아두이노 시스템 기반 궤도상태 평가를 위한 원거리 무선 데이터 송수신 시스템 파일롯 모델

Long Range Wireless Data Acquisition System for Rail Track Health Monitoring System using Arduino

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Abstract This paper describes a new pilot development of ARDUINO based health monitoring system to make a Long Range Wireless Data Acquisition System (LRW-DAQ). This device is used for monitoring the wheel load and the vibration of the slab when the rail car passed. Because the existing DAQ systems are usually expensive and complicated for setup and maintenance, they are not suitable to build an IoT system to monitor the railway slab track system. For this purpose, the prototype, which is made from Teensy-a USB-based microcontroller development system, is made to capture the data. Then the data will be stored in SD card. After that, it will be transferred to the coordinator via ZigBee/IEEE 802.15.4 protocol. This system has been tested by comparing with another commercial DAQ system.

Keywords : Railway slab track, Health monitoring, Arduino, DAQ

1. Introduction

Nowadays, because of the higher requirement of safety standard, more and better systems are invented to monitor and control system. Real-time monitoring system is the next generation of safety control system. However, the biggest drawback of this system is a large amounts of DAQ devices and recording equipment are required to collect the data. Those devices are expensive and difficult to setup and maintenance. A new alternative system based on Arduino is introduced for this purpose in this study. The new system will be used to collect the wheel load of the rail car and the vibration of the slab track for further researches.

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For checking the reliability of the alternative system, collected data will be used for comparison to another commercial DAQ system.

2. Hardware setup

2.1 Components

2.1.1 Microcontroller Teensy 3.6

The Teensy is a breadboard-friendly development board with loads of features. It is fully compatible with Arduino IDE. It has 32-bit, 180MHz processor and a few other features such as multiple channels of Direct Memory Access, several high-resolution ADCs 13bits, that is comparable with 12bits of Arduino Due. It has even an I2S digital audio interface, more memory (1M from 256K), more RAM, EEPROM and accessible pins.

2.1.2 Amplifier and Anti-aliasing

The Wheatstone circuit is used to collect the wheel load data. Due to small bending of the rail when it is loaded, the output voltage is also very small for the ADC to capture. Therefore, the INA125 chip is connected directly to the circuit output. This chip's gain factor is from 4 to 10000.

The MAX7404 filter permits a corner frequency between 1 Hz and 10 kHz, which is suitable for anti-aliasing filter.

2.1.3 Zigbee-Xbee

ZigBee-XBee ZB modules provide cost-effective wireless connectivity to devices in ZigBee mesh networks. Its power consumption is also low enough to be used in Arduino system. It can transfer data up to 1mile with 250kbs speed.

3. Result

For checking the reliability of alternative DAQ system, an experiment test is performed. One viabrator is attached intentionally with a geophone. The waveform generator system is used to create typical vibration forms. Then then the signal lines will transfer obtained measured data to Ni DAQ and the developed alternative DAQ at the same time (Fig.1). All data are obtained at the same time in both DAQ systems.

Fig. 1 System for checking collected data: waveform generator, linear power amplifier, vibrator, geophone, Ni DAQ, alternative DAQ and notebook

All the data collected by the developed alternative DAQ are stored in SD. Then these data will be transfered to the remote Arduino via Zigbee-Xbee protocol.

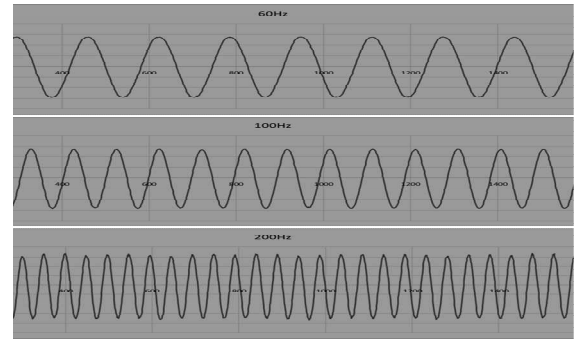

Fig. 2 Output data with different frequency setup 60Hz,100Hz, 200Hz

4.Conclusion

In this research, the alternative DAQ could be used to replace other commercial DAQ system for reducing cost and to simplify the setup and manternance process. This is the firs step to make a mesh in order to build a monitor system to control the railway track in future.

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