

APPLICATION OF ELECTRONIC GAUGES FOR AUTOMATIC DEVICES DIAGNOSTICS

ELEKTRONISKO DEVĒJU IZMANTOŠANA AUTOMĀTIKAS IERĪČU DIAGNOSTIKAI

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Annotation

The article is introduced approach to design state control sensing devices for automatic and remote objects on railway. The simply way for data acquisition to full and safe monitoring and diagnostic in existing railway automatic system is sensing devices application. The article is evaluated an approach for servicing concept.

The basics aspects are validated in article for relay automatic elements state sensing. The construction and the internal structure are considered for universal electronic sensing device in application for relay automatic elements. The application for sensing device to elements group monitoring is consider.

Introduction

The modern technology in the railway automatic complex servicing is not exist without monitoring and diagnostic for technical state of elements, to the goal automatic devices fault, failure and detect before failure state (fig.1). The appropriate control level of the monitoring and the diagnostic is not possible without integration special devices for data acquisition. The data acquisition is necessary to resolve system state integrally.

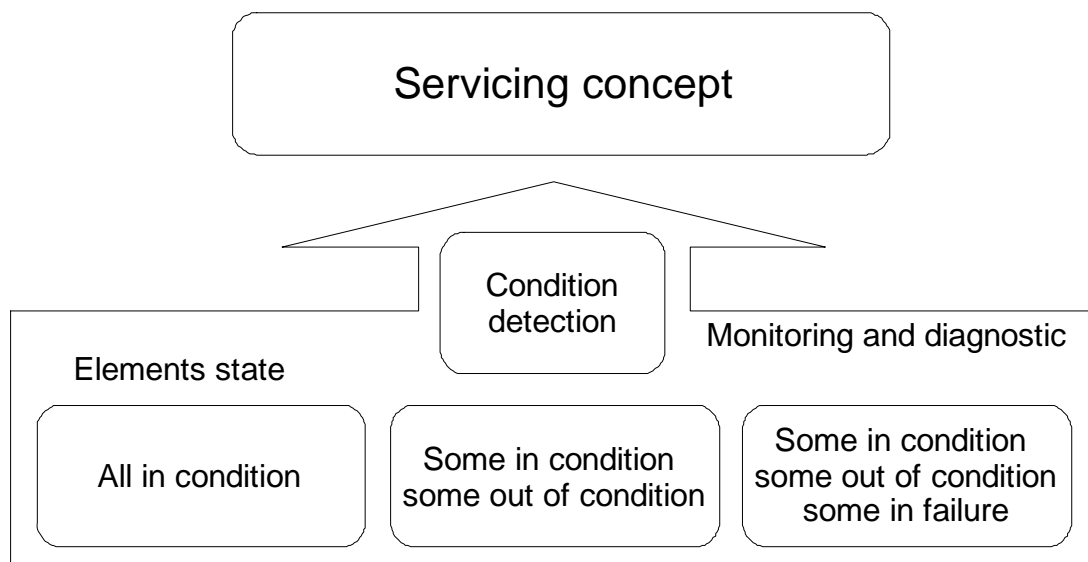


Fig.1. The basis of the servicing concept

Data acquisition most accepted means

The primary requirement to add-on devices for monitoring and diagnostic is minimum for upon influence in tested system. This requirement mishandling reduce safety degradation, this is inadmissible. The influence is depended from this add-on type and integration methods in controlled system.

The monitoring and the diagnostic use for the application in automatic microprocessor system, enable devices servicing conception by real state.

The situation is different in relay automatic system, is in use servicing conception by schedule time. The servicing conception by schedule time is not guaranteed devices failure. This conception is not optimal for materials and time cost.

Below, is discussed some ways to determine the status of relay equipment.

The most accepted way is with controlled relay unused contact. This mean is with minimum upon influence for tested device safety, but is used for relay only and is unused for the other elements. The information from relay is on or off is it. The most accepted means is with subsidiary relay. The relay state, on or off, is detected from subsidiary relay state, and this mean allow system safety degradation, materials and time cost up.

The system safety degradation is bound with failure probability growing.

Example, the probability for failure in relays group-controlled relay with an subsidiary:

$$P \text{ failure} = 1 - P \text{ safety} = 1 - (P \text{ safety el.} * P \text{ safety sub.el.}) \quad (1)$$

where

P failure - probability to elements group failure

P safety – probability to elements group safety

P safety el. – probability to element safety

P safety sub. el. – probability to subsidiary element safety

The mean with optic coupler is one low cost and easy way, but this mean is way with inadequate information. The mean is guaranteed system element safety, is compact, is low cost, but is no relationship with relay state, is controlled only the voltage existing in relay power pins, the voltage level not controlled.

This means are very simply in realization. The information quality about system elements and processing state is very low. This information level and content is not solved for base diagnostic goal.

The approach for necessary information quality level

The fasted approach for data acquisition about system state in wide sense is discussed below. What is known about electrotechnical objects? The electrotechnical object have electrical parameters and this measurement in real processed system is the guarantee for necessary data acquisition quality.

The approach is possible used for all railway automatic elements or elements group: relays, resistors, capacitors, connectors, fuses, contacts, accumulators, semaphore signaling lamps, semaphore with LED signaling, engine. We name this approach as universal and sensing device for this approach – universal sensing device. The approach use examples showed for the fuse and the connector (fig.2) and for the engine (fig.3).

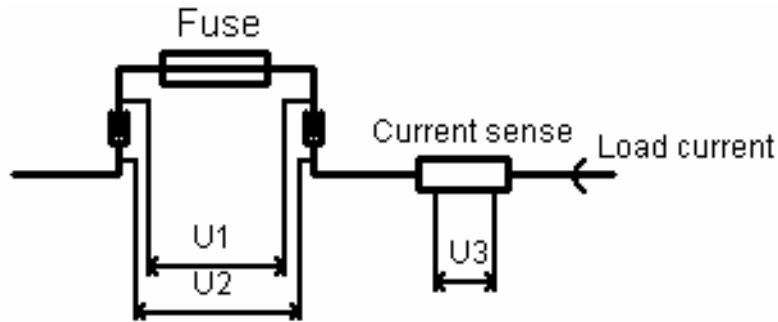


Fig.2. Universal approach example 1

If the load current in the examined circuit is normal and $U2 - U1 \leq \Delta$ - fuse and connector are normal.

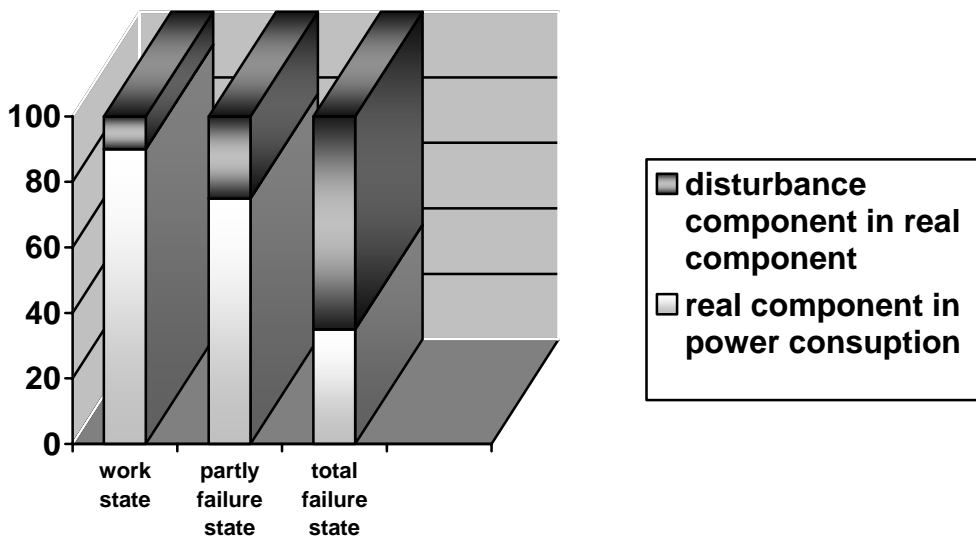


Fig.3. Universal approach example 2

The solving about examined engine is accepted from the relationship between real and disturbance components in the power consumption.

This way in data acquisition is with minimum influence upon safety, is compact in realization, have minimum add-on devices, is not low cost, but optimal cost.

The realization for approach, as add-on devices, is used two independents channels for voltage and current measurement (fig.4), switchboard, microprocessor unit, power supply, data transmission channel. The signals from voltage and current channels are analyzed in RMS for constant and nonconstant component.

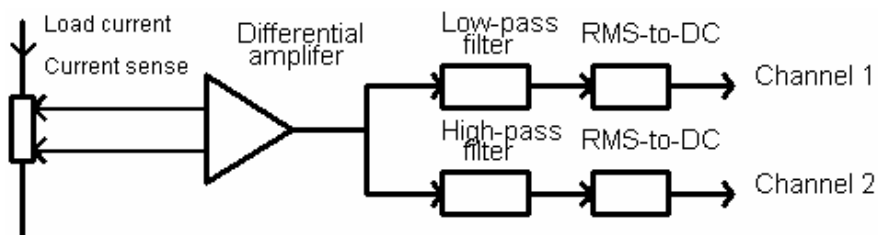


Fig. 4. The add-on device independents channels

Use of sensing information

The proportion between components and components level is a term for normal system element functionality. The database (a priori known information) is saved in MCU, it is information about electrical circuit with controlled element in normal functioning mode. The information is compared with sensing data (rule). The transmitted information about system state is information about miscoordination in system (stage).

MCU functioning

The function of MCU, in universal sensing device, is data acquisition and miscoordination detection. For fast processing in the MCU is used time measurement multiplexing (fig.5). The optimization for communication time is transmitting information about miscoordination from normal state to failure, but not measurement results, for this is necessary controlled elements allocation by importance in system and acceptable miscoordination level.

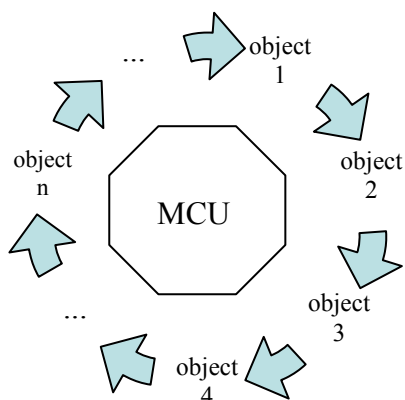


Fig.5. Measuring time multiplexing

Summary

The universal approach make possible monitoring and diagnostic for existing relay system with minimum add-on devices. The universal sensing device is necessary for full data acquisition in monitoring and diagnostic system.

The positive effect from this sensing device use is servicing conception evolution (to servicing by real state).

This data acquisition approach is first step for the fuzzy logic using in automatic devices monitoring and diagnostic.

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Karevs V., Mezitis M. Elektronisko devēju izmantošana automātikas ierīču diagnostikai

Publikācijā tika apskatīta iespēja ar elektrisko parametru kontroles devēju organizēt dzelzceļa automātikas sistēmas un iekārtu monitoringu. Piedāvāta releju un mikroprocesoru sistēmu diagnostikas pieejas un koncepcijas salīdzināšana. Releju sistēmas piemērā parādīta monitoringa vai diagnostikas papildu iekārtu ietekme uz sākotnējās sistēmas drošumu. Tika izanalizēti devēju dažādi pieslēgšanas veidi automātikas sistēmas shēmās. Parādīta mērījumu atkarība no pieslēgšanas veida un tās ietekme uz sākotnējo shēmu. Rakstā arī parādīts, ka informācijas apstrāde arī ietekmē mērījumu rezultātus.

Piedāvāts izmantot monitoringam un diagnostikai universālo devēju, kas ļaus realizēt ne tikai esošo dzelzceļa releju automātikas un telemātikas sistēmas diagnostiku, bet arī mikroprocesoru sistēmas diagnostiku, pie tam ar mazāku aparātūras skaitu. Tas ļaus organizēt lokālo eksperta tīklu un izmantojot neskaidrās loģikas algoritmu prognozēt iekārtu tehnisko stāvokli.

Karevs V., Mezitis M. Application of electronic gauges for automatic devices diagnostics

In article possibility of the organisation of monitoring and the control systems of railway automatics with gauges application of the control of electric parameters is considered. Comparison of concepts and approaches to diagnostics and to monitoring in relay and microprocessor systems is spent. On an example of relay system influence of additional devices of monitoring or diagnostics on reliability of work of initial system is shown. Various schemes of connection of gauges in automatics systems are analyzed. Dependence of measurements on the scheme of connection and influence on work of initial system is shown. In article, it is shown that the choice of a method of processing of the information also influences results of measurements. In work it is offered to use for monitoring and diagnostics the universal gauge which will allow to realise diagnostics not only existing relay, but also microprocessor systems of automatics and telematics with a minimum quantity of additional equipment. It will allow having organised a local expert network and using algorithms of indistinct logic to predict a condition of devices.

Карев В., Мезитис М. Использование электронного датчика в диагностике устройств автоматики

В статье рассматривается возможность организации мониторинга и контроля устройств систем железнодорожной автоматики с применением датчиков контроля электрических параметров.

Проведено сравнение концепций и подходов к диагностике и мониторингу в релейных и микропроцессорных системах. На примере релейной системы показано влияние дополнительных устройств мониторинга или диагностики на надежность работы исходной системы. Анализируются различные схемы подключения датчиков в системах автоматики. Показана зависимость измерений от схемы подключения и влияния на работу исходной системы. В статье показано, что выбор метода обработки информации также влияет на результаты измерений.

В работе предлагается использовать для мониторинга и диагностики универсальный датчик, который позволит реализовать диагностику не только существующих релейных, но и микропроцессорных системах автоматики и телематики с минимальным количеством дополнительной аппаратуры. Это позволит организовав локальную экспертную сеть и пользуясь алгоритмами нечеткой логики прогнозировать состояние устройств.