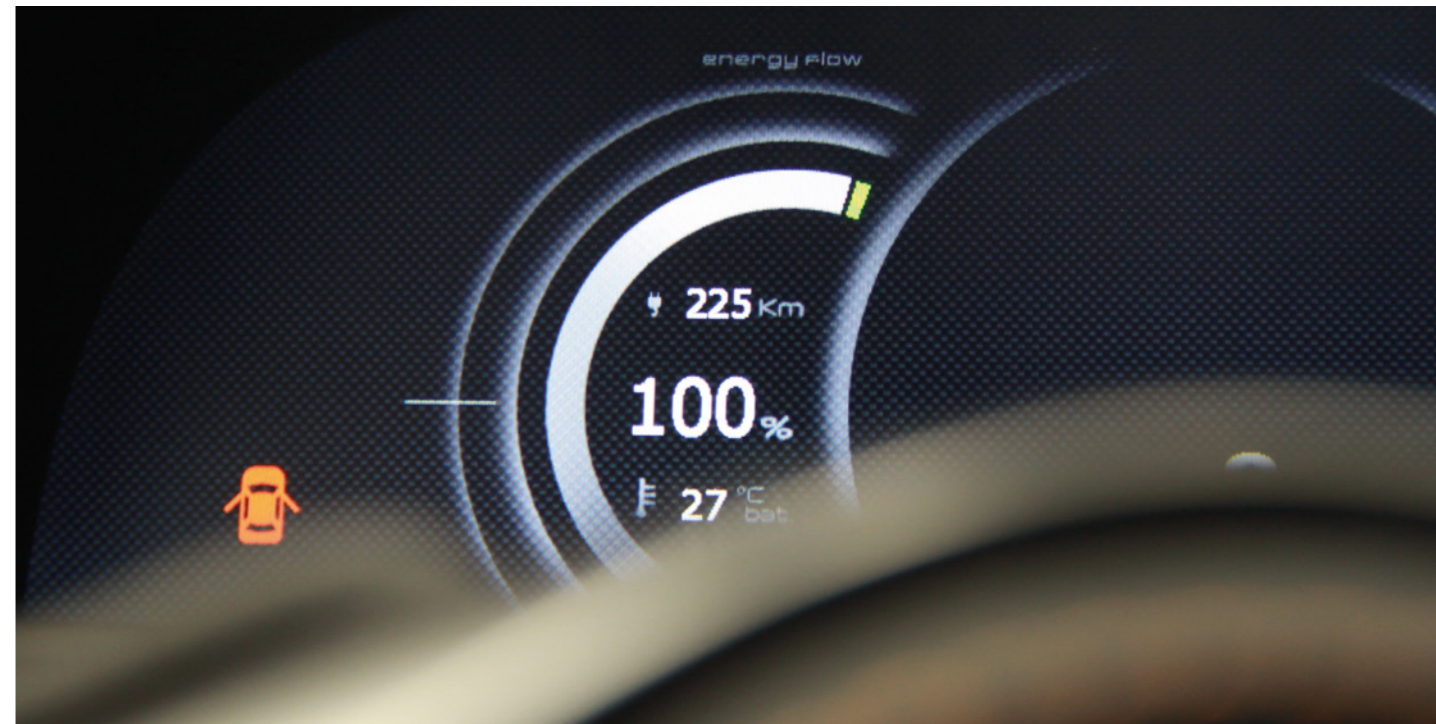


FAST CHARGING

European car manufacturers are currently defining a new fast charging standard, making it possible to charge with more power than existing standards and thus covering the specific needs of electric high-performance cars like the *VOLAR-e*. This standard is described in IEC61851 and is commonly called Combined Charging System as it is based on the Type 2 Plug.

Applus IDIADA has implemented this new technology in the *VOLAR-e*. Features:

- Capability to charge up to 200 Amps and up to 800 V
- Charging time of 15 – 20 min
- Vehicle to grid capability with PLC interface according to ISO15118



DRIVING MODES

To optimize the vehicle behavior under different driving conditions we have developed and implemented 4 different driving modes:



Maximum autonomy

Due to either a low remaining battery state of charge, a race strategy requirement, or a longer mileage to be covered, range may become a priority and the ECO mode will help the driver to maximize it.



Compromise between reactivity, comfort and autonomy

The DYNAMIC mode has been engineered to fulfill the expectations of the most demanding drivers during daily use, and results from an optimal compromise between reactivity, comfort and range.



Maximum performance and reactivity

When the best lap time is a must, the RACING mode allows the maximum performance, as well as to experience an accurate controllability in demanding racing conditions.



Optimal performance in raining conditions

In raining conditions the track becomes a low adherence surface and, by selecting the WET mode, the driver will appreciate optimal performance, more gentle torque delivery and enhanced control of the power transmitted to the asphalt. Moreover, this mode will also be appreciated in the case that comfortable driving is desired.

VEHICLE DYNAMICS

With *VOLAR-e*, Applus IDIADA has aimed to achieve a unique driving experience. Not only has Applus IDIADA developed the chassis systems that deliver a balanced and agile response, but also a wealth of active control systems work with the driver so that it responds to every input.

Applus IDIADA engineers have worked from first principles to define the suspension and chassis set-up, establishing targets from weight distribution to detailed suspension kinematic characteristics. Using the latest simulation tools, suspension geometry and suspension components have been optimized to meet these targets.

This work has enabled the final phase of development to be undertaken out on Applus IDIADA's own proving ground in record time. Here Applus IDIADA's experts have carried out fine tuning of the suspension, steering and braking systems to obtain the best handling response, braking performance and overall vehicle stability.





VOLAR-e takes advantage of having four individual high performance motors and a strong chassis base to employ the latest active chassis control systems.

Applus IDIADA's knowledge of torque vectoring technologies has led to further developments and *VOLAR-e* incorporates four active systems designed with the objective to maximize traction, handling response, drivability and all together minimizing lap time.

iTORQ+ is an evolution of the control module developed in Applus IDIADA but adapted to the high performance demands of *VOLAR-e*. From its inception through

to development and validation, the main objective was to improve the vehicle handling response to drivers' steering inputs.

iTORQ- is a complementary function to **iTORQ+** designed to intervene while braking by stabilizing the vehicle during corner entry and achieving a predictable turn-in.

TRACTION CONTROL and **LAUNCH CONTROL** systems both help to improve traction, with Launch Control acting to make the car accelerate as fast as possible by accurately controlling the torque delivery.



COMMUNICATION

A high performance car like the *VOLAR-e* required a state-of-the-art electronic architecture in order to provide a suitable platform for the integration of the different systems. The platform integrates, amongst others, the following functionalities specially developed for the *VOLAR-e* :

- HMI: Integrated LCD display with touch screen user interface for configuration of the vehicle and digital instrument cluster
- VEHICLE TO INFRASTRUCTURE (V2I) Communication: Transmission of vehicle data using WIFI 802.11p to an Internet Server for monitoring the vehicle main parameters in real time on mobile phones





Acknowledgements:





Online video at:

<http://www.youtube.com/user/PlusIDIADAGroup>

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