Smart City Platform

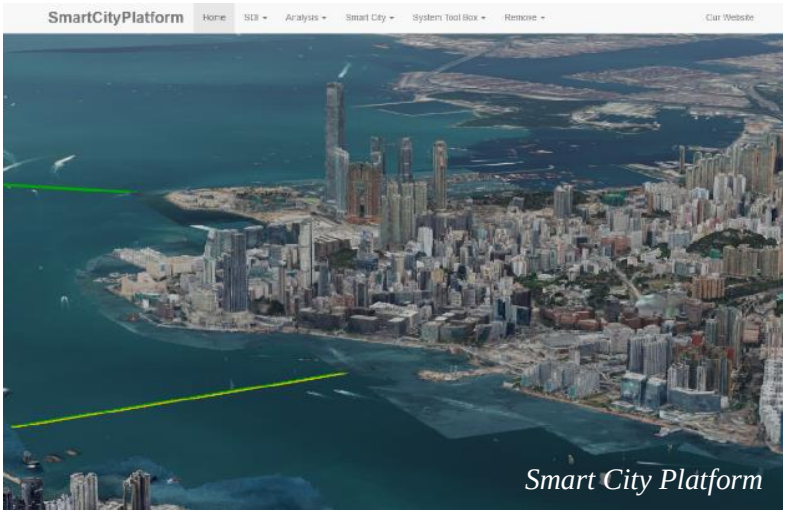
4D comprehensive spatiotemporal data infrastructure

In a smart city, intelligent machines communicate with each other via the Internet of Things (IoT) and their sensors collect data every second. To facilitate the smooth running of a smart city, such IoT data are geotagged, so that we know where the data are captured. But in a vertical city like Hong Kong, geotagging alone is not enough as there could be tens of floors stacked up at the same spot on a map. A 3D model, or better still, a 4D model that incorporate 3D geo-information from various sources plus temporal dynamic models would cover more grounds for various smart city applications.

In light of this, Prof. John Shi, Head of the Department of Land Surveying and Geo-Informatics, led a research team to develop the Smart City Platform, a 4D comprehensive spatiotemporal data infrastructure that consolidates spatiotemporal data from various sources under one roof, with a web-based visualisation interface for easy reference. The team also devised a portable 3D LiDAR system to acquire spatial data of older buildings and established an international standard for underground utility model.

Compatible with various data sources

A city is a complex cluster of buildings, roads and open spaces, where various activities take place at the same time. Mapping out all these infrastructures and activities are essential to make a city smart. Although experts have invented systems to collect various data, such as 3D city modelling, building information modelling (BIM) and IoT sensors, these systems run on different platforms collecting data in different formats. Users have to use different software to retrieve different spatial data, making cross-referencing tedious and difficult. Prof. Shi thus developed the Smart City Platform. "Our system can read data in various formats, including 3ds, obj, skp, shp and gdb files. It can also process data from IoT sensors directly



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without the need of conversion. All data are consolidated on one platform, and the results are visualised in 3D format accessible to any web browser. In other words, you don't need to install any software to read the 3D map and the layers of information embedded therein," Prof. Shi explained. The system incorporates indoor, outdoor, above-ground and underground 3D spatial information, plus spatiotemporal dynamic models.

3D LiDAR spatial data

Besides consolidating data from various sources, the system developed by Prof. Shi's team also captures its own raw data with 3D LiDAR. "There are many sources that provide the location and exterior configuration of a building, such as satellite positioning and 3D city modelling. But when it comes to its interior structure, we have to access its BIM which is rarely available in older buildings. So, we developed a portable 3D LiDAR spatial data acquisition system to collect their interior spatial data," Prof. Shi said. The system is made up of a backpack with a metal frame where laser emitters and sensors are attached. The operator puts the system on his back and walks around the interior of a building to capture the position and measurement of every dot and line with simultaneous localisation and mapping (SLAM) technology. The post-processing software then combines the data collected to re-create the interior 3D space automatically. That means BIM can be built for older buildings for smart city functions to operate seamlessly.

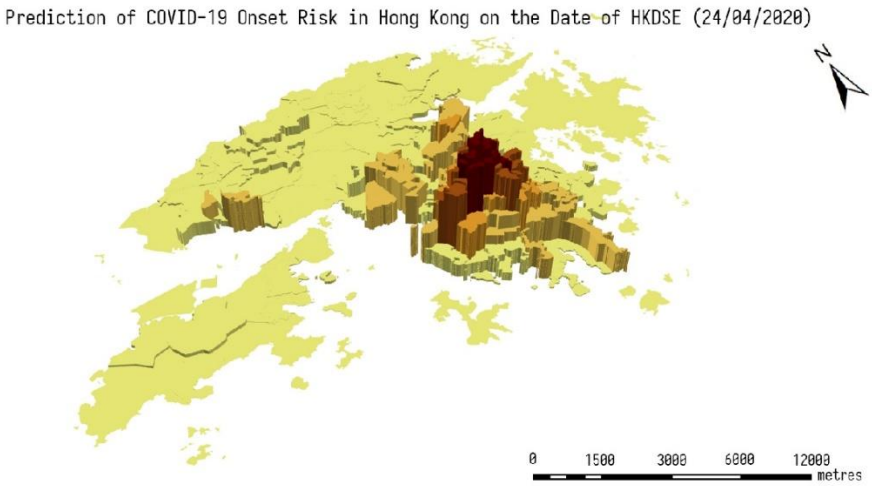
Establishing underground utility model standard

A smart city not only runs above ground, but also underground – there is a vast network of pipes and cables that carry water, gas and electricity to each building, while removing waste. Before digging underground, one must accurately locate all utilities. Prof. Shi said, "Each utility company keeps good records of its own pipes or cables underground. But it may not have access to the records of other utility suppliers. There wasn't even an international standard on how to document such underground utility network in the past. As our data infrastructure also covers underground spatial data, we figured we need to establish such a standard and we have submitted the specifications to the Open Geospatial Consortium (OGC) for approval."

Applications

The Smart City Platform is versatile and has great potential in various applications. It is suitable for urban planning, virtual test-bedding and visualisation of proposed developments. By analysing future urban development on the platform, developers can predict its impact on traffic and environment. Businesses also benefit from its functions such as spatiotemporal mapping of social

media engagement and supply chain logistics management. Amid COVID-19 pandemic, the system was able to predict the level of risk among various DSE examination centres based on distribution data of confirmed cases so that candidates might take extra precautions if necessary. The possibilities are endless.



Risk prediction of COVID-19 in DSE examination centres using the Smart City Platform

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