UNIVERZITET CRNE GORE
Centar za interdisciplinarne
i multidisciplinarne studije

UNIVERSITY OF MONTENEGRO
Center for Interdisciplinary
and Multidisciplinary Studies

Podgorica, 13. 05.2024.
Broj: 01/7 - 451/7/1

UNIVERZITET CRNE GORE
Centar za doktorske studije
Senat

Uvaženi,

U prilogu vam dostavljamo Izvještaj sa javne odbrane polaznih istraživanja (obrazac D1 - Ocjena prijave doktorske teze i kandidata) mr Helge Sallaku, studenta doktorskih studija studijskog programa Održivi razvoj, na dalju proceduru.

S poštovanjem,

DIREKTOR,

Prof. dr Nedeljko Latinović

Prilog:

- Odluka Stručnog Vijeća CIMS-a
- Obrazac D1
- Saglasanost Odbora za doktorske studije na sastav Komisije

Na osnovu člana 64 Statuta Univerziteta Crne Gore, i člana 35 Pravila doktorskih studija Univerziteta Crne Gore, Izvještaja sa javne odbrane doktorske disertacije br. 01/7-451/6 od 08.05.2024., Stručno vijeće Centra za interdisciplinarne i multidisciplinarne studije na 14. sjednici održnoj preko zoom platforme dana 13.05.2024. godine donijelo je

ODLUKU

I Predlaže se Centru za doktorske studije Univerziteta Crne Gore da prihvati Izvještaj Komisije o ocjeni prijave doktorske teze i kandidata (obrazac D1) broj 01/7-451/6 od 08.05.2024. kandidata Helge Sallaku, br. dosijea 9/22.

II Predlaže se Centru za doktorske studije da prihvati prijavu i odobri temu doktorske disertacije kandidata Helge Sallaku, broj dosijea 9/22 pod nazivom: "Prilog optimizaciji podataka i algoritama u realnom vremenu za IoT bazirane sisteme upravljanja kod koncentrisanih izvora solarne energije", naziv na engelsom jeziku: "Contribution to real-time optimization of data and algorithms for IoT based control systems for concentrated solar energy sources."

Obrazloženje

Stručno vijeće Centra za interdisciplinarne i multidisciplinarne studije Odlukom broj 01/7-451/5 od 24.04.2024. godine usvojilo je prijavu doktorske disertacije i imenovalo Komisiju za ocjenu prijave doktorske disertacije, studenta mr Helge Sallaku, br. dosijea 9/22.

Student Helga Sallaku je u propisanom roku iz Odluke, dana 29.04.2024. godine javno obrazložila ciljeve i očekivane rezultate, odnosno izložila istraživački program.

Komisija za ocjenu prijave doktorske disertacije podnijela je Stručnom vijeću Centra pozitivan Izvještaj o ocjeni prijave doktorske teze i kandidata (obrazac D1) pod brojem 01/7-451/6 dana 08.05.2024., u propisanom roku.

U skladu sa gore navedenim i na osnovu odredbi člana 35 Pravila doktorskih studija Stručno vijeće Centra za interdisciplinarne i multidisciplinarne studije donijelo je odluku kao u dispozitivu.

Crna Gora
UNIVERZITET CRNE GORE

Broj 01/7 - 451/7

Podgorica, 13. 05 20 24 god.

PREDSJEDNIK STRUČNOG VIJEĆA,
Prof. dr Neđeljko Latinović, direktor

Dostaviti:

- Centru za doktorske studije,
- studentu,
- u dosije,
- a/a.

OCJENA PRIJAVE DOKTORSKE TEZE I KANDIDATA

OPŠTI PODACI O DOKTORANDU	
Titula, ime i prezime	MSc. Helga Sallaku
Fakultet	Center for Interdisciplinary and Multidisciplinary Studies
Studijski program	Sustainable Development
Broj indeksa	9/22
Podaci o magistarskom radu	Building a data warehouse for public financial management systems of local government institutions, with an implementation at Municipality of Shkodra, Master of Science in Informatics, Faculty of Natural Sciences of the University of Tirana, study program System Information, date of completion of studies: July 11, 2013, average grade (7.2);
NASLOV PREDLOŽENE TEME	
Na službenom jeziku	Prilog optimizaciji podataka i algoritama u realnom vremenu za IoT bazirane sisteme upravljanja kod koncentrisanih izvora solarne energije.
Na engleskom jeziku	Contribution to real-time optimization of data and algorithms for IoT based control systems for concentrated solar energy sources.
Datum prihvatanja teme i kandidata na sjednici Vijeća organizacione jedinice	08.02.2024
Naučna oblast doktorske disertacije	Sustainable Development
Za navedenu oblast matični su sljedeći fakulteti	
Center for Interdisciplinary and Multidisciplinary Studies	

A. IZVJEŠTAJ SA JAVNE ODBRANE POLAZNIH ISTRAŽIVANJA DOKTORSKE DISERTACIJE

Crna Gora
UNIVERZITET CRNE GORE

Primljeno:	08. 05 2024		
Org. jed.	Broj	Prilog	Vrijednost
01/7	451/6		

The public defense of initial research and presentation of the research program (goals and expected results) of the doctoral dissertation of candidate Helga Sallaku, M.Sc., entitled: Contribution to real-time optimization of data and algorithms for IoT based control systems for concentrated solar energy sources, was organized on April 29, 2024, at 12:00 p.m. in the Rectorate of the University of Montenegro, in front of the commission composed of:

- Prof. Veljko Milutinović, Ph.D., full professor of the Faculty of Electrical Engineering, University of Belgrade, scientific field: Computer technology and informatics, president of Commission;
- Prof. Dr. Radovan Stojanović, full professor of the Faculty of Electrical Engineering of the University of Montenegro, scientific field: Electronics and Information Communication Technologies, mentor, member;
- Associated. Prof. Milan Šekularac, PhD., assistant professor of the Faculty of Mechanical Engineering, University of Montenegro, scientific field: Thermotechnics, member;

In the introductory part of the twenty-minute presentation, the candidate explained the topic of the work, gave an overview of previous research in the field, presented the methodology of the work, clarified the goals and hypotheses of the research and presented the expected results. After the candidate's presentation, the commission members opened a discussion, asked questions and made comments, to which the candidate successfully answered.

The members of the commission emphasized the topicality and importance of the proposed topic, its interdisciplinary nature, as well as its potential for improving public policies, and consequently the position of the Roma minority and their media representation. It was emphasized that the candidate demonstrated a high level of knowledge of the relevant literature and the subject matter, as well as the correct application of scientific methods. The commission unanimously decided that candidate MSc. Helga Sallaku, successfully defended the initial research and research program of doctoral studies. The public defense ended at 01:45 p.m.

B. OCJENA PRIJAVE TEME DOKTORSKE DISERTACIJE

B1. Obrazloženje teme

Renewable energy technologies are the baseline on which to build a European and global climate-neutral future. They encompass renewable electricity, renewable heating and cooling, renewable fuel, water purification and desalination technologies, establishing clean energy technologies, and to further diversify the technology portfolio.

Concentrated Solar Power (CSP) has emerged as a promising renewable energy source with significant potential for large-scale electricity generation. As the demand for clean and sustainable energy rises, CSP technology is being deployed in numerous regions around the world.

However, CSP plants are vast complexes, and to ensure optimal performance and efficient operations, from collecting solar energy to converting it into electricity an effective communication infrastructure is indispensable.

The aim of this research, will be the real-time data algorith leveraging edge computing for efficient IoT-based Energy Management Systems, enhancing efficiency and control communication innovations for CSP networks.

B2. Cilj i hipoteze

Concentrated Solar Power (CSP) systems generate solar power by concentrating sunlight into a Power Tower (Receiver) using an array of large mirrors mounted on dual-axis tracking reflectors (Heliostats). To provide accurate solar pointing during CSP operations, Heliostats have static and dynamic components like reflective area, control system, and a mounting and tracking mechanism. Electronic control of the Heliostat drivetrain is required to track sun position and accurately reflect concentrated sunlight toward a receiver. Heliostats often lose their alignment, perform inaccurate sun tracking and miss their target, Power Tower. This causes CSP plant to radically decrease their productivity, thus increasing the cost of electricity generation. Raised **Hypotheses**:

H1: Integration of the existing azimuth slewing drives and linear actuators (Gear-Drive) into real-time data environment, by installing inexpensive microcontrollers (Raspberry Pi, Arduino, or others) that can send Gear-Drive data to Cloud infrastructure via low latency IoT specific pub/sub message queuing telemetry transport (MQTT) architecture and receive commands to control them, will be a solution in a cost-effective manner.

H2: The usage of a specific algorithm will optimize tracker positioning and performance in real-time data processing, being capable of reacting to various disastrous events, perform remediation operations, and automate disaster recovery functionality.

H3: Utilizing the latest developments real-time data optimization leveraging edge computing for efficient IoT-based Energy Management System solutions, relational database management system (RDBMS), and time-series database management system (TSDB) capable of absorbing millions of records of real-time data, can allow seamless integration of any 3rd party hardware and sensors into an all-in-one platform.

B3. Metode i plan istraživanja

The methodology of the doctoral dissertation consists of:
- research work;
- field/onsite work on CSP plants or experimental environment;
- laboratory work (preparation, analysis, identification);
- hardware research;
- research and cognitive work on existing hardware devices;
- research and cognitive work on the existing software;
- research and cognitive work on database modelling and technologies;
- research and cognitive work on full stack development technologies available;
- comparison and analysis among renewable solar energies, its infrastructure and data processing;
- research and cognitive work on algorithms design for further improvement;
- statistical and analytical analysis;
- drawing conclusions.

During the first year of my studies in the doctoral program "Sustainable Development", I worked in a systematic way to collect the literature and determine the research direction that will lead me to the final preparation of the subject dissertation.

Based on an overview of the existing literature, the research object and plan are defined, and the object of the research is currently related to the one of the most popular renewable energy technologies among all the existing is called Concentrated Solar Power (CSP).

In the framework of a professional mobility exchange program, during the first year of doctoral studies at the University of Montenegro, I started research work in the role of innovation researcher at the University of Arizona Center for Innovation, based in Tucson, Arizona in the USA.

The University of Arizona Center for Innovation is a tech business incubator with affiliation in academia (University of Arizona), that does research studies in innovation supporting Tech Start-ups for the commercialization of innovative technological solutions.

Being included as team member, of the technical consulting team for the development of an "Electronic Management Platform" customized for a Start-up which implements a new generation of Solar Water Desalination and Concentrated Solar Power (CSP) technology, with innovative efficiency, offering a new solution to a major problem in the development of not just Arizona, but throughout USA and around the world, related to drought and unprecedented and lack of water, will be a good structure pathway to conduct the methodology of my research thesis and its topics developments.

Eighty-five percent of the year, the sun shines in Arizona, making this place the perfect place for testing, evaluation, and demonstration of solar technologies, bringing researchers and companies work together to evaluate how these technologies perform side-by-side under identical operating conditions.

According to the international meteorological data source, also Albania and Montenegro have a high number of climatic regions considering its area, nevertheless the weather is mainly sunny with an average of 300 days of sun per year: On the coastline the climate of Albania and Montenegro are Mediterranean with hot summers and mild winters. Thus, the proposed research can be implemented and replicated in Albania and Montenegro, too.

In coordination with the mentor, the work methodology and the scientific contribution of the research have been determined, and the literature that has been collected so far provides a solid basis for the continuation of this research thesis.

Necessary hardware components must be allocated and a CSP plant must be built (a real one or an experimental on) in order to have a demo environment where to implement a piloting the researches.

A modern software development life cycle (SDLC) will be studied using the agile methodology based in SCRUM framework for the minimum viable product (MVP).

Systematic reporting regarding data processing must be produced.

Web-based resource database will serve as the primary tool to compile all developed Resources, Training and Education (RTE) resources, facilitate information gathering.

Further attempts for education support apply opportunities will be researched through different opening calls in academia academic resources to increase accessibility and exposure of the heliostat and CSP industries implementations to be studied. These efforts will include curriculum development, internship opportunities, education outreach events, and funding opportunities available in the universities on heliostat research projects.

Further attempts for training resources apply opportunities will be researched to apply to introduce and market heliostat technologies and to provide training on fundamentals and institutional knowledge on this technology.

The obtained result will be compared with the available literature data from the regions and the world using Web of Science (WoS) which: represents the dominant global policy base with the aim of obtaining clearer and more accurate information as and with the aim of contributing to the scientific community.

The statistical analysis data of the results will contribute to clearer interpretation of the results. Based on the detailed analysis of the presented results, conclusions will be drawn that will represent an important and contributing scientific perspective.

B4. Naučni doprinos

This research contributes to the the capability of gathering and analyzing real-time data, as it is one of the main benefits of implementing solar-powered IoT technologies in renewable and clean energy management.

The study and developement of a specific algorithm which will optimize tracker positioning and performance in real-time data processing, being capable of reacting to various disastrous events, perform remediation operations, and automate disaster recovery functionality, interoperable thorugh abundance of data, may then be examined to find patterns, and areas for development, enabling proactive decision-making and energy-use optimization.

The implementation of the IoT application is investigated using sensors to gather and monitor real-time data and send that data to the end user within cloud solutions. The proposed study will provide preliminary results on an approach for filtering the data collected by the sensors where redundant/unneeded data are tracked and removed from the transmission queue. By eliminating redundant data, it is also possible to reduce energy consumption, both in the routing and scheduling of data over the internet. This would improve the performance of the system and thereby prolong the network's working life. This new approach will allow the end-user to track and check the behaviour and condition of the sensor nodes remotely.

The solar industry is rapidly evolving. My research thesis results will allow to stay head-to-head with current technological advancements, new components and continuing improvements, giving the industry ability to reduce costs of energy generation, enhance performance and increase sustainability.

B5. Finansijska i organizaciona izvodljivost istraživanja

Research within the framework of the doctoral dissertation will be conducted using the method of development of a specific algorithm which will optimize tracker positioning and performance in real-time data processing, capable of absorbing millions of records and big data. The analysis will cover potential projects that will be publicly available without requiring additional allocation of money. Part of the research will also be carried out publishing the results to the best and highest ranked big data scientific journals, like for example "*SpringerOpen*", which also will not require a lot of financial resources. It will be concluded as an organizationally and financially feasible research.

Mišljenje i prijedlog komisije

The committee gave a positive assessment to the application of the doctoral dissertation and the candidate, and unanimously decided that the candidate MSc. Helga Sallaku, successfully defended the initial research and earned the right to continue the scientific research work on the doctoral dissertation entitled "Contribution to real-time optimization of data and algorithms for IoT based control systems for concentrated solar energy sources".

The Commission proposes to the Council of the Center for Interdisciplinary and Multidisciplinary Studies of the University of Montenegro to accept the Commission's positive report and approve the continuation of the research work on the doctoral dissertation.

Prijedlog izmjene naslova

(po potrebi predložiti izmjenu naslova)

Prijedlog promjene mentora i/ili imenovanje drugog mentora
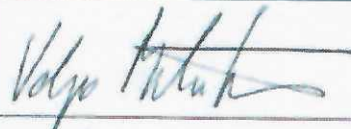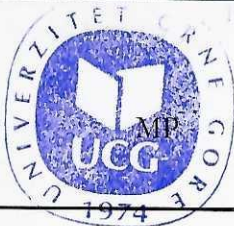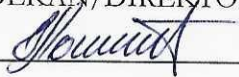
(titula, ime i prezime, ustanova)

Planirana odbrana doktorske disertacije

(godina i semestar)

Izdvojeno mišljenje

(popuniti ukoliko neki član komisije ima izdvojeno mišljenje)

Ime i prezime

_____

Napomena			
(popuniti po potrebi)			
ZAKLJUČAK			
Predložena tema po svom sadržaju **odgovara** nivou doktorskih studija.		**DA**	NE
Tema **je** originalan naučno-istraživački rad koji odgovara međunarodnim kriterijumima kvaliteta disertacije.		**DA**	NE
Kandidat **može** na osnovu sopstvenog akademskog kvaliteta i stečenog znanja da uz adekvatno mentorsko vođenje realizuje postavljeni cilj i dokaže hipoteze.		**DA**	NE
Komisija za ocjenu podobnosti teme i kandidata			
Prof. Veljko Milutinović, Ph.D., full professor of the Faculty of Electrical Engineering, University of Belgrade, president of Commission;			
Prof. Dr. Radovan Stojanović, full professor of the Faculty of Electrical Engineering of the University of Montenegro, mentor, member of Commission;			
Associated. Prof. Milan Šekularac, PhD., assistant professor of the Faculty of Mechanical Engineering, University of Montenegro, member of Commission;			
U Podgorici, 2024. godine		DEKAN/DIREKTOR	

UCG

PRILOG

PITANJA KOMISIJE ZA OCJENU PRIJAVE DOKTORSKE TEZE I KANDIDATA	
Prof. Veljko Milutinović, Ph.D., full professor of the Faculty of Electrical Engineering, University of Belgrade	Explain in 3 sentences: - the Problem Definition of your research regarding its implementation in Montenegro and Albania; - your solution of this challenging problem in a cost-effective manner - why your solution is better?
Prof. Dr. Radovan Stojanović, full professor of the Faculty of Electrical Engineering of the University of Montenegro	Can you explain and clarify the feasibility of the research and the contribution of this research, taking in consideration its implementation in our region, Albania and Montenegro?
PhD. Milan Šekularac, assistant professor of the Faculty of Mechanical Engineering, University of Montenegro	How will you identify the indicators and attributes that will guide your process for the study and the development of the specific algorithm which will optimize tracker positioning and performance in real-time data processing in concentrated solar power technology?
PITANJA PUBLIKE DATA U PISANOJ FORMI	
(Ime i prezime)	
(Ime i prezime)	
(Ime i prezime)	
ZNAČAJNI KOMENTARI	

Na osnovu člana 8 stav 4, a u vezi sa članom 32a Pravila doktorskih studija, Odbor za doktorske studije, nakon sprovedenog postupka glasanja, na sjednici održanoj 11. – 12. 03. 2024. godine dao je

SAGLASNOST

I

Da se prihvati prijedlog Stručnog vijeća Centra za interdisciplinarne i multidisciplinarne studije, broj 01/7-451/2 od 08. 02. 2024. godine, za imenovanje Komisije za ocjenu prijave doktorske disertacije mr Helge Sallaku, u sastavu: dr Veljko Milutinović, redovni profesor Elektrotehničkog fakulteta Univerziteta u Beogradu u penziji, dr Radovan Stojanović, redovni profesor Elektrotehničkog fakulteta Univerziteta Crne Gore i dr Milan Šekularac, docent Mašinskog fakulteta Univerziteta Crne Gore.

OBRAZLOŽENJE:

Odboru za doktorske studije dostavljen je prijedlog broj 01/7-451/2 od 08. 02. 2024. godine za imenovanje Komisije za ocjenu prijave doktorske disertacije mr Helge Sallaku, u gore navedenom sastavu.

Pravilima doktorskih studija propisano je da Komisija ima, po pravilu, tri člana, od kojih je jedan član mentor. Članovi komisije moraju biti iz naučne/umjetničke oblasti iz koje se doktorska teza predlaže. Uvidom u prijavu teme, zaključeno je da je predložena Komisija formirana u skladu sa Pravilima doktorskih studija.

Nakon sprovedenog postupka glasanja, od ukupno 11 članova Odbora, glasalo je 11 članova – **11 glasova ZA, nije bilo glasova protiv i uzdržanih,** utvrđen je prijedlog kao u dispozitivu.

Broj: 01/7-451/4

Podgorica, 12. 03. 2024. godine

Predsjednik Odbora za doktorske studije

Prof. dr Boris Vukićević