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A Study on Displacement Measurement Hardware of Retaining Walls based on Laser Sensor for Small and Medium-sized Urban Construction Sites

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Abstract

Measuring management is an important part of preventing the collapse of retaining walls in advance by evaluating their stability with a variety of measuring instruments. The current work of measuring management requires considerable human and material resources since measurement companies need to install measuring instruments at various places on the retaining wall and visit the construction site to collect measurement data and evaluate the stability of the retaining wall. It was investigated that the applicability of the current work of measuring management is poor at small and medium-sized urban construction sites(excavation depth<10m) where measuring management is not essential. Therefore, the purpose of this study is to develop a laser sensor-based hardware to support the wall displacement measurements and their control software applicable to small and medium-sized urban construction sites. The 2D lidar sensor, which is more economical than a 3D laser scanner, is applied as element technology. Additionally, the hardware is mounted on the corner strut of the retaining wall, and it collects point cloud data of the retaining wall by rotating the 2D lidar sensor 360° through a servo motor. Point cloud data collected from the hardware can be transmitted through Wi-Fi to a displacement analysis device (notebook). The hardware control software is designed to control the 2D lidar sensor and servo motor in the displacement analysis device by remote access. The process of analyzing the displacement of a retaining wall using the developed hardware and software is as follows: the construction site manager uses the displacement analysis device to 1)collect the initial point cloud data, and after a certain period 2)comparative point cloud data is collected, and 3)the distance between the initial point and comparison point cloud data is calculated in order. As a result of performing an indoor experiment, the analyses show that a displacement of approximately 15 mm can be identified. In the future, the integrated system of the hardware designed here, and the displacement analysis software to be developed can be applied to small and medium-sized urban construction sites through several field experiments. Therefore, effective management of the displacement of the retaining wall is possible in comparison with the current measuring management work in terms of ease of installation, dismantlement, displacement measurement, and economic feasibility.

Keywords: Retaining wall, Displacement measurement, 2D lidar sensor

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