A Zigbee Based Design and Monitoring System of Airport Boarding Bridge

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Abstract: In this paper, we propose a new technology called Monitoring Based Maintenance (MBM) that enables the bridge maintenance engineers monitor the condition of the bridge in real time. The application design of airport boarding bridge monitoring system is mainly introduced in this paper. To overcome the disadvantages of boarding bridge's collapse and scraping the plane without early warning, a design of wireless fault early warning and monitoring system combining ZigBee wireless network composed of a variety of wireless sensor nodes realizes automatic transmission of data, which contains the temperature, humidity, vibration, fault and other environmental parameters of boarding bridge. Due to the use of wireless sensor network technology, it greatly reduces the workload of field wiring, makes monitoring function realize more quickly, and achieves the timely warning of boarding bridge collapsed which may even endanger the safety. flexible and shortens the troubleshooting time.

Keywords: LPC 1248, IR, Zigbee, Vibration Sensor, Visual Basic App.

I. INTRODUCTION

The current bridge health monitoring system uses cables for data communication. The installation of data cables is a cumbersome job and it often causes the cost increase in sensor installation, maintenance, and repair. The cable based sensor has many difficulties that might be minimized or eliminated if wireless sensor is used. They are (1) installation cost of communication and power supply cables of the sensors is very high; (2) installation of steel pipelines that protect those cables is also difficult; (3) temperature changes on cables cause sensor data distortions; (4) hard-to-eliminate noises occur at connections between sensors and cables; and (5) it is hard to identify the defects of sensors and cables and difficult to replace and/or repair them. In this paper, the wireless solution that overcomes these problems is presented. The wireless sensors have the following advantages: (1) the installation cost is low because the sensors do not require wiring; (2) no additional supporting structure such as pipeline for cable is required; (3) Sensors are easily replaced when malfunctioning; (4) by using Ad-Hoc and Multi-Hop, re-organizing sensor network is relatively easy. Fig.1 shows the proposed system block diagram.

III. EMBEDDED SYSTEM BLOCKS

A. ARM7 BASED LPC2148 Microcontroller

The Main Control Module: In this design, we chose an ARM7TDMI-S core based microcontroller called LPC2148, which is the production of NXP Semiconductors. The LPC2148 microcontroller is high-performance 32-bit RISC Microcontroller with Thumb extensions. it has 512KB Flash Memory and 40KB Static RAM, it use 12.00MHz Crystal, so it can process data with the maximum high speed at 60MHz when using it with Phase-Locked Loop (PLL) internal MCU. It has Real Time Clock circuit with 32.768 KHz XTAL and Battery Backup. Support In-System Programming (ISP) and In-Application Programming (IAP) through On-Chip Boot-Loader Software via Port UART-0 (RS232), circuit to connect with standard 20 Pin JTAG
ARM for Real Time Debugging. Has standard 2.0 USB as Full Speed inside, has Circuit to connect with Dot-Matrix LCD with circuit to adjust its contrast by using 16 PIN Connector. RS232 Communication Circuit by using 2 Channel. SD/MMC card connector circuit by using SSP. EEPROM interface using I2C. It has PS2 keyboard interface and general purpose I/O pins.

B. IR Sensor
Infrared Sensor is an electronic device, that detects the infrared radiations to sense the aspects of its surroundings. It detects motions that measures the IR light from objects in the field of view, It’s invisible to human eye because body temperature radiates to infrared wavelength. It’s made by pyro electric materials (which generates exposed to heat), IR light is longer than visible light wave length but smaller than microwaves. Distance measuring Range is 5- 300cm (Needed), Temperature is -10 to 60 Celsius, Power Supply is 5to5.5 V, power Consumption current is 33mA. The IR sensor receiver is a three terminal device used to decrease the size of circuit, which consists of three terminals, VCC, ground and output signal. When any obstacle detected, the sensor receives the signal and sends it to controller. The controller senses the particular light on or off.

C. Vibration Sensor
It is consisted of piezoelectric element, spring oscillator, Sensitivity adjustment knob, and led. We can regulate the knob to adjust the sensitivity. For example when adjusting the knob clockwise, the sensitivity increases, oppositely it reduces and outputs alarm signal, led will light while testing the certain scope shock. The location algorithm has a good performance of precision, stability and robustness.

D. ZIGBEE
ZigBee wireless communication network has been implemented with the utilization of radio frequency modules. They operate within the ISM band at the frequency of 2.4 GHz. The receiver sensitivity is high and therefore the chance of receiving bad packets is low (about 1%). The modules ought to be provided by 3V DC supply, and then the power consumption is within the order of 50 mA.

IV. IMPLEMENTATION
The monitoring system of airport boarding bridge consists of sensor signal acquisition subsystem, data transmission subsystem, data analysis and management subsystem. Data acquisition and transmission subsystem, composed of wireless sensor networks nodes are the terminal equipment of the bridge monitoring system, and their main function is to collect, transmit and store all kinds of sensor signals. The airport boarding bridge mainly monitors the load of columns and the pressure of hydraulic racks. Sensor module mainly contains sensor element and digital output circuit. It monitors information acquisition and data conversion in the area. Processor module, which contains the micro processor and the memory, is the core of module design. It controls the operation of sensor nodes, at the same time, stores and processes data collected from it and other nodes. Wireless communication module includes the transceiver, the antenna and the communication interface RS-484. This module is used for wireless communication with other sensor nodes, exchanging control information and data. Power module usually provides the necessary energy for sensor nodes by micro batteries. When sensor nodes receive the data transmission commands from the coordinator, they begin to enter the working mode, collect data, and pass the data to the coordinator. After the completion of the transfer, sensor nodes come into the next round of data collection. When there is no data transmission, sensor nodes go into sleep mode, waiting for being awakened by the terminal. The system design is used to operate an on-site monitoring of a boarding bridge at the airport. First of all, the center coordinator is connected to the PC of control center via RS-485 serial port. Then the power supply of center coordinator node and terminal sensor nodes are turned on. After power-on initialization, the center network coordinator begins to establish a ZigBee wireless network and all terminal sensor nodes join it. The network communication is displayed by the monitoring software of control center. When the network communication is normal, terminal sensor nodes start to collect and parse signals. At last, the control center receives monitoring information from each terminal sensor nodes through the ZigBee wireless network.

V. RESULTS
Results of this paper is as shown in bellow Figs.2 and 3.
VI. CONCLUSION

Bridge health condition monitoring in real time has been a popular issue. The sensor technology is continuously advancing and condition monitoring has never been accurate and easier before. With the help of the wireless technology, many problems due to data cables and expensive optical cable are now minimized and eliminated. Sensor and ZigBee module combined becomes u-node (ubiquitous node). ZigBee is proved to be an excellent solution in short distance wireless data communication.

VII. REFERENCES


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