



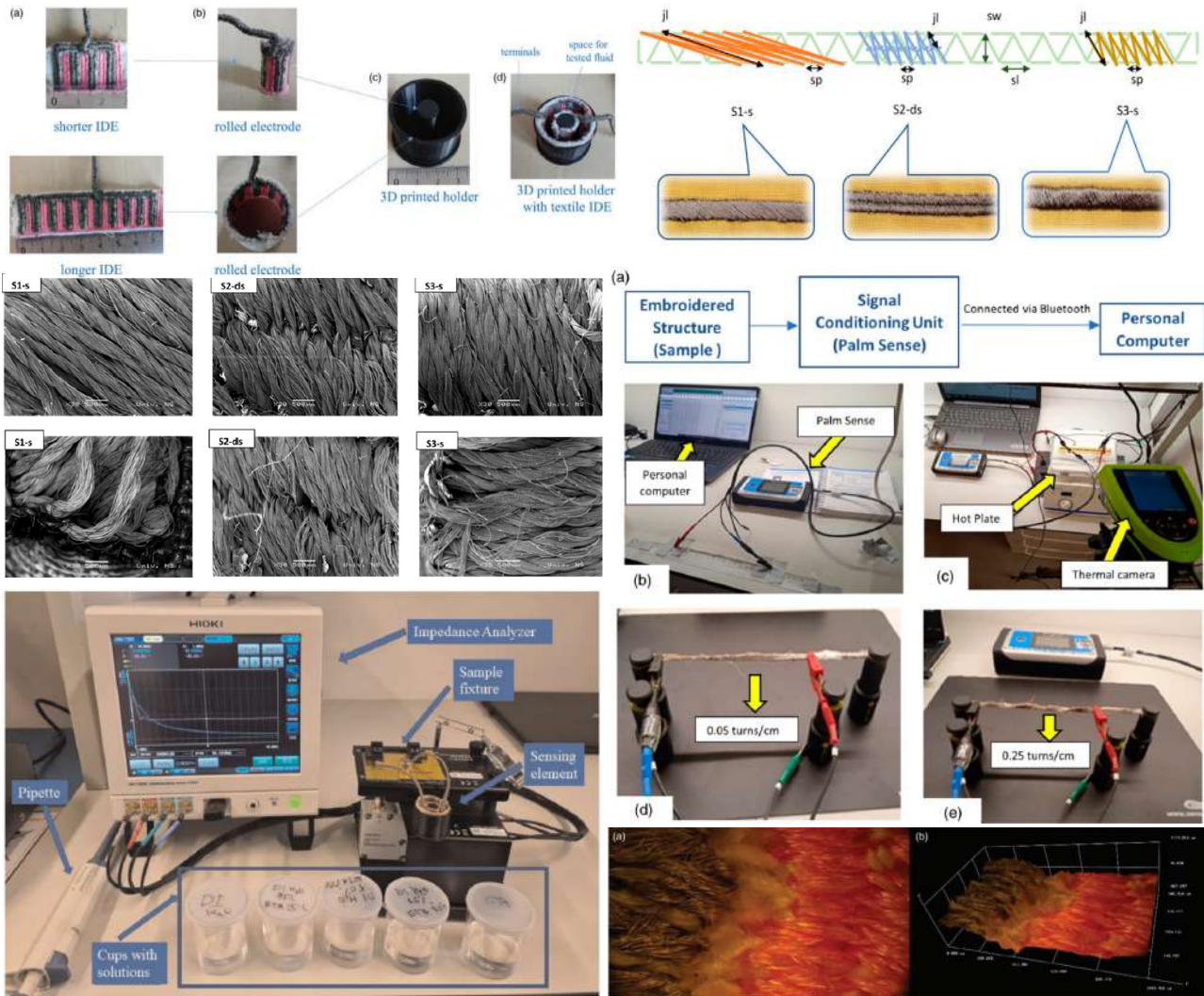
# Strentex

our path of excellence

## NEWSLETTER 2023



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Follow along to see what STRENTEx team has been up to in 2023:

- We did research
- We went to conferences
- We organized and participated in trainings
- We published papers
- We visited partner institutions
- We participated in international fairs

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 854194





The past year has been very busy for all the members of the STRENTEx team:

- 🌀 We developed a portable device for passive LC sensors readout with low-coupling enhanced sensitivity
- 🌀 We developed textile-based heating system for safe localized warts treatment
- 🌀 We embroidered wearable humidity sensor on a commercial face mask
- 🌀 We conducted parameter estimation of the randles equivalent electrical circuit using only real part of the impedance
- 🌀 We conducted feasibility study of conductive embroidered threads for I2C sensors in microcontroller-based wearable electronics
- 🌀 We developed a novel microfluidic compact disc to investigate electrochemical property changes between artificial and real salivary samples
- 🌀 We created paper card-like electrochemical platform as a smart point-of-care device for reagent-free glucose measurement in tears
- 🌀 We came up with a novel method for in-situ extracting bio-impedance model parameters
- 🌀 We developed a sensing system based on knitted electrodes for fruit quality evaluation
- 🌀 We conducted parameter estimation of 2R-1C circuit using embedded hardware
- 🌀 We developed textile-based wearable device for detection of date rape drugs in drinks
- 🌀 We studied the influence of stitch type division and geometry on the electrical properties of conductive embroidered structures

## Our presence in international fairs and conferences

### **OE-A meeting**

Following the very interesting take-aways from the OE-A meeting in Tampere, Finland in October '22, our team members Dr. Mitar Simic and Adrian Stavrakis also joined the OE-A meeting in Munich, Germany in February 2023.

During a full day, they got to hear various opinions and strategies on numerous topics such as green electronics and strategies for tackling employee shortages. All of this was coupled with an excellent networking dinner at the end of the day.





*Dr. Mitar Simić (left) and Adrian Stavrakis (right) at OE-A meeting*

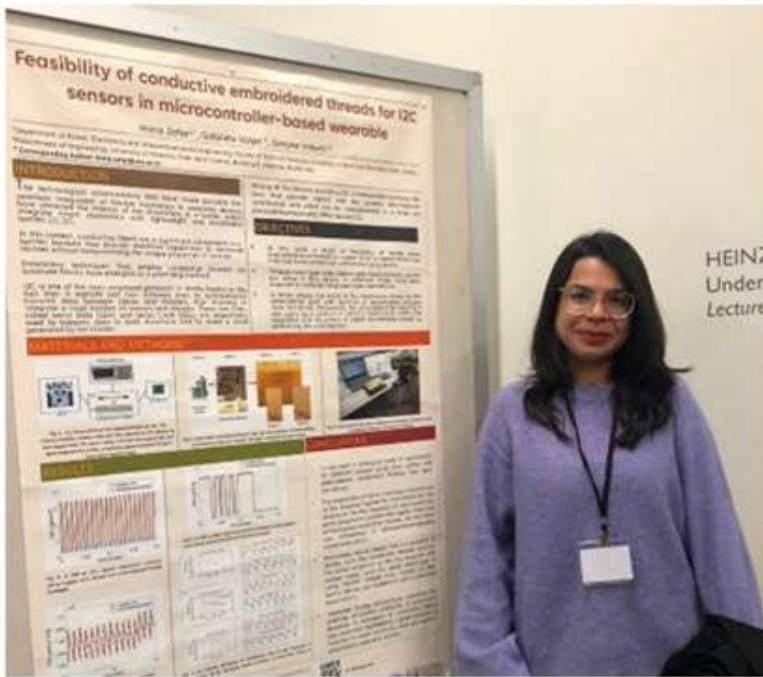
## INFOTEH 2023

The 22<sup>nd</sup> international conference "Infoteh Jahorina" was held from March 15 to March 17, 2023 at the Olympic mountain Jahorina, Bosnia and Herzegovina also with the STRENTEx participation. Our postdoctoral researcher, Dr. Mitar Simić, presented a paper entitled "A 1.5 GHz-1.8 GHz Voltage Controlled Oscillator for Passive LC Sensors Readout" within the poster session.



# SINTEC - Smart Bioelectronics and Wearable Systems final workshop

An early stage researcher at STRENTEX, Ms Hima Zafar, earned the “Best Poster Award” at the SINTEC workshop held at Uppsala University, Sweden 26<sup>th</sup> - 29<sup>th</sup> April 2023, for her work on integrating conductive embroidered threads with I2C sensors in microcontroller-based wearables. The research was praised by industry experts for its originality and consumer relevance, which holds promise for the future of comfortable and customizable health monitoring.



## SENSOR+TEST 2023



STRENTEX team participated in the measurement fair SENSOR+TEST 2023 which was held from May 9<sup>th</sup> to 11<sup>th</sup> 2023 in Nuremberg, Germany. As SENSOR+TEST 2023 is an event which offers for companies and professionals in the field of sensor and testing technologies to showcase their products, exchange knowledge, and discuss the latest advancements in the industry, it was great opportunity for the presentation of the STRENTEX team to this community. STRENTEX stand presented the main achievements of the team



with the developed demonstrators, including facemask respiration monitoring system, facemask heating system, textile FSRs and readout electronics, textile patches for warts treatment, and electronic system for wireless readout of LC sensors. We succeeded to attract a wide audience to visit the STRENTEx booth.



## 10<sup>th</sup> International Conference on Electrical, Electronic and Computing Engineering

The International conference on electrical, electronic, and computing engineering (IcETRAN) is annually organized by the ET(R)AN, which is the oldest, the largest and the most prestigious Serbian professional society in the domain of engineering since 1955. IcETRAN was organized from June 5 to June 7 in East Sarajevo, Bosnia and Herzegovina. Mitar Simic participated online with the invited talk "Measurement Methods, Instrumentation and Data Processing for Textile and Flexible Sensors".



## NANOTECHNOLOGY - EXPO23

Team Strentex proudly participated in the 13<sup>th</sup> International Exhibition on Nanotechnologies, Organic Electronics, and Nanomedicine (NANOTECHNOLOGY Expo 23), held from July 3<sup>rd</sup> to 7<sup>th</sup>, 2023, in Thessaloniki, Greece. This prestigious event, now Europe's largest marketplace for cutting-edge research, applications, and products in various nanotechnology fields, featuring two parallel conferences and one summer school under one roof, attracting over 42 countries and established itself as a premier global networking platform.

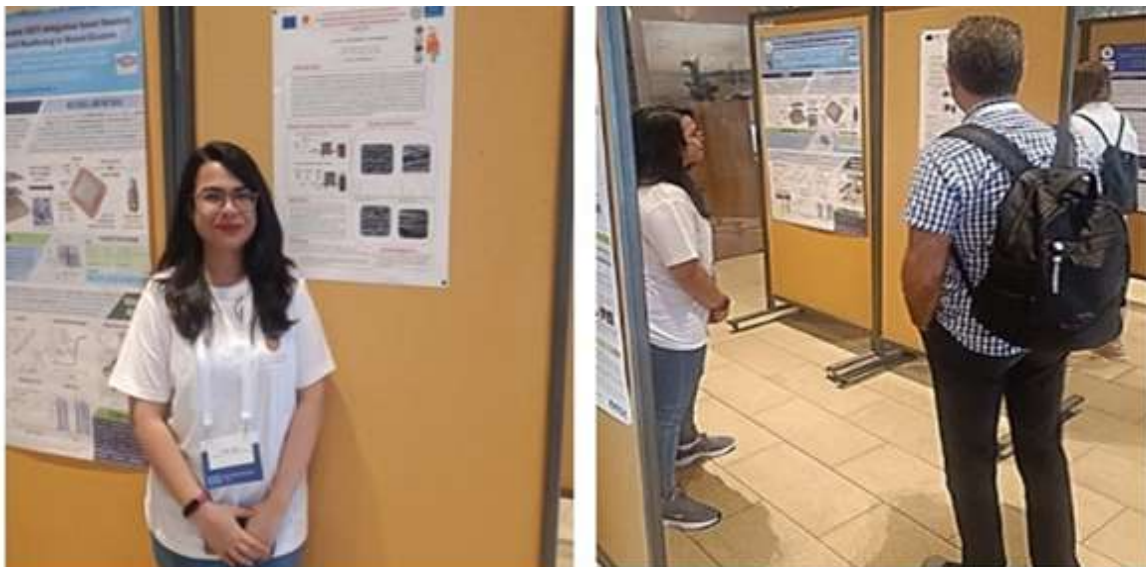
Notably, Strentex presented its latest prototypes including pressure/force measuring mats, breathing/stress monitoring belts, a warts treatment system, embroidered ECG electrodes, and interactive knitted toys.

Highlighting the concurrent nature of the event, NANOTECHNOLOGY Expo 23 hosted two impactful conferences and a dedicated summer school, among them was at the prestigious 16<sup>th</sup> International Symposium on Flexible Organic

Electronics (ISFOE23) in which our team member Hima Zafar presented her research on enhancing the properties of conductive fibers for wearable sensors. Her poster generated significant interest and sparked promising discussions within the specialized field.



*STRENTEX team at NANOTECHNOLOGY EXPO23*



*Ms Hima Zafar presenting her research*



# 16<sup>th</sup> Mediterranean Conference on Medical and Biological Engineering and Computing (MEDICON) and the 5<sup>th</sup> International Conference on Medical and Biological engineering (CMBEBIH)

Strentex is dedicated to fostering innovation in medical technology, and we are proud to see Ms. Hima Zafar research gain recognition at such a prestigious international forum at the MEDICON & CMBEBIH 2023 conference in Sarajevo, Bosnia and Herzegovina on September 14<sup>th</sup> to 16<sup>th</sup>, 2023, where she was invited to give a talk on "Current Scenarios in Serbia: Stretchable Textile Electronics for Non-invasive Glucose Monitoring" highlighting the development and potential of her innovative sensors that utilize sweat analysis to track glucose levels continuously. This non-invasive technology is comfortable and holds immense promise for revolutionizing diabetic care by offering a more user-friendly and convenient monitoring solution compared to traditional finger pricking methods.

Her work has the potential to improve the lives of millions of people living with diabetes by offering real-time glucose monitoring and simplifying disease management.



## IWIS2023

STRENTEx team member, Dr. Mitar Simic, participated at the International Workshop on Impedance Spectroscopy (IWIS2023) in Chemnitz (Germany) from September 26<sup>th</sup> to September 29<sup>th</sup> 2023, with paper entitled “A Low-Complexity Method for Processing EIS Data of R-RC Circuit and Parameter Identification”.



## IEEE Sensors 2023

Our postdoctoral researcher, Dr. Mitar Simic, participated as invited journal author at the IEEE Sensors conference which was held from October 29<sup>th</sup> to November 1<sup>st</sup> in Vienna, Austria. In session “Novel Interfacing Techniques for Sensing Systems” he gave a talk “Parameter Estimation of the Randles Equivalent Electrical Circuit Using Only Real Part of the Impedance”, which was based on our paper published in the IEEE Sensors Journal earlier in 2023.





# Published papers

## The list of published papers in peer reviewed journals:

- Simić, M.; Stavrakis, A. K.; Radovanović, M.; Iqbal, A.; Jeoti, V.; Stojanović, G. M. A Portable Device for Passive LC Sensors Readout with Low-Coupling Enhanced Sensitivity. *IEEE Transactions on Instrumentation and Measurement*, 2023, 72, 1-12. <https://doi.org/10.1109/TIM.2022.3232089> (IF:5.6)
- Simić, M.; Stavrakis, A. K.; Milić, L.; Vučinić-Vasić, M.; Stojanović, G. M. Textile-Based Heating System for Safe Localized Warts Treatment. *Journal of Science: Advanced Materials and Devices*, 2023, 8, 100607. <https://doi.org/10.1016/j.jsamd.2023.100607>. (IF:8.0)
- Sinha, A.; Stavrakis, A.K.; Simić, M.; Stojanović, G. Wearable humidity sensor embroidered on a commercial face mask and its electrical properties. *J Mater Sci* 2023. <https://doi.org/10.1007/s10853-022-08135-2> (IF:4.5)
- Simić, M.; Stavrakis, A. K.; Kojić, T.; Jeoti, V.; Stojanović, G. M. Parameter Estimation of the Randles Equivalent Electrical Circuit Using Only Real Part of the Impedance. *IEEE Sensors Journal*, 2023, 23(5), 4922-4929, <https://doi.org/10.1109/jsen.2023.3238074> (IF:4.3)
- Volpes, G.; Valenti, S.; Zafar, H.; Pernice, R.; Stojanovic, G. Feasibility of Conductive Embroidered Threads for I2C Sensors in Microcontroller-Based Wearable Electronics. *Flexible and Printed Electronics*, 2023. <https://doi.org/10.1088/2058-8585/acbbdc>. (IF:3.1)
- Thiha, A.; Ibrahim, F.; Joseph, K.; Petrović, B.; Kojić, S.; Dahlan, N. A.; Jamaluddin, N. F.; Qureshi, S.; Stojanović, G. M. A Novel Microfluidic Compact Disc to Investigate Electrochemical Property Changes between Artificial and Real Salivary Samples Mixed with Mouthwashes Using Electrical Impedance Analysis. *PLOS ONE*, 2023, 18, e0280381 <https://doi.org/10.1371/journal.pone.0280381>. (IF:3.752)
- Fiore, L.; Sinha, A.; Seddaoui, N.; di Biasio, J.; Ricci, F.; Stojanovic, G. M.; Arduini, F. Paper Card-like Electrochemical Platform as a Smart Point-of-Care Device for Reagent-Free Glucose Measurement in Tears. *Chemical Communications*, 2023, 59, 4300–4303. <https://doi.org/10.1039/d2cc06561d>. (IF:4.9)
- Simić, M.; Freeborn, T. J.; Šekara, T. B.; Stavrakis, A. K.; Jeoti, V.; Stojanović, G. M. A Novel Method for In-Situ Extracting Bio-Impedance Model Parameters Optimized for Embedded Hardware. *Scientific Reports*, 2023, 13. <https://doi.org/10.1038/s41598-023-31860-w> (IF:4.6).
- Kojić, T.; Simić, M.; Vučinić-Vasić, M, Stojanović, G. M.; Sensing system based on knitted electrodes for fruit quality evaluation, *Journal of Food Engineering*, 2023, 353, 111544, 1-9, doi: 10.1016/j.jfoodeng.2023. (IF:5.5)

Simić, M., Freeborn, T. J., Veletić, M., Seoane, F., and Stojanović, G. M.; Parameter Estimation of the Single-Dispersion Fractional Cole-Impedance Model with the Embedded Hardware, *IEEE Sensors Journal*, 2023, 12(12), 12978–12987, <https://doi.org/10.1109/jsen.2023.3269952> (IF:4.3)

Simic, M., Stojanovic, G. M.; Parameter Estimation of 2R-1C Circuit Using Embedded Hardware and Measured Impedance Modulus, *Journal of Circuits, Systems and Computers*, 2023. <https://doi.org/10.1142/s0218126624500890>. (IF:1.278)

Iqbal, A.; Driberg, M.; Jeoti, V.; Aziz, A. A.; Stojanović, G. M.; Simić, M.; Hussain, N. Advancing Multiband OFDM Channel Sounding: An Iterative Time Domain Estimation for Spectrally Constrained Systems. *IEEE Access*, 2023, 11, 103333–103349. <https://doi.org/10.1109/access.2023.3317431> (IF:3.9)

Zafar, H.; Vučinić Vasić, M.; Popović, Ž.; Babković, K.; Stojanović, G. M. Influence of Stitch Type Division and Geometry on the Electrical Properties of Conductive Embroidered Structures. *Journal of Industrial Textiles*, 2023, 53. <https://doi.org/10.1177/15280837231206556> (IF:3.2)

## The list of papers at conferences:

Mitar Simić, "A 1.5 GHz-1.8 GHz Voltage Controlled Oscillator for Passive LC Sensors Readout", in *Proceedings of the INFOTEH-JAHORINA Vol. 22*, 15-17 March 2023, Jahorina, Bosnia and Herzegovina, doi: 10.1109/INFOTEH57020.2023.10094084

Mitar Simić and Milan Radovanović, "Measurement Methods, Instrumentation and Data Processing for Textile and Flexible Sensors", *Proceedings of 10th International Conference on Electrical, Electronic and Computing Engineering (IcETRAN)*, ISBN: 978-86-7466-970-9, June 5-8, 2023, East Sarajevo, Bosnia and Herzegovina.

## Other activities

### **Attendance in a four-day Course on Communication and Presentation Skills in the Professional Environment**

STRENTEX team member Sohail Sarang attended a four-day course on Communication and Presentation Skills in the Professional Environment, organized by the European University Alliance for Global Health (EUGLOH) from May 6, 2023, to May 27, 2023. The course was designed to cover lectures, interactive discussions, and practical exercises related to communication and presentation skills.





*Sohail Sarang (on the right) after successfully completed four-day EUGLOH course*

## **INCOMING DLR PhD Summer School and Poster Presentation**

STRENTEX team member Sohail Sarang participated in INCOMING DLR PhD Summer School which was organized by the Institute of Communications and Navigation of German Aerospace Center (DLR), Germany, and the University of Novi Sad (UNS), Serbia from 12th – 16th June, 2023. It was supported by the European Union-funded project INCOMING (Innovation and excellence in massive-scale communications and information processing). The PhD school had 40 participants and covered topics related to wireless communication, IoT radio access networks, and the information freshness design of wireless networks. The poster presentation session was organized on the final day of the school.



## Optoelectronics lecture by Prof. Umair Korai

On April 19, 2023, members of the STRENTEX Project had an opportunity to hear a lecture of Prof. Umair Korai related to his results in the field of optoelectronics.



## ERA Chair holder in visit of MEMS, Microfluidics and Nanoelectronics (MMNE) Lab

MEMS, Microfluidics and Nanoelectronics (MMNE) Lab from India welcomed Prof. VARUN JEOTI (ERA Chair at Faculty of Technical Sciences, University of Novi Sad) in their lab. Prof. Varun delivered a lecture on "Integrating Battery-Free Sensing in Textile Electronics Application" on April 25, 2023.





## **ERA Chair holder in visit of School of Electrical and Communication Engineering (SECE) at BSA Crescent Institute of Science and Technology**

Prof. VARUN JEOTI (ERA Chair holder within the STRENTEX Project at the Faculty of Technical Sciences, University of Novi Sad) visited the School of Electrical and Communication Engineering (SECE) at BSA Crescent Institute of Science and Technology, Chennai, India for possible #academic and research collaboration in the period 27-28 April, 2023.



## **Lecture on polymeric bioactive composites for biomedical applications by Dr. Umar Khan**

Our project team had the privilege to attend a lecture by Dr. Umar Khan from Qatar University on November 9, 2023. Dr. Khan shared insights into the cutting-edge development of polymeric bioactive composites for biomedical applications.



## **Participation in JRC Summer School on the evaluation of air, soil and water pollution in support to the European Green Deal: a holistic approach**

The summer school on the “Evaluation of air, soil, and water pollution in support of the European Green Deal: a holistic approach” was organized by the European Commission Joint Research Centre (JRC) in collaboration with the University of Novi Sad, Serbia from 4-8 September, 2023. STRENTEX team member Sohail Sarang participated in this school that aimed to engage students and young scientists from the Western Balkans in enhancing their green skills and preparing them for a more sustainable and resource-efficient society. It covered the latest topics and advanced techniques for the evaluation of air, soil, and water pollution, featuring practical exercises and demonstrations, followed by results analysis.



## **Summer School on “Telemedicine Care: Towards sustainable and co-designed telemedicine system in Western Balkan”**

Our Early-stage researcher Ms. Hima Zafar was selected in PhD researcher Panel to present her poster on “Wearable Embroidered Sensor for Predicting Stress” in the DAAD German exchange program-funded Summer School on “Telemedicine Care” at the University of Polytechnic, Tirana, Albania, 4th -8th September, 2023, earning 3 ETC points.





## Participation in Bordeaux Summer School “Internet of things”

STRENTEX team member Sohail Sarang attended Bordeaux Summer School “Internet of things” which was organized by University of Bordeaux, Bordeaux, France from 18-22 September, 2023. This school was designed to cover both theoretical and practical sessions, focusing on sensing, energy efficient data transmission, data storage and analysis. The invited speakers delivered talks on various topics, including radio communications, data processing, artificial intelligence, energy harvesting, and long and short-range communication. The sessions were followed by hands-on tutored workshops conducted by experts.



## Open Science Forum

STRENTEX project organized Open Science Forum on May 29, 2023. During the event, you could hear more about Open Science in Horizon Europe projects, FAIR principles, Open Research in Europe, how to communicate science in open science era, all about escience and EOSC, measurement data for creation of AI systems, as well as replication studies and open science practices. We are thankful to all the participants,



especially the speakers Gareth O'Neill, Dr. Alicia Estacio Gómez, Tony Ross-Hellauer, Dobrivoje Lale Eric, Kosanovic Biljana, Milica Ševkušić, Almir Badnjević, Prof. Goran Stojanovic and Dr. Iris Žeželj and Aleksandra Lazić.

# We participated at the Open Door Day of FTS-UNS

On April 1st, 2023, Strentex team member Lazar Milić, presented the work done in the field of textile and flexible electronics during the Open door day at the Faculty of Technical Sciences, University of Novi Sad. The presented work describes exciting solutions in the field of e-textiles and flexible electronics for every day use, which were done by researchers from the Strentex team.



## STRENTEX joins Textile ETP

Our project joined the European Technology Platform for the Future of Textiles and Clothing (Textile ETP), which is the largest European open expert network of professionals involved in textile and clothing-related research and innovation. Through this platform, we expect to further advance our research efforts through collaboration, and disseminate our results to an even broader audience.



# STRENTEX Team Contributes to GENIUS Event Promoting Psychological Adaptation Research

The esteemed STRENTEX research team recently participated in the citizen science event "GENIUS" (Genetic and Environmental Influences on Psychological Adaptation of Children and Adults) organized by Dr Snezana Smederevac, Faculty of Philosophy, University of Novi Sad under Program IDEAS, Science Fund of the Republic of Serbia on 11th June 2023. This event aimed to foster a citizen science approach, encouraging the involvement of diverse stakeholders beyond academia.



## Our team participated at the European Researcher Nights

Starting on September 29th, science clubs across Serbia hosted activities for audiences of all ages throughout the Researchers Week. European Researchers Night, supported by the EU, aims to celebrate researchers and science in an engaging way and has been brought to Serbia through two exciting projects: ReFocuS Art and SciencesCool. With the participation of 300 to 500 scientists each year, this event, held across Europe, is not to be missed. Our project team showcased some of our demonstrators and attracted lot of young people interested in our stand.



## Worldwide Knit in Public event

STRENTEx Project team took part in the Worldwide Knit in Public event on June 10, 2023, at SKCNS Fabrika in Novi Sad.

Every year, on the second Saturday of June, people all over the world knit in public. The goal of the holiday is to show that knitting is a fun thing to do for people of all ages. Amidst the charming backdrop of our city Novi Sad, situated on bank of Danube River, STRENTEx team came together participating in worldwide event allowing us to connect with knitting enthusiasts, celebrate our shared passion, and contribute to the vibrant knitting community. It was a wonderful day filled with creativity, laughter, and warm camaraderie.



## Maker Fest

We were thrilled to be a part of this incredible event at Science and Technology Park Novi Sad, Serbia on October 14, 2023. It was an amazing day filled with innovation, creativity, and technology. What made this day even more special was the diverse crowd that joined us at the festival. #People of all ages came together to celebrate the spirit of making and learning.





## STRENTEX Team Member awarded PhD Degree

STRENTEX team member Sohail Sarang successfully defended his PhD in Electrical and Computer Engineering on 18 July, 2023. His PhD research work focused on the development of Prediction-based Adaptive Duty Cycle MAC Protocol for Solar Energy Harvesting Wireless Sensor Networks.



## Strentex team earns Spot in Prestigious Accelerator- NS Hackathon

Hima Zafar, an early-stage researcher at Strentex, wowed judges at the NS Smart Hackathon. Battling against 10 teams, she secured 4th place in the #3ALET program, an intensive business accelerator for winning tech ideas.



This prestigious program helped Hima and her team with the tools and skills needed to refine their concept and potentially launch a successful Small-Scale Business.

The hackathon's success stemmed from a vibrant collaboration between EU info Point Novi Sad, City of Novi Sad, and a diverse group of mentors and jury members from industry giants like Schneider Electric and academic institutions like BioSense Institute.

# 1st Autumn workshop on functional organic materials for sustainable future

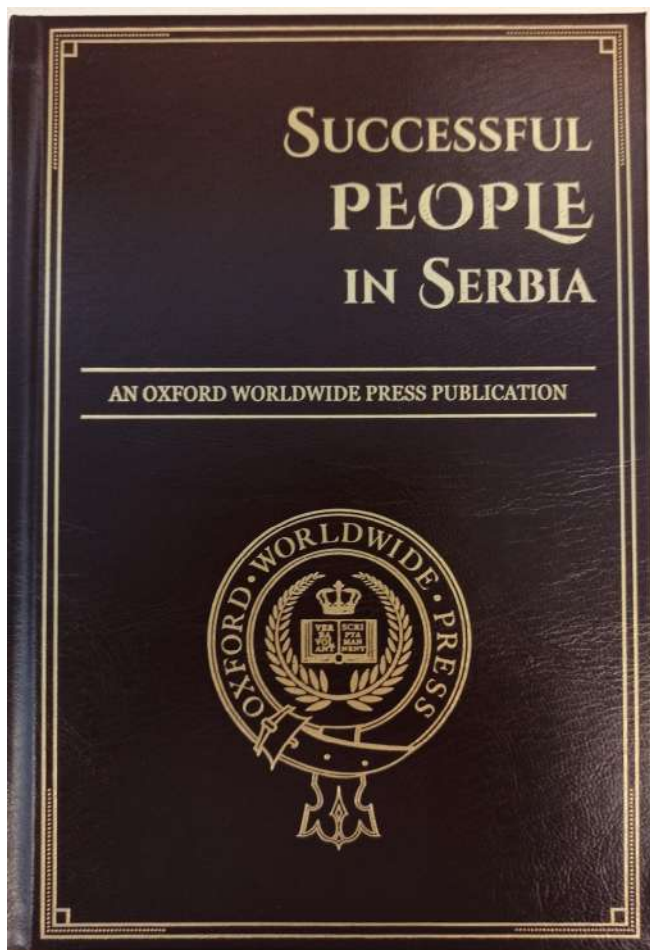
Our team member Sanja Kojić participated in the 1<sup>st</sup> Autumn workshop on functional organic materials for sustainable future held during 15-16 November 2023 in Brno, Czech Republic, organized by Brno University of Technology, Faculty of Chemistry. At the event, Sanja spoke about Application of textile and green materials in biomedicine.



## Media and Interviews

### Oxford Worldwide Press Ltd

Recently, a publication entitled "Successful people in Serbia" has been published by the OXFORD WORLDWIDE PRESS LTD. We are proud that our STRENTEx Project coordinator Prof. Goran Stojanovic's biography is presented inside of this publication, among the other respectful persons from Serbia.





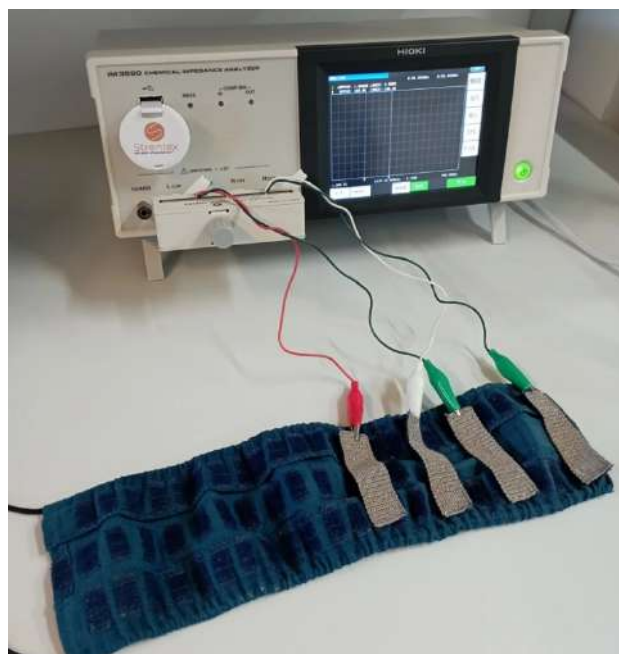
## National TV show “Šarenica”

Prof. Goran Stojanovic was hosted in national TV show “Šarenica”. He talked about practical innovations his team of researchers and associates is developing, including the ones from the STRENTEx Project. It was a great opportunity for wider community and audience to hear more about innovations we are creating.



## STRENTEx on Blic Newspaper

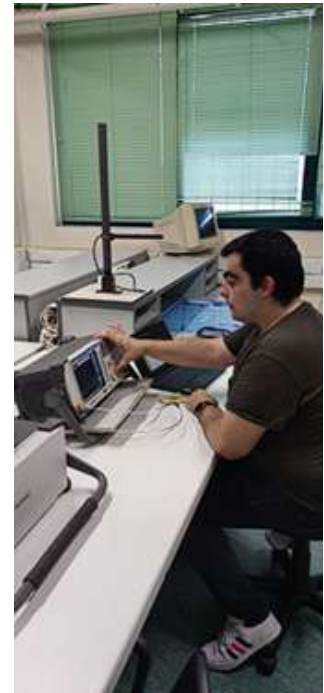
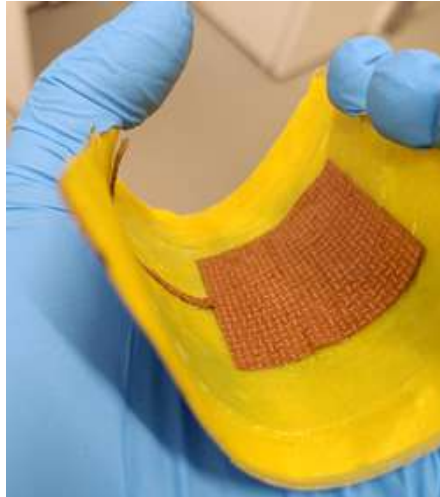
National daily newspaper “Blic” published an article about STRENTEx project researcher Dr. Mitar Simic, explaining how the device measuring fruit freshness works.



## Staff Exchange

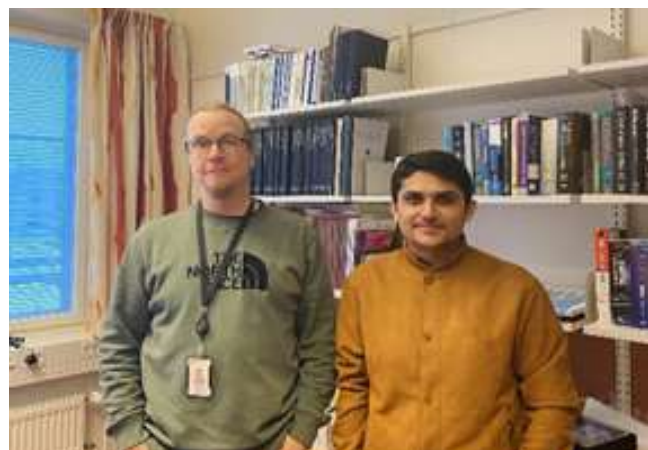
### Adrian Stavrakis

Adrian Stavrakis, doctoral researcher with the STRENTEx project visited the Department of Information and Electronic Engineering of the International Hellenic University in Thessaloniki, Greece between August 1<sup>st</sup>, and September 29<sup>th</sup>, 2023. During these two months he collaborated with researchers from the host institution in the fields of antennas, remote sensing and wave propagation theory, discussed future collaboration, and project ideas. They already wrote a joint funding proposal in the field, and part of their research work is already under consideration for publication.



### Sohail Sarang

STRENTEx project team member Sohail Sarang, from the Faculty of Technical Sciences at the University of Novi Sad, Novi Sad, Serbia, completed a two-month secondment at Tampere University, Finland, from October 1 to November 30, 2023. During this period, he collaborated with Prof. Mikko Valkama, a Professor of Communications Engineering, focusing on DECT-2020 NR and battery-free Internet of Things. In December 2023, a joint paper resulting from their collaboration has been accepted for oral presentation at the IEEE Wireless Communications and Networking Conference scheduled for April 21–24, 2024, in Dubai, United Arab Emirates.





# Contact us



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