

## Utilization of free software QGIS in road maintenance

Construction IoT Research Laboratory Nurulnajwa Khamis, AbdalRahman Elshafey, Jevica  
Kankyo Fuudo Techno Kiyotaka Suda  
IKEE Group Yougo Kurokawa, Gosuke Nishiyama

### 1. Introduction

QGIS is known as a free and open source Quantum Geographical Information System software that allow the users to create, edit, visualize, analyze the publish geospatial information on various platform. This software support a wide range of data formats, including vector, raster and database. This software also has a comprehensive set of tools for spatial analysis, maps and etc. In this paper, we would like to discuss about the utilization of free software QGIS for road maintenance.

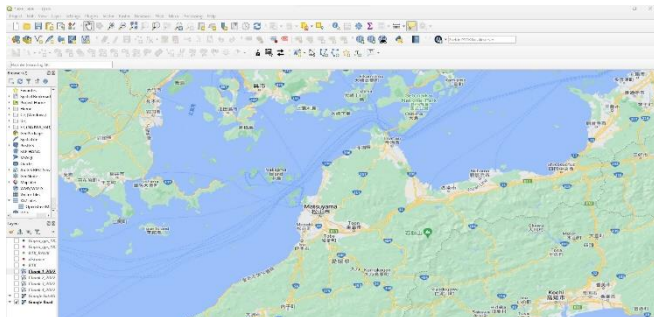


Figure 1 Example of QGIS software

### 2. Outline

This project is conducted at Ehime prefecture, Matsuyama city, road 196 and 56. The purpose of this project is to utilize the benefit of using QGIS software as a platform for implementation of digital twin and database for a road maintenance. The concept of digital twin is based on the point cloud data that is measured from photogrammetry. Besides that, we also implement a method by using a simple laser sensor to investigate the condition of the road surface and match between point cloud data together with laser measurement and GPS information to know the position information or the distance of the road. The total distance for both road is measured around 23KM. From the QGIS software also, we manage to implement the software as the database platform to store the document of the road quantity.



Figure 2 Camera action for photogrammetry



Figure 3 Example of simple laser sensor placed at back of car.

### 3. Method

#### 3.1 Collecting point cloud data.

In this method, the point cloud data is created by using the concept of photogrammetry from AGISOFT metashape software. The device we used in this experiment is action camera Gopro 11 with 120fps. The two-action camera is placed at the roof top of a car. Then we convert the point cloud data into .LAS file to input inside the QGIS software. As in figure 5 and 6, we manage to put the LAS file from the point cloud data in QGIS software.

#### 3.2 Laser sensor measurement.

In this method, we use a simple laser sensor model

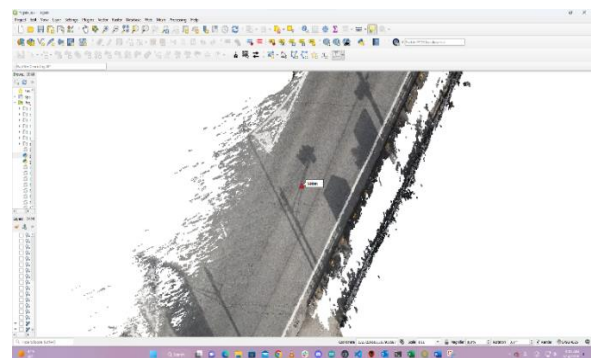


Figure 4 Example point cloud data in QGIS.

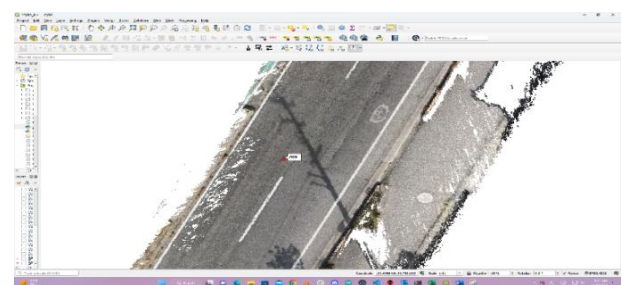


Figure 5 Example of point cloud in QGIS

Keyword: QGIS, RTK-GNSS, laser sensor, point cloud, photogrammetry, Digital Twin  
連絡先 〒485-0023 愛知県小牧市5丁目711番地 (株) 可児建設 TEL 05-6877-5355

Keyence LR-TB5000 as in the picture 6. This laser is a displacement sensor that uses a high-accuracy sensor to measure distances up to 50mm. it's commonly used in industrial automation and robotics applications to detect position and dimensions of objects.



Figure 6 Keyence laser sensor model LR-TB5000

### 3.3 Laser sensor configuration.

The figure 7 below shows the connection between the laser sensor and the software that we used to measure the laser data. The laser sensor is set into 100 Hz frequency with sampling rate is every 1ms. The laser sensor is connected



Figure 7 Laser sensor configuration

to the AC/DC converter and dynamic measurement instrument. Then we used the fanless CPU with Windows 10 for the operating system then it will be connected to monitor to show the laser software.

## 4. Analyze laser sensor data with point cloud data.

As shown in figure 8, from QGIS software we manage to show the graph measured by the laser sensor. For example, from the laser graph, we want to investigate the condition of the surface road at distance from 2KM until 3KM, by using the features from the QGIS software, we can zoom into that location and we can analyze based on the graph shows that at distance 2KM until 3KM it shows that there is a lot of cracks at the surface of the road as shown in figure 9.

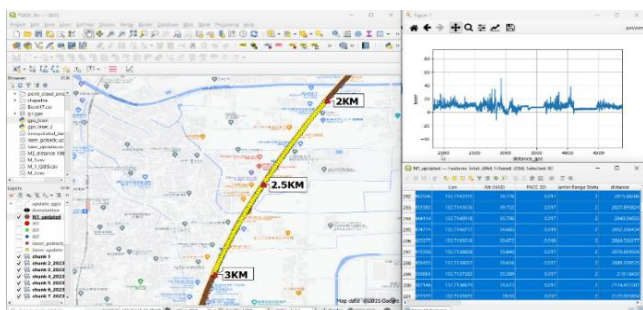


Figure 8 showing the laser graph and the positional information from GPS.

## 5. Database for documentation of road quality

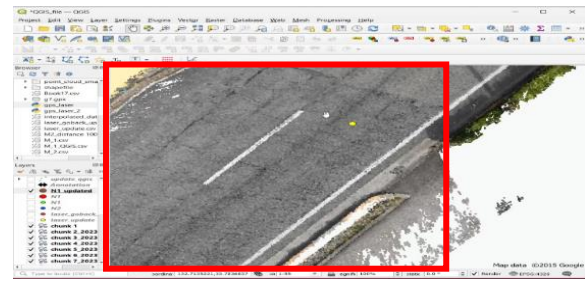


Figure 9 The point cloud shows the condition of the surface of the road.

The picture below shows how we can make the QGIS software as the platform for database and documentation. In this research, we manage to display the road quality PDF file in QGIS software. The method is for example the user need to check the road quality at distance 500M, the user can click at the location and the file of the road quality for that 500M location can be displayed.

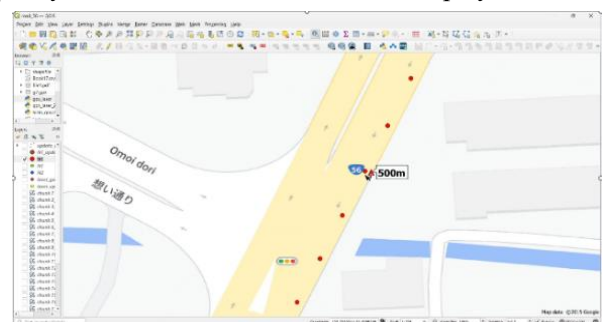


Figure 10 using QGIS features, click at the point.

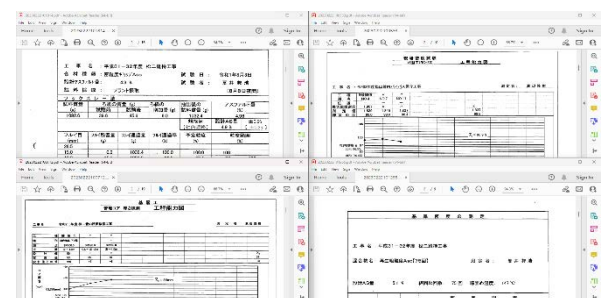


Figure 11 Example of road quality PDF file

## 6. Summary

- By using the applications and features of QGIS, it can be used as a platform for a digital twin application using a simple laser sensor and point cloud data to analyze the road surface condition.
- QGIS also provides a platform for analyzing and documenting geospatial information. For example, in this trial, a file of road quality inspection materials can be saved in QGIS software.

## 7. Future Work

As for future work, the application of point cloud data with QGIS maps could be displayed.