

# Design on Multi-Surveillance System for turn-out stations of the railway

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## Abstract

For train service, safety and reliability is an inevitable performance. Specially, turn-out system of the railway for safety because of actual part. Hence the management is strictly executed over turn-out systems of the railway. Also number of turn-out system need to monitoring systems.

In this paper, the data multi-acquisition system for monitoring it is necessary to reduce the cost from the expensive characteristics of multi-monitoring system according to the importance of each data because this system is based on communication of one to several units. We designed the data multi-acquisition system using numbers of micro-controller and the experiment was executed to the actual turn-out system.

## 1. Introduction

The rapid progress of industrial development demands on development of traffic system. Among the rest, the railway has advantage of transport capacity, and the general public, and speed and so on. Hence development of the railway has influence on industrial development. But accidents of railway remand to cause lose of lives and large property. Therefore, we thinks about safety and confidence of the railway. Especially, Short intervals between trains, high train frequency and the extensive synchronization of time-tables are making it increasingly difficult for railway administrations to carry out maintenance work.

Nowadays The Line Switching Point and The Level crossing use the surveillance systems for watching the railway. Most of the surveillance systems using in railway are operating the sensor for data acquisition. And Most of those systems use a serial communication. Serial communications have been using in the generality of cases rather than wireless.

We can treat those systems under the power line for supply power and communication line, especially data acquisition system with sensor. But in this case several problems can occur frequently. First, those systems have two lines.

One is power line and the other is communication line. If communication line doesn't work right, the surveillance system will not be working. Although the power line has no problems, the surveillance system doesn't work.

Second, it cost a lot of money at initial investment to construct the network. If distant is far away from main watch house to surveillance system, it costs a great deal.

And these systems need other system for collecting data from other place.

In this paper we proposed a surveillance system with power line communication in railway environments.

Figure1 represent a block diagram of proposed system. The power lines connected the surveillance system to middle watch house. And power lines substitute For Communication line in this system. So we can solve the problem caused by communication line. The obvious advantage of the power line communication (PLC) concept is the ubiquity of the electricity network, which is available in every where, in almost every house in the developed world - denser than today's existing telephony infrastructure. We can easily construct communication networks that consist of power line.

## 2. The whole structure

Multi-acquisition system for turn-out system in line switching station consists of three parts, which are the part of surveillance, the part of Power Line Communication(PLC) modem, the part of PC monitoring. Each part has the characteristics of its own.

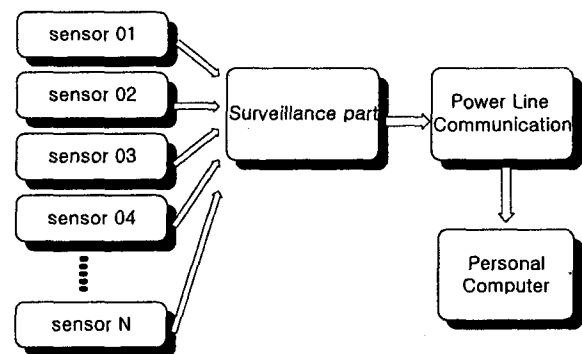


Fig. 1 The whole structure of multi-acquisition system

Fig. 1 shows the whole structure of multi-acquisition system. For the part of surveillance, the data of turn-out condition is acquired from sensors and transmitted to the part of communication control. For the part of Power Line Communication, the data acquired from the part of surveillance and transmitted to the part of PC monitoring. For the part of PC monitoring, the data acquired from the turn-out and additional functions by processing then is

supported to the users. This constitution of system has need of one PC for using multi-monitoring system. This three part connected to using serial communication and serial communication method has advantage of distance.

### 3. Design on the part of Surveillance

#### 3.1 Structure

The important function of surveillance part acquired the data of turn-out condition and the data is converted analog into digital.

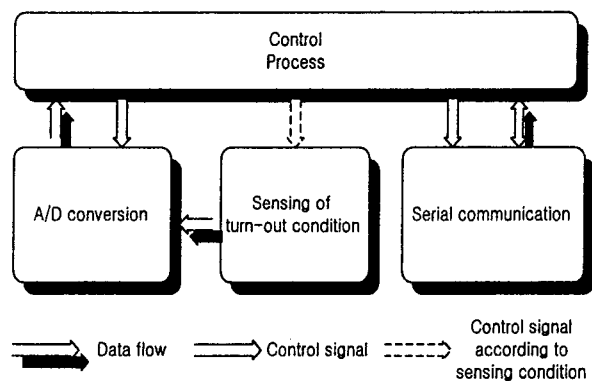


Fig. 2 Block diagram of surveillance part

Fig.2 shows block diagram of surveillance part. The units of this part consists of four units, which are the processing control unit, the unit of A/D conversion, the unit of sensing device, the unit of serial communication. The units have each different function. The unit of sensing of turn-out condition acquired analog signals at the state of turn-out system. The unit of A/D conversion change analog signals into digital data of 16bit (resolution capacity = 65536). Digital data of 16bit will make acquired observations of turn-out conditions. Also this unit used analog MUX to selecting sensors. The unit of serial communication transmitted useful data to communication control part. And control-process unit controls other unit. Also this unit processed the acquisitive data to make by useful information.

#### 3.2 Program Sequence

The program sequence of surveillance part is an acquisitive sequence of the data for several sensors at turn-out system.

Fig. 3 shows flowchart of surveillance part. Starting moment of surveillance fall under control of communication control part. The part of surveillance collected the states of turn-out system. Hence the part of surveillance demands on the number of sensor. The control-process fixed the sensing sequence using analog MUX. This sensing value converted analog into digital

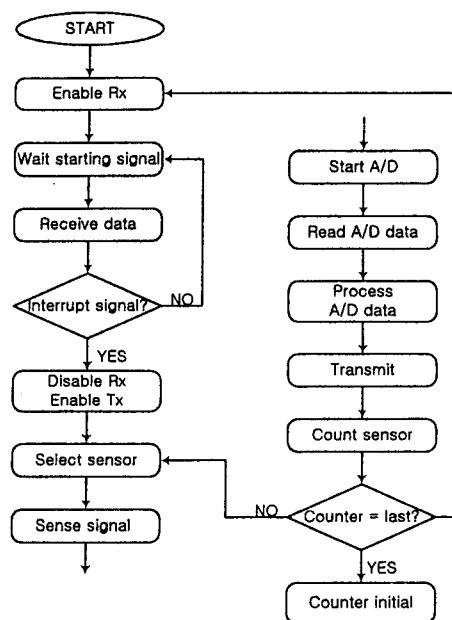


Fig. 3 Flowchart of surveillance part

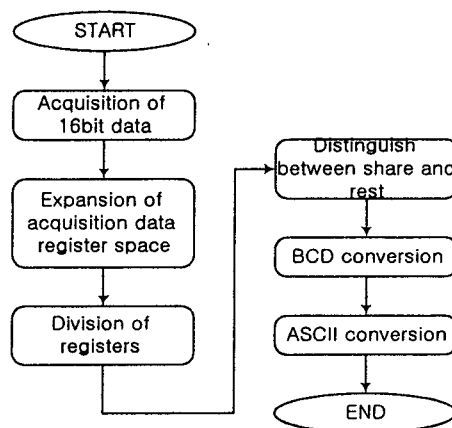


Fig. 4 Flowchart of ASCII code conversion

Fig. 4 shows ASCII code conversion of the acquisitive data. This conversion sequence needs the data to transmit at serial communication. And converted data of ASC II is transmitted to the part of control communication. But distinction of data will be essential because of several sensor..

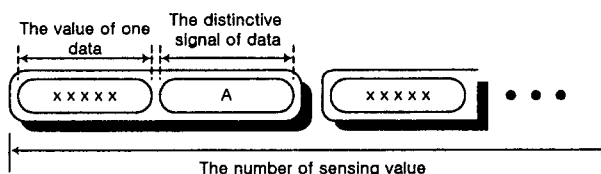


Fig. 5 The distinctive method of multi-sensing data

Fig. 5 shows the distinctive method of multi-sensing data. This method distinguished all kinds of sensing data-number at the surveillance part.

### 3.3 Sensing method

The acquisitive part of turn-out system is several kinds as well as numbers. Also kinds of the acquisitive sensing part are very different. Hence sensing method would be very different.

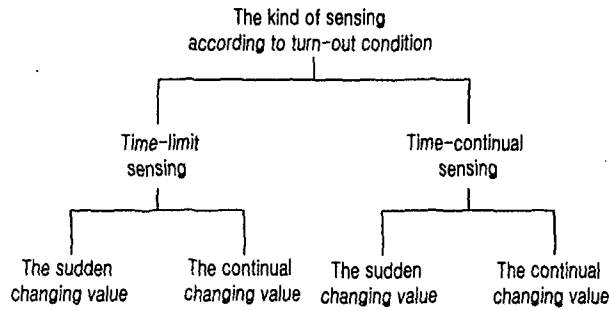


Fig. 6 The kind of sensing according to turn-out condition

Fig. 6 shows the kind of sensing in turn-out system. The method of sensing has restricted of time. Also the sudden changing data is very difficult to acquire. Hence it is distinguished acquisitive method between other's sensor. This sudden changing sensing point needs additional controller for acquisitive data. The parallel application of controller reduces a burden of main-controller in surveillance part and acquired accurate data.

## 4. Design on the part of Power Line Communication

### 4.1 Structures

Fig. 7 represents the circuit of the Power Line Communication part. It is consist of Transceiver chip, MIC(Medium Interface Card) system and Line coupler.

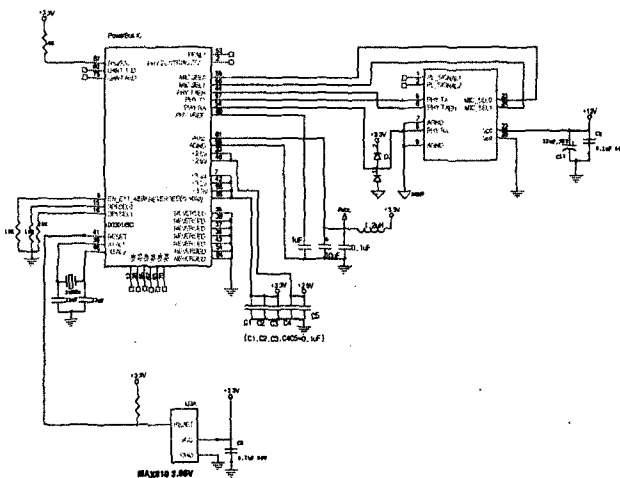


fig. 7. Power Line Communication circuit

Transceiver chip is developed by Domsosy Corporation. We had used a U510 series ICs. It has physical layers for communication over AC power line

and It has advanced digital signal processing adapted to power line environments. The U-510 ICs also implement the entire services required Local network, subnet network manager and a Network structure. So we can easily construct the network for the Multi-Surveillance system.

Fig. 8 represents MIC(Medium Interface Card) system of the Power Line Communication part. It is consist of filter, amp, and circuit protection.

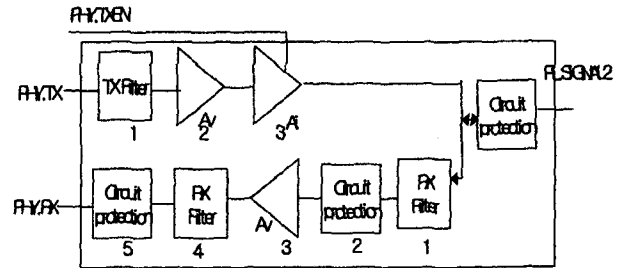


Fig. 8 MIC(Medium Interface Card) system

Fig. 9 shows a line coupler part that is directly coupled to power line. It operates both high pass filter and band pass filter.

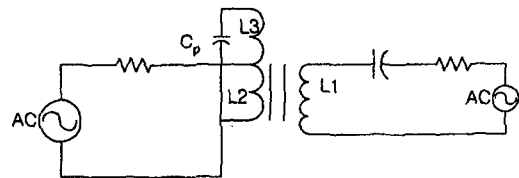


Fig. 9 Line coupler part

## 5. Programming of PC monitoring part

The part of PC monitoring was judged user in the state of turn-out system. Hence the part of PC monitoring has immediate connection with management system.

This part received acquisitive data from the part of communication control and calculated the acquisitive data for judgment of information. Also it judged to safety of turn-out system according to calculative data.

The demanded characteristic of this part was observed the state of turn-out system, and stored the acquisitive data for management of turn-out condition. Also user is discoverable to the occurrence of an accident at turn-out system immediately. Because the warning of turn-out system must be confirmed the sense of sight and the sense of hearing.

The acquisitive data is saved to hard-driver of PC. But the store data limited because of the many acquisitive data-capacity and the capacity of hard-driver. Hence the store data must be saved to selected-data at hard-driver. Also user must judge the state of turn-system by the saved-data. Because the select-saved method must satisfy two condition. We compared the saved-data to the saving-data and the saving-data saved only the changed data at hard-driver. This saved method of data is better efficient.

## 6. Experimental results and Simulation

### 6.1 The number of data acquisition through analog multiplexer

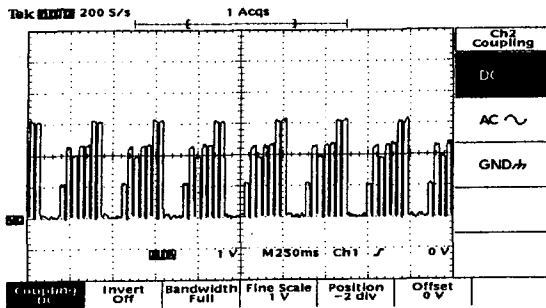


Fig. 10 Analog mux output signal

Fig. 10 shows analog mux output signal. We can confirm the number of output. Each of signals represents a value of the sensor. These signals go to A/D converter.

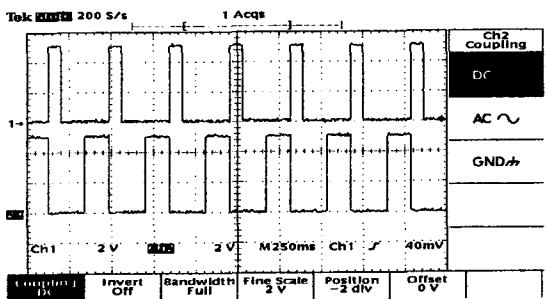


Fig. 11 A/D converter decoding signal

Fig. 11 shows A/D converter decoding signals that are controlled by 80c196kc. These signals represent the start of the A/D converting and the end of the A/D converting.

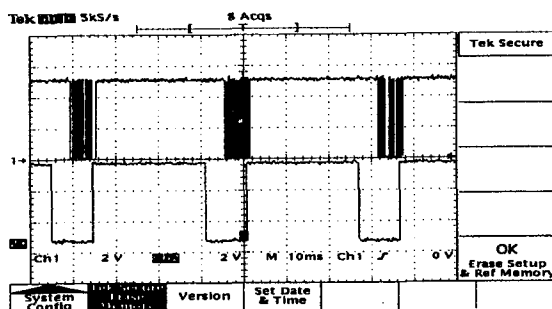


Fig. 12 Data from 80c196kc, A/D start and Mux Enable signals

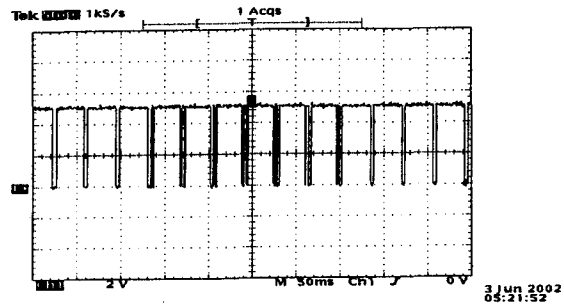


Fig. 13 Data Flow from surveillance system to PC

Fig. 12 and Fig. 13 show flow of data to PC from surveillance system and analog mux Enable signal. We can confirm flow of data from surveillance system after mux enable signal went to low.

## 7. Conclusion

The line switching stations need the monitoring system for safety and confidence. But the present, the data acquisition system for turn-out system is not enough. We designed the data multi-acquisition system for monitoring at turn-out system. This system acquired the data of turn-out system, calculated the acquisitive data, and transmitted calculated-data to PC. Also calculated-data is saved to the hard-driver of PC and the monitoring part judged the state of turn-out system. This data-based system is knew the point of repair-time and prevented from break-down of turn-out system. Hence this system will raise a safety at turn-out system of the railway.

### Acknowledgement

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