

How one TEMPUS project fostered a new scientific field in Montenegro and helped fight COVID-19

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Me and Tempus/Erasmus

No many European education and research programmes have contributed so much to the Western Balkan region as TEMPUS, later ERASMUS/ERASMUS+. From my current standpoint I can say, without any doubt, that this programme has been a guiding light for my professional and personal career. The beginning of the TEMPUS programme, in the early 1990s, coincided with my graduation from the University of Montenegro, when I realized that real professional and research growth was impossible without embracing the international dimension. The country of my youth, the former Yugoslavia, was among the first to join the programme, Tempus 1991 unfortunately, for only one year, because, after that we experienced both the dissolution of the country and the outbreak of civil war. I remember well that, in either 1991 or 1992, one of my professors, Prof. Novak Jauković, received a Tempus grant, but sadly, he was never able to use it, due to the international embargo that followed. Other republics of the former Yugoslavia continued to take part in the Tempus programme, often very quickly restarting their engagement, from as early as 1992, while we had to wait almost a decade to continue in 2001 as the Federal Republic of Yugoslavia, later as Serbia and Montenegro, and then as Montenegro. It was in 2001 that my professor, Prof. Momir Djurović, with whom I worked in the laboratory, received a grant as part of the Tempus III call and I started to be involved. In 2002, I tried with my own solo project and received an IMR (Individual Mobility Grant) that was devoted to an individual short term scholarship (about three months). I used my IMR to prepare a larger grant, and I succeeded in 2005 with my first Tempus Joint European Project (JEP) named "The Introduction of a New Study Program in Applied Electronics", under code JEP-40017-2005. At that time, we could not be a "grant holders", but I was the working coordinator. It was a great recognition for me and at the same time an obligation, as a young assistant professor. The modest website for that project, www.spiae.ac.me still exists to this day. I remember that one of the members of my consortium Prof. Ladislav Novak, a legend of Tempus in the former Yugoslavia, from whom I learned a lot about international projects. Through this project we composed a new curriculum for Applied Electronics at the University of Montenegro, equipping a modern laboratory, called MEDEL,

which remains among the best at the Faculty of Electrical Engineering and which is the birthplace of many experiments and innovations in Montenegro. Many brilliant students, who later went on to be excellent engineers took their first steps in this laboratory. In addition to offering education we also used this Laboratory to apply for and win other projects from different schemes. Although relatively young, I was already experienced enough to join the team of Tempus evaluators that worked at that time as part of the European Training Foundation (ETF), suited in Turin, Italy. Later the pool of evaluators moved to Brussels. I continue to live and work with this programme right up to the present day, covering almost two decades of my professional life.

BioEMIS project and its impacts

This story is about my 2nd Tempus project "Studies in Bioengineering and Medical Informatics (BioEMIS)", 530423-TEMPUS-1-2012-1-UK TEMPUS-JPCR. It was about Biomedical Engineering (BME) that in essence means the application of engineering sciences and skills in medicine. It is well known to everyone that modern medicine mainly developed thanks to technology, rather than breakthroughs in clinics. The medical devices we use today are the result of the joint work of physicians, scientists and engineers. BME is an extremely complex and extensive discipline that is not easy to summarize and teach through a couple of university courses. In developed countries it has its own clear educational profile, from the undergraduate to the doctoral level, and covers a number of scientific and technical fields such as: biomedical electronics, biomedical instrumentation and measurements, biomechanics, biomaterials, cell engineering, tissues and genetics, clinical engineering, rehabilitation engineering, pharmaceutical engineering, bio-nano technology, bioinformatics, safety standards of medical equipment, telemedicine and numerous others. In Montenegro, BME as a field was poorly developed, probably due to the lack of our own high-tech industry and the dominance of classical approaches in the health sector, where the "white coats" play the main role and sees new medical devices as somewhat suspect "black boxes". The Institute of Physical Medicine, Rehabilitation and Rheumatology "Dr Simo Milošević" in Igalo, was, for a long time, the only institution which dealt with BME, mainly through rehabilitation engineering. This institute was a member of our BioEMIS consortium.

From our current perspective, it could be said that the first milestones in developing biomedical technology and informatics in Montenegro were the BioEMIS project and the MEDEL laboratory. In terms of curricula reform, BioEMIS introduced two new study programmes: a 1 year Specialization in MEDICAL ELECTRONICS and a 1 year Masters course in MEDICAL ELECTRONICS, both offering 60 ECTS credits, <http://www.apeg.ac.me/medel/>. In addition to the University of Montenegro, other participants in the project from our country included the Ministry of Education and Sport, the Simo Milosevic Institute, the Montenegrin Medical Chamber and an ICT company called Cikom, out of a total of 24 partners from across the EU and the region. The leadership of the project was entrusted to the University of Birmingham, UK, and besides that institution, the EU partners included the University of Pierre and Marie Curie, known as the Sorbonne, in Paris, the Technical University of Tampere, Finland, and the University of Maribor, Slovenia. Among the partners from Serbia, there were the Universities of Kragujevac, Nis and

Belgrade, the University of Defense, the Military Medical Academy, several clinical centers, specialist medical and technology companies and the Medical Chamber of Serbia. Bosnia and Herzegovina was represented by, among others, the Universities of Banja Luka, East Sarajevo, Mostar and Bihac. Since 2016, about 60 students have attended MEDEL courses, 45 at the Specialist level and 15 at the Master's level. Some of them continued their careers abroad, where they successfully completed their Master's or PhD degrees. The engineers from MEDEL are the backbone in the process of maintaining medical equipment in Montenegro. Several of them have formed successful startup companies.

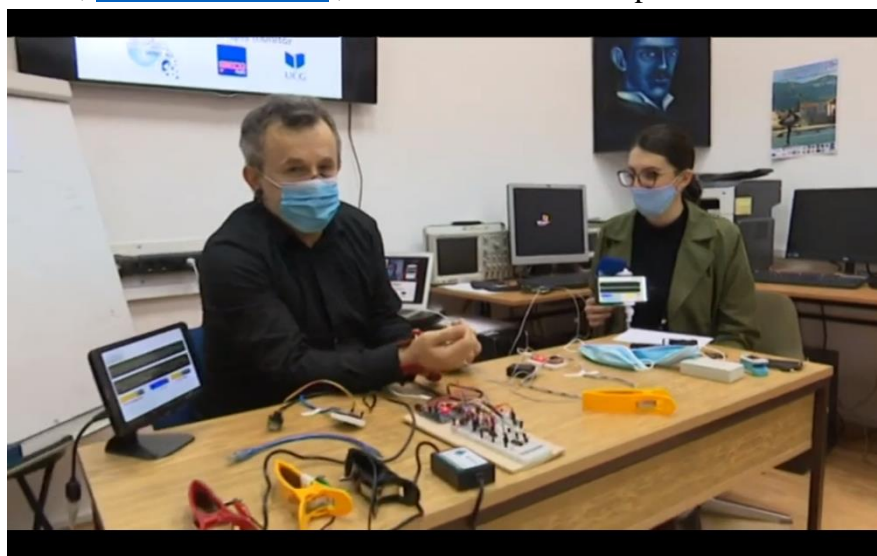
What made the BioEMIS project particularly recognizable and well regarded is its sustainability and impact. It launched an avalanche of new projects and research in the fields of biomedical engineering and biomedical technologies. Science and education policy makers in Montenegro have begun to understand the importance of this discipline and awarded several key projects in this area from the funds received from the World Bank in 2013: "BioICT" (ETF Excellence in Bioinformatics Center) , "New ICT trends based on a significantly smaller number of data / measurements and their application in multimedia, biomedicine and communications" -CS-ICT, "Development, validation and application of the telemedicine system TELEMONTKEG (TM ECG) for rapid diagnosis of heart disease in Montenegro" . A CENTER OF EXCELLENCE FOR BIOMEDICAL RESEARCH (CEBIMER) has been established at the Simo Milošević Institute in Igalo as a strategic project of the Ministry of Science. A POSTGRADUATE ACADEMIC MASTER'S STUDIES course on "INFORMATION MANAGEMENT IN HEALTHCARE" has been created at the University of Donja Gorica (UDG). One of the largest planned projects in science in Montenegro is the proposed International Institute for Sustainable Technologies (SEEIIST) which will offer a cutting edge cancer therapy department. The number of publications in this field authored by Montenegrin researchers has started to grow exponentially. There are now a large number of works by Montenegrin researchers in the field of biomedical research. The MEDEL programme has established one of the most widely respected workshops in the field of Biomedical Engineering and Medical Informatics in Europe, the "Workshop on Recent Advances in Computational and Engineering Methods in Biomedicine and Rehabilitation", <http://embeddedcomputing.meconet.me/special-sessions/#cembr> . This year, we are holding the 4th Workshop.



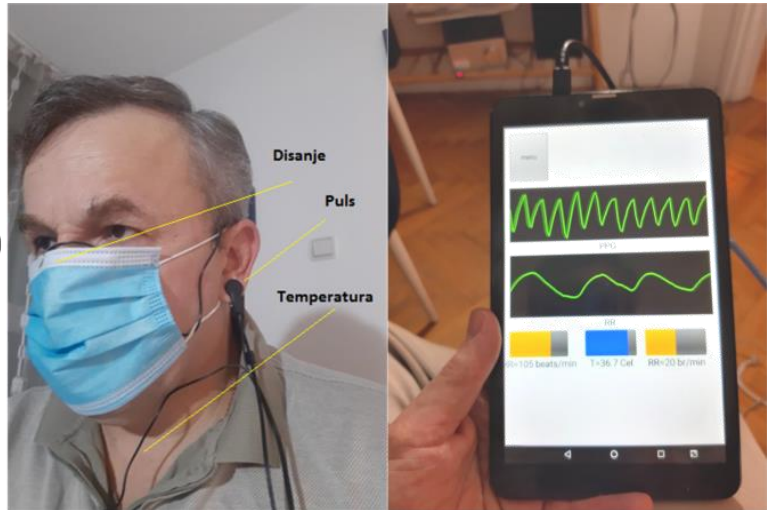
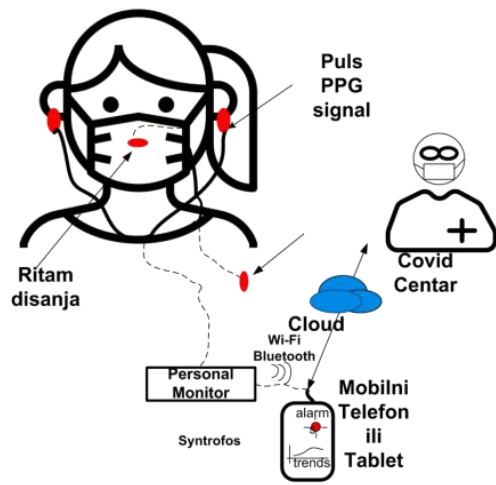
The first students of BioEMIS, now reputable experts, with Prof. Stojanović

BioEMIS and COVID-19

During the time of the COVID-19 pandemic, the programme has more than justified its existence. Several devices have been developed from its laboratories, helping people to fight COVID-19. One of them is a handheld-home monitor for COVID symptoms called Syntrofos (from the Greek for Companion). Syntrofos is an electronic device that monitors and measures the main symptoms of COVID such as body temperature, respiratory rate, heart rate, oxygen saturation and so on, and displays the information on a mobile phone, while also sending the data to a remote doctor at the COVID Center. Thanks to Syntrofos, it is possible for everyone to have a personal COVID symptoms monitor, at home, 24/7 all year round. Syntrofos will be produced by the startup company MECOnet, www.meconet.me, which is also a development of MEDEL.



A demonstration of various anti-Covid devices in the MEDEL laboratory



How Syntrofos is working