TEKA Kom. Mot. i Energ. Roln. – OL PAN, 2011, 11B, 185-190

MONITORING OF THE TECHNICAL STATE OF THE RAILWAY TRAIN WITH THE PURPOSE OF PASSENGERS' SAFETY IMPROVEMENT UNDER THE CONDITIONS OF TERRORIST ACTIONS

Iurii Statyvka, Galyna Osenina, Vladimir Orlov

Volodymyr Dahl East-Ukrainian National University, Lugansk, Ukraine

Summary. There is grounded possibility of automatic management of the train in condition of actuating of explosive or using of gas in passenger electrical train in the article. Block schematic diagram and principle of function of device is developed. List of necessary functions are defined. Recommendations on arrangement in the train suitable sensors are given. Algorithm and program of computer realization of devise operating is proposed.

Key words: railway transport, passengers' safety, safety sensors.

INTRODUCTION

It is well known, that terrorism takes one of the basic places among the problems facing the humanity nowadays [4, 5, 10, 13, 14]. Terrorism penetrates into all the spheres of human activity [8, 15, 16] including railway transport. It is proved by numerous examples of terrorist actions on the railway (Moscow metro in 2010; railway station in Spain in 2007; the section Moscow – St. Petersburg in 2008, etc.)

Monitoring of the train state is an actual problem because it creates the conditions for prevention the act of terrorism or, as minimum, decreases negative consequences.

The actuality of monitoring consists in the ability to disclose dangerous technological situations not connected with terrorism such as running the wheels off the rails, fire or non-adequate behaviour of the engine-driver because of physical or psychological problems.

OBJECTS AND PROBLEMS

Terrorism on railway can be shown in the following types: ill-intentioned creation of the conditions for running the wheels off the rails; use of poisonous substances; fire; explosion; harm to the engine-driver.

Monitoring is a systematic collection of information and its processing, which can be used for improvement of making decisions, for informing the people or as a means of retroactive connection with the purpose of the project realization, program evaluation or politics making.

The train can conditionally be divided into such components: a running part, saloon of carriages, platform of a railway carriage, engine-driver's cabin [2]. Each of these components is equipped by a sensor (detector). The monitoring sensor of the running the wheels off the rails is mounted on the wheels (fig. 1)

In the carriage and platform there carried out the explosion check, presence of toxic agents, fire and smoke check. For monitoring in the saloon-carriage and platform there installed a sensor for recording fire, a sensor for recording explosion (fig. 2).

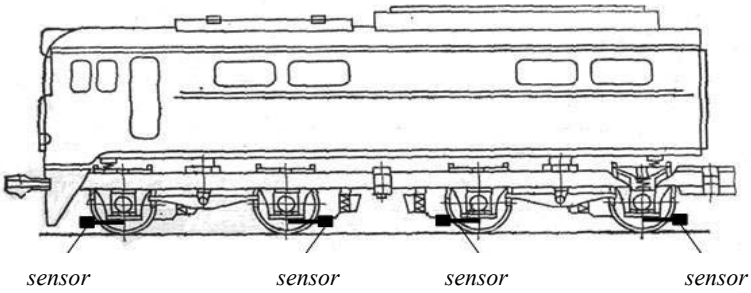

Fig. 1. Arrangement of the sensors that record the running the wheels off the rails

Additional monitoring of adequate behaviour of the driver is carried out in the engine-driver's cabin. It is executed with the help of comparison of current actions of the driver with the standard that is kept in a special data bank.

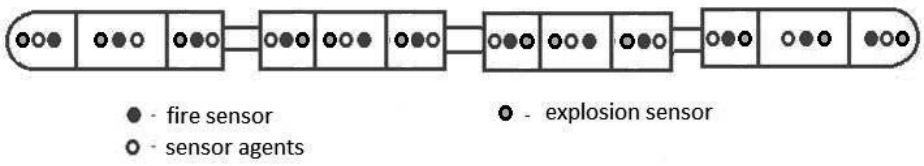

Fig. 2. The placement diagram of the sensors in the train

The sensors and the systems of the rolling stock are functionally connected and compose a device with the help of which it is possible to carry out monitoring the train

as a whole and to execute necessary actions. In this case the following problems are being solved: recording explosion in the saloon-carriage, recording the presence of toxic agents, recording fire in the saloon-carriage, recording the running a wheel-set off the rails, recording non-adequate behaviour of the engine-driver, automatic train control according to special algorithm in dependence on the situation.

The device holds five groups of the sensors (fig. 3):

- sensors recording explosion 4;
- sensors recording the presence of toxic agents 3;
- sensors recording the running a wheel-set off the rails 10;
- sensors checking adequacy of the engine-driver's actions 12;
- sensors recording fire 13.

The sensors 3, 4, 10, 12 and 13 are functionally connected with microprocessor control block 5. The control block 5 is designed for information processing that comes from the sensors and signal formation needed for automatic train control.

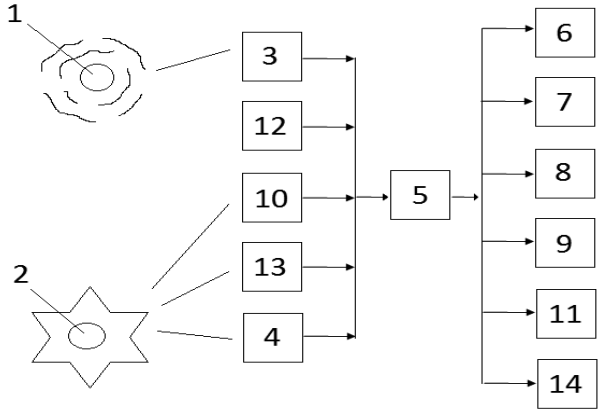

Fig. 3. Block-diagram of the device

In its turn a microprocessor control block 5 has connection with the following technical train systems: brake system 6, the system of door opening 7, emergency signals 8, ventilation system 11, radio-station 9, fire-prevention system 14.

The actions of the monitoring depend on the results of the sensor indexes and are determined on the basis of corresponding rules which are the base of the algorithm of the device functioning. For the development of the program component of the monitoring system the language of logic program Prolog [1, 6, 9, 11, 12] was chosen, namely, SWI-Prolog [17].

A main cause for it is that basic functionality of Prolog program consists in declarative component [1, 7, 11, 12], and programming consists in the formulation of facts and rules which determine the desirable relations between inlet and outlet values of the data.

Several combined formalisms [3] were analyzed with the purpose of getting some knowledge of the problem. In the result a productive model was chosen which is

suitable for formulation and gives the possibility to organize easy checking for non-contradictoriness and completeness.

The diagram of the variants of the application was made in the beginning of development (fig. 4).

The developed system is the program prototype for automatic train control under the condition of the act of terrorism. This program has no graph interface and it has a cantilever view because the given program is a prototype and requires further development for its application in real conditions.

In dependence on the sensor indexes the program characterizes the situation by means of one of the two regimes: extraordinary and emergency.

Extraordinary regime comes when there was running the wheel off the rails and it requires urgent train stop. Emergent regime comes while recording toxic agents in the saloon-carriage, fire or explosion, non-adequate behaviour of the engine-driver but the running the wheel off the rail is not recorded. The actions in emergency regime foresee the analysis of the surroundings for determination the favourable stop place.

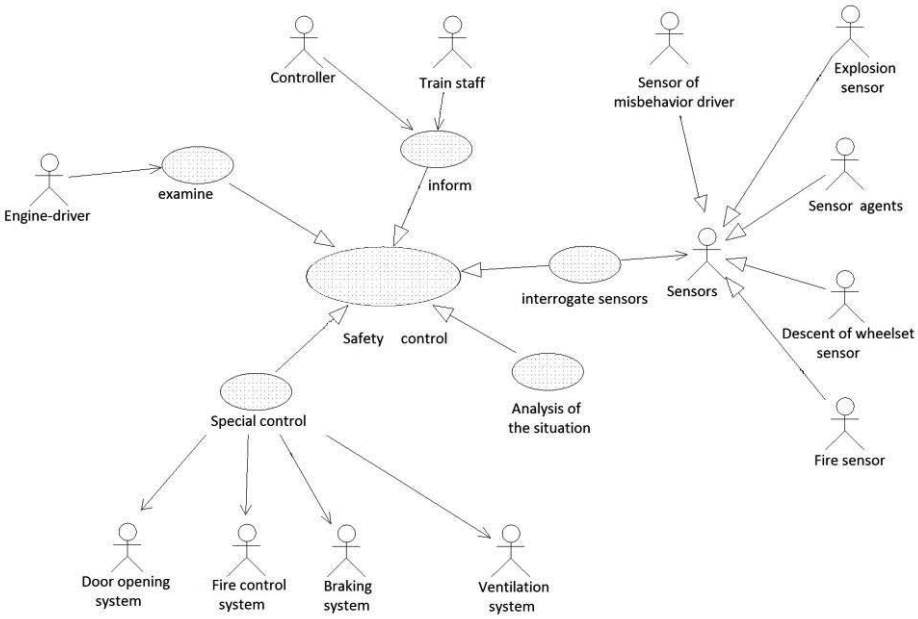

Fig. 4. Diagram of the variants of the application

In order to make any decisions the system determines the regime of the situation. It decides to stop the train immediately or to find a favourable place for it. The next step of the program is determination of further actions in dependence on the specific combination of the sensor indexes.

Its grounding is conducted after the decision has been taken. It is necessary in order to rise some trust to the system decisions and to give the possibility to disclose the defect of the "meditation" system.

Later on the given prototype can be applied for the program development taking into account the factors that influence on the passengers' safety of the railway trains.

CONCLUSIONS

In this paper there offered one of the possible problem solutions connected with the passengers' safety of the railway transport under the conditions of the act of terrorism. It consists in monitoring the state of basic systems of the rolling stock responsible for the passengers' safety and taking decisions on its base in the automatic regime.

For monitoring a special device is developed which records the running the wheel off the rails, toxic agents, fire, explosion and non-adequate behaviour of the engine-driver. The device ensures taking necessary actions according to the algorithm which depends on the sensor information.

There developed an expert system using agents-sensors – the program prototype for automatic train control. According to these requirements the given system gives the substantiation to each decision in order to rise trust to the system decisions and to check the search process with the purpose of disclosing possible defects of "meditation" on the stage of the system adjust.

REFERENCES

1. Bratko I., 1990.: Prolog programming for artificial intelligence. – M.: World, 560 p.
2. Golubenko A., Osenin Yu., 2010.: Minimization of terrorist action consequences in the trains of railway transport // TEKA Commission of Motorization and power industry in Agriculture. – Lyblin: Polska Akademia nauk Oddzial w Lubline, Vol. XD, P. 129 – 135.
3. Jekson P., 2001.: Introduction into expert systems. – M.: Publishing house "Williams", 624 p.
4. Emelyanov V., 1999.: Object of terrorism: its signs. – K.: Law of Ukraine, № 11.
5. Ivchenko V.I., 2000.: Terrorism. – K.: Politics and time, №№ 1, 2.
6. Kloksin Y., Melish K., 1987.: Prolog Language Programmingю – M.: World, 336 p.
7. Kovalsky R., 1979.: Logics for problem solution. – M.: Science, 280 p.
8. Krasnov A., 2000.: "Bloodless wars" – reality and myth // Foreign military revision, №1, P. 3-6, – access regime: http://ww-4.narod.ru/warfare/page0008.htm.
9. Malpas I., 1990.: Prolog relation language and its application. Trans. from English / Editor V.N.Sobolev. – M.: Science, 464 p.
10. Morosov Y. I., 1997.: International terrorism //USA, economics, ideology, № 11, 12 p.
11. Sterling Z., Shapiro E., `1990.: Art of Programming in Prolog language. – M.: World,
12. Stobo I., 1993.: Prolog language of programming. – M.: Science, 366 p.
13. Yatsko A., 1998.: Ontology of violence: terror and terrorism as the elements of political struggle // Ukrainian problems, № 9, P. 1070 – 1079.
14. Zamkovoy V., Ilchikov M., 1996.: Terrorism – global problem of present - M.: World, 43 p.
15. Electronic source: http://scbist.com/uchebnye-materialy-zheleznodorozhnoi-tematiki/6456-organ-zac-ya-tehnolog-avar-ino-v-dnovlyuvalnih-rob-t-na-zal-znicyah.html.

16. Electronic source: http://zakon.nau.ua/doc/?uid=1078.8366.0.
17. Electronic source: www.swi-prolog.org.

МОНИТОРИНГ ТЕХНИЧЕСКОГО СОСТОЯНИЯ ПОЕЗДА ЖЕЛЕЗНЫХ ДОРОГ С ЦЕЛЬЮ ПОВЫШЕНИЯ БЕЗОПАСНОСТИ ПАССАЖИРОВ В УСЛОВИЯХ СОВЕРШЕНИЯ ТЕРРОРИСТИЧЕСКОГО АКТА

Юрий Статывка, Галина Осенина, Владимир Орлов

Аннотация. В статье обосновывается возможность автоматизированного управления поездом в условиях срабатывания взрывного устройства или применения отравляющих веществ в пассажирском электропоезде. Разработана блок-схема и принцип действия устройства. Определен перечень необходимых функций. Даны рекомендации по размещению в поезде соответствующих датчиков. Предложен алгоритм и программа компьютерной реализации функционирования устройства.

Ключевые слова: железнодорожный транспорт, безопасность пассажиров, датчики безопасности.