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System control and metering devices of railway automatics and telemechanics using the technology of QR coding

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ABSTRACTThe article deals with the technology of control and accounting of automation and remote control devices with the use of QR-coding system for automatic identification of railway automation and telemechanics devices in order to collect data on installed devices, check the correctness of replacement of devices, data entry on the implementation of repair and acceptance, automated data entry on new devices received in the distances of signaling and communication. The module of generation of QR-codes for railway automation and telemechanics devices is presented.

KEYWORDS: railway automation and telemechanics, electronic document flow of technical documentation, QR-coding technology, automatic identification of railway automation and telemechanics devices.

1. INTRODUCTION

Along with one of the most important tasks of Uzbekistan Temir Yollari under the transition program to “Electronic Government” is the introduction of electronic document management in the areas of enterprises. Transport processes, including the management and control of systems and devices of railway automation and remote control from the point of view of the analysis of the functioning of automated technological complexes are analyzed using formal methods.

The introduction of electronic document management is one of the most important tasks of railway transport and the transition program to the “Electronic Government”. Uzbekistan Temir Yollari JSC currently stores huge volumes of technical documentation, which are created, processed and analyzed “manually”. At the same time, the same stages of primary data input are performed repeatedly by different services and organizations, increasing the cost of unproductive labor and the number of “operator errors”.

Electronic document management systems are a powerful tool for increasing labor productivity and the quality of work performed when creating and designing new equipment. They play an important role in the development and implementation of railway automation and telemechanics systems (RAT), both existing and new generations [1].

Transport processes, especially from the point of view of analyzing the functioning of automated technological complexes, including the management and control of systems and devices for railway automation and remote control, are naturally formalized using queuing schemes. So, for example, the continuous process of a train moving to RAT is represented as a sequence of discrete events - occupation and release of track circuits [2,3].

II. PROBLEM ANALYSIS

Application of various types of automated workstations, automated control systems, as well as elements of increased reliability in devices of railway automation and telemechanics is a prerequisite for switching to the repair and maintenance technology of maintenance, during which the work is done: routine, as-is and devices are operated to failure. The use of repair and restoration technology for certain types of signaling, centralization and blocking (SCB) equipment will allow: to increase the efficiency of transportation management based on the high reliability of the serviced devices; to ensure the implementation of additional organizational and technical measures to improve train

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traffic safety by reducing the specific labor intensity of maintenance and increasing labor productivity. Further automation of the control of device parameters using digital and analog signals will enable a switch to the restoration technology of servicing virtually all elements of the signaling equipment. At the same time, an important place will be given to the reservation and use of highly reliable elements with extended service life equal to or close to the service life of the electrical centralization systems, automatic locking, centralized control room, etc.

Currently, a part of technical means has developed a service life (25% in signaling and interlocking devices). In order to prevent further aging of devices, signaling and communication management will have to significantly increase the pace of modernization of technical facilities in the coming years. At the same time, newly developed and developed systems of electrical interlocking, automatic blocking, and dispatching interlocking on a microprocessor basis should be introduced. At the same time, it is necessary to switch to new modern service technologies. The task is to automate as much as possible the servicing of signaling system devices due to technical progress, minimize the likelihood of a negative impact of the human factor on the process of ensuring trouble-free operation of technical equipment and, as a result, on the state of traffic safety of trains. Considering the fact that at present it is impossible to fully equip the production with highly qualified and responsible performers, the task is to ensure the centralization of control over the state of technical means and the correctness of actions of the performers.

Special role in improving the efficiency of the industry and ensuring the safety of train traffic belongs to the specialists of the signaling and communication economy. The creative interaction of the workers of this complex production and technological complex will contribute to the successful solution of problems.

In work [4] for the solution of storing huge amounts of technical documentation created, processed and analyzed "manually" the "Automated system of accounting and control of railway automation and remote control devices" (ASU-KJAT) was proposed.

The process of electronic document management of technical documentation (EDTD) is formally presented in [5–8], the logical level of the formal model EDTD is implemented using the graph theory theory [9–14], the automaton model is used to describe the EDTD system and became the basis of the developed software RAT [15].

III. QR CODING TECHNOLOGY

To organize accounting of railway automation and remote control devices, tracking their movement and operational identification, it is proposed to use a QR-coding system, which is a development of a bar-coding system.The main advantage of using QR-coding technology is the automatic identification of signaling devices necessary for the complex tasks of the management level of the automated system in terms of collecting data on installed devices, checking the correctness of replacing devices, entering data on repair and acceptance, automated data entry on new devices received in repair technology plots.

The data obtained by reading the QR-code can be used when performing other work related to signaling and interlocking systems - eliminating failures, searching for devices at electrical interlocking stations, instrument storage depots.The use of QR codes aims to improve the quality and efficiency of work on the replacement and repair of signaling systems, optimize and monitor the performance of work on technological maintenance of devices, simplify technology and increase the speed of collecting data on installed devices and devices, increasing the speed of detecting and eliminating equipment failures RAT.

QR code belongs to the category of two-dimensional (matrix) bar codes. QR abbreviation stands for a quick response from English. "Fast response". The code was developed in 1994 by Denso Wave division of Denso Corporation. Denso corp. does not limit the use of this technology, and the technology itself is published as ISO standards [16].

A QR code differs from a bar code in that it is defined by a sensor as a two-dimensional image. Three large squares in the corners of the image and smaller synchronization squares throughout the code allow us to normalize the size of the image and its orientation, as well as the angle at which the sensor is located to the image surface. Points are converted to binary numbers with checksum checks.

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The QR code includes data and service information (error tracking, coding method, code version, etc.). The resulting bit sequence is divided into blocks, to which a correction block is added.

There are several ways to encode information into a QR code. The choice of method depends on which symbols are used: digits - a maximum of 7089 symbols is encoded using digital coding; numbers and letters (Latin) - 4296 characters, coding is performed using alphanumeric coding; binary code - 2953 bytes (therefore, about 2953 Cyrillic letters in windows-1251 encoding or about 1450 Cyrillic letters in utf-8), is encoded using the byte-coding method; hieroglyphs - 1817 bytes, coding way Kanji.

The result will be a bit matrix that can be rendered as a black and white bitmap image [17].

IV. AUTOMATED SYSTEM

In the "Automated system of accounting and control of railway automation and remote control devices", a module for generating QR codes for signaling and interlocking systems was developed. The view of the module is presented in Fig.2.

With this module you can recognize the information hidden behind this abstract image.For this, a special form has been developed. Form view is shown in Fig.3.A QR code was generated for the PS-220 device located at cabinet 11 of Khamza station.

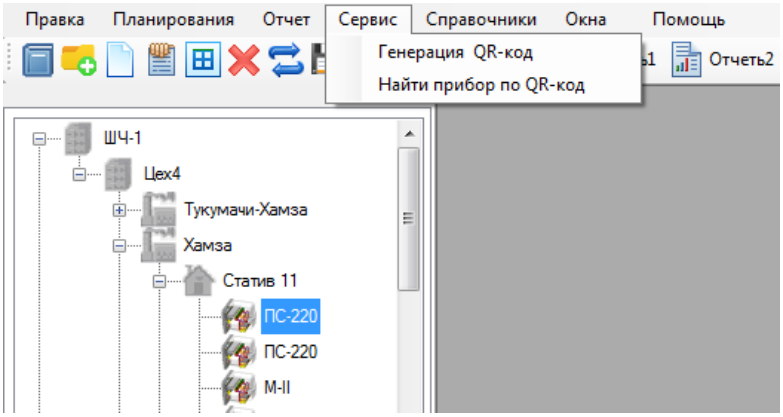

Fig.2. Module for generating QR codes

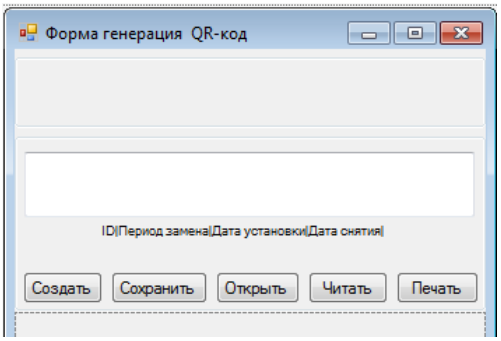

Fig.3. Form of generation of QR codes

Fig.4. The generated QR code of the device

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The generated QR code is saved for further use (Fig.5).

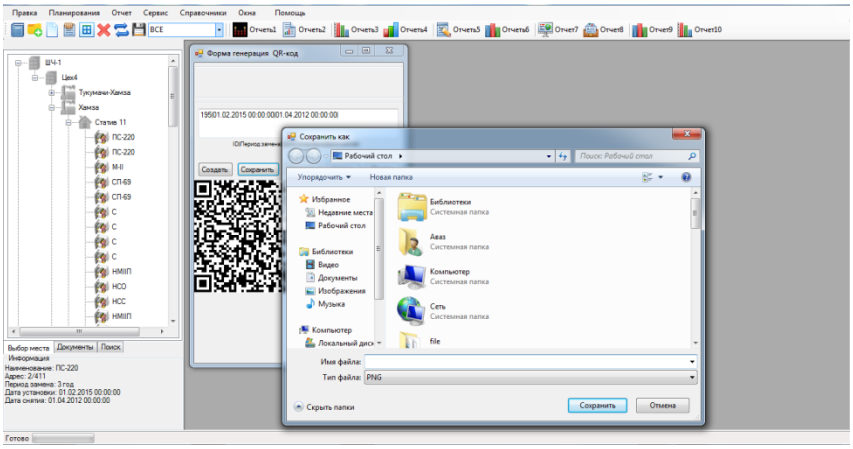

Fig.5. Saving a QR code

Also this module allows you to open a saved QR code (Fig. 6).

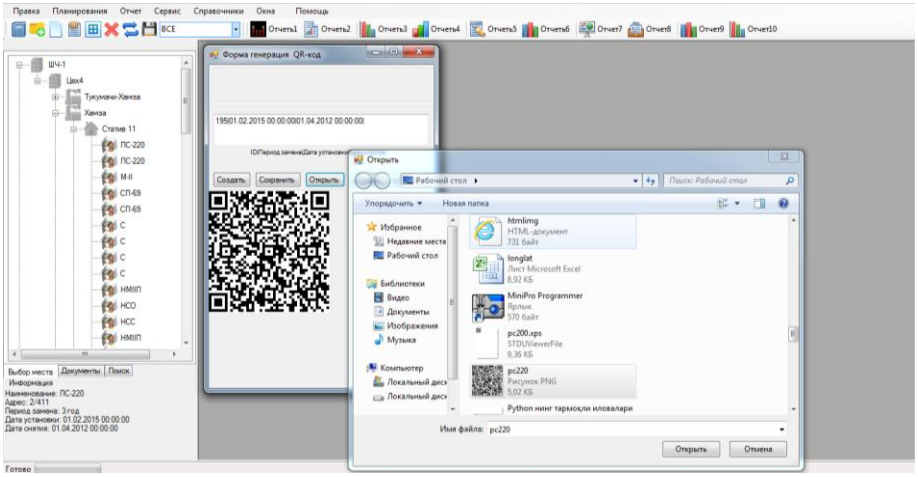

Fig.6. Opening the QR code of the device

This module also allows you to recognize and print the QR-code of the device (Fig. 7).

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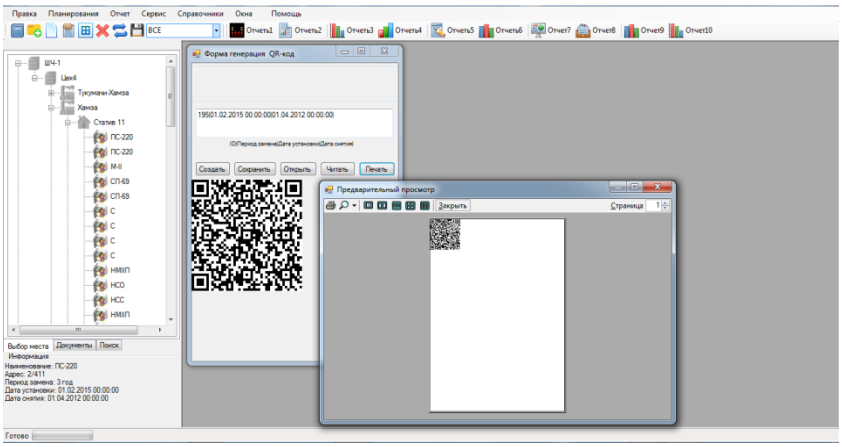

Fig.7. Print function of the QR code of the device

Electronic document management for the control and accounting of railway automation and remote control devices in the form of ASU-KJAT can significantly improve the efficiency of the operation of the automation and remote control economy, and enterprises associated with this document management.

It is advisable to use this technology to monitor and record automation and remote control devices using QR-coding for automatic identification of signaling devices to collect data on installed devices, verify the replacement of devices, enter data on repair and acceptance, automatically enter data on new devices received in the repair and technological areas.

Information obtained by reading a QR code can be used when performing other work related to signaling and interlocking devices — eliminating failures, searching for devices at electrical interlocking stations, instrument storage depots.

REFERENCES

[1]. Булавский П. Е., Баратов Д. Х., (2008). *Принципы организации и особенности электронного документооборота технической документации службы автоматики и телемеханики железной дороги. Автоматика и телемеханика железных дорог России. Техника, технология, сертификация* [BulavskyP.E.; BaratovD.Kh.б (2008). *Principles of organization and features of electronic document circulation of technical documentation of the service of automatics and telemechanics of the railway* // Automation and telemechanics of the railways of Russia. Technology, technology, certification], pp. 31-37.
[2]. Булавский П.Е., (2011). *Концептуальная модель электронного документооборота технической документации*. Транспорт Российской Федерации [Bulavsky, P.Y. *Conceptual model of electronic document management of technical documentation.* The Transport Of The Russian Federation]. №1(32),pp. 60-63.
[3]. Булавский П.Е., Марков Д.С., (2010). *Синтез формализованной схемы электронного документооборота систем железнодорожной автоматики и телемеханики*. Известия ПГУПС [Bulavsky, P.Y., Markov, D.S., (2010). *The synthesis of a formalized schema of electronic document management systems of railway automatics and telemechanics.*Proceedings of Petersburg transport University], № 4, pp. 63–74.
[4]. Арипов Н.М., Баратов Д.Х., (2015). *О документообороте в хозяйстве автоматики и телемеханики и внедрение безбумажной технологию ведения технической документации*. Вестник ТашИИТ [Aripov, N.M., Baratov, D.X., (2015). *About document management in the Department of automation and telemechanics and implementation of a paperless management of technical documentation.*Bulletin Of The Tashkent Railway Transport Engineering Institute],№2, pp.77-81.
[5]. Булавский П.Е., Марков Д.С., Соколов В.Б., Константинова Т.Ю., (2015). *Формализация алгоритмического описания систем обеспечения жизненного цикла железнодорожной автоматики и телемеханики.*Автоматика на транспорте [Bulavsky, P.Y., Markov, D.S., Sokolov, V.B., Konstantinova, T.Y. *Formalization of algorithmic description of railway automation and telemechanics life cycle support systems.* Automation on transport], №4, pp.418-432.
[6]. Булавский П.Е., Марков Д.С., (2012). *Электронный документооборот технической документации.* Автоматика, связь, информатика [Bulavsky, P.Y., Markov, D.S., (2012). Electronic document management of technical documentation. Automation, communication, Informatics], №2, pp.2-4.
[7]. Круковский М.Ю. Графовая модель композитного документооборота // Математичні машини і системи [Krukovsky, M. Yu. *Graphmodelofcomposite workflow. Mathematical machines and systems*]. – 2005. – № 3. – С. 149-163.
[8]. Aripov N.M., Baratov D.Kh., Tokhtamysova A.B.б (2016) *Formalization of electronic technical document management of railway automatics and telemechanics*. Bulletin Of the Kazakh Academy of transport and communications named after M. Tynyshpaev, № 3 (98), pp.175-180.
[9]. Diestel R. (2005). *Graph Theory*, Electronic Edition. — NY: Springer-Verlag, 422 p.
[10]. Baratov D., Aripov N., (2016). *Formalization of electronic technical document management of railway automatics and telemechanics.* European Applied Sciences, #8,pp.33-36.

ISSN: 2350-0328

International Journal of AdvancedResearch in Science, Engineering and Technology

Vol. 6, Issue 2, February 2019

[11]. Круковский М.Ю., (2005). *Графовая модель композитного документооборота*.Математичні машини і системи [Krukovsky, M.Y., (2005). *Graph model of composite workflow*. Mathematical machines and systems], № 3, pp. 149-163.
[12]. Carson J. S., (2002).*Model verification and validation*. Proceedings of the 2002 Winter Simulation Conference, San Diego, CA, USA, pp. 52–58.
[13]. Karim, K.,Faron, M.,Anton, S., (2009).*Automated Verification of Signalling Principles in Railway Interlocking Systems*. Electronic Notes in Theoretical Computer Science. #250. pp. 19–31.
[14]. Ibrahim, S., Ozgur, T. K., Ilker U., Galip, C., (2016). *Specication and formal verication of safety properties in a point automation system*. Turkish Journal of Electrical Engineering & Computer Sciences, #24,pp.1384-1396.
[15]. Арипов Н.М., Баратов Д.Х.? (2017). *Методика построения математической модели электронного документооборота техническойдокументации железнодорожной автоматики*.Автоматика на транспорте [Aripov, N.M., Baratov, D.X., (2017). *A method of constructing a mathematical model of the electronic document tehnicheskomprodlenii of railway automatics*. Automation in transport], Vol.3, № 1,pp. 98-111.
[16]. Иванова Н.А., Бекезина К.М., (2015). *Развитие и возможности технологий QR-кодирования в современном мире.* Современные научные исследования и инновации [Ivanova, N.A., Bekezina, K.M., (2015). *Development and capabilities of QR-coding technologies in the modern world.* Modern research and innovation. Availablefrom www.web.snauka.ru/issues/2015/11/59467, Accesed:30/05/2018], № 11.
[17]. Sumit Tiwari, (2016). *An Introduction To QR Code Technology*. 2016 International Conference on Information Technology. Availablefrom www.computer.org/csdl/proceedings/icoit/2016/3584/00/07966807.pdf, Accesed: 8/01/2019.
[18]. Николаенко Г.А., Евсикова Е.В., (2015). *Перспективы использования QR-кодировки в академической сфере*. Социологиянаукиитехнологий [Nikolaenko, G.A., Evsikova, Y.V. *Prospects of using QR-coding in the academic sphere*. Sociology of science and technology],Vol. 6, № 2,pp.109-118.