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Doctoral School
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ABSTRACT OF THE DISSERTATION

„Concept and Implementation of a Simulated Virtual Environment as a Tool for Researching the Perception and Effectiveness of Cartographic Communication in Indoor Navigation Applications”

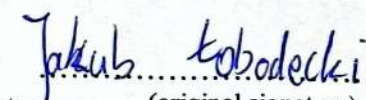
dissertation supervisor: DSc PhD Eng. Dariusz Gotlib, Associate Professor

The primary objective of this study was to develop and verify an innovative research platform utilising simulation technologies (game engines) and digital twins of buildings for multi-faceted testing of cartographic communication methods and navigation application functionalities.

The theoretical section analysed existing solutions for indoor positioning, highlighting the difficulties in conducting research under real-world conditions. In response to these challenges, a thesis was formulated that a virtual environment could significantly mitigate this problem and enable the testing of selected functions of navigation applications designed for indoor navigation.

The research methodology assumed the use of digital twin models of real buildings and gaming technologies. The essence of the work was the design and implementation of such an environment using the Unreal Engine and its integration with the operational navigation application, Mapa PW. The developed environment allows for multiple repetitions of experiments under controlled conditions and enables the analysis of user behaviour and perception regarding navigation applications. A key element of the work was conducting comprehensive research involving over 200 study participants. Seven experiments were carried out examining, amongst other factors, the influence of map scale, route visualisation methods, and map view rotation on the efficiency of movement within buildings. Scenarios difficult to implement in reality were also tested, such as evacuation in emergency situations. The study demonstrates that the application of simulation constitutes an economical and effective alternative to field testing, enabling the optimisation of cartographic communication and thereby influencing the quality of developed navigation applications.

An additional outcome of the work was the formulation of recommendations, based on the conducted research, for designers of indoor navigation systems regarding the method of defining cartographic communication.


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