ISSN 2616-5767 Vol.5, Issue 3: 1-4, DOI: 10.25236/AJETS.2022.050301

Design of data acquisition system for geotechnical investigation

Yang Chengwei

College of Civil Engineering, Anhui Architecture University, Hefei, Anhui, China
yyccww666@126.com

Abstract: *The types of geotechnical investigation data are rich and the amount of data is huge. The traditional data acquisition method needs to consume a lot of human and material resources, and the efficiency of data acquisition is low. Based on this, the optimal design of geotechnical investigation data acquisition system is proposed. The hardware of the system adopts BS architecture and the PC adopts SSH framework, which can improve the logic control ability of the system. The software of the system realizes the synchronous acquisition of field and office work by designing the data acquisition module; Analyze the attribute and logical relationship of the collected target data, and establish a system database to reflect the dynamic process of geotechnical investigation data collection; Combined with the principle of three-dimensional imaging technology, the survey data call function of the system is designed. The test shows that this data acquisition system runs faster and the accuracy of the acquisition results is high.*

Keywords: *Geotechnical Engineering; Survey; Data Collection; System; Accuracy*

1. Introduction

With the continuous development of information technology, geotechnical engineering investigation has gradually changed from manual output results to visual management stage [1]. In geotechnical engineering investigation, mobile collection of geological data is very important and of great significance for engineering application [2]. As the basis of geological engineering application, geotechnical engineering survey data is different from traditional survey data. There are many sources of data and strong spatial distribution [3]. The traditional geotechnical investigation data collection mainly adopts the way of handwritten record, manually screening and sorting the data, and finally input the sorting results into the corresponding investigation database [4]. The traditional survey data acquisition method has some defects in work efficiency, requires a lot of human and material resources, and has a high probability of errors in handwritten records, resulting in poor accuracy of survey database [5].

With the rapid development of GIS technology and computer technology, aiming at the shortcomings of traditional geotechnical investigation data acquisition methods, combined with the auxiliary function of professional equipment and computer, this paper designs a survey data acquisition system to provide help for the development of geotechnical engineering.

2. Hardware design of data acquisition system

The PC end of the geotechnical investigation data acquisition system designed in this paper adopts SSH framework and has strong logic control ability. Select JSP page Jump engine to realize the flow and control between system pages [6]. The server side of the system adopts MySQL 5 with small volume 5. The development language adopts Java, which can realize the cross platform operation function of the system [7]. The hardware of the system adopts BS architecture to synchronously manage and release the project progress of survey work in the process of data collection. Based on the demand of massive survey data collection, this paper selects ArcGIS Server equipment to provide a good hardware environment for the operation of the system. The server is equipped with 3-5 scalable processors to achieve the goal of browsing geotechnical survey data information in real time. The server adopts dual core CPU and the bandwidth is set to 6Mbps, which is suitable for various geotechnical investigation environments. In the hardware equipment, multi-channel accelerator shall be installed to ensure the mutual balance between the system hardware equipment and survey data, and

ISSN 2616-5767 Vol.5, Issue 3: 1-4, DOI: 10.25236/AJETS.2022.050301

improve the operation speed of each performance of the system.

3. Software design of data acquisition system

3.1. Design of data acquisition module

The system data acquisition module designed in this paper can collect geotechnical engineering survey data in an all-round way by using the intelligent characteristics of the terminal. GPS function is installed in the system to improve the accuracy of field data acquisition of the system. Set the remote data transmission function, reduce the manual transmission operation of data acquisition, and realize the goal of real-time data transmission back to the system server. The system realizes the attribute sampling of engineering geological data and the collection and input of spatial data by reading the file data of geotechnical engineering database and importing and converting. The field auxiliary collected by the system obtains the location information and positioning accuracy of geotechnical engineering survey data through GPS information, ensures the synchronous operation of field and indoor collection of the system, and uploads the collected survey data to the system database through FTP remote data transmission service.

3.2. Database design

In the data acquisition system of geotechnical investigation, the design of database is very important. In the design of the database, this paper first analyzes the attribute and logical relationship of the target data, and establishes the survey data association attribute table according to the analysis results. The structure is shown in Figure 1.

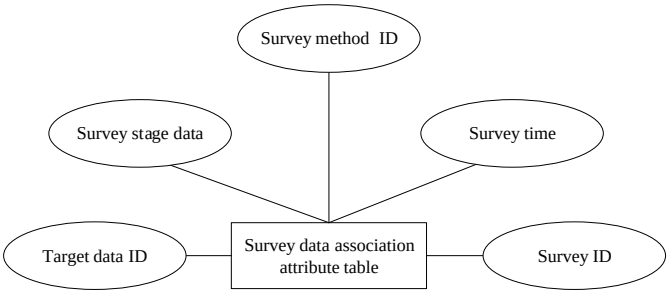

Figure 1: Structure of survey data association attribute table.

As shown in Figure 1, the survey data association attribute table in the database mainly includes target data ID, survey stage data, survey method id, survey time and survey ID. Among them, the survey method id and target data ID are set as the primary key of the system database to reflect the dynamic process of geotechnical survey data collection through the above attributes.

3.3. Survey data calling function design

Based on the above software design, combined with the function of system iterative analysis, based on the attribute of geotechnical investigation data, the mutual call function between system investigation data is designed to realize the collection of investigation data. Based on the principle of GIS three-dimensional imaging technology, the geotechnical investigation data is reflected into the system for artificial intelligence processing, so as to improve the transfer rate of geotechnical investigation data. The function diagram of the system geotechnical investigation data call designed in this paper is shown in Figure 2.

As shown in Figure 2, the system hardware collects the spatial data and attribute data of the survey area and geotechnical project names respectively, and generates the corresponding electronic document of data acquisition through the mutual call function of data information. Check the electronic documents of data acquisition. After checking, upload the data to the display page of the system, pack the data offline, import it into the database of the acquisition system through wireless network transmission and save the data.

ISSN 2616-5767 Vol.5, Issue 3: 1-4, DOI: 10.25236/AJETS.2022.050301

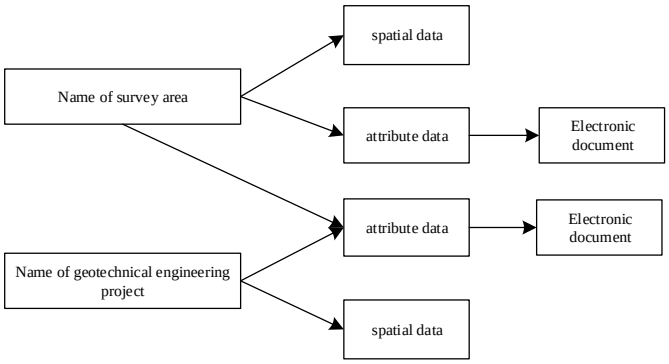

Figure 2: Schematic diagram of system survey data calling function.

4. System test

In order to verify the feasibility of the geotechnical investigation data acquisition system designed in this paper, the following test and analysis are carried out. This test takes a geotechnical engineering construction area with the same geological characteristics as the survey object, and puts the survey data acquisition system designed in this paper into use. Divide the survey area into two groups, delineate the specific scope of engineering survey, and ignore the impact of the system on geotechnical engineering survey. Set 15 drilling points with the same shape and size, control the range of drilling points, and collect diversified survey data through the survey data acquisition system. Upload the survey data to the data server of the system in real time, and carry out traceable management of the data to reduce the repeated operation of data collection. Combined with the data processing software in the system, the synchronous operation of indoor and outdoor work of geotechnical engineering investigation is realized, and the space vector parameters of data are calculated by using the iterative analysis function of data acquisition system. Set the geological condition parameter of the test area as N, the number of spatial iterations of the survey data as I, the change coefficient of the survey condition of the test engineering as s, and the calculation formula of the spatial vector parameter of the survey data is:

$$c = \sum_{i=1}^{n} \min\left(e_i, f_i\right) / s$$

Where, e_i represents the parameter of survey data vector change under I iteration in the test; f_i represents the accuracy of survey data vector change under I iterations in the test. The space vector parameters of geotechnical investigation data are obtained through the formula as the basic data for the system to collect information. Six groups of test data are set, and the amount of geotechnical investigation information is 34500. The application effect of the survey data acquisition system designed in this paper is compared with the traditional data acquisition system based on GIS technology. The results are shown in Table 1.

Table 1: Comparison of application effects of two survey data acquisition systems.

Number	Test items	Paper system	Traditional system
1	Single point data acquisition time	About 30s	About 68s
2	project duration	4 days	9 days
3	Storage time of survey data	50s	2037s
4	Data processing time	60s	2017s
5	Acquisition accuracy	99.85%	80.12%

According to Table 1, compared with the traditional system, the geotechnical investigation data acquisition system designed in this paper has faster operation speed, shorter investigation data acquisition, storage and processing time, and higher accuracy of system acquisition results, which is conducive to the development of geotechnical engineering projects.

5. Conclusions

To sum up, in view of the shortcomings of the traditional data acquisition method of geotechnical engineering survey, this paper designs the data acquisition system, optimizes the hardware and software

ISSN 2616-5767 Vol.5, Issue 3: 1-4, DOI: 10.25236/AJETS.2022.050301

of the system in an all-round way combined with computer technology, realizes the data acquisition and processing of geotechnical engineering geological survey, improves the accuracy of data acquisition and reduces the resource consumption in the acquisition process, It provides some help for the sustainable development of geotechnical engineering projects in China.

References

[1] Tang Chao, Hou haiqian, Ma Quanming, Hu Xiaofei Design and implementation of data acquisition service system for geotechnical investigation of rail transit [J] Urban rapid rail transit, 2021, 34 (03): 113-118.

[2] Guo Lili, Design and implementation of geotechnical investigation information system based on GIS [J] China Metal Bulletin, 2020 (08): 297-298.

[3] Cao Jufeng, Zhang Lin, Chen Zhijun, Discussion on indoor and outdoor integrated system of geotechnical engineering survey in Guizhou Province [J] Sichuan cement, 2020 (07): 286-287.

[4] Xu Qishi, Jiang Xinhui On the development prospect of geotechnical engineering investigation in the era of big data [J] World nonferrous metals, 2020 (10): 210-211.

[5] Cao Yang, Zhang Yihua, fan Kun, Tian Ling, etc Research and application of Chongqing engineering survey field information collection and supervision system [J] Chongqing Architecture, 2021,20 (03): 27-29.

[6] Liu Xiangwu, Integrated analysis of geotechnical engineering survey and design supported by GIS [J] World nonferrous metals, 2021 (02): 211-212.

[7] Qi Yonghui, Digital technology and implementation of geotechnical investigation [J] Construction technology development (139,05-2020): 140.05.