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The Future of In-Car Applications: How can Data & AI personalize the User Experience?

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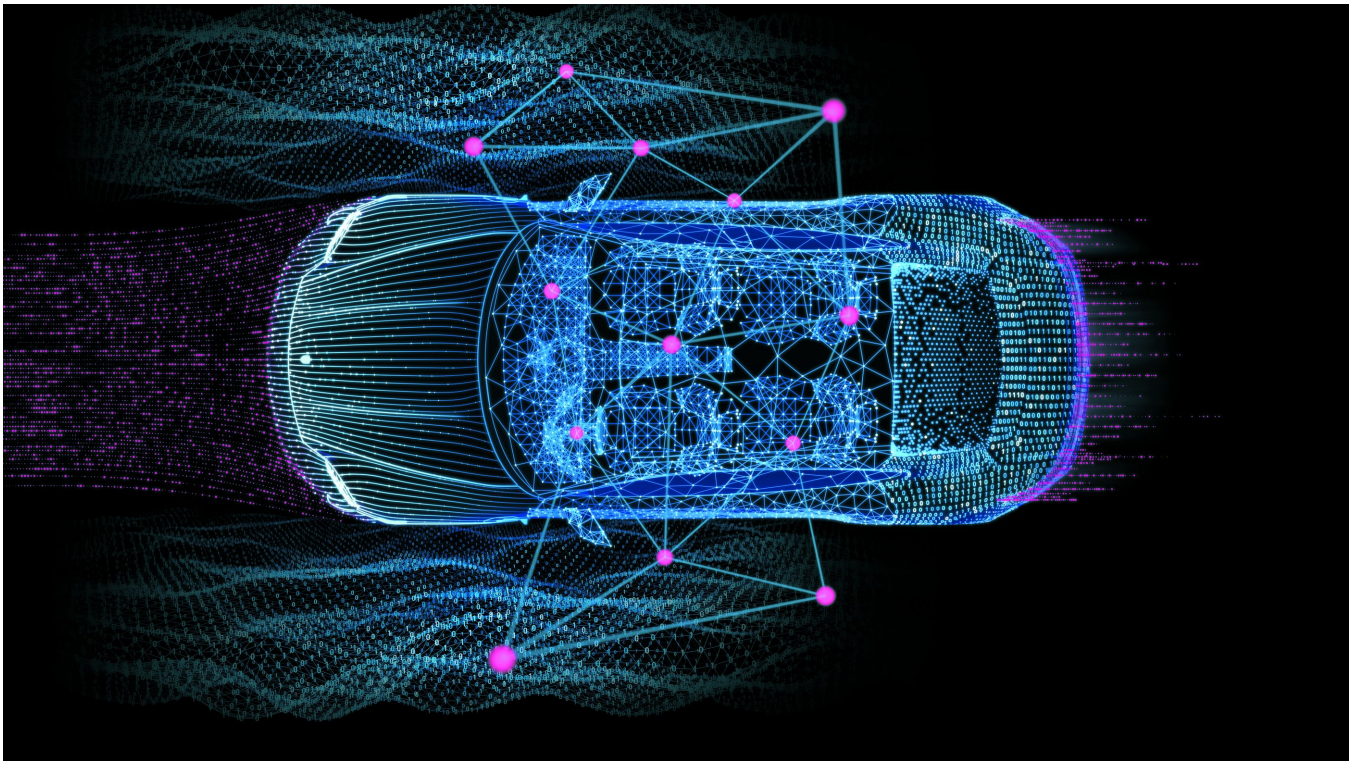

Figure 1: Car Data & AI: Future cars will generate tremendous amounts of data. How can this data be leveraged with AI to develop highly-personalized In-Car Applications?

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Abstract

As in-car applications evolve, the potential to personalize the user experience through data and AI is becoming a key focus in automotive research. This workshop will explore how real-time data from sensors, user preferences, and behavioral insights can be leveraged to create individual in-car experiences. Current trends in AI-driven personalization, including voice assistants, adaptive interfaces, and

predictive algorithms, will be discussed. Participants will dive into challenges such as privacy, data security, and user acceptance, while also exploring new possibilities for enhancing the in-car experience. Through interactive discussions and hands-on case studies, this workshop aims to uncover innovative ways to use data and AI to enrich automotive user interfaces.

CCS Concepts

• **Human-centered computing** → **Ubiquitous and mobile computing**; *Interaction design*; *Natural language interfaces*; • **Computing methodologies** → **Machine learning**; *Knowledge representation and reasoning*; • **Information systems** → *Data mining*; • **Security and privacy** → *Privacy protections*; • **Computer systems organization** → *Embedded systems.*

Keywords

Automotive User Interfaces, In-Car Applications, Personalization, Artificial Intelligence, User Experience, Context-Aware Computing, Edge AI, Driver Behavior Modeling

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1 Workshop Overview

As vehicles transition from simple transportation tools to advanced, connected, and interactive devices that seamlessly integrate into digital ecosystems, the future of in-car applications relies heavily on **personalization**. Personalized in-car user experiences powered by data and AI have the potential to drastically improve driver safety, comfort, and satisfaction. Yet, challenges remain in seamlessly integrating **real-time data** from sensors, **user behavior**, and **environmental factors** into AI-driven systems that adapt to each individual's needs. This workshop will gather researchers, automotive experts, and designers to discuss how to harness data and AI to craft smarter, more intuitive in-car experiences, and explore the trade-offs and challenges associated with these innovations.

2 Goal of the Workshop

The goal of this workshop is to facilitate knowledge exchange and collaboration on how data and AI can personalize in-car user interfaces and applications. Specifically, we aim to:

- Examine **current trends** in data-driven, AI-powered in-car systems
- Explore **challenges and opportunities** for leveraging user data to create adaptive, personalized in-car environments
- Discuss ethical concerns such as **privacy** and **data security**, and how they influence user experience
- Understand the real-world **challenges of implementation**, from system integration to real-time data processing and AI optimization

3 Key Topics

3.1 Current Trends in Data-Driven In-Car Personalization

Personalization is at the forefront of innovation in automotive user interfaces. Recent advancements in AI have made it possible to process large amounts of data in real time and create **adaptive systems** that learn user preferences. In-car voice assistants, infotainment systems, and even **autonomous driving systems** are all incorporating AI to provide increasingly personalized experiences. In this section, we will explore emerging trends such as:

- AI-powered voice assistants (e.g., adaptive responses based on user mood, preferences, or context) [11]
- Context-aware infotainment systems (e.g., changing media preferences based on driving conditions, time of day, or the route) [10]
- AI systems that adapt to the driver's emotional state, driving behavior, or even physical health [1]
- Predictive algorithms that adjust vehicle settings, like temperature and seat position, based on historical data [4]

3.2 AI Algorithms and Personalization in the Car

AI personalization hinges on the use of sophisticated **machine learning** algorithms to interpret complex data streams. In this session, we will discuss different types of AI techniques currently being explored for personalization, including:

- **Reinforcement learning**: Used to optimize adaptive behaviors based on user feedback over time [8]
- **Natural Language Processing (NLP)**: Enhancing voice assistants and conversational UIs to improve understanding and context awareness [15]
- **Predictive analytics**: Systems that predict driver needs based on historical and contextual data (e.g., predicting the driver's mood or needs based on driving history) [5]
- Multimodal interfaces: Integrating visual, auditory, and haptic feedback to personalize the in-car interaction experience [16]

3.3 Ethical Considerations: Privacy and Data Security

Collecting and processing data from users in the vehicle raises important **privacy and security concerns**. Participants will explore questions such as:

- What types of **data** should be collected (e.g., location, behavior, emotional state)?
- What data should be processed **on the edge** instead of the cloud?
- How can companies ensure **data security** while maintaining personalization?
- What are the best approaches to ensure **user consent**, transparency, and control over their data? [13]
- How do the **legal frameworks** around data (e.g., GDPR, CCPA) apply in the context of automotive systems? [14]

3.4 User Acceptance and Trust

While AI personalization promises significant benefits, its success hinges on user trust and acceptance. This session will discuss the **user experience** aspects of personalization, covering:

- How users perceive AI-driven personalization: Do they feel that the systems are too intrusive or genuinely helpful? [6]
- User education: How do we ensure users understand how their data is being used and benefit from personalization? [9]
- Designing for **user comfort**: How can systems be made to feel intuitive and responsive without overwhelming the user with options or complexity? [2]

3.5 Challenges in Real-Time Data Integration and AI Implementation

Implementing personalized AI systems in the car presents numerous technical challenges, such as ensuring **real-time data processing, system integration, and hardware limitations**. This session will tackle:

- Challenges in **sensor fusion**: How can data from different sensors (e.g., cameras, LIDAR, biometric sensors) be effectively combined to enhance personalization? [12]
- **Real-time data processing**: How can AI systems process and respond to data in real time while ensuring low latency? [7]
- **Resource constraints**: How can vehicle systems handle AI processing power without overburdening the car's hardware? [3]

4 Outcome of the Workshop

By the end of this workshop, participants will have a clear understanding of the current state of AI-driven personalization in the automotive industry, as well as the challenges and opportunities it presents. The workshop aims to foster collaboration and **cross-disciplinary dialogue**, resulting in several tangible outcomes:

- **Actionable insights** into the best practices for personalizing in-car experiences, focusing on user needs and technical constraints
- An understanding of the **ethical implications** of AI personalization in the car, with strategies for addressing privacy and data security concerns
- A **roadmap** for integrating AI-powered systems into vehicles in a way that prioritizes safety, user acceptance, and technical feasibility
- Establishment of potential **research collaborations** or industry partnerships, with a focus on addressing gaps in existing literature and technology

5 Tentative Schedule - 3 Hours

This workshop will provide a blend of **presentation, interactive discussions**, and **hands-on activities** to ensure participants engage deeply with the content. The tentative schedule is as follows:

0:00 - 0:10 (10 minutes): Welcome and Overview

- Introduction of the workshop, objectives, and participants
- Brief introduction to current trends in AI-powered in-car personalization

0:10 - 0:40 (30 minutes): Session 1 – Current Trends in In-Car Personalization

- Presentation on the state of AI and data-driven personalization in the automotive industry
- Discussion on emerging technologies such as adaptive voice assistants and predictive algorithms

0:40 - 1:10 (30 minutes): Session 2 – Breakout Ideation on Challenges

- Participants will be divided into small groups to discuss specific challenges related to personalization:
  Privacy and security in AI systems
  Integration of real-time data in vehicle systems
  Ethical concerns and user acceptance
- Each group will report back on insights and potential solutions

1:10 - 1:20 (10 minutes): Break

1:20 - 1:50 (30 minutes): Session 3 – Case Studies and Best Practices

- Present real-world examples of successful AI-driven personalization in vehicles
- Explore case studies from companies and researchers that have deployed personalized in-car systems at scale

1:50 - 2:30 (40 minutes): Session 4 – Interactive Design Session

- In this hands-on activity, participants will collaborate to design a new in-car application that uses data and AI to personalize the user experience
- Focus on user needs, AI algorithms, and ethical considerations
- Each group will present their design, with feedback from peers and experts

2:30 - 2:50 (20 minutes): Wrap-up and Future Directions

- Summary of key takeaways and discussion of next steps
- Opportunities for continued collaboration and partnership
- Open floor for participant feedback and closing remarks

6 Expected Audience

This workshop will appeal to a diverse audience, including:

- **Students and researchers** in the fields of human-computer interaction, AI, machine learning, and automotive user interfaces
- **Industry professionals** working in automotive technology, AI, infotainment systems, and UX design
- **Product designers and developers** interested in creating personalized in-car experiences
- **Ethicists** focused on privacy, security, and data ethics in the context of emerging technologies

7 Biographies

7.1 Marco Wiedner

Marco Wiedner is a Senior Specialist for Car Data & AI at the Porsche R&D Center in Weissach, Germany. His work encompasses

context-aware recommender systems, advanced vehicle architectures, vehicle monitoring, and in-cabin monitoring. After spending several years abroad acquiring diverse experiences in the energy, transportation, and automotive sectors, Marco Wiedner joined Porsche in 2018 as a Data Scientist focused on connect and infotainment systems. In 2025, he completed his doctorate at the Institute for Dynamic Systems and Control (IDSC) at ETH Zurich in collaboration with the Porsche R&D Center in Weissach.

7.2 Dominik Kratky

Dominik Kratky is a Product Manager for Data-Driven Services and Digital Enablers at the Porsche R&D Center in Weissach, Germany. He holds a degree in Business Information Systems from the Baden-Württemberg Cooperative State University (DHBW Stuttgart), where he completed his studies in cooperation with Porsche. Since 2016, he has been actively involved in the development of connected vehicle technologies, focusing on digital service architectures and data-enabled product innovation. His work bridges the domains of automotive engineering, data platforms, and user-centric digital services.

7.3 Assistant Professor Euiyoung Kim

Dr. Euiyoung Kim is an Assistant Professor of Design for Dynamic Stability and Co-Director in the Automated Mobility Lab (DDL) at the Faculty of Industrial Design Engineering at TU Delft. Euiyoung was previously a lecturer & postdoc at the Jacobs Institute for Design Innovation at the University of California, Berkeley. He was the research director at the Berkeley Research for Autonomous Vehicle Opportunities (BRAVO) and a co-principal investigator on several research projects focusing on future mobility, design processes and methods, cybersecurity, and next-generation digital technologies. He received his Ph.D. degree in the Department of Mechanical Engineering at the University of California, Berkeley. He was awarded a MS degree in Engineering Design Innovation at Northwestern University in 2011. Before moving to the United States, he worked in a strategic marketing team at Samsung Electronics. Dr. Kim's research and teaching interests encompass a range of areas, including future mobility, user-centered roadmapping, human-centric research, design thinking, product design and development, design-driven innovation, IoT, cybersecurity, and engineering design education. With his co-authors, Euiyoung has received several research and teaching awards, including the Honorable Mention Award AutoUI 2024, the ASME (American Society of Mechanical Engineers) 2020 & 2016 Best Paper Awards, the ICED (International Conference on Engineering Design 2015 & 2013 Reviewers' favorite Awards, the Outstanding Graduate Student Instructor Award 2014, UC Berkeley. His industry collaborators/sponsors include Royal Schiphol Group (Amsterdam Airport), Airbus North Ameria, KLM, Scania, Renault Innovation Lab (Silicon Valley), The Center for Long-term Cybersecurity (CLTC) UC Berkeley, Samsung Research America, Mercedes-Benz Research & Development North America, Samsung Advanced Institute of Technology, and Samsung DMC UX & C-Lab.

7.4 Professor Emilio Frazzoli

Emilio Frazzoli is a professor of Dynamic Systems and Control at ETH Zurich. Until March 2021, he was Chief Scientist of Motional, the latest embodiment of nuTonomy, the startup he founded with Karl Iagnemma in 2013.

His main research interests are in robotics, autonomous systems, and intelligent mobility. In acknowledgement of his work in these fields, Emilio has received several awards, including the 2015 IEEE George S. Axelby Award and the 2017 IEEE Kiyo Tomiyasu Award, and has been named an IEEE Fellow in 2019. In 2022, he received the RSS Test of Time award for his papers on RRT*, with Sertac Karaman.

As former full professor at MIT, he directed the research group that first demonstrated an autonomous mobility ("robotaxi") service to the public, and performed the first analysis of the social and economic impact of such a service, based on real transportation data. He holds a Laurea Degree in Aeronautical Engineering from the Sapienza University of Rome, and a PhD in Aeronautics and Astronautics from MIT.

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