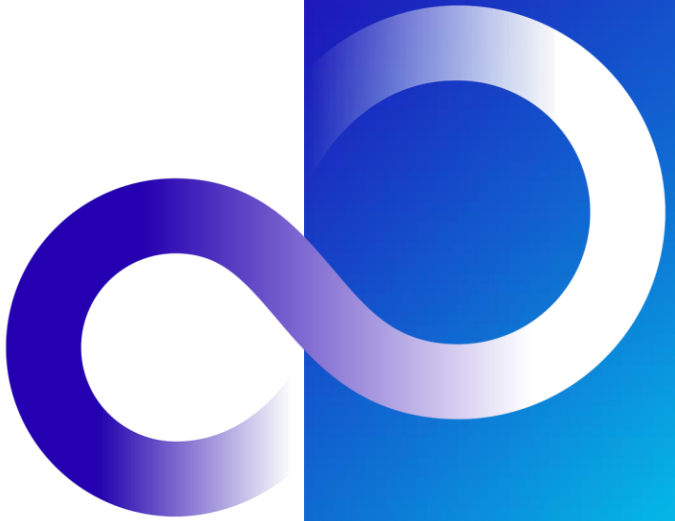
Fujitsu and Carnegie Mellon University develop AI-powered social digital twin technology with traffic data from Pittsburgh

Technical document

03/07/2024

Fujitsu Research of America



What is Converging Technologies?

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- **Complex and diverse societal issues cannot be solved by a single technology alone.**
- **To achieve net positivity, it is essential to understand and encourage people and society.**

Digital Technologies

Computing
Network
AI
Data & Security
・・・

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Humanities and Social Sciences

Psychology,
Cognitive Science,
Economics,
Sociology
・・・

Converging Technologies

Converging Technologies

Social Digital Twin : Direction and Technology

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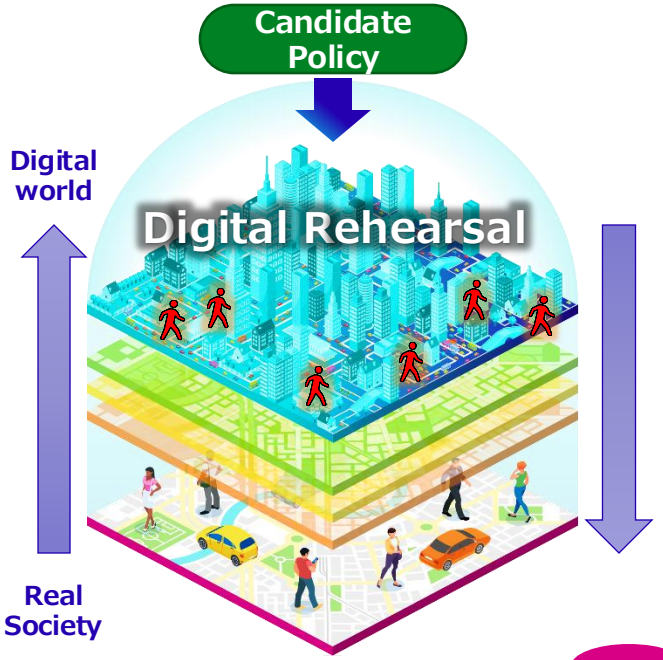
- Demonstrate the value of Social Digital Twin by addressing diverse societal issues around the world
- Develop advanced core technologies through industry-academia collaboration with universities such as CMU

Reproducing whole people and society

Digital Twin Generation Technology

Real-time creation of human and social twins that follow changes in the real world in seconds.

Strengths Reproducing people and society with high accuracy through Behavioral Economics x AI (World's No. 1 accuracy)

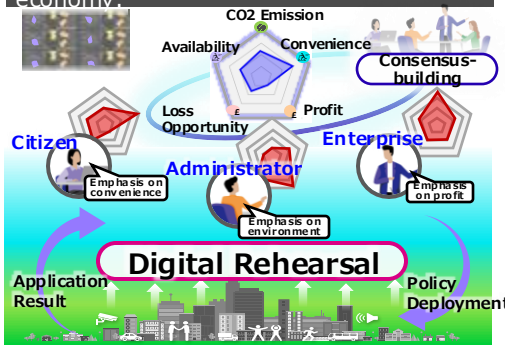


Social Digital Twin

Policy creation & preliminary verification & continuous improvement

Digital Rehearsal Technology

Automatic generation and pre-verification of policies that consider multiple stakeholder perspectives such as citizens, administrators, and enterprises. Realize the trade-on of environment, society and economy.



Strengths Generating high-quality and effective policies through the utilization of Cognitive Psychology and Empirical Economics (World's First)

Converging Technologies

Tackling Six Areas of Societal Issues with Global Partners

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Mobility | Energy/ Environment | Disaster prevention / Crime prevention | Wellbeing | Water / Food | Education / HR development

Using digital rehearsal technology, succeeded in exploring a measure to promote the use of e-scooters

Making progress toward the realization of both CO_2 reduction and mobility convenience in the local area

the Isle of Wight

Exploring measures to promote the use of shared e-scooters (Beryl) that balance convenience with the environment

"Fujitsu launches 'digital twin' trial on Isle of Wight for e-scooter sharing service" (April 19, 2023)

Pittsburgh

Joint research on technologies and measures for improving urban infrastructure with Carnegie Mellon Univ.

"Fujitsu, Carnegie Mellon University Collaborate to Develop 'Social Digital Twin' Technology for Smart Cities" (February 8, 2022)

Yamagata

Applying measures to balance the quality and costs of medical services to the local healthcare ecosystem

"Fujitsu and Tsuda University launch joint research on social design to realize sustainable, flexible community health care amidst aging society" (August 25, 2022)

Kawasaki

Building an ecosystem with 15 companies to promote decarbonization activities by citizens and companies

"Kawasaki City and Fujitsu Begin Demonstration to Promote Behavioral Change for Realizing a Decarbonized Society" (October 31, 2022) (Japanese version only)

Collaboration with Carnegie Mellon University

- Fujitsu and Carnegie Mellon University Collaborate to Develop ‘Social Digital Twin’ Technologies.
- Developed technology can digitalize fine-grained human behaviors with monocular cameras to visualize potential risks.
- To verify its practicality and effectiveness on real fields, a field trial has been initiated in Pittsburgh, US.。

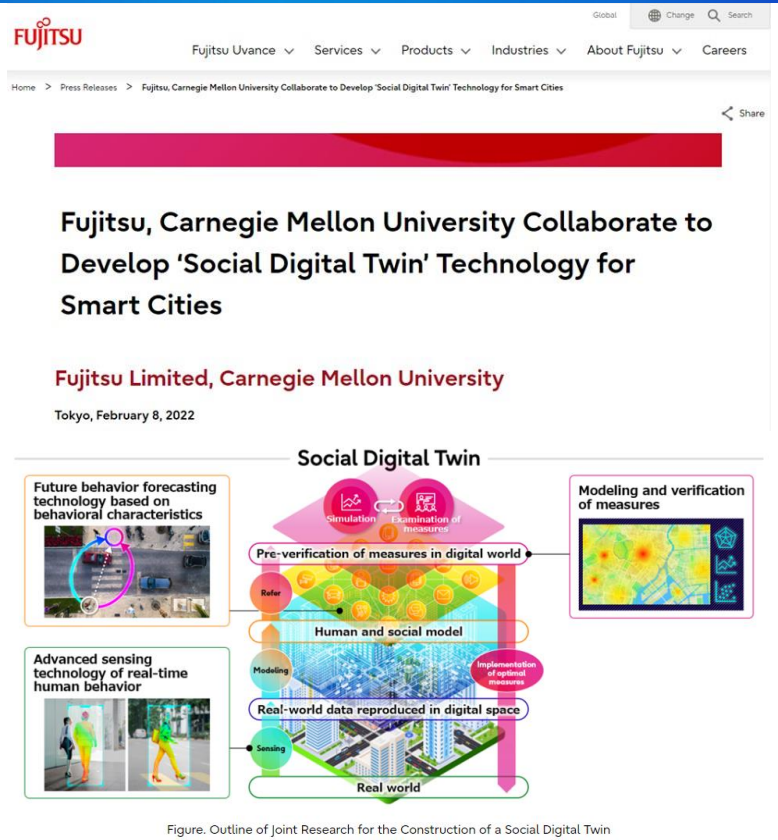

Figure. Outline of Joint Research for the Construction of a Social Digital Twin

Usecase and issues

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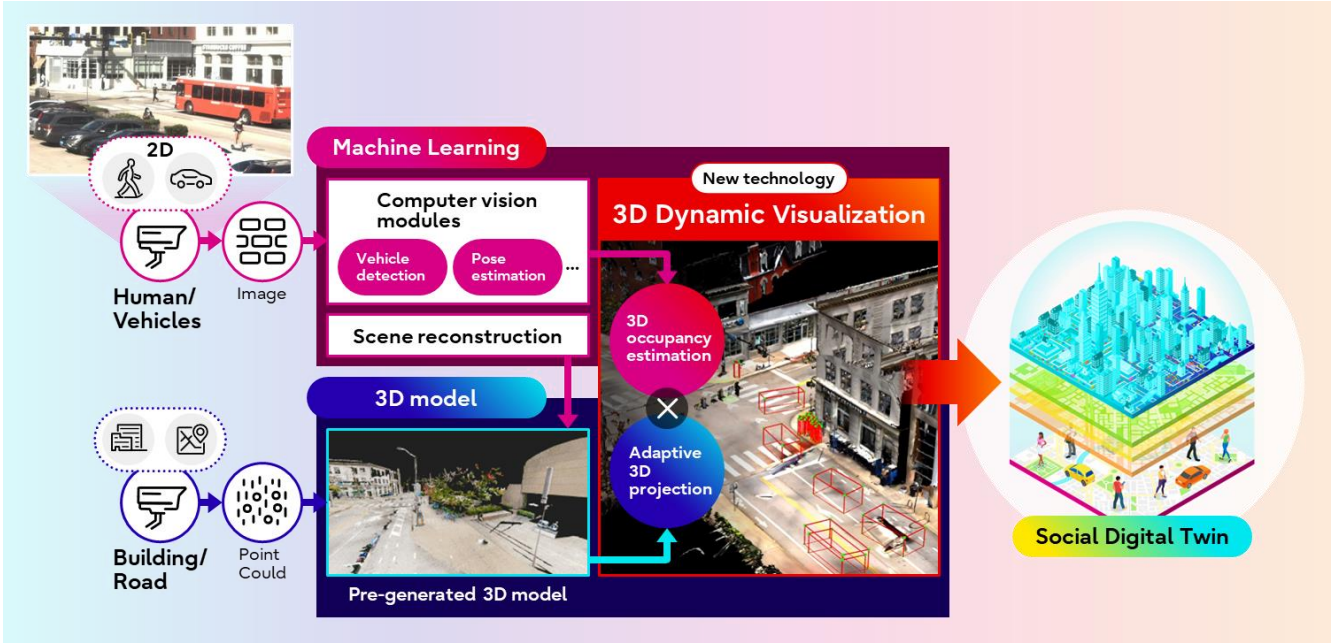
- Existing technologies enable the high-precision 3D reconstruction of objects from multiple photographs taken from videos shot from different angles.
- However, as the joint research proceeded, it was found that existing video analysis methods were technically insufficient to dynamically reconstruct captured images to 3D. Multiple cameras were required to reproduce this, and there were issues with privacy, workload, and cost, which became a barrier to social implementation.

- To address these issues, Fujitsu and Carnegie Mellon University have developed a technology that reconstructs a dynamic 3D scene model even when an object is photographed from a stationary monocular RGB camera, without combining images shot simultaneously by multiple cameras.

Technology development

Core(1) : 3D Occupancy Estimation Technology
Core(2) : 3D Projection Technology



Core(1) : 3D Occupancy Estimation Technology

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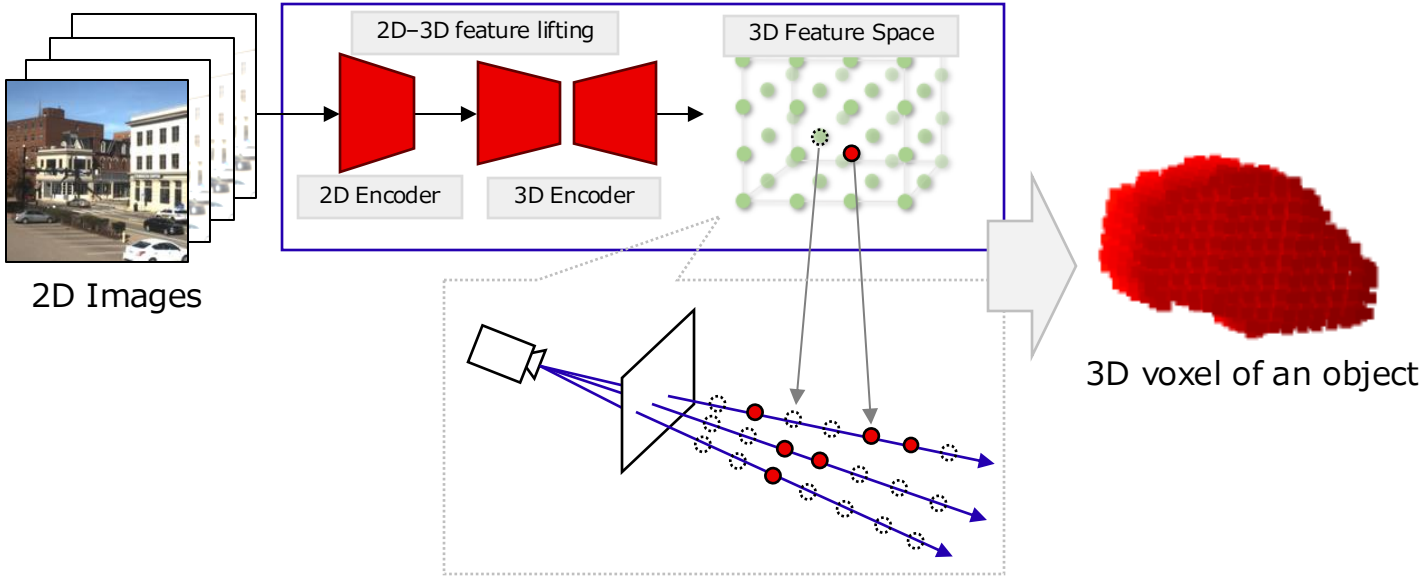
- This technology leverages deep learning networks. Even a single image of a city from a monocular RGB camera can be expressed as a collection of Voxels in 3D space, including categories such as buildings and people.
- Our method enables accurate 3D shape estimation of areas that are not visible in the input image.



The result of 3D Occupancy Estimation Technology

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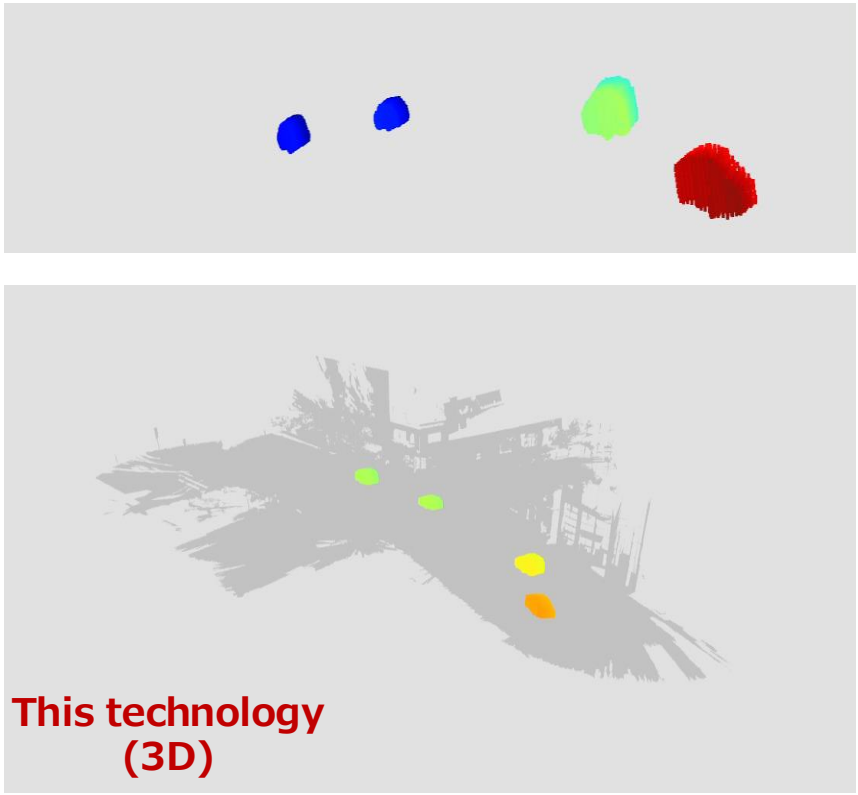

Core(2) : 3D Projection Technology

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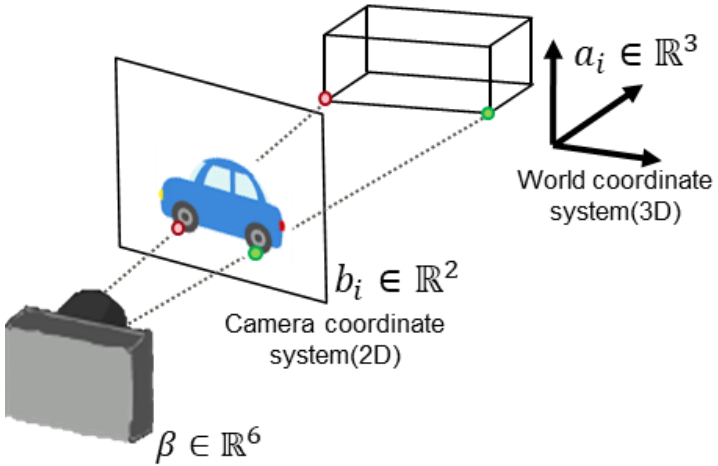
- Based on the output results of 3D Occupancy Estimation Technology, this maps them with high precision in 3D virtual space by incorporating know-how in human behavior analysis.
- This not only makes it possible to reconstruct the movements of people and vehicles in a manner more consistent with the real world, but also enables accurate position estimation even when specific parts of objects are hidden by obstructions.



The result of 3D Projection Technology

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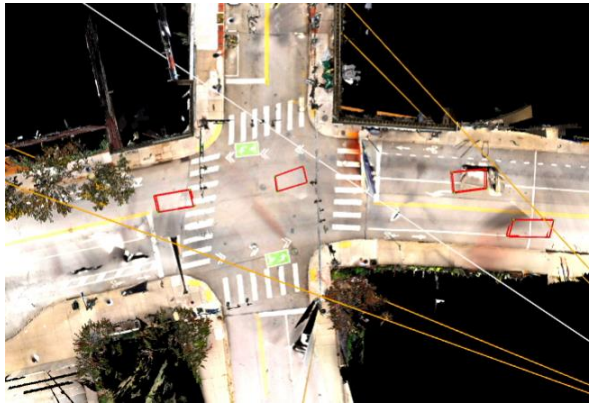
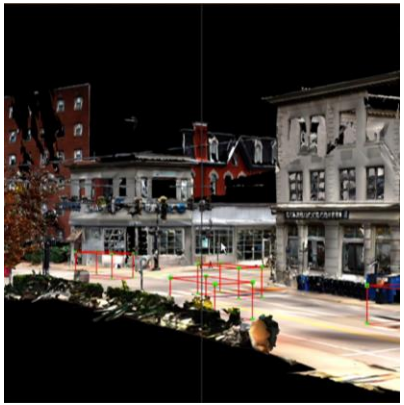
Real video
(2D)

**This technology
(3D)**

**This technology
(3D)**

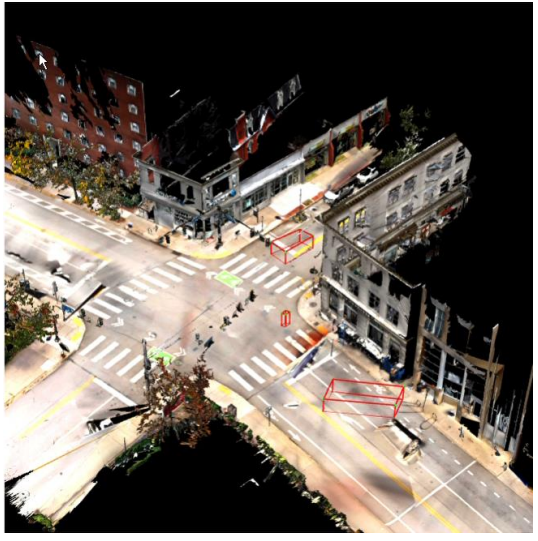


**This technology
(3D)**






STARBUCKS COFFEE




About the field trials

- **Period**: From February 22, 2024 (Thursday) to May 31, 2024 (Friday)
- **Location**: Pittsburgh, Pennsylvania, USA
- **Detail**: A field trial was conducted where a monocular RGB camera was installed on the campus of Carnegie Mellon University, and data from intersections such as buildings, people, and vehicle traffic around the university were reproduced on a Social Digital Twin. The goal was to verify the effectiveness of the developed technology by analyzing the crowd and traffic conditions around the university, using the analysis results to discover potential accidents such as blind spots caused by buildings and temporary crowds, and exploring ways to prevent them.

【出典】https://www.cs.cmu.edu/~walt/

Future plan

- Going forward, Fujitsu and Carnegie Mellon University aim to commercialize this technology by FY 2025 by verifying its usefulness not only in transportation but also in smart cities and traffic safety, with the aim of expanding its scope of application.

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