Abstract: The article presents selected components of the prototype of the Integrated System of Supporting Information Management in Passenger Traffic (ZSIKRP system) The system is equipped with significantly expanded range of offered functionality, which corresponds to the current demands of the market. Additionally, it has features distinguishing it from other products available on the market. Prototypes of the system were installed in two versions: for electric (EMU) vehicle (EN57 1756 – type in Koleje Mazowieckie (Mazovia Railways)) and diesel (DMU) (SA 132 006 – type in Przewozy Regionalne (Regional Public Transport)) vehicle. ZSIKRP system also ensures the safety of travelers in both types of vehicles: EN57 1756 (EMU) and SA 132 006 (DMU). It is done by installation of the fire alarm module, thus it will be possible to transfer information about possible emergency situation to Supervision Center and immediately to Crisis Management Center. The XML frame structure that can be sent to the already existent dispatch systems (SWD) was presented. Particular attention has been given to test fire alarm systems and to provide information to the competent services.

Keywords: fire protection systems, supervision support system (SWD), safety in passenger railway traffic

1. INTRODUCTION

The main target of the ZSIKRP project was the construction of a prototype of integrated system supporting Information Management of Railway Passenger Traffic and test it in real conditions for the commercialization and introduction to business. The ZSIKRP project was based on components (modules) Passenger Information System implemented by ENTE during the previously R & D financed from own funds, which are on offer in ENTE. System Project ZSIKRP has been significantly improved, and developed new modules of the system (Fig. 1). The main targets of the ZSIKRP Project [1-5] were achieved as:
1. developing the concept of a functional system Project ZSIKRP,
2. execution of research and test engineering,
3. prototype systems for: electric (EMU) vehicle EN57 1756 – type in Koleje Mazowieckie (Mazovia Railways) and diesel [6] (DMU) (SA 132 006 – type in Przewozy Regionalne (Regional Public Transport)) were made (Fig. 2),

4. test the prototype in the laboratory and in real conditions (2 pilot installations: in Koleje Mazowieckie (Mazovia Railways) and Przewozy Regionalne (Regional Public Transport)).

Integrated systems executing functionality achieved in the project in such a wide range are currently unavailable on the Polish market. Developed and tested module for monitoring the work of the driver is a novelty on a global scale, and can be used in other areas, e.g. medical research in Rett syndrome. Proposed system contains devices made by Polish producers specialized in the production and development of railway systems. Integration of such devices typically causes operational problems and have no added value for the vehicle. Integrated system is free from these defects.

2. THE FIRE ALARM MODULE – REALIZATION ON REAL OBJECT

Innovation of the solution was made basing on modeling completely new, not currently operating on trains functionality, especially the module of fire alarm. The necessity of developing of the modules was the consequence of tragic disasters in Baby and Szczekociny. In the case of train crash, fire alarm module will significantly minimize negative effects of fire through the sending specific information immediately to the Crisis Management Centers, e.g.: geographic location, size of accident and the number of passengers etc. The system count on-line passengers at the entrance / exit from the vehicle.
This information will allow more effective planning and carrying out rescue and help in the search for causative factors of disaster. Practical integration of modules allows better management in crisis situations, e.g. in the case of fire in the vehicle. It allow to inform the responsible services (fire brigade).

In case of an occurrence of a crisis situation, integrated modules: fire alarm and passenger information system will allow to automatically inform passengers by voice and visual information and inform the Supervision Center Module about the situation and nature of the threat. The Crisis Management Center (Fig. 3), appropriate for a particular administrative area was informed.

Fig. 2. Rail vehicles in real conditions such as: EN57 (EMU) a) and SA132-006 (DMU), b) ready for testing

Fig. 3. Elements of the system: a) Signaling of a smoke detection in the vehicle SA132-006, b) activation of the fire sensor automatically change the view on the driver’s terminal on the image from the camera closest to the activated sensor
In case of fire smoke and temperature detectors used in the project allow detection of these parameters. The system is configured to allow automatic preview threatened passenger compartment by the driver. At the same time information about the parameters of the vehicle (number of people, geographical location, activation module fire alarm) will be sent to Crisis Management Center. The following is a XML frame design, enabling to send information about the event. De facto XML frame includes other information, for example: accelerations in three axes X, Y, Z and exceed their critical values indicating, for example an accident of the vehicle. Fire can be also the result of the accident.

XML frame
<object>@oName@</object>
<objectID>@oID@</objectID>
<longitude>@lon@</longitude>
<latitude>@lat@</latitude>
<date>@date@</date>
<passengers>
@passengers@
</passengers>
<accelerometers>
<accelerometer name="Kabina 1">
<accX>@k1accX@</accX>
<accY>@k1accY@</accY>
<accZ>@k1accZ@</accZ>
<tiltX>@k1tiltX@</tiltX>
<tiltY>@k1tiltY@</tiltY>
</accelerometer>
<accelerometer name="Kabina 2">
<accX>@k2accX@</accX>
<accY>@k2accY@</accY>
<accZ>@k2accZ@</accZ>
<tiltX>@k2tiltX@</tiltX>
<tiltY>@k2tiltY@</tiltY>
</accelerometer>
</accelerometers>
<popo>
@ppoz@
</popo>
<redlight>
<ID>@rlid@</ID>
</redlight>
<optional>
<speed>@speed@</speed>
<din>@din@</din>
<train_number>@trainNO@</train_number>
</optional>
</Event>
3. PRACTICAL TESTS OF THE ZSIKRP SYSTEM IN REAL CONDITIONS

In normal operation of railway vehicles it is assumed that while driving with an active cab a fire in any member and the site of a rail vehicle of EMU or DMU triggers both light and sound alarm signal with the location of the accident in the active driver's cab without causing a stop of the vehicle (with the ability to turn down the sound signal in the driver's cab in case of device failure), while the image from cameras covering the accident place is automatically displayed on the monitor. Designed and practically implemented system ZSIKRP contains integrated modules to allow better management in crisis situations, such a fire in the vehicle. In such case, from each integrated fire alarm module (Figs. 5-7), and passenger automatic notification system (Fig. 9) voice and visual information about the threat is sent to Supervision Center module together with information about the nature of the threat.

Additional integration with IT SWD (existent dispatch systems - Supervision Support System) module in Crisis Management Center information system (Fig. 12) allows for instant notification of reports. The Central Unit on-line module sends the image from video-monitoring module to Supervision Center module. IT technology allows presentation video from rail vehicle in Crisis Management Center (Fig. 4).

Fig. 4. IT technology allows presentation video from rail vehicle in Crisis Management Center online (www)

The aim of the tests was the practical testing and verification correctness of the information transmitted using communication protocols to devices, such as terminal driver (Fig. 8), LED arrays, server, activation of smoke detectors, fire control unit activation and transmission of signals through hubs.

The primary objective of the studies was verification of effectiveness of the transmission of useful signals, correctness of communication between the individual modules and...
algorithms implemented in the system after installation on the prototype of ZSIKRP integrated system platform pilot (rail vehicles) in real conditions.

Fig. 5. Activation of smoke and flame detectors, a) forcing the alarm using soldering iron, b) verification of the sensitivity of the detector using a cigarette - alarm

Fig. 6. Alarm activation on fire alarm module in terminal

Fig. 7. Video-monitoring module a) no alarm b) activation of the sensor changes the preview of the monitoring system in the cockpit of rail vehicle
Data in Supervision Center server module thoroughly were analyzed. The relevant bits of information frames carried the useful information of alarms occurring on specific fire detectors in the individual passenger compartments (Fig. 10).

CPU (Central Unit) module via the CAN bus and CANopen protocol communicates with the fire alarm module, sends data to the Supervision Center module and visualizes (Fig. 11) the alarms based on these data (Fig. 10).
The final element was to test the communication between the integrated system modules ZSIKRP (Fig. 4) and Crisis Management Center system SWD (Fig. 13), check effectiveness of sending information and putting it into Description field of SWD frame (Fig. 14). Below the various stages of data transmission in ZSIKRP system are illustrated (Fig. 12).

Fig. 12. Information from the vehicle to Crisis management center were transmitted

Result of integration ZSIKRP system and Crisis Management Center is presented below. Actual information from XML frame in Description field SWD system. The main goal has been achieved (Figs 13-14).

Fig. 13. The list of entries generated from the server Supervision Center module Surveillance to Crisis Management Center - SWD system (existent dispatch systems - Supervision Support System)

Fig. 14. The value indicating the alarm in module fire alarm
4. CONCLUSIONS

Fire alarm module is a part of the ZSIKRP Demonstrator. It allows the transfer of specific information activated in a vehicle in fire alarm module to the Supervision Center Module. Activation of the fire sensor automatically changes the view on driver's terminal and send the information immediately both to the Supervision Center Module and to the Crisis Management Center. It can also expand cooperation in module fire alarm sensors on various types of toxic gases. Normally semiconductor sensors are used. As an alternative to the above sensors can be used a SAW [7] sensors based on surface acoustic wave with the differential frequency measurement. Sensors of this type should have a simple construction, small dimensions and detect the concentration of a wider range than conventional gas sensors. In the project innovative structures of the toxic gas sensors using SAW were presented. Development of the system will allow sending information wirelessly [8-10] and the use of advanced mathematical algorithms [11-15]. The project wasn't considering references to the requirements of railway vehicles specified by the directives (safety, interoperability) and the specifications of the EU (especially LOC & PAS, SRT, TAP).

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The Polish Patent Office received a patent describing alternative construction designs of toxic gas sensors, dated 05.10.2015, the number of the P.414278, "The use of hybrid sensor surface acoustic wave".

Bibliography


NOWE MOŻLIWOŚCI MONITOROWANIA ZAGROŻEŃ POŻAROWYCH I ICH PREDYKCJA


Słowa kluczowe: system przeciwpożarowy, system wspomagania dowodzenia, bezpieczeństwo Kolejowego Ruchu Pasażerskiego