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APPLICATIONS OF INTELLIGENT DIAGNOSTIC SYSTEMS OF GROUND SUPPORT EQUIPMENT IN AVIATION

s. 125-131

The article is dedicatded to the technology for monitoring and diagnosing GSE (Ground Support Equipement).
The system of remote diagnostics is a telecommunication solution enabling data transmission regarding the technical condition or location of devices dislocations. There is the possibility to encrypt data transmition for safety purposes.
The system of inteligent remote diagnostics aids to collect information for analysis, providing information about the technical condition of devices and their readiness for use and locations of the equipment.
Thanks to its continous monitoring, it is possible to generate periodical reports regarding the technical state of the item as well as delivering information regarding further uses and the necessity of maintanence and service.
Using the remote, inteligent diagnostic system, helps to increase the effectiveness of the equipment its efficiency and safety.

KEYWORDS

Inteligent Remote Diagnostic System, Ground Support Equipment, Aviation, Maintenance.

The Remote Diagnostics System is an IT solution intended to transmit the information regarding technical status or location of the airfield equipment and is intended for aircraft handling purposes.
The system monitors operation of the airport equipment and utilizes a technology, which contributes to effective maintenance of the equipment, thus improving its operational safety, availability and reducing servicing costs.
Utilization of such systems involves constant recording of various data and its further analysis in advanced diagnostic modules, which detect non-standard or dangerous

operating conditions of the equipment. In situations requiring special attention, experts will perform thorough analysis of respective devices. Should they detect any indicators of a developing damage or a fault, they will immediately notify device user about such condition. Continuous monitoring of the equipment allows users to generate periodical reports detailing condition of all pieces of the equipment connected to the system. These reports may also include recommendations regarding further use of the equipment as well as lists of components, which should be subjected to special monitoring in further operating cycles, in order to prevent breakdowns or other operational issues.

Currently there are several systems available on the market, which perform remote diagnostics and monitoring functions. These are mainly solutions developed by original equipment manufacturers and are offered as add-on services or customized solutions for specific types of the equipment only. Until recently, among those systems there was no solution that could support monitoring and remote diagnostics of the aircraft ground support equipment. The first system of this type has been developed and implemented in production conditions by the Central Military Bureau of Design and Technology. The company has been involved in delivering innovative Ground Support Equipment (GSE) solutions for many years. Its production of proprietary, high-tech aircraft ground support equipment positioned it as the leader on the Polish market and a key player internationally.

The intelligent system for airfield equipment diagnostics supports collection of data, which can be further used for analysis and for supplying information on technical condition of the equipment, its operational readiness and equipment locations. Constant monitoring allows to generate periodical reports describing technical condition of the equipment, provisioning of the information on its further use, facilitates maintenance and repairs and indicates urgent replacement needs of its consumables and wearable components. Utilization of an intelligent diagnostic system will increase the effective use of the Ground Support Equipment (GSE). It will ensure its more efficient operation and improve operational safety thus ensuring aircraft airworthiness and in this way solution will guarantees their safe take-off.

Remote Diagnostics System was developed basing on many years of experience, perfect knowledge of the market and of customer needs. It permits monitoring of multiple devices at various locations and memorizes their last-known positions. Solutions used in the system permit remote diagnostics also in places with poor Internet coverage and therefore ensure continuous remote access to equipment status information and to measurement data. This enables the technical support staff to monitor all operating parameters of each piece of the equipment and thus to supervise its proper operation by users. It also allows to predict component wear and to conduct preventive maintenance operations. The information collected by the system is archived and analyzed to determine possible future improvements and design modifications. Thanks to its fault detection functionality, in the initial phase of fault occurrence the system automatically notifies upon alert conditions and allows users to respond immediately. This prevents costly repairs and equipment outages. New devices may be added to the system by simply equipping them with a diagnostic electronic modules, which do not interfere with the device operation and which are just external add-ons. The system is intended for both civil and military equipment, which makes it compatible with stringent quality and IT security standards.

The Remote Diagnostics System consists of three main functional modules. The first one is responsible for the equipment being monitored. Each device being supervised by the system is equipped with a GSM communication module with GPS location capability. Additional elements include sensors and measurement interfaces and a controller,

which logs required operational parameters of the device being monitored and sends them to the main system server.
The second module of the Remote Diagnostics System contains the hardware and the software that is responsible for the acquired data storage, for data processing and for making the data accessible to users.
The third one is a web application that publishes this data to selected users. This application is intuitive and user-friendly.

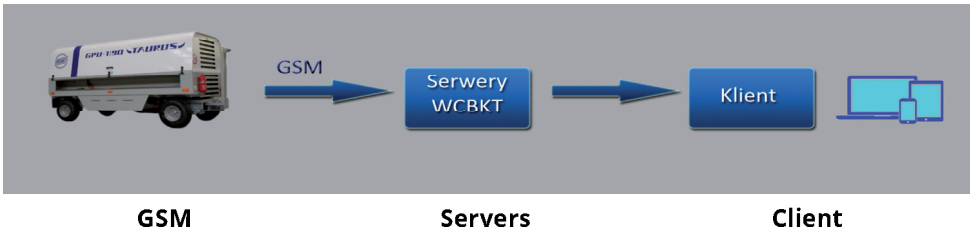


Fig. 1. Remote Diagnostics System - operating principle [own study]

Having logged on to the application, user is redirected to the main page which shows a menu on the left side. The menu includes a list of all devices grouped by categories: military, civil and test devices and a link to a map page, which displays last-known positions of all pieces of the equipment. Devices that are currently active are marked with a green LED icon. Device names are shown on the left. Inactive devices are indicated by a red LED icon. After a name of a particular device is clicked, the main view of shows the basic data of the device. Above the main view, a device menu is displaced, which allows users to access sub-pages with additional information.

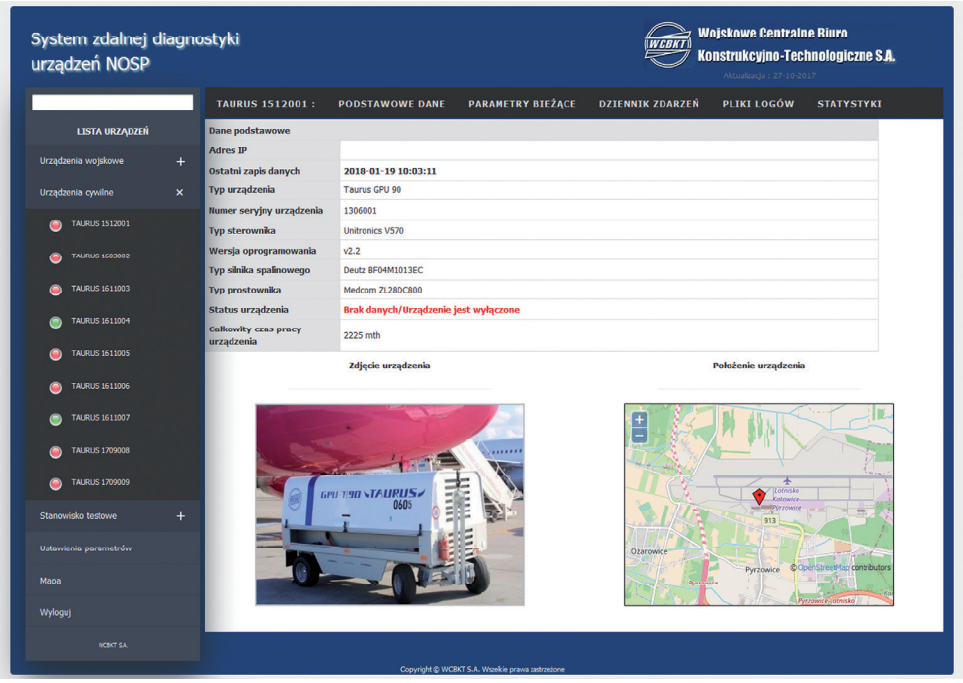


Fig. 2. The page with basic data describing the selected device. [own study]

When user selects the "current parameters" table, while a device is working, the information on its current status and measured motor and power parameters is shown.

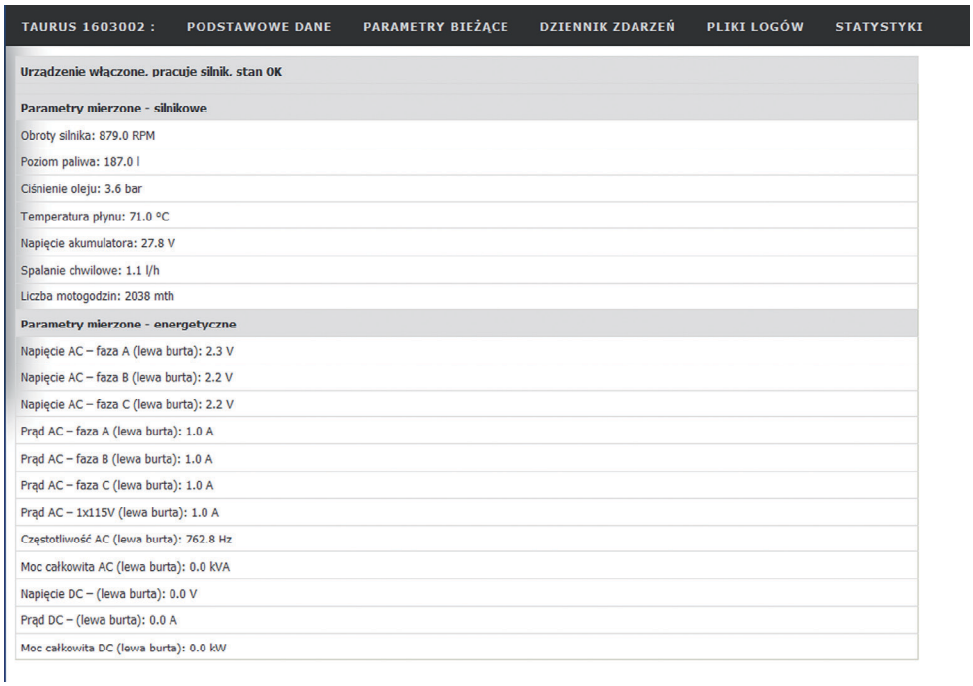


Fig. 3. The current parameters page of the selected device [own study]

The "event log" table shows the information on tasks performed by the device, on states it was in and on potential faults and failures.

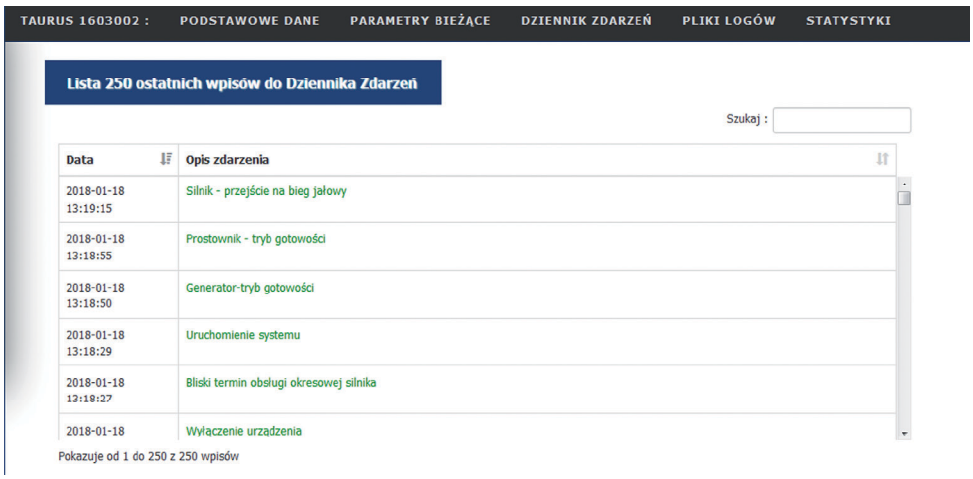


Fig. 4. The event log page of the selected device [own study]

When a device fails or when any of its protections are triggered, a special file is generated containing detailed information about its operating parameters at the time of such event. This information can be found in "log files" entry, in the device menu.

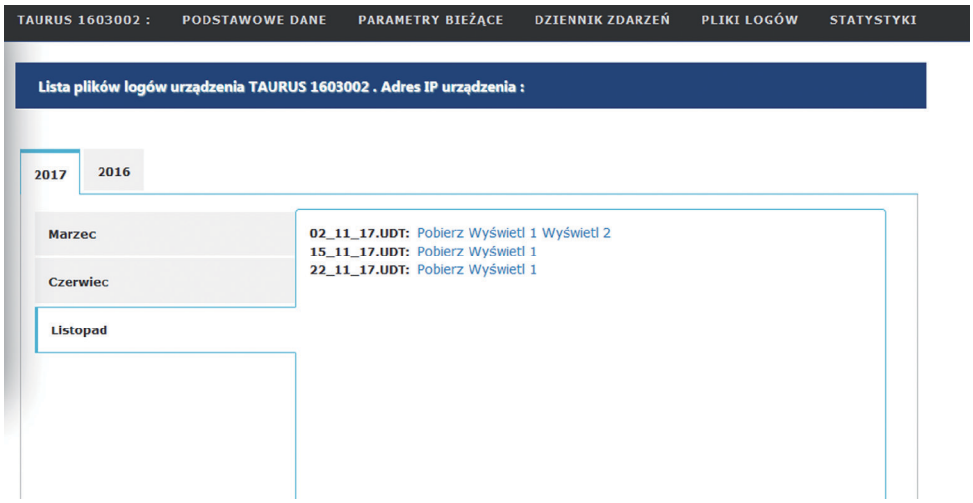


Fig. 5. Log files page of the selected device [own study]

The last table is "statistics". The information shown in this table is grouped by subject and shown in the form of charts and tabular summaries.

Fig. 6. Selected device statistics [own study]

In the "statistics" table, user may inspect e.g. selected device operation parameter trends. Tabular summaries allow users to check selected parameters, e.g. parameters related to motor operation and output power.

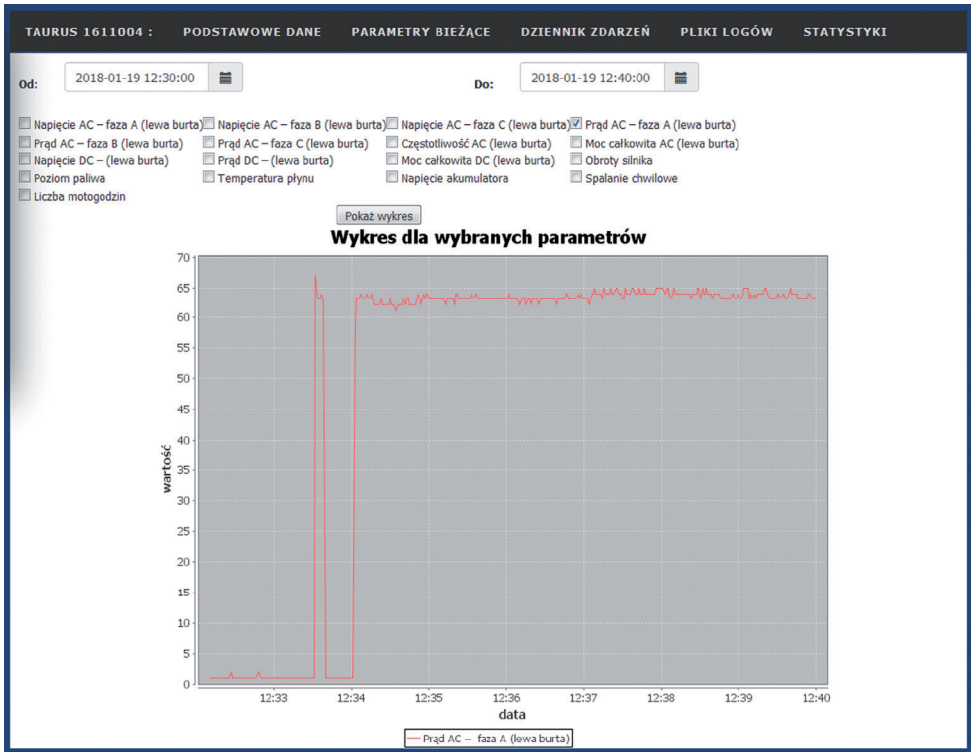


Fig. 7. Selected operating parameters of the device [own study]

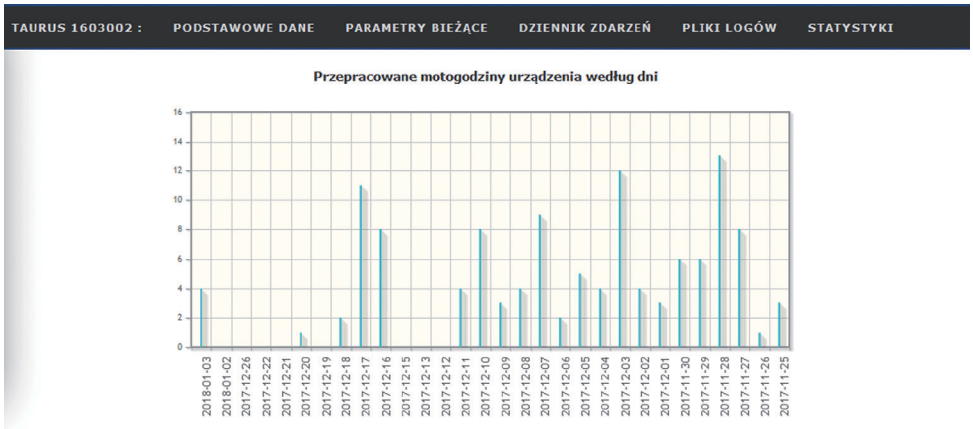
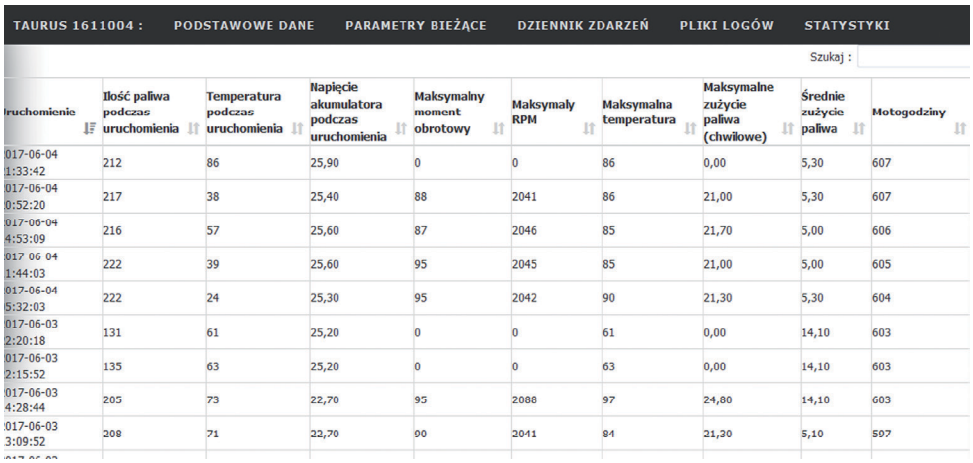


Fig. 8. Motor running hours during a specific period [own study]



TAURUS 1611004 : PODSTAWOWE DANE PARAMETRY BIEŻĄCE DZIENNIK ZDARZEŃ PLIKI LOGÓW STATYSTYKI

Szukaj :

uruchomienie	Ilość paliwa podczas uruchomienia	Temperatura podczas uruchomienia	Napięcie akumulatora podczas uruchomienia	Maksymalny moment obrotowy	Maksymaly RPM	Maksymalna temperatura	Maksymalne zużycie paliwa (chwilowe)	Średnie zużycie paliwa	Motogodziny
017-06-04 1:33:42	212	86	25,90	0	0	86	0,00	5,30	607
017-06-04 0:52:20	217	38	25,40	88	2041	86	21,00	5,30	607
017-06-04 4:53:09	216	57	25,60	87	2046	85	21,70	5,00	606
017 06 04 1:44:03	222	39	25,60	95	2045	85	21,00	5,00	605
017-06-04 5:32:03	222	24	25,30	95	2042	90	21,30	5,30	604
017-06-03 2:20:18	131	61	25,20	0	0	61	0,00	14,10	603
017-06-03 2:15:52	135	63	25,20	0	0	63	0,00	14,10	603
017-06-03 4:28:44	205	73	22,70	95	2088	97	24,80	14,10	603
017-06-03 3:09:52	208	71	22,70	90	2041	94	21,30	5,10	597

Fig. 9. Basic statistics of the selected device operation [own study]

TAURUS 1611004 : PODSTAWOWE DANE PARAMETRY BIEŻĄCE DZIENNIK ZDARZEŃ PLIKI LOGÓW STATYSTYKI

Szukaj :

Typ	Włączenie wydawania	Wyłączenie wydawania	Czas wydawania	Napięcie [V]	EF	Napięcie podczas wyłączenia [V]	EF podczas wyłączenia	Energia [kWh]
DC	2018-01-17 19:53:05.0	2018-01-17 22:52:16.0	02:59:11	28,00	Wył.	28,00	Wł.	8,20
DC	2018-01-12 06:35:27.0	2018-01-12 07:42:13.0	01:06:46	28,00	Wył.	27,80	Wł.	3,10
DC	2018-01-11 22:51:51.0	2018-01-11 22:51:53.0	00:00:02	28,00	Wył.	28,00	Wł.	0,00
DC	2018-01-11 20:32:18.0	2018-01-11 22:51:45.0	02:19:27	28,00	Wył.	28,00	Wł.	5,30
DC	2018-01-11 19:12:54.0	2018-01-11 19:58:03.0	00:45:09	28,00	Wył.	28,00	Wł.	2,80
DC	2018-01-11 18:13:06.0	2018-01-11 18:49:59.0	00:36:53	28,00	Wył.	28,00	Wł.	2,60
DC	2018-01-11 13:38:29.0	2018-01-11 14:19:53.0	00:41:24	28,00	Wył.	28,00	Wł.	2,60
DC	2018-01-11 09:51:11.0	2018-01-11 11:26:08.0	01:34:57	28,00	Wył.	28,00	Wł.	5,50
DC	2018-01-11 06:46:44.0	2018-01-11 07:16:54.0	00:30:10	28.00	Wył.	28.00	Wł.	2.00

Fig. 10. Data on the selected device operation and its energy output [own study]

The system is open and can be expanded and upgraded with additional statistical functions, depending on the needs of the technical support staff or the client.

CONCLUSION

The implemented Remote Diagnostics System for the GSE equipment supports efficient management of the GSE equipment and maintenance of devices from other manufacturers as well. Periodically collected data (basing on event logs, error codes and detailed reports containing equipment operation parameters during a failure) facilitate troubleshooting, failure prediction and allows appropriate preventive measures to be undertaken. In addition, in many cases the System functionality allows the technical support services to ensure quick response and to avoid additional financial expenses. It is a comprehensive solution intended for all types of the GSE equipment.

References
The article is based on inner materials of the Central and Military Bureau of Design and Technology S.A.