SPONSORED BY THE
Federal Ministry of Education and Research

UNICARagil news

2. Issue | December 2019

Subscribe online:
www.unicaragil.de/newsletter

Disruptive Modular Architecture for Agile Automated Vehicle Concepts

Dear Readers,

An eventful, exciting and intensive year 2019 is coming to its end. The concept stage of the UNICARagil project has been completed and important milestones have been reached. Also the vehicle design has made some progress, which we would like to present in this newsletter.

We hope you enjoy this edition of our newsletter

Yours sincerely,

Lutz Eckstein

UNICARagil Halftime Event

Technical University of Munich

Tuesday, March 24, 2020
Public Event

You haven't registered yet?
If you are interested, please contact our project office at
pr@unicaragil.de

SPONSORED BY THE
Federal Ministry of Education and Research

Newsletter
www.unicaragil.de
2. Issue 12/2019

Exterior Design

Exterior design of the vehicles in the final version

The development of the exterior design of the four vehicles in the UNICARagil project is completed.

In June 2018 already, a design competition was started to support the project. Five design studios developed their individual version of a modular toolbox approach for urban automated vehicles. The big challenge was to find a design language that works both for differently sized vehicles and for various use cases. In addition, the design should enable a maximum number of common parts. The individual characteristics of the vehicles range from a luxurious and cozy, which is needed for the autoELF, to a robust and industrial for the autoCARGO.

Key Sketch

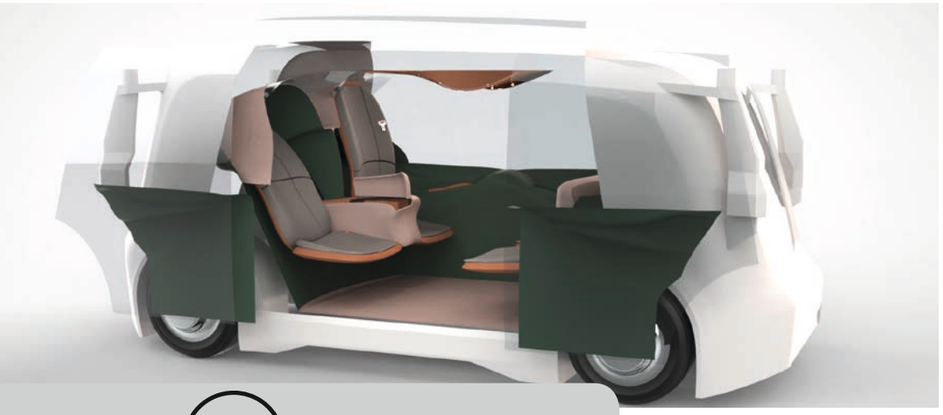
The underlying idea is to scale the main structure not only in length but also in height. Based on the smallest vehicle derivate, a first exterior design is laid out and separated into modules. The carryover modules can then be repositioned. By adding common modules, a new larger derivate is formed. Due to the double symmetry of the load bearing structure and the identical technical package for all derivates, a high number of common parts is achieved. The individual exterior designs, the use-case-specific functionalities and the interior layouts enable four profoundly different characteristics.

Scaling of the Main Structure

But UNICARagil is not only about the exterior design. For our four vehicles described above, individual interior concepts are developed and designed by different project partners. Learn more on the next pages.

SPONSORED BY THE
Federal Ministry of Education and Research

Interior Design



Interior Design autoTAXI

autoTAXI

The autoTAXI is intended as an exemplary vehicle of a taxi fleet. By automating the vehicles, it is possible to diversify the vehicle fleet into „motto taxis“, which are designed according to the current needs of the passengers. The implemented autoTAXI of the UNICARagil vehicle fleet is designed to satisfy the needs of business people as a „working taxi“.

The design of the interior should satisfy the individual needs. The smooth shaping without strong edges and a division into main and additional seats make this possible. The two main seats are placed in the direction of travel, where passengers are mostly located in the vehicle. Therefore, the design development starts at this point to create a clean and productive office atmosphere.

The choice of materials and colors is tailored to the needs of the users of a „working taxi“. The interior components are kept in wooden optics, whereas soft goods and trim panels are arranged in a coordinated grey and green. This choice of materials and colors is intended to enhance the smooth atmosphere in the vehicle.

The last aspect of the interior design is the internal HMI. The touchpads are designed as direct and simple as possible. They are located on the sides of the main seats. In order not to make communication with the vehicle unnecessarily complicated for the passengers, a novel input in the center console between the additional seats is introduced.

Interior Design autoELF

autoELF

As an automated family vehicle, the autoELF is designed to meet the needs of various generations. Its design is aiming to compensate the absence of accompanying persons, which today are necessary when transporting children or elderly people in conventional cars. Therefore, requirements resulting from the application had to be elicited and respected during the interior design. At the same time, the autoELF, which is the only UNICARagil vehicle designed for private ownership, should present a homely and personally designed interior to its passengers.

SPONSORED BY THE
Federal Ministry of Education and Research

The autoELF has four comfortable seats that automatically adjust according to user profiles. The seats are facing each other and are positioned with a lateral offset to provide extra legroom. One of the seats can be modified into a space for wheelchairs, baby carriages, or walking aids. Moreover, the autoELF's utility is increased by luggage storage facilities below and behind the seats.

In addition to the textiles and generously used wooden elements, a carpeted floor, which can be heated on cold days, provides a living room atmosphere. A lighting with adjustable colors also contributes to a cozy ambience. Music fans can look forward to a powerful sound system. In addition, the autoELF has very distinct details that could be expected in a living room, such as a bonsai plant and a bookshelf.

autoSHUTTLE

The aim in designing the autoSHUTTLE was to make the interior of the automated vehicle clever, valuable and inviting. Inspiration comes from the timeless and functional Scandinavian style, which is expressed in a minimalist, clean design language.

The interior includes ideas from architecture, since the vehicle will be used predominantly in urban space. Clear horizontal and vertical lines characterize the design and create a calm interior ambience. This was important in order to create a connection to the existing exterior design.

In terms of color, the interior combines light tones, harmonious transitions, balanced proportions and clearly defined color and material contrasts.

When looking at the interior, the main theme of the „Wooden Frame“ catches the eye as a special highlight. A wooden frame integrated harmoniously into the interior accommodates the seemingly floating bench seat at the rear and runs continuously to the foldable double bench seat at the front of the vehicle.

In addition to the elegant esthetics, this wooden frame offers the integration of handles, USB plugs, an HMI screen and indirect lighting. It is a unique optical feature compared to existing interiors of automated vehicles.

Interior Design autoSHUTTLE

SPONSORED BY THE
Federal Ministry of Education and Research

Workshops on the interior design of the UNICARagil autoSHUTTLE

Impressions of the Workshops

With the further development towards automated vehicles, there are countless possibilities for the public transport of tomorrow. It is possible that not only private cars, but also public transport vehicles will automatically drive through the streets in the future. Two series of workshops were held at the Institute for Automotive Engineering (ika) of RWTH Aachen University in order to consider the various interests of potential passengers and experts regarding the design. Concepts about the presence and arrangement of interior elements, such as seats, sockets or displays, must therefore be carefully considered in automated vehicles.

In the first series of workshops, 44 participants took part and focused on the comfort as well as the desired seating position of the passengers during a ride with low to medium vehicle occupancy. The participants were given the possibility to set up their personal shuttle as they desired in a design that restricted the available space. With the help of flexible materials, thirteen individual interior concepts were recorded. Following the individual group design of the interior concept, a test drive with requisites was simulated so that the previously constructed shuttle concept could be tested as a prototype directly.

Overall, 20 experts took part in the second series of workshops, which simulated the shuttle occupation at rush hour. The experts were tasked to place elements for the interior of the vehicle in a way such that all passengers would be able to stand comfortably. Both groups experienced two situations each: One with a bench at the rear of the vehicle and another with no bench available.

As a result of the first series of workshops, it was possible to create a design that met the requirements of the test persons. Most of the passengers preferred a seat orientation in the direction of travel and indicated that they would prefer the seat to be aligned with the direction of travel. Younger participants were on average more interested in comfort elements such as air conditioning, Wi-Fi or power sockets, while middle and older test persons also attached importance to safety elements such as seat belts, an emergency button, airbags or the presence of a surveillance camera. From the second series of workshops, it emerged that the bank in the rear part of the vehicle was desired by the experts even when the vehicle was fully occupied. The two workshop groups developed two individual arrangements of handles.

Based on the results of the two-workshop series, certain design recommendations for the design of autonomous shuttles can be derived. The seating arrangement could be one bench or three seats in the rear part of the vehicle. Additional seats can be provided in the form of foldable seats. Sockets and other elements can be placed in convenient locations (e.g. under the seats or near the handrails), while safety and comfort elements can be integrated depending on the age of the target group.

SPONSORED BY THE
Federal Ministry of Education and Research

Newsletter
www.unicaragil.de
2. Issue 12/2019

autoCARGO

autoCARGO in the parcel center: loading energy and parcels

Good design is often invisible: Inside autoCARGO and inside of underground storage.

In the parcel center, the parcels to be delivered are loaded into the automated autoCARGO parcel delivery vehicle in one go. The parcels are efficiently stacked in the loading container, taking into account the forces acting during the journey.

The autoCARGO drives and delivers automated and electrically, is locally emission-free and designed for urban areas. By being connected to other vehicles and information systems, autoCARGO can react flexibly to traffic disruptions. On its route, autoCARGO stops at all parcel boxes to which consignments are to be delivered or from which they are to be collected. Various private and public parcel boxes can hold a single parcel or a large number of parcels. For this purpose, an underground parcel warehouse, for example, can be connected to the parcel box. In this way, the urban space can be used as efficiently as possible. Customers can deliver parcels to a parcel box or pick them up at any time.

How are the packages in the vehicle autoCARGO recognized and handled?

In the interior, the loading container with the parcels is automatically analyzed with several color and depth cameras. This is used to calculate the location and orientation of the individual parcels. The special handling technology with robot arm and vacuum gripper safely picks up the parcels and delivers them to a parcel box according to customer requirements. The customer can pick up the parcels when it suits him or her best. To send parcels, the customer picks them up at a parcel box of his choice. The autoCARGO receives the parcels from the parcel box and stows them securely in the vehicle.

Efficient use of urban space: autoCARGO loads parcels into a parcel box with underground warehouse

SPONSORED BY THE
Federal Ministry of Education and Research

Evaluation of the pedestrian behavior at the arrival of an automated vehicle

Strategy 1: Classic Front Axle Steering

Strategy 2: Connected Dynamic Four-Wheel Steering

Strategy 3: Opposite Four-Wheel Steering

The Technical University of Munich examines the human machine interaction within the project UNICARagil. For example, the autoSHUTTLE shows three different approach strategies at stops, which are set from the perspective of a waiting passenger in the pictures below.

As part of the UNICARagil project, the driverless autoSHUTTLE vehicle concept is being developed. The suspension systems of the vehicles are designed as innovative dynamics modules, which contain the electric power unit and allow a steering angle of the wheels up to 90°. Fundamentally, the external impression of the vehicle as well as the assessment of pedestrians and waiting passengers with regard to three different steering strategies for arriving at a stop had to be analyzed. For this study, a virtual reality participant study was constructed at the pedestrian simulator of the Chair of Ergonomics at the Technical University of Munich in virtual reality.

As long as the vehicle is moving with conventional front wheel steering angles or with a four wheel steering of up to 60° steering angle, the motion is based on a continuous trajectory. By using the maximum of 90° steering angle, the vehicle's motion flow is interrupted. Within the study the participants recognize the high technological potential of the dynamics modules. Especially the possibilities for the optimal use of the existing traffic area are evaluated very positively and are appreciated. Nevertheless, the results approve the concept of external HMI usage for a notice of unconventional steering maneuvers.

SPONSORED BY THE
Federal Ministry of Education and Research

UNICARagil worldwide

IEEE ICVES 2019 | Egypt, Cairo

2. FKFS-Conference | Source: FKFS/Detlef Kansy

28th Aachener Colloquium | Aachen

3. ADAC Forum | Hannover

IEEE ITSC | New Zealand, Auckland

IEEE ITSC | New Zealand, Auckland

The researchers of UNICARagil have travelled far and are on their way all over the world.

At the „IEEE ICVES 2019" conference, Minglu Li from the Institute for Automotive Engineering (ika) at RWTH Aachen University presented our fail-safe steer-by-wire system for automated vehicles.

On the 1st and 2nd of October, the 12th FKFS-Conference took place in Stuttgart. As part of the thermal management session, the UNICARagil project was presented and some challenges of developing the thermal management were highlighted by Daniel Gehringer.

Both, Fabian Prinz and Bastian Lampe (ika) gave lecture on the project UNICARagil at the „28th Aachen Colloquium 2019". They talked about the topics „How do we drive autonomously? User needs for interior concepts and requirements for occupant protection" and "Collective Driving - Cloud Services for Automated Vehicles in UNICARagil", respectively.

The publication „autoELF - Development of an autonomous family vehicle" was presented by Tobias Schräder at the event „3rd ADAC Forum for Automated and Networked Driving" in Hannover.

Alexandru Kampmann as well as Haohao Hu, Andreas Danzer, Nils Rexin, Björn Klamann and Moritz Lippert travelled to the conference „IEEE ITSC 2019", which took place in New Zealand. The UNICARagil project was represented next to others with the topic „ A Portable Implementation of the Real-Time Publish-Subscribe Protocol for Microcontrollers in Distributed Robotic Applications" by Alexandru Kampmann.

Take a look at our publications online.

SPONSORED BY THE
Federal Ministry of Education and Research

Advisory Board Meeting in Bonn

Advisory Board Meeting | BMBF, Bonn

„Safety and Security", „AI" and „Service-oriented Architecture" - these were just a few of the highly relevant topics for which the UNICARagil Project Advisory Board met at the Federal Ministry of Education and Research (BMBF) in Bonn on Monday, September 2, 2019. Regularly, the project advisory board joins the steering committee of the project. Together, they discuss the current progress of the project.

Consortium Meeting in Stuttgart

Impressions of the Consortium Meeting in Stuttgart from September 30, to October 1, 2019

A very successful consortium meeting took place at the Institute for Internal Combustion Engines and Automotive Engineering (IVK) of the University of Stuttgart from September 30 to October 1, 2019. About 50 project researchers met and successfully worked on topics such as the service orientation.

Furthermore, a special day occurred during the meeting because 40 years ago, the original UNI-car project started on October 1, 1979, the consortium celebrated this awesome moment.

SPONSORED BY THE
Federal Ministry of Education and Research

Newsletter
www.unicaragil.de
2. Issue 12/2019

Campus of the University of Passau

Membership of the University of Passau

Since September 2019, the Chair of Computer Engineering at the University of Passau, directed by Prof. Katzenbeisser, has been a member of the UNICARagil consortium. The University of Passau focuses on research and education prioritizing topics of digitalization and connected society. As a future-proof and internationally recognized university, it strives to make a significant contribution in solving present and future European challenges. It aims to become one of the leading institutions in Europe for interdisciplinary basic research regarding the social effects of digitization.

Prof. Katzenbeisser had already been represented in the project when he was part of TU Darmstadt. He and his team continue to work on effective and efficient means to both detect and defend the UNICARagil platform against cyberattacks. Besides obvious advantages such as automated driving and high scalability, the high degree of automation and the seamless interconnectivity of all four vehicle types also involve significant risks. Interventions in the on-board electronics, deactivated brakes or being remote controlled by attackers are nightmares for every passenger. Those risks need to be prevented in automated driving.

At the University of Passau, IT security becomes an integral component of UNICARagil as part of a security-engineering-process. Instead of adding security solutions to an existing vehicular platform, security issues will be considered during the entire evolutionary process: **Security by Design**. Risk management allows the identification of potential threats and their prevention with appropriate countermeasures. Ideally, such a risk assessment takes place periodically in order to be able to react adequately to constantly changing attacks. A special focus is put on secure in-vehicle communication.

Through its contribution, the University of Passau intends to make UNICARagil vehicles ready for future security challenges.

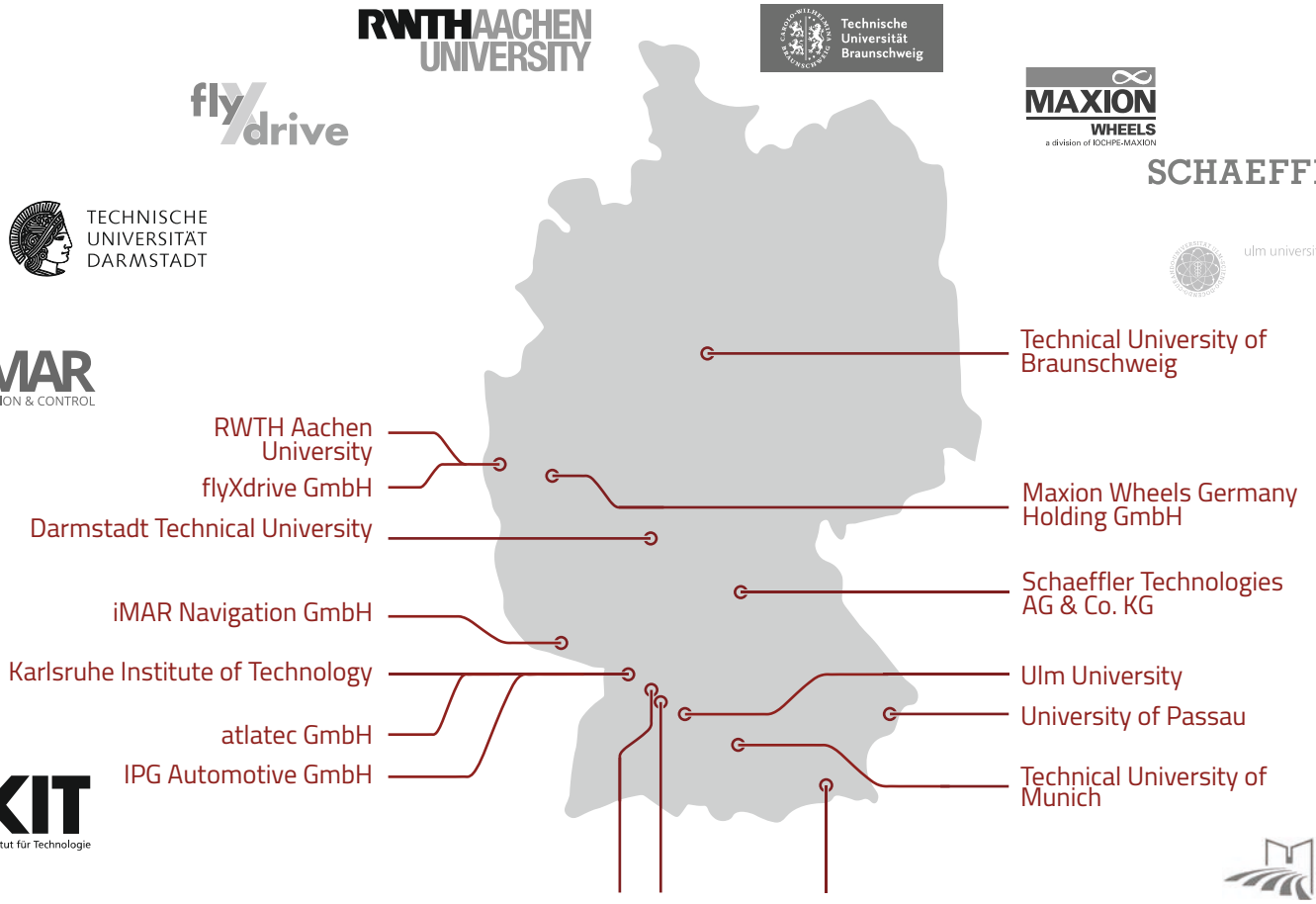
The New Website is Online

Our website has a new design. Feel free to visit and read all the current information about the project UNICARagil at

www.unicaragil.de/en

SPONSORED BY THE
Federal Ministry of Education and Research

The Project Consortium



Contact

Overall Coordinator:
Prof. Dr. Lutz Eckstein
RWTH Aachen ika
Steinbachstraße 7 | 52074 Aachen
lutz.eckstein@ika.rwth-aachen.de

Project Management:
Timo Woopen, M. Sc.
RWTH Aachen ika
Steinbachstraße 7 | 52074 Aachen
timo.woopen@ika.rwth-aachen.de

Project Office:
Miriam Ludwigs
RWTH Aachen ika
Steinbachstraße 7 | 52074 Aachen
pr@unicaragil.de

Imprint

V.i.S.d.P: Prof. Dr. Lutz Eckstein
RWTH Aachen
Templergraben 55
52056 Aachen

Printing
Image Druck-Medien
Karl-Friedrich-Straße 76
52072 Aachen

SPONSORED BY THE
Federal Ministry of Education and Research