OPINION
on a dissertation for awarding a scientific degree "Doctor "

Field of higher education: 5. Technical sciences
Research area: 5.3. Communication and computer systems and technologies
Doctoral Program – „Automated information processing and management systems"

Author of the dissertation: MSc. Eng. Victoria Tsvetanova Velkova

Dissertation theme: "DEVELOPMENT AND RESEARCH OF A SERVICE FOR DELIVERING PERSONALIZED CONTENT TO VISITORS OF OPEN-AIR MUSEUMS"

Scientific jury member: Assoc. prof. Elena Ivanova Stoyanova, PhD

1. **Topic and relevance of the dissertation**

The topic of the dissertation is related to the digitization of museums as part of cultural institutions. The scientific research is aimed at delivering personalized content to visitors to archaeological sites and open-air museums. Recently, with the progress in the area of digital technologies, many researchers are working on topics related to the digitization of cultural and historical heritage for the purpose of its preservation and conservation. Modern technologies are entering the museum business both to support the work of employees and to attract visitors as well. Unless they are professional researchers, people visit museums in their free time to enrich their knowledge and culture and at the same time they rely on interesting and pleasant experiences. Very often, museum visitors are faced with the problem of finding the most interesting exhibits and the information related to them. Studying the interests of museum visitors, delivering personalized content to each visitor about the museum's exhibits and artifacts plays a key role in their pleasant experience of the visit and good impressions of the museum on the whole.

These problems are addressed in this dissertation, their solution is proposed based on modern technologies (NFC tags, BLE beacons, geofencing, etc.), including integration with AI, which makes the topic extremely relevant.

2. **Research methodology**

The methodology of the study coincides with the best practices adopted as an approach in scientific research. A literature review in the subject area was conducted on the work, 158 sources were cited. Based on this research, the aim and objectives of the dissertation were defined – to design, develop and experiment with a system for delivering personalized content to visitors in outdoor museums using advanced positioning and identification technologies. After studying the problem, solutions were proposed. An architecture and an algorithm for the operation of a service for delivering personalized content to visitors to open-air museums were created, and a mobile application was developed using this algorithm. A methodology for segmenting museum visitors was developed, a system for delivering multimedia content and services for delivering personalized content were created using NFC tags, BLE beacons and geofencing. A methodology for estimating the value of the attenuation exponent was developed.

In connection with the dissertation research, experiments were conducted and the results

obtained were analyzed. The research is supported by statistical analyses, surveys, and a testing methodology created by the Msc. Eng. Victoria Velkova.

3. Contributions of the dissertation work

The contributions in the dissertation are structured as scientific, scientific-applied and applied. The contributions are presented in each chapter and summarized in the Conclusion: 3 scientific, 3 scientific-applied, and 4 applied contributions resulting from the development, experiments, and analyses.

The scientific contributions are as follows:

• An innovative architecture based on microservices is proposed, which integrates geofencing, NFC technologies and artificial intelligence.

• An original algorithm for personalized delivery of museum content is developed.

• An innovative methodology for visitor segmentation is developed, which uses several approaches and creates user profiles that adapt in real time.

The scientific-applied contributions are summarized as:

• Development of a methodology for experimentally determining the signal attenuation exponent when using BLE beacons;

• Creation of an iterative algorithm that dynamically determines the attenuation exponent in different zones of a museum environment for the purpose of localization in the absence of a GPS signal;

• Creation of an algorithm for real-time selection of beacons in the immediate vicinity of a visitor.

The applied contributions are related to the creation of databases in GeoJSON format for the sites of the Ethnographic Open-Air Museum Etar, as well as the development and testing of mobile applications with innovative functionalities for delivering personalized content to visitors to open-air museums.

4. Publications and citations of publications on the dissertation work

The results of the research in the dissertation have been published in a total of 8 conference papers at international conferences in Bulgaria (7 papers) and abroad (1 papers). In two of the papers, Msc. Eng. Victoria Velkova is an independent author, and the remaining 6 were published in co-authorship with the research supervisor Assoc. Prof. Rosen Ivanov.

To date, five of the doctoral student's scientific publications have a total of 10 citations.

5. Authorship of the results obtained

The publications related to the dissertation are authored either by the PhD student alone or in co-authorship with her supervisor. In two of the joint publications, Msc. Eng. Victoria Velkova is the first author. This gives me reason to believe that the results of the dissertation are mainly the personal work of the PhD student.

6. Remarks and recommendations

I have no significant remarks regarding the research, development and documentation of

the dissertation. The dissertation and the abstract are well structured according to the requirements.

As minor comments related to the design of the dissertation, the following can be mentioned: Although rare, in some places in the note there are some inaccuracies in the statement (p. 47, p. 106, p. 107, etc.) and an inappropriate style of expression (p. 136).

7. Conslusion

I believe that the presented dissertation meets the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria. The achieved results give me grounds to propose that the educational and scientific degree "Doctor" be acquired by MSc. Eng. Victoria Tsvetanova in the field of higher education – 5. Technical Sciences, professional direction - 5.3. Communication and computer systems and technologies, doctoral program " Automated information processing and management systems "

4.09.2025 г.

Signature:
/Assoc. prof. Elena Ivanova Stoyanova, PhD/