Support system for generating statistics of existing railway rolling stock

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Abstract. Rail transport is a very important element of the transport system in European countries. Assumptions of rail transport has become more and more attractive in both passenger and freight transport. An example of this may be just noisy action "lorries on track", the promotion of intermodal transport. The principal factors affecting the condition of railway traffic safety are: the technical condition of the railway infrastructure, the technical condition of the rolling stock, the operation of crossings. The main purpose of this article is to present a tool to assist generate statistics operation railway wagons. As part of the project telemetric module allows the location of the freight wagon and the state of its load. Computer program supports GPS module will enable the location of a wagon with an accuracy of 1 meter, generate graphs of speed, road grade and load freight wagon.

1. Introduction
Rail transport is one of the most important modes of transport in Poland. In 2011, rail carriers transported more than 250 million passengers and 250 million tons of goods. They are carried mainly coal, coke, oil and metal ores. The advantage of rail transport compared with passenger automotive are small costs on the assumption longer routes, and the speed of execution of transport. An additional advantage of rail transport compared with the electric motor transport is lower emissions of air pollutants. Rail transport also has drawbacks for example not hand over the goods to any place. An additional advantage of rail transport compared with the electric motor transport is lower emissions of air pollutants. Very popular in recent years has become the carriage of goods using more modes of transport, the so-called intermodal transport. A transport unit, for example a lorry uses the road on the start and end part of the route, while the rest part of the route is performed by, for example rail transport.
Utilitarian objective of combined transport is primarily to protect the environment. At the Faculty of Mechanical Engineering Technical University of Silesia are conducted research on the analysis and synthesis of mechanical systems and mechatronics [2-4, 6, 9, 10], concern both theoretical [3,4,12,16] considerations how practical industrial tasks [7, 17]. Recent works undertaken relate to research the properties of composite materials [9,10] as components and assemblies railway wagons. Some of the work is conducted in collaboration with other research centers [5,7]. In this article, authors use also the knowledge and experience of other research centers [8, 13-15].

Recently, the authors of the article are working on a project carried out by the consortium composed of: Institute of Engineering Processes Automation and Integrated Manufacturing Systems from the Silesian University of Technology, and DB Schenker and Germaz companies. The aim of this research project is to modernize the analyzed wagon during its renovation using new materials. The main objective of the work is modernize of the wagon during its renovation using new innovative composites in order to protect sheathing of the wagon against corrosion.

Modern cars are manufactured from standard materials such as steel plates and profiles. During meetings with representatives of the leading transport companies the following issues concerning the application of the existing structure were reported. The material being carried in the winter term freezes to the surface plates, and makes it impossible to rapid unloading. In order to unload the wagon it is necessary to warm up the walls or use mechanical tools for separation of the material. However, the biggest problem is the corrosion of metal parts. This concerns mainly plating the walls and floor of the wagon. As part of its work use of innovative composite materials as components or assemblies freight wagon in order to eliminate the presented problems.

This work is a continuation of the previous research works concerned with analysis of new, composite materials application if freight wagons.

One of the tasks was undertaken to establish a system for monitoring and collection of data on freight wagons. Of course, such systems exist, but the data to the database are entered manually by the staff. This article proposes a method of automatic data collection and provide statistics crossings railway wagons. The most important data from the point of view of the representatives of the railway lines were long trips, travel time, the degree of loading wagon.

2. The device for automatic data archiving

Proposed a system called telemetry system is capable for locating freight wagon with an accuracy of one meter, also it has the ability to collect from piezoelectric sensors. Piezoelectric sensor which is glued to the frame of the wagon can indicates if the car is moving or stopped on a siding. It also has another task, on the basis of the signal of this sensor, we can conclude whether the car is moving loaded or empty. During the tests voltage was simulated by potentiometer P1 at the measuring input analog AN3 (figure 1). System after 5 minutes of inactivity goes into sleep mode, which allows for significant extension of battery life. Analog input marked on the diagram AN3 has a measuring range of 0-30V and input resistance 230kΩ. Optocoupler input with series resistor 2,7kΩ a minimum value of switching voltage of 3.5V and a minimum current of 0.5mA optocoupler switching. For higher voltages, to limit the current, must-core select the appropriate additional series resistor.
As part of the first attempts it was assumed that the data collected by the system will be as presented on figure 2.

Figure 1. Telemetric system (A), wiring diagram analog sensor (B)

Entering the server address in any web browser to obtain the view of the map. Then user can choose which car will be monitored and in what period of time. After indicating the dates the system automatically generates a route as shown in figure 3. The positioning accuracy is dependent on the factory settings, but it is worth noting that increasing the sampling frequency significantly reduces battery life.

Figure 2. Archived data by system
Figure 3. Sample route monitored wagon

On figure 3 characteristic points of the route was marked. After clicking on the selected point left window (figure 3) with main parameters of the route. In this window is indicated value of the signal from sensor for example 10.13V, which means that the car is about 33% loaded.

3. Laboratory stand for first tests

The first tests the device to collect telemetry data were carried out on a special stand made to scale. This the stand was prepare for study the possibility of changing the shell of a freight wagon was presented. In order to confirm or deny the possibility of using these materials model car and drive unit was created. The wagon was designed to allow easy change his shell. To change a travel parameters as: acceleration, delay, variable speed travel, the electrical control box with inverter were established. In figure 4 model for the analysis of observed driving was shown.
At presented figure 4 it was indicated the main components of the laboratory stand by the numbers. The control unit (1) contains residual current devices and overcurrent protection necessary for safe operation of the station. In order to determine the running speed, acceleration and deceleration times and the number of cycle travel LG inverter was used. Guides for power cables are marked (2). The drive unit with an electric motor (3) and a model railway carriage in the scale (4) which are moving on tracks (5)

### 4. Summary
This article shows how to monitoring by GPS system location and load condition of the freight wagon. The obtained statistics can be automatically transferred to the database at any time and collected by the service. Presented location system is not a new concept, but only indicates the possibility of a new use of previously used solutions in the industry.

**Acknowledgments.** The work was carried out under the project number PBS2/A6/17/2013 agreement implemented under the Applied Research Program, funded by the National Centre for Research and Development.
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