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MANAGEMENT OF ENTERPRISE ASSETS WITH THE USE OF THE iRIS SYSTEM

Key words

Mining industry, IT systems, RFID technology.

Abstract

The KOMAG Institute of Mining Technology, in collaboration with ELSTA Group, had worked on IT systems supporting the management of assets in the mining industry for many years. Experience gained from the implementation of developed solutions using RFID technology results in the necessity to extend these systems with the registration of component functionality as well as adapting the solutions to the current user's needs. The increase of interest in the present solutions forced KOMAG to undertake work on a complex, modular identification system – iRIS. The system enables the identification of the main subsystems of mining machines, underground and on the surface, capital assets, equipment of offices, as well as forms of transport, by marking them with RFID transponders or barcodes. The main assumptions of the iRIS system and possibilities of its use are presented.

Introduction

Studies on the implementation of the RFID (Radio Frequency Identification) technology in the mining industry were initiated at the KOMAG Institute of Mining Technology in 2004. A system for electronic identification

of powered roof support components has been developed as a result of collaboration between KOMAG, Silesian University of Technology, and the ELSTA Group. The system has been implemented, commercially or on a testing level, in nearly 30 hard coal mines in Poland as well as in companies manufacturing the powered roof supports. Valuable feedback information, including suggestions of functionality changes or improvements, has been obtained from the users during research work. The advantages of the implementation of an RFID-based system resulted in increased interest from manufacturers and users of the mining machines and equipment. Therefore, a project aimed at a development and commercial implementation of a complex hardware and software solution for identification of machines, equipment, fixed assets, and transportation means has been started.

1. Electronic system for the identification of powered roof support components

The longwall system, in which powered roof supports play the main role in protecting mining personnel, dominate in the Polish hard coal mining industry.

Safe operation of the powered roof support depends on proper technical maintenance realized according to the work schedule as well as on the periodical assessment of its technical conditions. The periodical assessment requires collection and processing of a lot of data, e.g. processing information about a date and scope of last repair, the intensity of the operation, as well as conditions in which the support had operated. These factors have a direct influence on the scope of servicing activities as well as on the range of technical assessment. To manage of such a huge amount of information, it is required to use a computer database [1], [2], [3], [4].

In the process of the allocation, the roof supports have to be frequently disassembled and reassembled. As a result, the replacement of components in each of the roof supports occurs. It creates a need for the identification of the main components of the powered roof support, according to the EN-1804 harmonized standard [3].

The marking methods used in the collieries for identification of powered roof supports in a form of data plates have been based on welding identification codes or paint marks (Fig. 1). It does not properly secure the marking in tough operational conditions that occur in the mines. This makes accurate technical assessment and inspections difficult [3], [6].

The first system for the electronic identification of powered roof support components has been implemented, commercially or on a test level, in nearly thirty hard coal mines in Poland as well as in companies manufacturing the powered roof supports [3, 4].



Fig. 1. Examples of marking methods used in the collieries [3, 4]

A consortium consisting of KOMAG Institute of Mining Technology, Silesian University of Technology, and the ELSTA Group have started to work on a successor system for the identification of powered roof support components, with the recording of time and conditions of their use, based on RFID (Radio Frequency Identification) technology [1, 2].



Fig. 2. Examples of installation of TRID-01 transponders on the support components [3, 4]

The basic components of a powered roof support were identified explicitly, with the use of RFID transponders, in the developed system. The introduction of

logic relations between the transponder identification number and a series of support attributes allowed automating logistic processes associated with repair or replacement of selected components. It enabled rational management of the capital assets [4].

The first KOMAG identification system consisted of the following [4]:

- Passive, electronic transponders TRID-01, which were permanently fixed on the roof support components (Fig. 2);
- RFID reader (TRMC-01 microcomputer (Fig. 3), TRH-01/* reading lance (Fig. 4) and a docking station (Fig. 5)); and,
- Gather software, which enabled the management of the database with information about the roof supports and their components.



Fig. 3. TRMC-01 microcomputer manufactured by ELSTA Group [4], [10], [11]



Fig. 4. Reading headers manufactured by ELSTA Group [4], [10], [11]



Fig. 5. Docking station type SDR-01 manufactured by ELSTA Group [4], [10], [11]

2. iRIS – system for identification of machines, equipment, fixed assets, and forms of transportation

The increase of interest in the modern systems, which are resistant to environmental conditions, for identification of machines, equipment, fixed assets, and forms of transportation, which are used in hard coal mines, was the reason to start collaboration between the ELSTA Group and the KOMAG Institute of Mining Technology. It aimed at the development of comprehensive, modular system, based on RFID technology [5], [7], [8].

Based on the experience of the ELSTA Group, research on a prototype of intrinsically safe mobile terminal and new applications dedicated for portable devices were conducted. The work aiming at a development of the iRIS IT software (intelligent Rapid Identification System), compatible with the previous hardware solutions and aimed at comprehensive identification and control of fixed assets was carried out in KOMAG. The iRIS system consists of the following platforms [5], [7], [8], [9]:

- PECM (for machines, equipment and components used underground),
- PEUBP (for explosion-proof machines and equipment),
- PEŠT (for transport forms),
- PEMP (for machines, equipment and components designed for use on the surface), and
- PEŠTB (for office equipment).

R&D work on the first system for electronic identification of powered roof support components was the basis for a development of new, integrated hardware and software iRIS solutions.

A new model of the system has a layered structure (Fig. 6). The applications of the iRIS system were qualified to the master management layer. This model provides full functional flexibility, and the product, based on it, satisfies most of declared customers' needs [5], [7], [8].

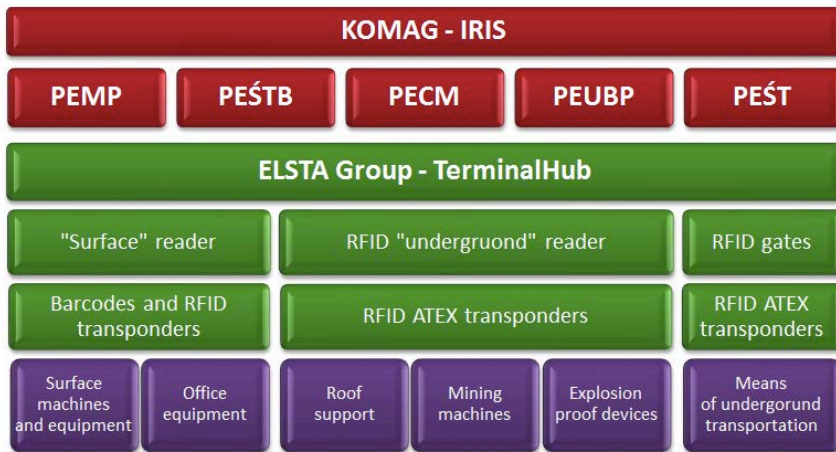


Fig. 6. System structure [7]

A new generation of devices manufactured by the ELSTA Group cooperate with the iRIS software system. For this purpose, new communication modules have been developed (Fig. 7–8) [10], [11]. Due to the large number of devices based on the RFID technology, the new IT system can cooperate both of the available hardware platforms: TRMC-01 as well as new portable terminals.



Fig. 7. Mobile terminal manufactured by ELSTA Group [11]



Fig. 8. Wireless reading header manufactured by ELSTA Group [11]

The following assumptions for the development of a new version of the system have been formulated [5], [7], [9]:

- A backward compatibility with the TRMC-01 terminals,
- A possibility to use mobile terminals with access via TCP/IP network (wired, wireless),
- A possibility of simultaneous communication with many terminals (old and new ones),
- A possibility to support different hardware platforms functionalities, a possibility to record all the processed parameters values and types of actions performed by the mobile terminals during their synchronization,
- A possibility to record data files sent by the terminals and storing them in the internal files' structure (clients should have access to the data on demand everywhere, if the network is available),
- A possibility of work with a specified terminal and session,
- The separation of data transmission directions, and
- Data files should be stored on a server and available through the web services.

“TerminalHub” application, providing an interface for management of the terminals, has been developed by the ELSTA Group (Fig. 7), while KOMAG has implemented the modules that are responsible for communication with this application [5], [11].

The screenshot shows the TerminalHub web interface. At the top, there is a navigation menu with links: Strona główna, Monitoring, Raporty, Ustawienia, Terminal center, and Pomoc. Below the menu, there are several buttons: DODAJ, PODGLĄD, EDYTUJ, USUŃ, FILTRUJ, and CZYSZC. The main content area displays a table titled 'Typy terminali' with the following data:

ID	Typ	Producent	Opis
30	TRMC-01	ELSTA	Terminal TRMC-01
31	ET-01	ELSTA	Terminal ET-01
252	DT-X8	CASIO	Terminal Casio powierzchniowy

At the bottom of the interface, there is a copyright notice: © Copyright 4 www.eletronika.elsta.pl and a note: Powered by TerminalHub.

Fig. 9. TerminalHub software – web interface [5], [7], [11]

“TrmcGateway” application, which is used as a gateway for TRMC-01 terminals, has been developed to enable communication between the iRIS and the old generation terminals. This auxiliary application is available to the user who has a PC computer connected to the SDR-01 docking station. When connection is detected, the user is informed and data synchronization procedure starts, similar to a mobile terminal [5], [7], [11].

The works on the new mounting methods of the RFID transponders, involving riveting and gluing, have been started as a result of the needs to mark the explosion proof devices (Fig. 10–11).

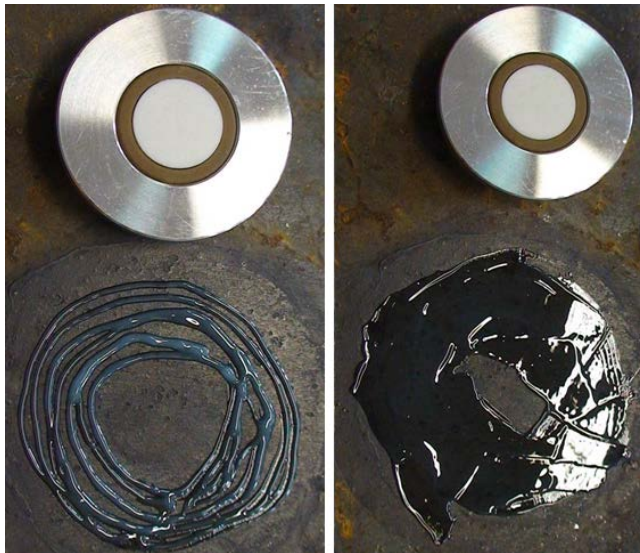


Fig. 10. Alternative methods of TRID-01 transponders assembly [9]

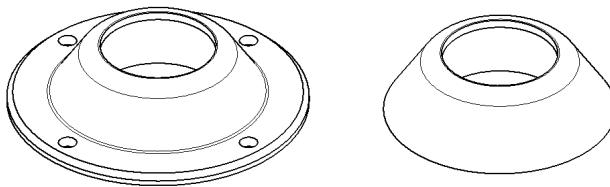


Fig. 11. The elements supporting TRID-01 transponder new mountings methods [9]

Summary

The system for electronic identification of powered roof support components, developed by KOMAG, Silesian University of Technology and ELSTA Group, consisting of the iRIS system, are successively implemented in

mining facilities. The system is continuously updated and extended with new functionality to provide professional maintenance support for the users. A continuous development of new technologies indicates the need for the adaptation of solutions to the current users' requirements.

The idea of the system is quick identification of basic components of mining machines, fixed assets, office equipment, and forms of transportation, underground and on the surface, by marking them with RFID transponders or barcodes.

The hardware and software solutions presented in this paper simplify the work and provide a reliable source of information about the technical condition of individual components, machines, and equipment. Intrinsic safety, remote reading, and ergonomics issues have been taken into account during designing of the system.

References

1. Fitowski K., Jankowski H., Jaszczuk M., Jenczmyk D., Krzak Ł., Pieczora E., Stankiewicz J., Szczurkowski M., Rogala J., Warzecha M., Worek C.: RFID nowa metoda identyfikacji elementów w podziemiach kopalń (in Polish). *Napędy i Sterowanie* No. 2: s. 82–88, 2006.
2. Fitowski K., Jankowski H., Jaszczuk M., Jenczmyk D., Krzak Ł., Pieczora E., Stankiewicz J., Szczurkowski M., Rogala J., Warzecha M., Worek C.: Nowoczesny sposób identyfikacji elementów sekcji obudowy ścianowej za pomocą technologii RFID (in Polish). Conference proceedings: „Nowe trendy w budowie maszyn górniczych 2006”, Konferencja Naukowo-Techniczna, Wysowa, 27–28 February 2006, s. 37–39.
3. Jaszczuk M., Piecha A., Pieczora E., Rogala-Rojek J., Fitowski K., Szczurkowski M.: Wykorzystanie technologii RFID oraz nowoczesnych systemów bazodanowych do zarządzania bezpieczeństwem użytkowania sekcji ścianowej obudowy zmechanizowanej (in Polish). Conference proceedings: EMTECH, Ossa k. Rawy Mazowieckiej, May 2009.
4. Jaszczuk M., Jenczmyk D., Pieczora E., Rogala J.: Use of RFID technology to increase operational safety of powered roof supports. Conference proceedings: “High Performance Mining”, RWTH Aachen, June 3rd and 4th, 2009, pp. 91–102.
5. Mięka S., Warzecha M., Rogala-Rojek J., Latos M.: Zarządzanie flotą wielozadaniowych terminali mobilnych jako niezbędny element efektywnej strategii zarządzania majątkiem trwałym w zakładzie górniczym (in Polish). KOMTECH 2012 Monograph – Innovative technics and technologies for mining industry. KOMAG Institute of Mining Technology, Gliwice 2012, s. 555–568.

6. PN-EN 1804-1+A1:2011 Maszyny dla górnictwa podziemnego – Wymagania bezpieczeństwa dla obudowy zmechanizowanej – Część 1: Sekcje obudowy i wymagania ogólne (in Polish).
7. Rogala-Rojek J., Latos M., Piecha A., Mięka S., Warzecha M.: Gospodarka majątkiem przedsiębiorstwa z wykorzystaniem systemu iRIS (in Polish). KOMTECH 2012 Monograph – Innovative technics and technologies for mining industry. KOMAG Institute of Mining Technology, Gliwice 2012, s. 541–554.
8. Stankiewicz K., Jasiulek D., Rogala-Rojek J., Woszczyński M., Jendrysik S.: Control and identification systems in the mining industry. Conference proceedings: 22nd World Mining Congress & Expo, vol. II, Istanbul, 11–16 September 2011, pp. 243–250.
9. Warzecha M., Stankiewicz K., Jasiulek D., Rogala-Rojek J., Piech A.: iRIS – system elektronicznej ewidencji środków trwałych w zakładach górniczych (in Polish). Maszyny Górnicze 2011 Nr 3, s. 92–96.
10. <http://www.elsta.pl>, last access 12/2014.
11. <http://www.elektronika.elsta.pl>, last access 12/2014.

Zarządzanie środkami trwałymi przedsiębiorstwa z wykorzystaniem systemu iRIS

Słowa kluczowe

Górnictwo, systemy informatyczne, technologia RFID.

Streszczenie

ITG KOMAG, przy współpracy z firmą ELSTA Sp. z o.o. i ELSTA ELEKTRONIKA Sp. z o.o. SKA, od lat prowadzi prace nad systemami informatycznymi wspomagającymi zarządzanie majątkiem w zakładach górniczych. Doświadczenia z wdrażania opracowanych rozwiązań z użyciem technologii RFID skłaniają do doskonalenia autorskich systemów ewidencji elementów maszyn górniczych, jak również dostosowania rozwiązań do bieżących potrzeb użytkowników. Wzrost zainteresowania dotychczasowymi rozwiązaniami skłoniły do podjęcia prac nad kompleksowym, modułowym systemem identyfikacji – iRIS. System umożliwia identyfikowanie podstawowych podzespołów maszyn górniczych w warunkach dołowych oraz powierzchniowych, środków trwałych i wyposażenia biur oraz transportu poprzez oznakowanie ich transponderami RFID lub kodami kreskowymi. W artykule przedstawiono główne założenia systemu iRIS i jego możliwości zastosowań.