RESEARCH INSTITUTE FOR SUSTAINABLE URBAN DEVELOPMENT (RISUD)

News Article for RISUD Emerging Frontier Area (EFA) Scheme

		Name	Department
1.	**Principal Investigator**:	Dr. Xintao LIU	LSGI
2.	**Name of EFA:**	3D Digital Twin for Smart Mobility	
3.	**Project Title:**	Towards a Digital-twin System for Smart Mobility for People with Disabilities (PwDs) Using Multi-data Sensing and Big Data Analytics	

4. **Annual Progress/Achievement (***in layman's language, no more than two A4 pages, pls attach photos***)**

According to World Health Organization, about 15% of the global population has some forms of disability. In Hong Kong, the proportion of people with disabilities (PwDs) is 8.1% in 2015 and the proportion of elderly people aged 65 and over is 17% in 2016, projected to increase to 31% in 2036 (CSD). The population of PwDs is expected to climb with the rising proportion of the elderly. However, as a world-leading city advocating "Smart City" staunchly, Hong Kong lacks an intelligent pedestrian platform for PwDs to provide real-time and accurate walking strategies with the consideration of disabilities-friendly facilities and environment. The research team led by Dr. Xintao LIU believes that disability should not be a barrier in Hong Kong and an IoT-based digital twin platform should be on the agenda to provide a holistic walkability solution. Therefore, the project aiming to develop a 3D integrated digital twin system to facilitate smart mobility for PwDs toward a walkable smart city is initialized by the team.

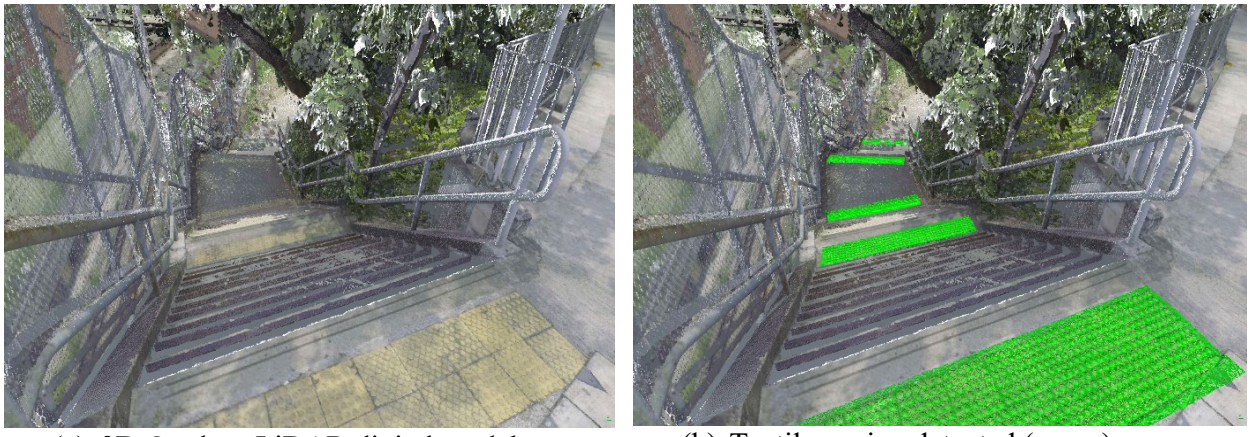
To support the digital twin-based navigation system, three-dimensional(3D) digital models, which are the foundation required for the construction of the city digital twin, is first constructed via Light Detection and Ranging (LiDAR) by the team. The models built capture the physical environment, which are composed of indoor facilities, such as elevators and stairs, as well as outdoor facilities such as roads and tunnels. They are high in accuracy and resolution, so measurement and subsequent analysis are available. More importantly, various data layers, including open geospatial data (e.g., building footprint and road network), are collected from the open-source geo-databases and integrated with the models in order to maintain the completeness of the city digital twin.

The successful construction of multi-data sensing 3D digital models enables the next step, which is the development of a navigation model for PwDs. The team starts by prompting the mobility of visually impaired persons, where the construction of the tactile paving network is the major challenge. Compared with the traditional methods that mostly require a visually impaired person with a smartphone camera on hand and implement a tactile paving detection model on images capture by the smartphone, the project team has proposed an advanced model for the automatic construction of the tactile paving network. The ground segmentation work is first applied on the collected LiDAR point clouds. The tactile paving indoor and outdoor, including warning paving and directional paving from the processed point clouds, are then identified and located by a computer vision algorithm based on Efficient

RANSAC for shape detection. After the extraction of tactile paving, clustering method is adopted to clean the noise and form the network. The proposed automatic tactile paving network has shown promising performance in inventorying the network of tactile paving from 3D models (figure1&2). It overcomes the limitations of existing approaches that mainly rely on the color properties of paving and fall shorts of robustness when it comes to complex scenes.

(a) 3D Indoor LiDAR digital model (b) Tactile paving detected (green)

Figure 1: Tactile paving network constructed in the indoor 3D model



(a) 3D Outdoor LiDAR digital model (b) Tactile paving detected (green)

Figure 2: Tactile paving network constructed in the outdoor 3D model

The team have achieved a significant contribution in supporting the smart mobility of visually impaired person by proposing the automatic construction model of tactile paving inventory, which plays an important role in training and enhancing the pathfinding model for the digital twin based navigation system. The achievement can substantially improve the walkability and social well-being of PwDs in Hong Kong. In the coming future, the team will expand the scope of the project to benefit other kinds of disabilities, particularly wheelchair users. In addition, comprehensive data layers, such as human perception and urban environment data, will also be collected and integrated into the digital twin model to perform real-time data sensing flow of the city digital twin. The team hope the 3D digital twin project can lead to a more “accessible” Hong Kong for people with disabilities.