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Design And Implementation Of Safety Monitoring Information System For Full Scaffold

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ABSTRACT. *This paper proposes a safety monitoring system based on Internet of things (iot) for steel tubular scaffold with couplers, which can monitor the safety hidden danger of the scaffold in real time. When the monitoring data exceeds the warning value, the personnel will be informed by SMS, so as to realize the safety monitoring and warning of the scaffold.*

KEYWORDS: *full scaffolding; safety monitoring; information system design*

1. Introduction

With the increasing number of modern high-rise buildings, the use of scaffolding is increasing, followed by scaffold collapse accidents occur from time to time, once the scaffold collapsed, it will have an impact on the progress of the project, to the lives and property of the people has brought significant losses[1]. For the safety accidents on the construction site, the safety accidents related to scaffolding account for a large proportion. Scaffold accident is one of the major hazard sources that cause safety accidents during construction. Scaffolding safety accidents are caused by many factors, the scaffold safety accidents are mainly divided into two categories: fall accident, capsizing and collapse accident. In order to avoid quality safety accidents in engineering construction, the safety and reliability of full scaffold is especially important.

2. The Significance of Safety Monitoring System Of Full Scaffold.

Multi-sensor information fusion and safety situation assessment are applied to provide the early-warning model and information for the safety of full scaffold, and the management personnel can make corresponding measures in time to reduce the occurrence times of full scaffold accidents. It provides scientific and effective means for the supervision of construction units and supervision departments such as buildings and Bridges, as well as safety and technical guarantee for construction enterprises and on-site construction personnel. This system solves the problem of

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safety monitoring of full scaffold in complex areas such as construction and bridge construction, and makes the safety monitoring and warning of full scaffold intelligent, so as to improve the safety of full scaffold, and at the same time avoid or reduce the economic and even loss of life and property caused by the safety accident of full scaffold[2]. The system has high practical value and can be deployed in large construction sites. Through the use of sensor technology, on the one hand, reduce the cost of safety monitoring of full scaffolding, on the other hand, also reduce the incidence of full scaffold accidents[3].

3. Overall Architecture And Functional Analysis Of The System.

The safety monitoring system of steel pipe scaffolding with couplers designed in this paper mainly consists of three parts: data acquisition part, data transmission part and upper monitoring center. Application of laser displacement sensor and accelerometer to and scaffolding, monitoring parameters, such as impact acceleration and Angle displacement, APC220-43 wireless communication module receives the data sent over from the various monitoring node, and to monitoring center through GPRS remote transmission in a timely manner, using Java programming software development system, and the scaffold on the Web browser for display of the displacement, acceleration, Angle, and set up corresponding early warning value, when the monitoring data of more than warning value, via text message to personnel.

The bottom layer of the system is the monitoring layer, which is used to obtain the displacement, impact acceleration, inclination and other parameters of the full scaffold. It is mainly composed of sensor nodes. Firstly, several points to be monitored should be selected to monitor each layer of the scaffold, and sensors should be connected to the steel pipe of the scaffold. According to the “building construction fastener type steel pipe scaffold safety technical specifications” calculated full scaffolding warning value. The laser displacement sensor monitors the displacement of the scaffold, and the laser displacement sensor shall be fixed and installed in the construction site to monitor the displacement of the steel tubular scaffold full of couplers. The set scaffold laser displacement sensor measured the distance between the fixed position and the target full coupler steel pipe scaffold for many times, and the average value was set as D1. In the later period, the monitoring distance of the full scaffold displacement was set as D2, then D was the displacement of the full scaffold. To monitor the impact acceleration and inclination Angle of full scaffold, MPU6050 shall be installed on the full scaffold for monitoring the x axis acceleration, y axis acceleration, z axis acceleration, x axis inclination Angle, y axis inclination Angle and z axis inclination Angle of full scaffold. The data of MPU6050 is transmitted to the gateway monitoring system through the wireless communication module. Finally, the displacement, impact acceleration and inclination monitoring data of the laser displacement sensor and MPU6050 on the scaffold are displayed on the software of the monitoring system in real time.

The middle layer of the system is the data transmission part, which is composed

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of wireless communication gateway. Composed of downlink communication apc220-43 wireless communication module, responsible for data acquisition and control, reception and processing; The uplink communication consists of GPRS module, and the data received by the downlink communication is sent to the management and warning platform.

The top layer is the remote monitoring center. The management and warning platform uploads the data received by the gateway through the GPRS module SIM900A, displays the displacement, acceleration and inclination of the scaffold on the Web browser, and sets the corresponding warning value. When the monitoring data exceeds the warning value, the personnel will be informed by SMS.

The main functions of the system are as follows: scaffold information monitoring: using laser displacement sensor and accelerometer to collect the parameters of scaffold such as displacement, acceleration and inclination. Scaffolding information transmission: wireless communication gateway system. The downlink communication consists of wireless communication module apc220-43, which is responsible for data acquisition control, reception and processing of each monitoring subsystem. The uplink communication consists of GPRS module, which packs the data received from the downlink communication and sends it to the management and warning platform. Upper computer management system: B/S architecture, MySQL database and Java language development and implementation of the system management platform, used to achieve real-time monitoring of steel pipe scaffolding full of fasteners. Mobile terminal: the management and warning platform will manage and analyze the data. Once the data exceeds the warning value, it will send SMS to the mobile terminal for alarm.

The monitoring node consists of laser displacement sensor, accelerometer, PIC18F4520 single chip microcomputer, apc220-43 module and power supply module. The laser displacement sensor selected in this system is GHLM07C module, which needs to be fixed and installed to monitor the displacement of the scaffolding in the construction site. After the GHLM07C module is powered on, it is in standby state and sends the measurement command through RS232.

The accelerometer USES MPU6050, which reads the measurement data of MPU6050 with a microprocessor, and then sends it out through a serial port, avoiding the development of complicated and huge communication protocol by itself. This module is integrated with a voltage stable circuit, and can be adapted to a 3.3v /5V embedded system for easy access. In addition, this module adopts efficient digital filtering technology, which can effectively reduce the measurement noise and improve the measurement accuracy. The MPU6050 module inherits the dynamic kalman filter algorithm, which can accurately output the real-time state of the module in the complex and changeable dynamic environment, with the measurement accuracy up to 0.01 degree and stable output. It is a low-cost sensor suitable for various occasions.

The wireless communication module USES apc220-43, which is a highly integrated micro-power wireless data transmission module with a high-performance microprocessor and a high-speed rf chip embedded in it.The apc220-43 module

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provides users with a variety of channels to choose from. This module can transparently transmit data information of various lengths and sizes, and users themselves do not have to write huge and complicated programs. In addition, due to the remote transmission of data modules, software Settings are simple and diverse, so that it has a universal application in various fields. The apc 220-43 module mainly communicates through a serial port. In this system, the apc220-43 module needs to be connected with each node and the main control board to pack and send the data collected by the sensor to the main control board.

Gateway node completes the collection and summary of data, which is mainly composed of wireless communication module, processor module, GPRS module and power module. In order to improve the universality of nodes and reduce the design cost of the system, the wireless communication module and microprocessor still adopt apc220-43 module and PIC18F4520 module to realize data receiving and processing. The GPRS module selects SIM900A, and SIM900A is embedded with TCP/IP protocol. This module has an AT instruction set interface. PIC18F4520 sends the collected data to the SIM900A module.

4. Implementation Of Security Monitoring System Platform.

The software design of the system function module adopts MVC design pattern, and the interface layer adopts Jsp technology to design the main interface and data chart of the server system. The logic layer USES Servlet to implement the processing of server-related business logic. The data layer USES MySQL database to realize the system data storage call to the server.

First initialized to the system, basic system Settings, when reading data cycle comes, will read the data extraction, and the results show that, at the same time save data in databases, and call the corresponding module according to the results of the show, if the data is more than set warning value, record the ultra limit and inform personnel through messages.

5. Conclusions

This paper puts forward a kind of technology based on Internet of things and fastener type steel pipe scaffold safety monitoring system architecture, application of laser displacement sensor and MPU6050 of scaffolding, impact acceleration and displacement monitoring parameters, such as offset Angle, APC220-43 wireless communication module receives the data sent over from the various monitoring node, and to monitoring center through GPRS remote transmission in a timely manner, using Java programming software development system, in a Web browser on displacement, acceleration, deviation Angle of scaffolding, The system solved the fertility in the area of the building construction and other complex fastener type steel pipe scaffold safety monitoring problem, make a bunch of fastener type steel pipe scaffold intelligence of safety monitoring and early warning, so as to improve the security of a bunch of fastener type steel pipe scaffold construction, at the same

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time, avoid or reduce the fertility fastener type steel pipe scaffold collapse accident of the economic and even loss of life and property.

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