Title:
GIS SOLUTIONS FOR ROAD DISPLAY AND MANAGEMENT

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(Bachelor thesis, master, research, project, etc.)

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Area of interest
(Identifying the problem, explain why it is important and the current relevance of the topic, up to 250 words)

The quality of a road surface is characterised by various parameters, which are obtained through regular road inspections and measurements. For company-wide usage, the data sets are typically stored and analyzed separately in spreadsheets. Currently, only a limited number of specialists have access to specialized software that enables visual interpretation of data sets. However, it is essential to make this data more accessible company-wide. This means not only enabling measurement collectors to understand the data but also ensuring that project managers and other employees can comprehend and utilize the information effectively.

GIS (Geographic Information System) provides an opportunity to visualise data beyond the usual spreadsheets and to analyse multiple datasets against each other both in terms of spatial location and attribute information. In road management such a solution can ensure the flow of information throughout the road life cycle, and extend the lifespan of the road, by taking timely data-based preservation-type measures, therefore reducing or postponing the need for costly road reconstructions in the future.

In 2021, Latvian State Roads approved new guidelines for road and street resurfacing. The guidelines help determine whether resurfacing is still possible and set criteria for resurfacing works planning by determining the pavement condition mainly from four regularly collected road surface quality data sets. The road sections in these guidelines are analysed with a static matrix that the author of this work wanted to make interactive, map-based and always with the most recent data.

Approach to the problem

(Describe your methodology or technology and how it will solve the problem you identified, up to 300 words)

Each dataset is prepared in spreadsheets by catching data errors and merging the instrument output files according to road index and measurement date. These spreadsheets are then imported into GIS software, visualised as lines or point features according to the coordinates included in the attributes, and symbolised according to predefined criteria of pavement condition assessment from road resurfacing guidelines. Arcade expression language is used not only for customised labels, but also to make a link in the feature' pop-up window to Google StreetView of each element's location. An interactive map is made for each dataset that focuses on that specific dataset display, and has background feature layers such as road network, administrative areas, kilometre reference pole locations and orthophoto. Also, every dataset is combined in a summary map with measurements from 2021 only. Further, all maps are uploaded in a cloud-based mapping and analysis solution, where interactive map-based dashboards are created for each map. These dashboards include attribute tables, feature selectors with map markup, feature filtering with road category, road index and linear reference number selectors. Every dashboard has at least four panels that are interactively connected - data changes depending on the selection. Dashboards are made for two main purposes: various operations with tables, filtering and selected data export; and for in-depth analysis of the dataset in graphs, both in terms of trends over several years and between the road lines separately.

By putting road surface quality measurement data on maps and dashboards, it is allowing to:

- accelerate the identification of critical and potentially critical road sections with enhanced visual ease;
- make data-based decisions;
- see tendencies, predict road surface condition and make decisions for future management and maintenance work;
- facilitate easier data exchange between the client and designer by sharing dashboards or exporting the required data for specific road sections.

Results, conclusions and next steps

(Present your research results and conclusions of your study, up to 250 words)

The result is map-based dashboards that analyse road surface quality parameters, their assessment, and changes over the years (Fig. 1.). From the summary of the 2021 dashboard (Fig. 2.) it is possible to deduce whether a section of road can be resurfaced and, consequently, to select the appropriate type of resurfacing design.

Fig. 1. In-depth analysis dashboard.

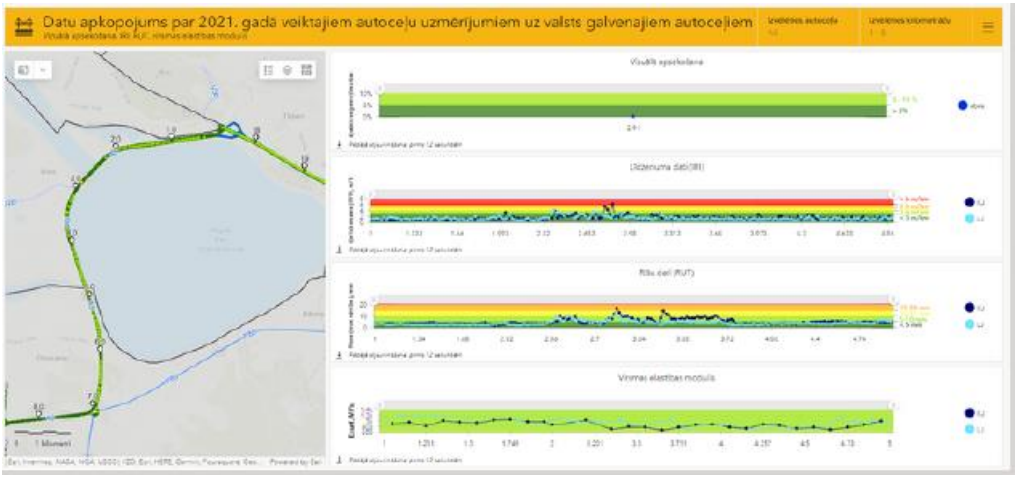

Fig. 2. Summary dashboard of 2021 data.

The graphs are interconnected by linear reference that allows to determine the resulting road surface condition of the road section. A total of 2.6 million data records have been processed, ranging from surface modulus of elasticity measurements in 2007-2021, to roughness and rutting measurements in 2018-2021, to visual survey of cracks data in 2021. In total, 6 interactive maps and 6 dashboards have been created and can be accessed via a single web page.

The GIS-based dashboards developed in this work are the first of their kind in road management in Latvia. These dashboards have already been validated in the Latvian State Roads and solutions for their implementation in the Latvian State Roads GIS and Road Asset Management System are currently being explored.

References
(Additional information, publications, or links, up to 200 words)

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