POINT CLOUD OBSERVATION DEVICE THAT CAN BE INSERTED INTO A CAVITY OBSERVATION HOLE UNDER THE ROAD SURFACE

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1. GENERAL INSTRCUTIONS

In the cavity survey, we already have the technology for observing the existence and an approximate shape. Detailed information is needed to know the volume and whole shape of the cavities. However, it's impossible of only 6cm in diameter. Therefore, the small point cloud observation device has been newly developed.

2. POINT CLOUD OBSERVATION DEVICE

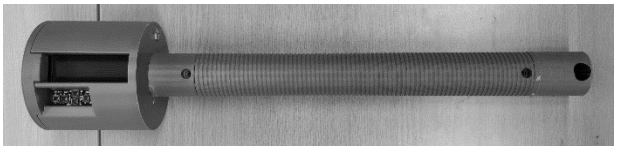

Figure 1. The Overall point cloud observation device

This device is based on an Arduino board, equip some low-priced MEMS sensors (including LIDAR), requires several AA batteries, has a lightweight 3D printed body, and has good portability. The head on the left side of the above figure is the main part of the device, that implemented the majority of parts except for LIDAR. The bottom part at the right edge of the above figure included LIDAR.

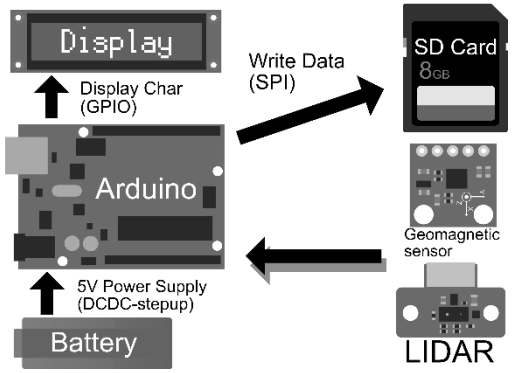

Figure 2. About the system and sensor connections

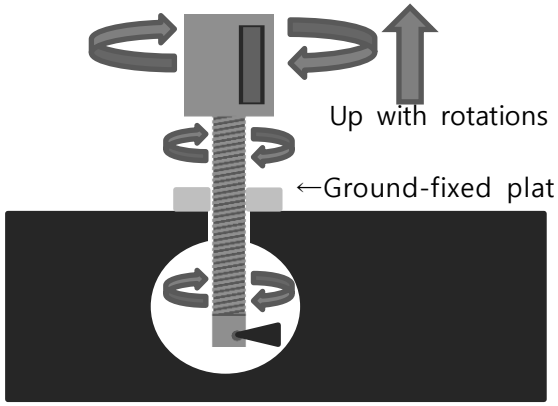

Figure 3. How does the device observe the cavity

The head has a geomagnetic sensor that can measure the azimuth(deg). And the bottom has the LIDAR that can measure the distance(mm). We can calculate the XY position data by using the trigonometric function. And, as you can find in Figure 3, the rod between the head and bottom has a screw on the outer. When we rotate the rod by hand, the device can gradually move up or down with rotations. We can calculate the Z position data by using the screw pitch(mm/rot) and the azimuth(deg). Then we can get XYZ point cloud by merging these.

3. EVALUATION TEST

In the first step, the simple evaluation test using a cardboard box that has several objects was conducted, as shown in Figure 4. This device could visualize the shapes of the objects accurately.

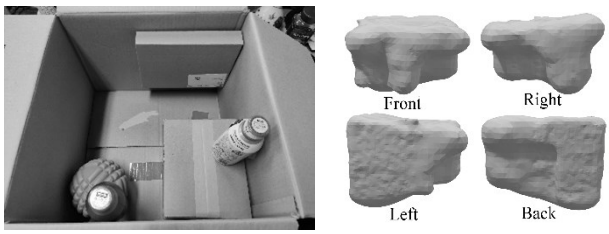

Figure 4. Simple evaluation test and result

Then trial test was performed at an actual sinkhole, as can be seen in Figure 5.

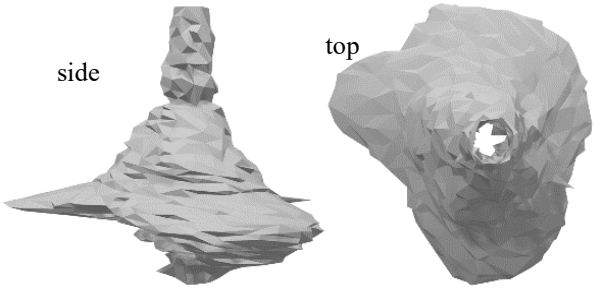

Figure 5. Actual sight result

4. CONCLUSIONS

A small observation device for a subsurface cavity was developed. The advantages of the device are low price, easy construction, and good portability. The disadvantages are the degree of the LIDAR module and the problem with the stable voltage. The LIDAR module is equipped horizontally. Therefore, it couldn't measure the roof or floor accurately. The voltage that supplies to LIDAR sometimes dropped less than the required level because the resistor of wires is ignored.