REVIEW

Prof. Stanimir Nedyalkov Stoyanov,
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on a dissertation for the award of the educational and scientific degree 'Doctor'
Professional field: 4.6 Informatics and Computer Science
Doctoral program: "Informatics"

Author: Georgi Kostadinov Kostadinov
Topic: "Research for the development of an ambient-oriented route generator"
Scientific supervisor: Prof. Asya Stoyanova-Doycheva

General description of the submitted materials. By order No. RD-22-1309/29.06.2026 of the Rector of Plovdiv University "Paisiy Hilendarski" Prof. Rumen Mladenov, I have been appointed as a member of the scientific jury for conducting the procedure for the defense of a dissertation on the topic "Research for the development of an ambient-oriented route generator" for the acquisition of the educational and scientific degree "doctor" in the doctoral program "Informatics" with author Georgi Kostadinov Kostadinov, doctoral student at the Faculty of Information and Communication Technologies of Plovdiv University, discharged with the right to defense, with scientific supervisor Prof. Asya Stoyanova-Doycheva. The set of materials submitted to me includes the following documents:

- Application;
- Curriculum vitae in European format;
- Minutes of preliminary discussion;
- Abstract in Bulgarian and English;
- Declaration of originality and authenticity of the attached documents
- Certificate of compliance with the minimum national requirements;
- List of publications;
- Dissertation;
- Copies of publications on the topic of the dissertation.

Biographical data. Georgi Kostadinov Kostadinov received his master's degree in "Software Technologies" at the Faculty of Information Technology of the University of Plovdiv in 2014. From 2019 to 2022, he was a full-time doctoral student at the Faculty of Information Technology of the University of Plovdiv, enrolled with the right to defend. He works as a programmer, senior software engineer and technical manager in various software companies.

Relevance of the topic, knowledge of the problem, appropriateness of the goals and objectives set. The topic of the dissertation is relevant and original. Today, consumers of tourist services expect not only access to a catalog of tourist sites, but an intelligent environment that is able to help them make an informed choice, assessing various circumstances. Intelligent tourist systems are the subject of increased practical and theoretical interest. The motivation for conducting such a study is very well presented in the text of the dissertation. The unresolved problems on the topic, the weaknesses and shortcomings of existing systems, as well as modern trends in the provision of digital tourist services are clearly and unambiguously formulated.

From the structuring of the dissertation, the formulation of the problem and the results obtained, I can conclude that the doctoral student has a thorough understanding of the essence of the research problem. The referenced literature also confirms my statement.

Research methodology. Although the research methodology is not clearly described in the dissertation, from the text of the dissertation, the publications and the results obtained, I can conclude that the doctoral student consistently and purposefully followed an effective and methodologically correct approach in conducting the research.

Characteristics and evaluation of the dissertation work. The dissertation work is 157 pages long, consists of an introduction, four chapters, conclusion, bibliography and appendices. The number of referenced literary sources is 83. The literature used is up-to-date and appropriately selected in accordance with the purpose and nature of the research.

In my opinion, the dissertation is structured logically and consistently presents the evolution of the research – after the analysis and critical assessment of existing systems, relevant conclusions are drawn, on the basis of which a conceptual model, architecture and prototype implementation are proposed and it ends with experimental validation. At the end of each chapter, main conclusions are summarized.

The introduction provides general reflections on the state and shortcomings of advisory systems in tourism, and on this basis the theses and objectives of the research presented in the dissertation are formulated. A brief structure of the dissertation is given.

The first chapter provides a detailed overview of the current state of the problem area of the dissertation. Various aspects of recommender systems in tourism (approaches and limitations, context-dependent recommendation, multi-criteria, meteorological context) are examined, as well as interactive tourist guides. Attention is paid to the use of ontologies in tourist systems and to the explainability, accessibility and uncertainty of intelligent tourist systems. A comparative analysis of existing solutions is summarized in a table. The introductory part ends with conclusions that are essential for conducting the study – five research options for developing an intelligent tourist guide are formulated.

The second chapter presents the architecture of an environment-oriented intelligent tourist guide. The architecture includes five components that directly correspond to the research aspects formulated in the previous chapter. One of the main advantages of this solution is that the proposed tour guide covers the entire cycle of tourist assistance (registration and profiling, semantic search of objects, route generation, feedback). Another characteristic feature is the variety of personalization options - during registration, weights of ambient factors, spatial coordinates and restrictions are determined, which are later taken into account when generating a route convenient for the tourist; maintenance of the current user profile; maintenance of feedback and accumulation of data for future personalization. The proposed architectural solution also satisfies non-functional characteristics, structured in accordance with the ISO/IEC 25010 standard for quality of software systems. Four typical scenarios for using the tourist guide are presented. The proposed solution complements and extends the ViPS concept, as in the proposed architecture the virtual-physical space is not used as an abstract metaphor, but as a design principle. The chapter ends with a detailed description of the four layers of the architecture, illustrated with a well-made diagram.

The third chapter of the dissertation describes in detail the implementation of the prototype. The development platform, relational data model, ontological model, user profile, four ambient characteristics (location, accessibility, exposure, working hours), integration with a meteorological service are considered. An essential element of the prototype is the mechanism for controlled completion of missing data using a language model. Another essential element is the algorithm for generating routes with a built-in formalism for personali-

zation. The prototype has a built-in ability to explain the recommendations. The description of the prototype is supplemented with various diagrams.

The fourth chapter presents an experimental validation of the prototype, conducted on two corpuses. The first is a three-dimensional cluster containing a controlled synthetic set of 100 tourist sites in Plovdiv. The second is a real corpus of 143 sites of the cultural and historical heritage of Bulgaria with the center in Gabrovo. Three ranking strategies are compared on the two corpuses - "Proximity only", "Ambient model without meteorological data" and "Proposed ambient model". The results of testing the functionality of the prototype are summarized in 17 tables.

The conclusion summarizes the main results, formulates the contributions of the dissertation, outlines the limitations of the validation, and suggests directions for future research.

I would like to note that the text of the dissertation is very well-formed and organized. The excellently prepared graphs and diagrams further enhance the pleasant impression when reading the text. The dissertation is written in a very good style.

In summary, the results obtained show that the purpose of the research presented in the dissertation has been achieved. I think that the doctoral student has systematically and consistently completed all the tasks. I did not notice any plagiarism.

Contributions and significance of the results of the dissertation. I think that the main results of the research are correctly summarized. In my opinion, the contributions can be defined as scientific, scientifically applied and applied:

- Scientific - a formalized model for validating ambient-oriented route recommendations is proposed, combining comparative baseline strategies, ablation analysis and scenario profile checking on a controlled corpus. Explainability, accessibility and uncertainty management are treated as first-class properties of the intelligent tourist guide, and not as peripheral additions. A numerical assessment of the quality of the routes using metrics is proposed. Thus, the tourist guide's suggestions can be tracked and explained.
- Scientific and applied - a two-step approach is proposed for implementing an intelligent tourist guide that separates the semantic extraction of candidates from subsequent ambient re-evaluation. Objects are re-evaluated through a set of ambient

characteristics with different semantic functions — spatial, temporal, personal and contextual — which provides a basis for both ranking and explaining the recommendations received. A multidimensional accessibility model has been developed that considers separately motor, visual and auditory limitations as real constraints on ranking, and a dynamic meteorological context is integrated as an external factor in assessing exposure. Thus, the model reacts simultaneously to personal and environmental conditions, and not only to static properties of the object. A mechanism is proposed for supplementing missing ambient data through a language model with structured outputs, domain rules and priority of explicitly entered values over inferred values during merging.

- Application results – based on the proposed model and architecture, a prototype has been implemented and verified, including a REST interface, an ontology layer, a relational database with JOINED inheritance between a general abstraction and specific ambient subclasses, a parameterizable user profile with individual factor weights, integration with a meteorological service, supervised AI-inference, factor explanation of recommendations through a separate REST resource, and storage of user ratings.

Assessment of publications related to the dissertation. Four publications on the topic of the dissertation are presented. Of these:

• One publication is in a journal.

• Three publications are included in the proceedings of international conferences, referenced in SCOPUS and WoS.

I am impressed by the high level of the publications presented, which is indisputable evidence of the correspondingly high level of the results obtained.

Personal contribution. The dissertation work, as well as the publications presented, suggest that the results achieved are primarily the personal work of the doctoral student.

Abstract. The abstract summarizes the content and results of the dissertation. The volume of 32 is the usual accepted one.

Recommendations for future continuation of the research. As one of the merits of the dissertation text, I would point out the relatively detailed outline of the possibilities for

continuing the research in the future. The presented guidelines are mainly related to the improvement and detailing of multi-criteria planning of tourist routes. I think that these are problems of very significant importance for increasing the intelligence of the tourist guide and thus its wider practical use.

Personal impressions. I know the doctoral student personally from his participation in the activities of the department during his doctoral studies.

CONCLUSION

The dissertation contains scientific-applied and applied results, representing an original contribution to science and meeting the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADSRB), the Regulations for the Implementation of the ADSRB and the relevant Regulations of the Plovdiv University "Paisiy Hilendarski".

The dissertation shows that the doctoral student Georgi Kostadinov Kostadinov possesses in-depth theoretical knowledge and professional skills in the scientific specialty "Informatics" by demonstrating qualities and skills for independently conducting scientific research.

Due to the above, I confidently give my positive assessment of the conducted research, presented by the above-reviewed dissertation, abstract, achieved results and contributions, and I propose to the esteemed scientific jury to award the educational and scientific degree of 'doctor' to Georgi Kostadinov Kostadinov in professional field 4.6. Informatics and Computer Science, doctoral program "Informatics".

31. 08. 2026

Reviewer:

(Prof. Stanimir Stoyanov)