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The Design Thinking Practice of Future Urban Public Transport Service Under the Thinking of Double Diamond Model

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ABSTRACT

In the post-epidemic and digital era, with the rapid development of autopilot technology and transformation processes of society, the project aims to study the service design strategy and specific scheme of the transport system in complex urban public environments for the future. Based on the divergent convergence and iterative characteristics of the double diamond model, the collaborative design of community residents and professional design based on research methods and design tools were connected to carry out design practice and envision future scenarios intertwined with physical and digital in the autopilot system. In this paper, the whole process of transport in the urban scene was investigated, the key pain points of users and corresponding design opportunities were sorted out, and the service system framework of future transport in urban settings in the future era was proposed. The key touch points of transport services for residents in urban scenes were explored to form integrated design interventions of convenient, considerate, constructive, and inclusive products and systems. The innovative solution with strong integration in this project is conducive to better grasping the product and service forms of transport at the grassroots level and improving users' positive feelings, sense of participation, and experience in the autopilot system in their daily life, thus improving the quality and availability of public transport services which have a positive impact on the efficiency and sustainability of urban areas.

Keywords: Urban public transport service design, Human-computer interaction design, Double diamond model, Design for future

URGENT NEED FOR THE ADOPTION OF A NEW PARADIGM FOR SUSTAINABLE TRANSPORTATION AND DEVELOPMENT

Urban Public Transport Service and Status Quo of Paradigm

Urban public transport services are a crucial component of urban transportation systems that provide safe, reliable, efficient, and affordable transportation options to facilitate the movement of people, goods, and services within urban areas. The importance of urban public transport services in promoting sustainable urban development has been widely acknowledged by scholars and policymakers, especially in the context of rapid urbanization and associated challenges in managing vehicular traffic and environmental impacts. Studies have highlighted the role of public transport in reducing traffic congestion, air pollution, and carbon emissions, while also promoting social equity and economic benefits (Newman and Kenworthy, 2015; Glaeser et al. 2008; Holmgren et al. 2019; Litman, 2019). Nevertheless, many urban areas struggle to provide affordable and efficient public transport services, emphasizing the need for investing in public transport infrastructure to improve urban life and enhance economic opportunities.

SERVICE DESIGN HELPS AUTOMATED DRIVING-BASED TRANSPORTATION

Service Design Double Diamond Model

Service design is a human-centered design approach that focuses on the creation of effective and efficient services, which incorporates elements of UX design, design thinking, and business strategy. The concept was put forward by G. Lynn Shostak in the field of management in the 1980s. In 2011, Marc Stickhorn and others put forward the concept of "service design thinking", forming a systematic and effective system. The Double Diamond model is a framework for the service design process first introduced by the UK Design Council in 2005. The model consists of four stages: Discover, Define, Develop, and Deliver, which has become a widely used tool for practitioners with the benefits of improving customer satisfaction, and loyalty, as well as enhancing user experience and retention.

Usability Analysis of the Double Diamond Model

Service design is a valuable approach to creating innovative and effective services, including in the context of urban public transportation (Kim and Park, 2017; Bitner et al. 2008; Polaine et al. 2013; Sangiorgi and Prendiville, 2017; Foss et al. 2018). The intelligent automation service system using AI and autonomous driving technology presents an opportunity for improving public transport, and service design can guide and optimize user participation through tangible and intangible design. Effective collaboration among government, transportation service providers, urban planners, and community members is crucial for developing reliable, efficient, and equitable public transportation systems. The four stages of service design involve conducting user research and case studies, considering user attributes and pain points, ideating solutions from multiple perspectives, and implementing solutions with scenarios while establishing user trust.

A DESCRIPTION OF THE PROCESS FOR THE SERVICE DESIGN

Discover Phase

The group employs a mixed-methods approach to analyze urban public transportation from multiple perspectives, using both existing literature and first-hand investigations (see Figure 1). They conduct user research and case studies to understand the current situation and prospects of automated public transportation. The group collects data through questionnaire interviews and

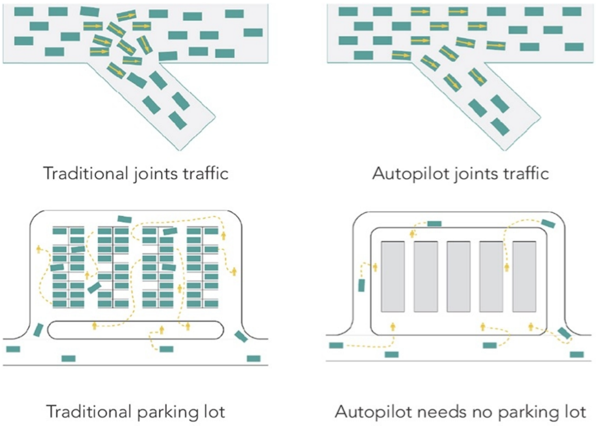

Figure 1: Autopilot transportation enhances total efficiency and saves public expenditure at the system level.

observations of local workers, ordinary citizens, and tourists to identify different groups' understanding and pain points. Field research in Copenhagen was conducted, and 106 valid questionnaires were collected with 54.72% of respondents aged 15–35 living in and around Copenhagen. Results show that most citizens prefer walking and cycling, and few use public transportation due to accessibility issues. Respondents lacked systematic knowledge of automated driving, and 60% noted public transportation shortcomings. The challenge is to design a product that satisfies human-level needs while providing an autopilot transportation system for a prosperous future.

At the same time, a case study of existing Autopilot transportation systems for public transportation was made (see Table 1). A total of 9 cases were selected from developed countries (USA, UK, Germany, Denmark, Japan, South Korea, and Singapore) and developing countries (Russia and India).

The implementation and regulations of autonomous public transportation systems vary by country, but their potential benefits, such as increased efficiency, reduced emissions, and improved mobility, have garnered significant interest from governments and companies worldwide. The next stage of functional exploration will analyze the needs of the public and tourists in the city as the service subjects.

Define Phase

The research team engaged in user-centered design by reflecting on user roles and attributes to identify core values and understand user needs. Target users were invited to participate in in-depth interviews to discuss their transportation pain points and needs. The affinity graph method was utilized to summarize common needs into four categories: personality, frustration, motivation, and expectations. Two groups of users were identified: local workers/citizens and tourists. Prioritized needs differed between the groups, with workers valuing price, comfort, and efficiency, and tourists valuing convenience, leisure, and accessibility of travel information. Both groups emphasized

Table 1. Analysis of autopilot transportation systems in other countries.

	Transportation type	Company	Typical case	Policy and initiative
United States	Bus, shuttle, train	Waymo, Uber, Tesla, EasyMile, Local Motors	Waymo autonomous ride-hailing services pilot program (2020)	Guidelines for the testing and deployment
United Kindom	Bus, shuttle	Stagecoach, Transport Systems	AI-controlled shuttle project (2021)	Support and funding for development; code of practice for testing
Germany	Bus, shuttle	Mercedes-Benz, Audi	Future Bus project (2016)	National strategy and legal framework for development
Denmark	Bus, train	Autonomous Mobility, Sensible4	Aalborg Autonome Buses project (2018)	National expanding plan and program
Japan	Bus, shuttle, taxi	Toyota, Honda, Yamaha, DeNA, Isuzu, NEC	The e-Palette project (2018)	Investment and Strategic Innovation Promotion Program (SIP)
South Korea	Bus, shuttle, taxi	Hyundai, Samsung, KT Corporation, LG	K-City testing facility project (2018)	Legal framework and roadmap
Singapore	Bus, shuttle, taxi	ST Engineering	The Sentosa Island autonomous shuttle service pilot project (2019)	Expanding plan and regulatory framework; launched the Autonomous Vehicle Initiative
Russia	Bus, taxi	Yandex, Kamaz, Cognitive Technologies, Hyundai	Yandex.Taxi ride-hailing service project (2020)	Expanding plan and roadmap
India	Bus, shuttle, metro	Tata Motors, Ashok Leyland, Mahindra & Mahindra	The Delhi Metro Rail Corporation (DMRC) project (2022)	Policy framework and the Smart Cities Mission

convenience and systematization while rejecting cumbersome and inefficient transportation forms (see Figure 2).

Develop Phase

The journey map depicts the content and support system of the pre, during, and post-service. The diagram outlines stakeholders and their interaction relationships. The user experience process is divided into three stages: pre-service (finding means and reaching starting point), service (trip start, travel

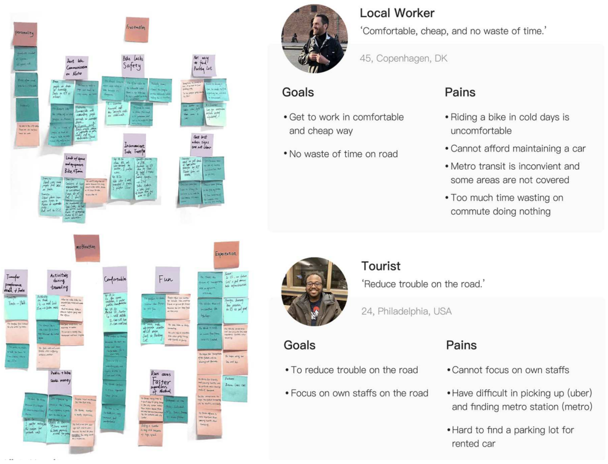

Figure 2: Personas and affinity map of interviewees.

process, approaching destination), and post-service (arriving at the destination, ending the trip). The user's emotional peaks, negative emotions, and needs for convenience, service comfort, and information traceability are identified to clarify service pain points, user flow, and human-machine-background interaction (see Figure 3).

The service blueprint analyses service processes, emotional changes, and touchpoints with scenarios to find opportunities. In the pre-service stage, users feel negative due to a lack of understanding of travel information. The focus is on online information retrieval, and the App can organize relevant information. During the service, users want a convenient and comfortable travel experience, focusing on their own needs with minimal disturbances.

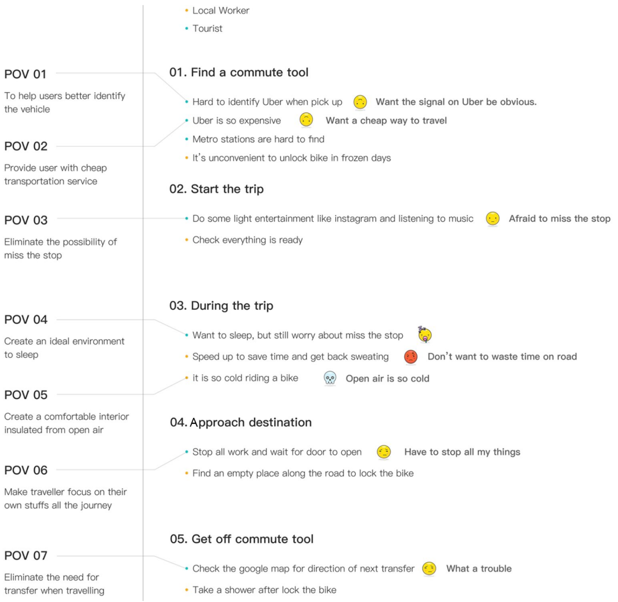

Figure 3: As it journey map.

The focus is on the systematization and humanization of user interaction with autonomous mobility products. In the post-service stage, users want to stay connected and informed about the destination through online connection and feedback (see Figure 4).

A service design system is proposed using intelligent autonomous travel products, information interaction platforms, and traffic service systems to address major pain points, which consider the needs of users and reflect inclusiveness and universality. The system includes an app and inbuilt interaction port, communities, and a personalized big data platform. Service operators organize and iterate service content, contact service providers, and cooperate with agencies to improve user participation and promote public transportation.

Hardware Product Design

To fulfil users' needs for a comfortable, cheap, and convenient transportation service, the design needs to create a minuscule space as an individual transport solution and make it versatile to all kinds of scenes such as single/multi passengers, long-distance transportation, and integrated assembly attributes (see Figure 5).

The creation for single passengers has an inbuilt interaction port and exterior digital display for easy identification (see Figure 6). Versatile pods are designed for multiple usage scenarios, eliminating the need for more parking space and transfer between transportation, as well as being assembled for group travel or freight and loaded onto the rail for long-distance transportation (see Figure 7).

Interaction Design at the Product Level

Four most common activities extracted from storyboards within pods: getting services, mobile work, entertainment, and resting (see Figure 8). Ergonomic factors were considered such as space size, screen layout for attention

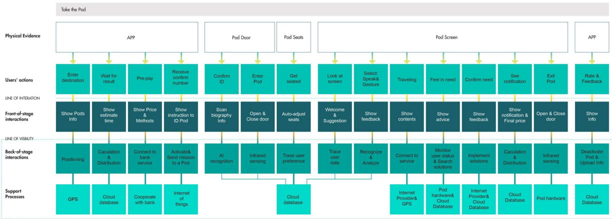

Figure 4: Service blueprints.

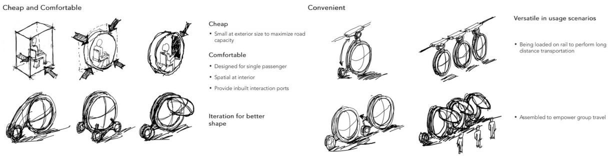

Figure 5: Autopilot transportation product ideation sketch.

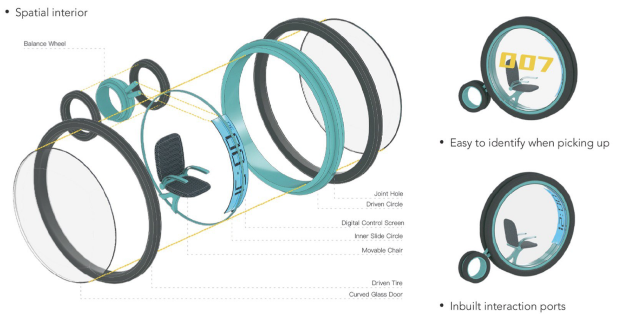

Figure 6: Pod design for a single passenger.

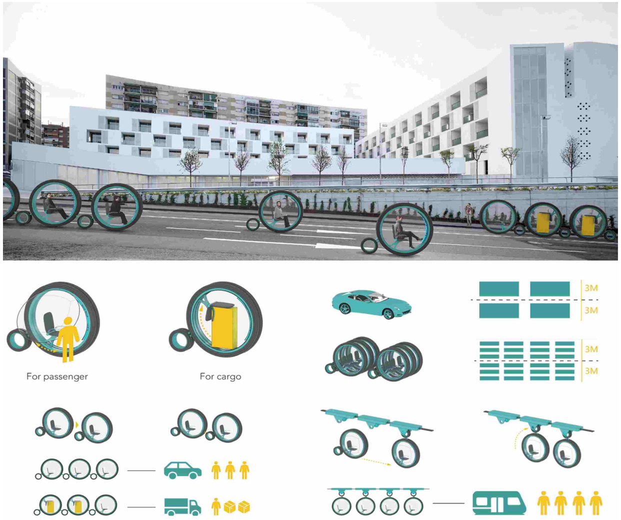

Figure 7: Versatile pods that are economical and convenient in multiple usage scenarios.

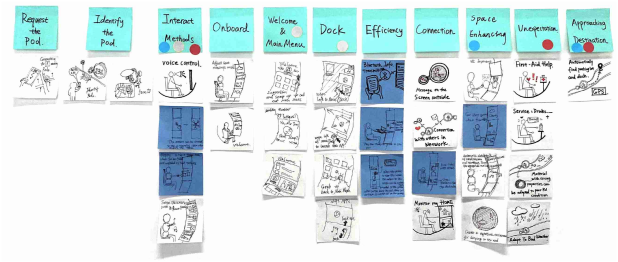

Figure 8: Storyboard of common transportation activities.

allocation, movement boundaries, and optimal screen viewing angles (see Figure 9).

Interaction Design at the Software Level

To address ergonomic concerns, the screen was divided into three parts. As shown in the wireframe and user flow (see Figure 10), the status and notification area are located above the optimal viewing area, while the auxiliary

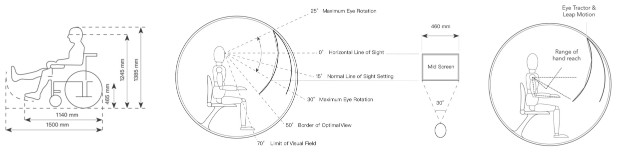

Figure 9: Decision on the optimal area for viewing.

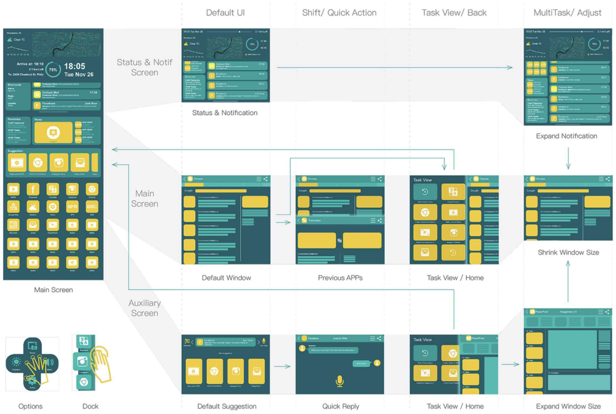

Figure 10: Wireframe and user flow.

actions and suggestion area is within reach of hand for efficient interactions. Non-touch gesture control was designed, including palm and finger gestures (see Figure 11), and incorporates VR/AR technologies to create immersion.

Deliver Phase

A 1:1-size prototype with MDF boards and printed sliders were built. 15 participants (8 female, 7 male) aged between 23 and 42 were recruited according to personas. Three tasks were designed to cover the main workflow of the interaction system (see Figure 12). During the 15-minute interview, participants were asked about their concerns and preferences for interface and feature.

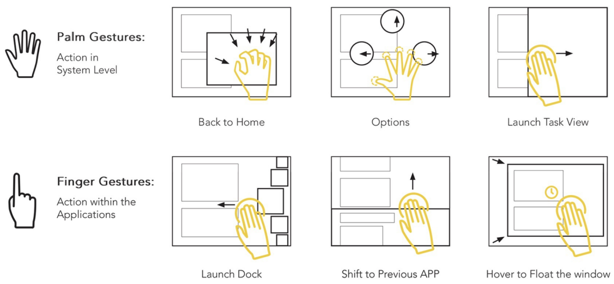

Figure 11: Non-touch gesture control language design for inbuilt interaction port screen.

Figure 12: User test and 1:1 scale prototype of inbuilt interaction port screen.

1. Main screen: ask about the present status of the journey and launch an app.
2. Quick actions and dock: resume watching the video left last time and reply to a message on social media opened from the dock with a quick reply.
3. Multi-task and adjust window size: open the email and PowerPoint at the same time to finish the assignment. At last, pin the browser to the dock.

Analysis of the data through observation and interviews with 15 participants revealed that the participants were able to comprehend the product's purpose without explicit instructions. However, they suggested areas of improvement, such as the irrational layout and confusion caused by multiple apps. Although the participants expressed satisfaction with the product's comprehensive design, some interaction aspects were found to be confusing and challenging without guidance. To address these issues, the researchers proposed optimizing the UI interface, adding user prompts, and enhancing the prompt interaction mode with multi-modal channels and additional information. The service design scheme and usage scenarios were displayed (see Figures 13 and 14). The urban autonomous transportation service system

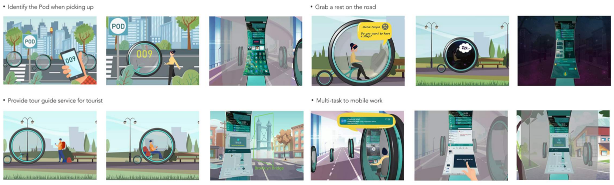

Figure 13: Usage scenarios and address pain points.

Figure 14: App design and function display.

design of residential communities, traffic information, and service operators were connected to improve user participation and promote the value orientation of public transportation.

CONCLUSION

This paper utilized the double-diamond model to develop an autonomous travel scheme for future transportation. Pain points were identified, and smart autonomous mobility products and apps were designed. The study highlights the significance of considering human needs at both the system and individual scale to create promising solutions that meet the middle point. The research proposed the service system framework and explored the key touchpoints of sustainable transport services, resulting in integrated design interventions that improve users' positive feelings, sense of participation, and experience. The model requires iterative testing and improvement and can serve as a reference for future research to explore trends and methods for urban public transportation products and services.

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