Our team organized a community-driven hands-on event called Greener Mobility Ideathon on December 5, 2024 at OIST to discuss actionable solutions that promote greener, more efficient, and sustainable urban mobility in Okinawa. Building on the momentum from the Sustainable Transport Hackathon held in 2023, the event invited local residents, as well as representatives from local government and industry, to collaborate with leading experts in computer science—particularly in geographic information systems, transportation, data science, and cloud computing—to develop solutions for improving sustainable mobility in the Onna-Ishikawa area according to SMART (Sustainable, Measurable, Achievable, Realistic, and Timely) goals.

Keynote Talks

We invited three keynote speakers to learn about the current state of transportation in Okinawa, ride-sharing initiatives in other regions, and the latest research trends in smart transportation:

Keynote talk (1) "Re-design of Transport in Okinawa" by Mr. Akihiko Hoshi, a director for Transport and Tourism, Cabinet Office in Okinawa
Mr. Hoshi gave a talk from an administrative perspective on the transportation challenges faced by Okinawa, as well as future directions for improvement and specific initiatives being undertaken. He highlighted issues such as overcrowded buses, heavy reliance on private cars, and severe traffic congestion, all contributing to high fuel consumption and time loss. In response, the Okinawa General Bureau has initiated a public-private project to redesign the transportation system with a focus on greener mobility. The initiative aims to improve service quality, engage citizens and stakeholders, and balance economic, social, and environmental goals. Key strategies include reorganizing expressway buses, exploring maritime transport, and leveraging tourism.

Keynote talk (2) "Toward Infinite Driving: Harmonizing Autonomous Systems and Low-Carbon Vehicle Technologies" by Prof. Yudai Honma, an associate professor at Institute of Industrial Science, the University of Tokyo
Prof. Honma introduced a key site for smart mobility research located at the Kashiwa Campus, highlighting its urban transformation and accessibility. He then focused on autonomous driving, particularly rail-based autonomous buses, and the challenge of advancing from Level 2 to 4 automation using a cooperative infrastructure system with sensor-equipped traffic signals. He also explained low-carbon transport, including discrete optimization for electric vehicles (EV) charging station placement and the Dynamic Wireless Power Transfer System (DWPTS), which enables continuous wireless charging in expressway and urban-scale scenarios. His research demonstrates the transformative potential of WPTS in creating low-carbon, autonomous, and highly efficient urban transport networks. Key takeaways include: strategic placement of WPTS minimizes infrastructure costs, EVs can operate continuously without stopping for charging, and

autonomous vehicles benefit significantly from WPTS integration. By leveraging advanced optimization techniques, we can efficiently integrate WPTS into urban infrastructure, accelerating the adoption of sustainable mobility solutions.

Keynote talk (3) "Recommendations for New Mobility Services for Sustainable Well-being: Comparative Analysis of Cases in Japan" by Dr. Koichi Fujisaki, a distinguished research fellow and director general for research at Japan Transport and Tourism Research Institute (JTTRI)
Dr. Fujisaki introduced sustainable mobility challenges in Japan, particularly in rural areas affected by an aging population, declining public transport, and driver shortages. Citing JTTRI pilot projects and over eleven case studies, he highlighted solutions such as demand-responsive transport, AI-assisted dispatching, Mobility as a Service (MaaS) platforms, and community-driven models. Japan's 2020 transport law revision now supports new mobility services. Key recommendations included complementing rather than replacing public transport, ensuring financial sustainability through diverse revenue streams, and adapting technology to local needs. He also clarified the distinction between ridesharing and ride-sourcing, emphasizing that sustainable mobility requires community involvement and localized approaches.

Ideathon

In this ideathon event, participants formed six teams to discuss given themes ("Public transport integration," "Incentives/gamification," "Evaluation metrics," "Ride-sharing," and "Involvement of local community") and brainstorm relevant solutions:

Public transport integration: The team "Hop & Go!" discussed Okinawa's transit challenges from the perspectives of bus companies, users, and the overall system. Short-term solutions include improving bus stop facilities, enabling bicycle transport on buses, enhancing real-time apps, and adding clearer signage. Medium-term goals focus on better revenue models for driver wages, route optimization, and school bus systems. Long-term plans involve expanding bus lanes, developing alternative routes, implementing smart traffic systems, prioritizing buses, and offering comprehensive driver training. Ultimately, they suggest integrating all transport modes to create a seamless and efficient public transit experience across Okinawa.

Incentives/gamification: The team "Matrix" proposed a multi-level incentive framework to promote sustainable transportation in Okinawa. Aiming to reduce environmental impact and improve mobility, the strategy integrates economic, environmental, psychological, health, and social factors. Incentives may include financial rewards (e.g., discounts, cashback, tax breaks), non-financial benefits (e.g., priority access, service perks, recognition), and app-based systems that track and reward eco-friendly behavior. These incentives target individuals, families, communities, businesses, and institutions. Digital tracking and mobile platforms are essential for monitoring progress and ensuring the long-term success of ride-sharing and optimized mobility initiatives in a sustainable transportation ecosystem.

Evaluation metrics: The team "Routing progress" proposed a comprehensive set of indicators for assessing transportation systems, grouped into four categories. HEALTH focuses on safety and mobility using metrics like DALYs lost. EASE OF USE includes accessibility, satisfaction,

comfort, and affordability. EFFECTIVENESS is measured by speed, reliability, coverage, and usage levels. RESOURCES evaluates energy efficiency, CO_2 emissions per person-kilometer, financial costs, land use, and environmental impact. These indicators will provide a holistic framework that balances user experience, efficiency, sustainability, and public health in transportation planning and policy-making.

Ride-sharing: The team "Blue" proposes water-based public transport as a solution to transportation challenges in a densely populated, land-constrained region with limited public transit and heavy reliance on private cars. Due to the hot climate and hilly terrain, cycling is impractical. Drawing on global examples, the plan suggests using small, passenger-only boats that can stop at local fishing ports, forming a “water metro” connecting key areas like Naha and Nago in around 30 minutes per segment. The system could offer new income sources for fishermen and integrate with airports and monorails, improving connectivity and promoting sustainable, congestion-free mobility.

Involvement of local community: The team "uGOki" proposed a citizen participation platform to promote sustainable transportation by gathering community feedback. To reduce the current bias toward car users, they recommend shifting the platform’s focus to public transit and walking. Inspired by Dutch urban planning, key features include a mobile app, feedback hotline, community events, and physical “listening hubs.” Citizens can report issues with photos and vote to prioritize them. Data on travel patterns and challenges will be analyzed using SO-SMART Analytics and shared with the public, researchers, government, and the private sector to inform better policies and solutions for sustainable mobility.

Real voices from local residents: The team "Jimoppy"—meaning "local people" in Japanese—was composed of local residents, including members from the Okinawa Prefectural Government, Onna Village, and the city of Ishikawa. They proposed community-based solutions to local transportation issues, reflecting the perspectives of both local residents and users. Noting the lack of hospitals and supermarkets within Onna Village, they emphasized the importance of regional cooperation. While highlighting the advantage of buses as a mode of transportation that anyone can use without hesitation, they suggested several measures to address high fares and poor usability. These included a two-tier fare system offering discounts for local residents and higher rates for tourists, the introduction of a chatbot that integrates bus route information, and the establishment of a park-and-ride bus terminal at the Ishikawa interchange.

Through this ideathon event, we gathered a wide range of knowledge of, insights in and inspirations from the transportation challenges faced by people in the Onna-Ishikawa area and their preferrable directions for solutions. As explained by Mr. Hoshi, compared to other prefectures in Japan, public transportation in Okinawa is limited, with the monorail operating only within the center of Naha City, and the main road network excessively concentrating around a single major road. There is a need for systems that allow cross-searching of multiple bus services and ride-sharing solutions. However, the implementation of ride-sharing also faces legal challenges. It will be necessary to start with small-scale experiments while referring to examples implemented in other regions shown by Dr. Fujisaki. Furthermore, it is essential to properly evaluate how much the environmental impact is reduced. It is crucial to consider ways to enhance citizens’ satisfaction and well-being regarding transportation while also taking

environmental sustainability into account. It would also be important to evaluate the effectiveness through simulation as introduced by Prof. Honma.

The directions we should commit in the future study.

A More Real-time and Flexible Data and Feedback Gathering System:
In addition to a one-time intense group brainstorming and discussion event, streamlining the data collection and analysis is also crucial when researchers and developers are identifying the aspects to improve. The LINE app (https://line.me/R/ti/p/@781mllol) we have been developing to collect and aggregate citizens' feedback on transportation would be useful for this. Thanks to the Ideathon, we have started constructing a pipeline that enables the stakeholders such as bus companies or government officers or everyday service users to share their transportation data with us.

Documentation and Insights Gathering:
This Ideathon report will comprehensively analyze and document the proposed solutions and progress of our long-term project. To support this, we have established a data repository that archives all video, paper-based, and image materials generated during the Ideathon. This repository will serve as a critical foundation for future research and experimental design. While it is difficult to implement all of the proposed ideas within the scope of a single research project, each suggestion offers valuable insights and will serve as an important reference for considering future directions.

On-going Design Process:
Building on the ideas and feedback gathered during the Ideathon, we are designing a map-based mobile application that integrates functionalities offering transportation opportunities with tangible benefits—such as improved health, reduced CO_2 emissions, enhanced social interaction, and positive behavioral change. We are also exploring the integration of electric bicycles and other environmentally friendly mobility options to diversify and complement existing transportation systems. From a technical perspective, we collect and integrate public transportation (bus) timetables, road network data, and social data, including location-linked statistical information, and plan to develop a geographic information system within a cloud computing environment. The system will incorporate gamification elements and designed incentive mechanisms to promote sustainable behavior and enhance user engagement.

Engage Stakeholders and Provide Follow-up:
One noteworthy feedback from our participants is their potential frustration and concerns of the "lost to follow-up" nature of the one-time event. Many participants happened to be the second-time participants and would appreciate more in-depth, progressive and practical implementation of their concepts. We believe these long-term enthusiasts are valuable assets to our project. Therefore, engaging stakeholders and individuals with a vested interest in this issue is crucial for raising awareness and encouraging grassroots change. A preliminary framework will be developed based on the outcomes of this event and is scheduled to be demonstrated in a mini participatory workshop at OIST in November 2025. As part of our proposed “eco-design" approach, we will refine the prototype and seek to actively involve both citizens and relevant stakeholders in the development process.

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