Manhole Cover Intelligent Detection and Management System

Xinru Fu

North China Electric Power University, Beijing, China

xinruF@163.com

Keywords: Manhole cover; Detecting system; Intelligent detection; Internet of things.

Abstract. In order to avoid the risks that imperfect manhole cover and feature to bring, this paper, aiming at the existing problem of manhole cover, proposed a detectable and maintainable regionalization covers intelligent security management system. Many sensors set up in the manhole cover to real-time monitor its situation, Through MCU、RF Wireless Data Communication Module and upper computer to understand and control manhole cover, this system could monitor the city manhole cover in real time and give an alarm automatically. There is no double that it could improve the management ability of the manhole cover and greatly enhance the safety of people's travel.

Introduction

With its great quantity and wide distribution, manhole cover is an important part of city drainage system. But owing to the complex structure and imperfect function of manhole cover, hundreds people suffer from all kinds of losses because the manhole cover is broken or missing every year. In order to save this problem, we established the integration of urban drainage manhole cover intelligent monitoring system to safeguard people's travel safety and improve urban management capacity. This system has real-time monitoring, alarm timely, accurate positioning, rapid processing, etc.

System Design Ideas

Design of system shown in Fig. 1.Setting the LED light and warning signs around the cover, this system can check the state of manhole cover by angle sensors and hall sensors [1-3]. When the cover is broken or missing, it would light LED to warn pedestrian and sent the message to related department by RF modules. Meanwhile, this system will collect and process the information and send the alarm signal to the monitoring system.
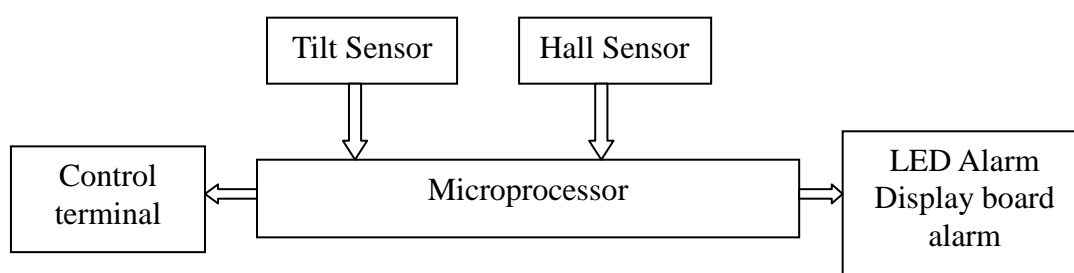

Figure 1.   Monitoring system interface

System Operation Principle

Hardware Part. The core of the system uses the MCU MSP430G2553 [4-6] for data processing and intelligent control. MSP430G2553 specific parameters are shown in Table 1, it possesses the characteristics of low power consumption, fast processing speed, can effectively achieve energy savings, real-time monitoring requirements. The tilt sensor and Hall sensor detection manhole cover

angle and the surrounding magnetic field changes. The collected information is converted into electrical signals through the AD module [7]. When the manhole cover is damaged or lost, abnormal electrical signals will be transmitted to the microcontroller. By the MCU control, high level signal is output, the LED lamp covers on lighting to blinking, and the pop-up warning signs in order to play prompts pedestrian detour function. In the radio transmission section, since NRF905 [8] has high emission frequency characteristics, so the use of radio frequency NRF905 module covers the data transmission and reception can be guaranteed within a predetermined range of the signal without transmission distortion.

Table 1   MSP430G2553 Specific Parameter

Operating Voltage [V]	1.8~3.6	
Operating current [μA]	Operation mode	230
	Standby mode	0.5
	standby mode	0.1

Software Part. Software part mainly realizes monitoring interface display. By monitoring platform can quickly receive, query the measured information, detect security risks and quickly covers treatment, strengthen the management of the covers. Monitoring platform shown in Fig. 2.
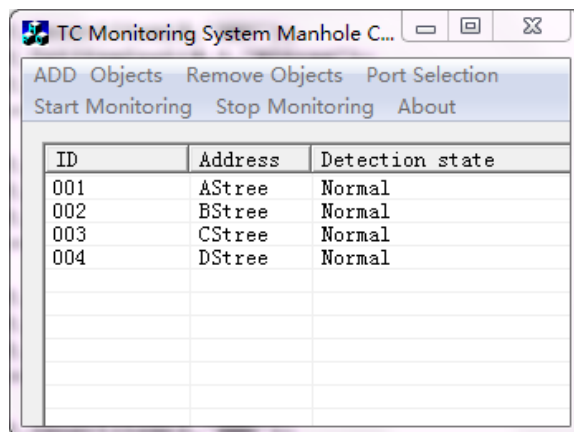

Figure 2.   Monitoring system interface

In the control interface selected Microsoft Visual C ++ as a development platform, specifically using Microsoft Visual C ++ foundation class library MFC (Microsoft Foundation Class Library) to develop monitoring interface. Making full use of MFC foundation class library and oriented object program design of encapsulation, inheritance, overloading and polymorphism all OOP technology and modular programming method, the system adopts top-down, stepwise refinement design method [7]. The system structure and main modules are shown in Fig. 2.
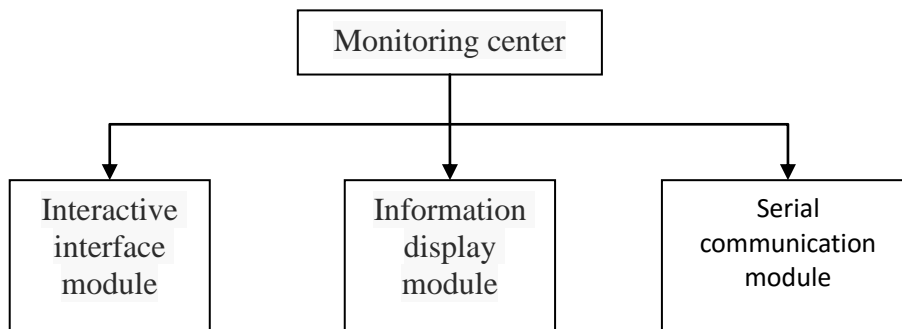

Figure 3.   Monitoring System Module

Interactive module using MFC dialog based framework program. With a simple, easy to this, all the operations are completed by menu and sub menu.

Information display module uses the ListView control achieved by this control displays the test covers number, address, and status.

Serial communication module to achieve the collected information covers state reception. Using Visual C ++ to provide OLE control MSComm (Microsoft Communication Control) [10] to achieve this functionality.

System Value

At this stage covers vulnerable to theft and easily damaged problems, its security and economic losses caused by difficult to count. In this paper, the combination of intelligent detection technology and Internet technology, through the system design, development, testing and etc stage realizes the real-time monitoring on the covers. When a thief stealing manhole covers or covers damage occurred, etc., on the one hand through the light alarm, warning signs remind reminder pedestrian detour, on the other hand to alert the monitoring center, enabling managers to quickly carry out repairs on the covers. Not only to protect the life and property safety of the public, but also for digital infrastructure, intelligent management of attempt reliability.

Rreferences

[1] S.P. Zhu: *Sensing and Detection Technology* (Peking University press, China 2006), p.1-p.13 (Language: In Chinese).

[2] Information on http://baike.baidu.com/link?url=vES6zDcPxolECSrCLc-sm7rBbw00ZENSeJCM7OrZ9QNaW-7IofJcNQZJUW5LZG1Oq0SxiP9i4uyms514 sjgq (Language: In Chinese).

[3] Information on http://baike.baidu.com/view/614188.htm (Language: In Chinese).

[4] Information on http://www.ti.com/cn/lit/ds/symlink/msp430g2553.pdf (Language: In Chinese).

[5] J.G.Hao: *MSP430 microcontrollers basic and applied design* (Electronic Industry Press, China 2014), p.100 (Language: In Chinese).

[6] Z.B.Wang, Y.D.Ma, W.H.Sun and Y.J.Ma: *MSP430 family of ultra-low power 16-bit microcontroller Principles and Practice* (Tsinghua University Press, China 2014), p.150-p.265 (Language: In Chinese).

[7] J.H.Shen and Y.Q.Yan: *MSP430 MCU Principles and Practice of Engineering Design* (Beijing University of Aeronautics and Astronautics Press, China 2008), p.54 (Language: In Chinese).

[8] Juan Carlos Trujillo; Manuel Palomar and Jaime Gómez: *Applying Object-Oriented Conceptual Modeling Techniques to the Design of Mul tidimensional Databases and Applications.* (Shanghai, China, June, 2000). Vol. 23, p.154.

[9] G.W.Yan, W.Peng and L.X.Xu: *Case-based Visual C ++ programming tutorial* (Tsinghua University Press, China 2012), p.146-p.257 (Language: In Chinese).

[10] X.lv: *VC++ employment training collection MFC video tutorial* (Machinery Industry Press, China 20124), p.23-p.37 (Language: In Chinese).