REVIEW

from Prof. Stefka Fidanova – IIKT-BAS
to

PhD thesis
for obtaining an educational and scientific degree
"Doctor"
in professional field 4.6 "Informatics and Computer Science"
doctoral program "Informatics"
on the topic: "Innovative methods to support decision-making in forest fires or floods"
by Stefan Kostadinov Stefanov

By Order No. 132 dated 01.06.2021 of the Director of Institute of Information and Communication Technologies at Bulgarian Academy of Sciences, Prof. Galia Angelova, pursuant to Art. 4, para. 2 of the Law on the Development of Academic Staff in the Republic of Bulgaria (LDASRB) and decision of the Scientific Council of IICT-BAS (Minutes No. 5 of 26.05.2021) I have been appointed a member of the scientific jury under the procedure for obtaining the educational and scientific degree "doctor" in professional field 4.6 "Informatics and Computer Science", doctoral program "Informatics" by Stefan Kostadinov Stefanov witht PhD thesis on the topic "Innovative methods to support decision-making in forest fires or floods".

According to Law on the Development of Academic Staff in the Republic of Bulgaria, the rules for its implementation and the specific requirements introduced in the regulations of IICT-BAS, applicants must meet the following requirements:

1. The PhD thesis must contain scientific or scientific-applied results that represent an original contribution to science. The tesis must show that the candidate has in-depth theoretical knowledge in the relevant specialty and abilities for independent research.

2. The PhD thesis must be presented in a form and volume corresponding to the specific requirements of the primary unit. The thesis must contain: title page; content; introduction; exposition; conclusion - summary of the results obtained with a declaration of originality; bibliography.

According to Low and rules for its implementation and the specific requirements introduced in the regulations of IICT-BAS, applicants must meet the following requirements:

Group of indicators	Contents	Number of points
A	Indicator1	50
Г	Sum of indicators from 5 to 10	30

The PhD student is supervised by Assoc. Prof. Nina Dobrinkova.

Actuality

Climate events account for 90% of all major disasters in recent decades. They have an adverse effect on the economies of individual countries and cause billions of dollars in damage. In our country alone, over BGN 600 million have been spent on rehabilitation and over BGN 100 million on rescue and emergency activities for the last 2 decades. The risks of natural disasters are expected to increase due to climate change. Therefore, the development of new methods to support decision-making in natural disasters plays an important role in the sustainable development of the country and the protection of the population. Geographic Information Systems (GIS) are modern, computer-based technologies that, in addition to visualizing objects through digital mapping, allow the integration and analysis of a variety of data in a geographical context. One of the applications of GIS is the development of special maps of areas at risk and threat of natural disasters.

The object of research of my dissertation are innovative methods for creating Web GIS applications for forest fires and floods.

The subject of the research are open source software and software tools for developing an information system to support decision making in case of forest fires and floods.

Forest fires and floods cause great damage to the economy, flora, fauna and human health worldwide every year. This shows the urgency of the problem and the need to create applications to support decision-making in natural disasters.

The object and the subject of the research determine the goals set before the dissertation.

Goals of the thesis

The goals of the thesis are formulated on page 8. They are divided into theoretical and empirical. At the theoretical level, the aim is to study methods for developing web GIS applications and to present a methodology for developing Information System (IS), supporting decision-making in forest fires or floods. At the empirical level, the aim is to develop and test IP that supports decision-making in forest fires or floods.

To achieve these goals, the author sets himself the following tasks:

1. Theoretical analysis of basic concepts related to the development of Information System (IS), supporting decision-making in forest fires or floods - forest fires, floods and Geographic Information Systems (GIS);
2. Presentation of a methodology for creating IS supporting decision-making in forest fires or floods;
3. Development of IS, supporting decision-making in forest fires or floods;
4. Collection, analysis, evaluation and processing of the available geospatial data for forest fires and floods;
5. Selection of appropriate software solutions for the development of web GIS applications, in connection with the available open source web GIS software products, in terms of cross-platform integration with stable interoperability of geospatial data.

Thesis structures

The thesis is 122 pages long and contains 107 cited sources. It includes Introduction, 4 chapters, conclusions and conclusion.

The Introduction emphasizes the relevance of the problem, presents the methodological parameters of the dissertation, its structure, object, goals and objectives for their achievement.

In the first chapter a theoretical analysis of the concepts used in the dissertation is made. Official statistics on fires and floods for a 10-year period, fires in the period from 2009 to 2018 and floods for the period from 2010 to 2019 are presented.

The second chapter presents a methodology for developing an information system to support decision-making in forest fires or floods. Two models that are basic for the development of Web

GIS applications are considered. An open source architecture is proposed for the development of Web GIS applications and a conceptual model of an information system to support decision-making in forest fires and floods.

The third chapter presents the architecture and software implementation of a Web GIS application, which is part of the information system that supports decision-making in floods and forest fires.

In the fourth chapter, two decision-making systems are presented and tested. One is for forest fires in the area of SFE "Zlatograd", and the other is for floods in the area of Syunik, Armenia.

Knowing the state of the problem

There is no doubt that the dissertation has entered very well into scientific issues. The list of cited scientific sources is current - publications from the last 10 years are 33% of the total, and 10% are from the last 5 years. On the other hand, there are older but important sources for the area. The dissertation's knowledge of the field is very well illustrated by Chapter 1, which provides general information and statistics on fires and floods in recent years and existing decision support applications.

Research methodology

The methodology for conducting the research, chosen by the dissertation, derives from the set goals and corresponds to the tasks arising from these goals. The author uses a combination of an empirical model describing the event and its development and a model of information system architecture that supports decision making. Open source software has been developed.

Contributions

The contributions to the dissertation can be divided into scientific and scientific-applied.

The main scientific contributions are:

- An analysis of existing Geographic Information Systems (GIS), as well as a comparative analysis of open source software - QGIS and commercial software - Esri ArcGIS;
- An algorithm has been developed for the development of Information Systems to support decision-making in forest fires or floods with open source.

The main applied contributions are:

- A methodology for working with real data has been developed and tested to visualize parameters for relief, meteorology, plant species and water resources;
- The architecture of a web GIS application is applied, which is realized with open source software products and tools;
- Information Systems (IS) for decision support in forest fires and floods have been developed and tested.

The achieved results allow for further research in the following areas:

- Study of the opportunities provided by the European program Copernicus for satellite monitoring in its part for Emergency Management Services.
- Complementing open source software applications with risk assessment algorithms for: critical infrastructure and points of interest (Points of Interest) for different hazard criteria (vulnerability index assessment).

- Development of a GIS application for visualization of meteorological data generated by the system for overlay and correction of forecast data via GRIB, WRF, ECMF, EURO4 for forecasts and measurement of microclimatic features applied in the operational mode of MOS schemes and NOWCASTING in forecast data.

Evaluation of the dissertation's publications

The dissertation has published 4 articles related to the topic of the dissertation. Two of the articles are in editions with impact rank (20 points each), one is in an edition referenced in the world indexing and referencing system (SCOPUS) without impact factor or impact rank (12 points) and one publication is not referenced in the world referencing and indexing system (0 points). Thus, according to the indicators from group D, the dissertation has 52 points with a required 30, which significantly exceeds the minimum requirements of IICT-BAS for the acquisition of ONS "Doctor".

The main results obtained by the dissertation were reported at 4 specialized international conferences. The doctoral student has participated in two international projects. The obtained results were part of his work on the projects.

Resume

In general, the abstract correctly reflects the content of the dissertation.

Critical notes

I have no significant critical remarks. I noticed a confusion in the numbering of the contributions on page 9. In some places there is a use of foreigners who could be replaced by their Bulgarian counterparts. All these are technical notes and do not diminish the significance of the results achieved.

Significance of development for science and practice

The work done by the dissertation is sufficient in volume and depth of the study. Undoubtedly, the practical orientation of the developed developments and the obtained results, as well as the need to work in this direction. In this sense, I find the work significant both scientifically and practically.

Questions
I have the following question for the PhD student:

Can the developed information systems, with slight adjustments, be used for other types of disasters, such as landslides, accidents, etc.?

Personal opinion

I know the PhD student vaguely, but I know part of his scientific work, as he has participated in scientific forums in which I was the organizer. I was left with very good impressions of his work. In general, the dissertation is well written and designed. The goals and tasks for their achievement are clearly set. The contributions are short and concise and to the point. The dissertation has a separate publication, which is a guarantee that his personal contribution to achieving the results in the dissertation is significant. It also shows that he can work independently and is built as a scientist.

Conclusion

As a consequence of the above, it can be stated that all the requirements of the Law on the Development of Academic Staff , the Regulations for its implementation and the Regulations on the terms and conditions for obtaining scientific degrees and occupying academic positions at IICT-BAS. I can say that the level of this dissertation and the publications related to it significantly exceeds the minimum requirements.

The critical remarks I have given do not diminish the significance of the results obtained and the scientific value of the work provided to me.

All this gives me grounds for a positive assessment and I propose to the esteemed Scientific Jury to award the educational and scientific degree "Doctor" in professional field 4.6 "Informatics and Computer Science" to Stefan Kostadinov Stefanov.

02.08.2021
Sofia

(Prof. Stefka Fidanova)