

Development of Monitoring System for Management of Railway Logistics Processes

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The Silk Road makes it possible to deepen economic ties between the countries along its path, which will enhance Georgia's transit potential, opens up new business opportunities and increase cargo turnover in the region, and all this will contribute to the development of the Georgia's economic growth. Therefore, it is important that Georgia offers the Silk Road countries low railway tariffs, increased speed, high levels of reliability and convenient transportation services. Today, in Georgia, hundreds of railroad employees are involved in the identification of rolling stock who walk in the stations alongside the stopped rolling stock. Once they have visually recognized the freight wagons number, they dictate them to the relevant station operators through transmitters. This significantly reduces the speed and level of reliability of rail freight transportation. The paper discusses the algorithm for identifying train wagon numbers, which is based on optoelectronic and radio frequency technology. © 2024 Bull. Georg. Natl. Acad. Sci.

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The geopolitical situation made Georgia come under the influence of the field of global interests. It became more visible after the concept of the New Silk Road was announced, which represents the transit route of transport logistics shipments [1].

The concept of the New Silk Road mainly implies new connections and new opportunities for relations between China, Europe and the Middle Eastern countries.

Georgian Railway is important for the socio-economic development of the country, playing the most important role in raising the transit corridor of

Georgia and strengthening the economic cooperation with the countries of the region. 30% of the transport loads are transported by the Georgian railways. In addition, Georgian railways will play a special role in the development of the Silk Road. There are several aspects to understand how railroad transportation contributed to the creation of the new Silk Road:

Efficient and fast transport – railway transport provides faster and more efficient transportation of goods compared to traditional sea cargo.

Saving the costs – rail transport service has advantages over air transport and can be competitive with sea transport for certain types of cargo.

Expanding trade and market access – the connection between China and Europe opens up new markets and trade opportunities for businesses. It promotes the exchange of goods and economic cooperation by establishing railway connections.

Diversification of transport options – rail transport service enhances global supply chains and flexibility.

For this, the need for accurate identification of rolling stock, efficient management of vehicles, operational safety, efficiency and effective management has become especially important.

For example, the conducted analysis showed that about 60% of the cargo transported by Georgian railways are oil products. Oil products belong to such types of cargoes for which technical production and then identification of such wagons is much more difficult compared to other cargoes.

As it is known, each train wagon is assigned a unique identification number that helps distinguish it from other wagons. These numbers are displayed on the exterior of the wagon. Oil products very often cause “dirt” in the numbers displayed on the exterior of the wagons, which makes it difficult to recognize them. However, railway wagons must be unambiguously identified to track their movements, maintenance schedules and other important information. Wagons are identified throughout the world using physical methods such as barcodes, serial numbers or radio frequency identification (RFID) tags.

Radio Frequency Identification (RFID): The RFID technology is used in rail systems to automatically identify and track wagons. RFID tags or transponders are attached to the rolling stock and these tags can be read by RFID readers installed along the railway or in the station area [2].

The RFID has the advantage of contactless reading, sustainability and the ability to store additional data. It enables real-time monitoring of train location, speed and identification, facilitating effici-

ent logistics management and improved technical planning.

In the current environment with technological advances and increasing demands for efficiency, the use of radio frequency identification (RFID) technology for the identification of freight wagons is one of the most effective and promising approaches.

The implementation of RFID technology for the identification of freight wagons will achieve the following results:

- increasing the accuracy of identification of the wagon;
- increasing the efficiency of production and organizational operations;
- simplification of technical processes of tracking;
- enhancing security and preventing unauthorized access;
- reducing the possibility of errors in manual data entry;
- strengthening of logistics management.

The RFID technology provides high-accuracy identification and tracking of freight wagons, which reduces manual entry errors. Real-time tracking and automatic data recording during wagon identification ensures fast and efficient management of processes. RFID technology reduces the need for widespread manual work and paper-based record-keeping, resulting in cost savings. It also plays an important role in the identification of the biological and chemical composition of transported products [2].

Enhanced security approaches prevent unauthorized access and reduce the risks of theft or fraud. RFID can facilitate predictive maintenance of wagons, reducing stopping time and associated costs [3].

The implementation of RFID technology for the identification of freight wagons is a critical step in improving efficiency, safety and accuracy in railway operations. It is related to the successful implementation of the railway infrastructure strategic plan.

In addition to RFID technology, other systems and technologies are important, and play a crucial

role in the management and operation of railway infrastructure [4].

In Georgia, railway rolling stock identification process involves hundreds of railway workers walking through stations, manually recording wagon identification numbers alongside stopped/moving rolling stock, and after visual recognition of the freight wagon number, dictate to their respective station operators, by transmitters, which takes a considerable amount of time and resources.

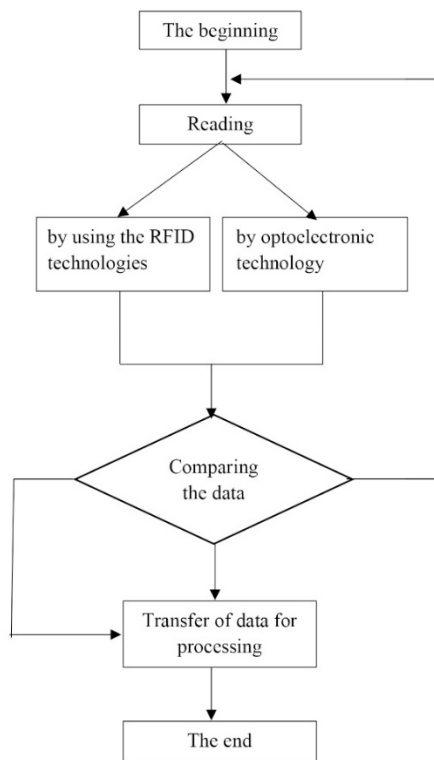


Fig. Algorithm for development of an integrated system based on modern technologies.

The use of the abovementioned means of identification contributes to the effective management implementation, safety and efficiency of railway operations. But in certain cases, for example, when the wagon numbers are not clearly visible, due to various environmental factors, problems arise and it is not possible to recognize the identification numbers. There is also a high probability of making a mistake.

The system proposed by us aims to develop an integrated system based on modern technologies,

where optoelectronic video surveillance and radio frequency identification system will be used in parallel mode.

An automatically controlled monitoring system will provide information on the identification of moving wagons to the relevant service in real time (Figure).

Conclusion

The New Silk Road concept has assigned significant opportunities for Georgia's economic growth and global ties. The paper emphasizes the crucial role of the Georgian railways in strengthening its transit corridor and economic ties with the countries of the region. Efficient and fast transport that facilitates rail services is very important, which ensures faster rail operations and lower costs compared to traditional sea and land transportation.

The use of identification technologies in rail transportations is one of the most effective and important solutions to face today's challenges. With the integrated use of the RFID technology and optoelectronic system, Georgia can further strengthen its role in the New Silk Road initiative, simplify operations and add more clarity to its position in the global logistics landscape.

The development of the railway infrastructure as well as the efficiency and competitiveness of freight wagon management will be ensured by the algorithm suggested in the paper during the analysis of identification systems used in railway transport. This algorithm calls for the simultaneous use of optoelectronic video surveillance and radio frequency identification systems.

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ინფორმატიკა

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მონიტორინგის სისტემის შემუშავება

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აბრეშუმის გზა იძლევა ეკონომიკური კავშირების გაღრმავების საშუალებას აბრეშუმის გზის ქვეყნებს შორის, რის საფუძველზეც გაიზრდება საქართველოს სატრანზიტო პოტენციალი, გაჩნდება ახალი ეკონომიკური შესაძლებლობები, რეგიონში გაიზრდება ტვირთბრუნვა, ეს კი ხელს შეუწყობს საქართველოს ეკონომიკის განვითარებას. ამიტომ მნიშვნელოვანია, რომ საქართველომ აბრეშუმის გზის ქვეყნებს შესთავაზოს სარკინიგზო ტვირთების გადაზიდვის დაბალი ფასები, გაზრდილი სიჩქარე, საიმედოობის მაღალი დონე და სატრანსპორტო მომსახურების სიმარტივე. დღეს, საქართველოში სარკინიგზო შემადგენლობის იდენტიფიცირებისთვის, ჩართულია ასეულობით რკინიგზის თანამშრომელი, რომლებიც სადგურებში დადიან გაჩერებული მოძრავი შემადგენლობის პარალელურად და სატვირთო ვაგონის ნომრის ვიზუალური ამოცნობის შემდეგ, გადამცემების მეშვეობით, კარნახობენ მათ სადგურის შესაბამის ოპერატორებს. ეს საგრძნობლად ამცირებს სარკინიგზო ტვირთების გადაზიდვის სიჩქარეს და საიმედოობის დონეს. ნაშრომში განხილულია ვაგონების ნომრების იდენტიფიცირების ალგორითმი, რომელიც დაფუძნებულია ოპტოელექტრონულ და რადიოსიხშირულ ტექნოლოგიაზე.

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