ANNOTATION OF THE MATERIALS

under Art. 65 of the Regulations for the Development of the Academic Staff at Plovdiv University "Paisii Hilendarski"

of

Assist. Prof. Stanislav Mitkov Asenov

for participation in the open contest for the academic position of "associate professor" in the area of higher education **5 – Technical Sciences, Professional Field 5.3 Communication and Computer Engineering (Computer Systems, Complexes and Networks) at the Faculty of Physics and Technology, Paisii Hilendarski University of Plovdiv, announced in the State Gazette, issue No. 96 of 11 November 2025.**

All scientific publications, provided for participation in the contest for the academic position of "Associate professor", are published after the candidate obtained her PhD degree and started working at the academic position of "Assistant professor". A total number of 33 publications are included in this application.

The main scientific topics of the candidate's publications presented in the competition are focused on computer systems, microprocessor and microcontroller-based electronic systems and sensors, artificial intelligence systems, and their validation and application in engineering education.

Source: SCOPUS (19 December 2025)
Link to SCOPUS profile:
https://www.scopus.com/authid/detail.uri?authorId=57211760523

Publications:

- **Following B 4 criteria: Habilitation work – scientific publications in journals, indexed in the world's leading scientific databases (Web of Science and/or Scopus):**

B4.1 S. M. Asenov and D. M. Tokmakov, "Dual MCU Wireless Sensor Node For Engineering Education," *2021 XXX International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2021, pp. 1-4, doi: 10.1109/ET52713.2021.9580055.

URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9580055&isnumber=9579476 **(Scopus)**

In the last few years, IoT devices have multiplied their number and functionality. These devices are located all over the world, and batteries are their main source of energy. It is extremely important to reduce the energy consumed by the sensor nodes in order to prolong the life of the batteries. Following this trend, we have integrated in the practical classes of students laboratory exercises in the engineering discipline "Design of microcontrollers" and

"Microprocessor technology", software and hardware methods to reduce the consumption consumed by wireless sensor nodes. This article presents a designed and manufactured laboratory kit of a two-controller LoRaWAN wireless sensor node, which is used for educational purposes of students of engineering disciplines. It is made of two microcontrollers – ESP32 and ATMEGA328P, as well as an RF96 LoRaWAN transceiver. The emphasis in the designed stand is the possibility for the sensor unit to be powered by both batteries and a battery-free harvester system and supercapacitors. In addition to the architecture, a TPL5110 nano timer has been added, which can be used as an external timer to implement an interruption to the microcontrollers. It is possible to additionally connect various sensors to the SPI and I2C communication interfaces of the microcontrollers. Through hardware jumpers, different scenarios of operation of the sensor units can be realized, and students can monitor the energy consumed in each of these scenarios, as well as include and exclude various components of the architecture. In this way, they acquire skills and knowledge for the implementation of low-energy wireless sensor nodes.

B4.2 S. Asenov and D. Tokmakov, "Using of Batteryless LoRaWAN Ultrasonic Sensor Node for Smart Garbage Collection," *2022 13th National Conference with International Participation (ELECTRONICA)*, Sofia, Bulgaria, 2022, pp. 1-4, doi: 10.1109/ELECTRONICA55578.2022.9874361.
URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9874361&isnumber=9874359 **(Scopus)**

This paper presents the use of a batteryless LoRaWAN ultrasonic sensor node for the realization of LoRaWAN-based smart garbage collection, intended for deployment in waste management within the Smart Cities context. In particular, the paper presents the possibility of using LoRaWAN waterproof ultrasonic sensor nodes powered by solar harvester systems to measure the level of waste in waste bins and to reduce harmful emissions from garbage trucks by lowering their fuel consumption and, in this way, decreasing the frequency of waste collection procedures.

B4.3 D. M. Tokmakov **and S. M. Asenov**, "Autonomous Smart Wireless LoRaWAN Vehicle Parking Sensor," *2022 XXXI International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2022, pp. 1-5, doi: 10.1109/ET55967.2022.9920335.

URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9920335&isnumber=9920204 **(Scopus)**

This paper presents the use of a battery-powered LoRaWAN ultrasonic sensor node for the realization of an autonomous smart LoRaWAN vehicle parking sensor. In particular, the paper presents the possibility of using a waterproof LoRaWAN ultrasonic sensor node powered by solar harvester systems to manage parking areas. The hardware design and software implementation of the sensor node are presented. The designed and implemented sensor node was tested under real external atmospheric conditions in order to guarantee its autonomous operation.

B4.4 S. Asenov and D. Tokmakov, "Using Solar Energy Harvesters in Engineering Education," *2022 30th National Conference with International Participation (TELECOM)*, Sofia, Bulgaria, 2022, pp. 1-4, doi: 10.1109/TELECOM56127.2022.10017330.

URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10017330&isnumber=10017257 **(Scopus)**

This article presents our experience in integrating solar harvester systems into engineering training. The increased capacities of supercapacitors, as well as their advantages over conventional batteries, together with energy harvester systems, make them extremely attractive and widely used by researchers and engineers for the implementation of various projects. Following this trend, laboratory exercises have been integrated into students' practical classes in the engineering disciplines "Microcontroller Design" and "Microprocessor Technology," focusing on software and hardware methods for reducing the power consumption of wireless sensor nodes and on the use of solar energy harvesters as power sources for sensor nodes. The article focuses on experimental studies of different harvester systems—LTC3588 and BQ25570—collecting energy from various photovoltaic panels. Students are able to design and implement autonomous wireless sensor nodes powered by solar energy harvesters. In this way, they acquire skills and knowledge for implementing low-energy wireless sensor nodes without the use of harmful chemical batteries. Good knowledge of solar harvester systems leads to an improvement in the quality of engineering education.

B4.5 D. Kashokova, A. Bekyarova-Tokmakova and **S. Asenov**, "Artificial Intelligence in Teaching Students on Microcontrollers and Embedded Systems," *2024 XXXIII International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2024, pp. 1-4, doi: 10.1109/ET63133.2024.10721571.
URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10721571&isnumber=10721478 **https://www.scopus.com/inward/record.uri?eid=2-s2.0-85209187643&doi=10.1109%2FET63133.2024.10721571&partnerID=40&md5=c804e743dc739220ecc1453537a8dd92 (Scopus)**

Artificial Intelligence (AI) is increasingly integrated into education to enhance learning experiences and outcomes, particularly in engineering disciplines such as microcontrollers, sensors, and embedded systems. This paper explores the application of AI in supporting student learning in programming and in understanding microcontrollers, sensors, and embedded systems, with a focus on personalized learning, interactive simulations, and real-time feedback mechanisms. By leveraging AI-driven tools, educators can provide tailored educational experiences that deepen students' understanding and improve their proficiency in these critical areas of engineering.

B4.6 R. Popov,S. Lyubomirov, S. Stoyanova, S. Petrova, B. Nikolov, V. Yancheva, E. Georgieva**, S. Asenov**, D. Tokmakov, (2024), "Sensor system for in-situ monitoring the surface waters quality of the Veleka River, Strandzha Nature Park (Bulgaria)," DSpace Repository https://doi.uni-plovdiv.bg/handle/store/306

https://eb.bio.uni-plovdiv.bg/wp-content/uploads/2024/09/199-206_eb24108.pdf **(Scopus)**

Monitoring the environmental status along the Veleka River (Strandzha Mountain, Bulgaria) is an essential measure for preventing the risks of ecological catastrophes and for preserving the unique biological diversity of the region. A system for monitoring key parameters of surface waters, soils, and air, as well as sunlight levels, has been designed and initially

tested. For this purpose, an automatic remote measuring station was developed, intended for installation on the riverbank near the riverbed. The station is designed not only to collect and archive information on the physicochemical status of the river, but also to periodically transmit the data to a communication server. The developed system of multiple automatic measuring stations will enable not only analysis of the current environmental status, but also the generation of early warnings in the event of a potential ecosystem health decline.

B4.7 K. Asparuhova, D. Shehova, **S. Asenov,** H. Kanevski and A. Parushev, "Using WOKWI Simulator to Support Engineering Student Learning in Microcontrollers and Sensors," *2024 XXXIII International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2024, pp. 1-4, doi: 10.1109/ET63133.2024.10721553. URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10721553&isnumber=10721478

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85209182799&doi=10.1109%2FET63133.2024.10721553&partnerID=40&md5=67d42991f0cabdc6bf3e533e2a265b68 **(Scopus)**

The authors present the use of the Wokwi online environment for the creation of digital educational content in the disciplines "Microprocessor Technology" and "Microcontroller Programming," which are included in the curricula of engineering programs in higher education institutions. Simulation models of various implemented microcontroller systems are proposed, incorporating a wide range of sensors and actuators, LCD displays, communication modules, and other peripherals. These simulation models enable examination, configuration, and diagnostics of hardware, processor software, and peripheral devices. The simulation models implemented in Wokwi provide a solid foundation for successful subsequent software and hardware implementation.

B4.8 H. Kanevski, **S. Asenov**, D. Shehova, S. Lyubomirov, K. Asparuhova and P. Fidanski, "Laboratory Bench of a Driver's Authorization System with Application in Engineering Education," *2024 XXXIII International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2024, pp. 1-4, doi: 10.1109/ET63133.2024.10721555.

URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10721555&isnumber=10721478

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85209181037&doi=10.1109%2FET63133.2024.10721555&partnerID=40&md5=14a61b9a8f1f3381bce757f1ce19746e **(Scopus)**

This study presents the development and application of a laboratory bench for a driver's authorization system based on components from a Mercedes-Benz W203. The bench includes an engine control module, an airbag module, a SAM module, an instrument panel, and an electric steering wheel lock, while maintaining CAN communication between them. The purpose of the bench is to serve as an educational tool in engineering education by providing students with hands-on experience using real automotive systems and technologies. The research demonstrates that this approach improves students' understanding of the complex interactions in modern automotive systems and supports the development of their practical skills. The experimental results from pilot testing of the system are also presented and discussed.

B4.9 D. Tokmakov, **S. Asenov** et al., "Development And Research of an IoT WSN For Measuring Fine Dust Particles PM10 and PM2.5," 2023 31st National Conference with International Participation (TELECOM), Sofia, Bulgaria, 2023, pp. 1-5, doi: 10.1109/TELECOM59629.2023.10409689.

URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10409689&isnumber=10409647

(Scopus)

This paper introduces a successfully developed and tested state-of-the-art IoT-based real-time air quality monitoring system tailored for Smart Cities. The system is distinguished by its low energy consumption and relies on the combined use of LoRaWAN and GPRS wireless communication technologies. Its versatility allows deployment in both indoor and outdoor environments. The key components of the system include a single-chip microcontroller, air pollution sensors capable of measuring NO_2, CO, PM1, PM10, and PM2.5 concentrations, as well as Long Range (LoRa) and GSM modems. To ensure a sustainable power supply, the system integrates a photovoltaic panel and a battery. In addition, it features a graphical user interface for visualization of the collected data. The use of these technologies provides the fine particulate matter monitoring system with several significant advantages, including cost-effectiveness, long-range communication capability, wide coverage, extended battery life of the devices, and ease of operation. Overall, the proposed system represents a significant advancement in real-time air quality monitoring and fully aligns with the objectives of Smart Cities and IoT-driven urban development.

B4.10 **S. Asenov**, D. Tokmakov, K. Asparuhova, H. Kanevski and D. Shehova, " Autonomous Human Presence Solar Energy Harvesting Sensor Node for IoT Applications," *2023 14th National Conference with International Participation (ELECTRONICA)*, Sofia, Bulgaria, 2023, pp. 1-4, doi: 10.1109/ELECTRONICA58875.2023.11173913.

URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=11173913&isnumber=11173846 **(Scopus)**

This work presents the use of a solar-energy-powered LoRaWAN sensor node for the realization of an autonomous smart LoRaWAN human presence sensor intended for enterprise Internet of Things applications. In particular, the paper presents the possibility of using a LoRaWAN human presence sensor node powered by solar energy harvester systems to manage bus stops and to count bus passengers. The hardware design and software implementation of the sensor node are presented. The designed and implemented sensor node was tested under real external atmospheric conditions to ensure its autonomous operation.

According to Criterion Г 7: Scientific publications in journals that are peer-reviewed and indexed in international scientific databases

Г 7.1 D. Tokmakov and **S. Asenov**, "Operational Amplifier Open Loop Gain Simulation in Electronics Engineering Education," *2020 XI National Conference with International Participation (ELECTRONICA)*, Sofia, Bulgaria, 2020, pp. 1-4, doi: 10.1109/ELECTRONICA50406.2020.9305128.URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9305128&isnumber=9305093 **(Scopus)**

Simulating the open loop gain of an amplifier circuit is a highly misunderstood subject in Electrical and Electronics Engineering. In order to address that issue we describe four methods that we use to successfully simulate an operational amplifier open loop gain in an engineering education environment.

Г 7.2 S. M. Asenov and D. M. Tokmakov, "Low Current Measurement System For Wireless Sensor Nodes," 2021 XXX International Scientific Conference Electronics (ET), 2021, pp. 1-4, **DOI:**10.1109/ET52713.2021.9579667, ISBN:978-166544518-4, https://www.scopus.com/record/display.uri?eid=2-s2.0-85118969697&origin=resultslist **(Scopus)**

In this article, we present a successfully designed and tested system for measuring low currents from wireless sensor nodes. In the last few years, IoT devices have multiplied their number and functionality. These devices are located all over the world, and batteries are their main source of energy. It is extremely important to reduce the energy consumed by the sensor nodes in order to prolong the life of the batteries. Measuring the current consumed by wireless sensor nodes is a process that is of great importance to engineers and designers in terms of reducing the energy consumed by the batteries of the sensor units. Wireless sensor nodes consist of many elements such as sensors, transmitters and microcontrollers. All of them consume different amounts of energy during each operation performed by the sensor node - sending, measuring, falling asleep, etc. In the individual operating modes, the current consumption is very small, reaching nano amperes. This is one of the main problems in measuring the current consumed by the sensor nodes. The devices for measuring the energy consumed by the wireless sensor units are very expensive, which leads to their limited use. This requires the design and implementation of low current measurement systems to be used in the training of engineers and designers.

Г 7.3 H. Kanevski and **S. Asenov**, "Integrating Open-Hardware ECUs into Engineering Education," *2025 XXXIV International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2025, pp. 1-4, doi: 10.1109/ET66806.2025.11204147. URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=11204147&isnumber=11204022 , https://www.scopus.com/inward/record.uri?eid=2-s2.0-105022617825&doi=10.1109%2FET66806.2025.11204147&partnerID=40&md5=6718220da817432bd7be7552fb601d57 **(Scopus)**

This article examines the implementation and testing of an open-source electronic engine control unit (ECU) in the context of engineering education. The aim is to evaluate the effectiveness of open-source ECUs as a training platform for students in technical disciplines related to automotive electronics, process control, and embedded systems. The article presents the results of a survey conducted among students from the "Automotive Electronic Systems" and "Automotive Engineering" programs at Paisii Hilendarski University of Plovdiv regarding the integration of an open-hardware engine control unit into the educational process. The study shows that this approach enhances students' understanding of the internal logic of engine control systems in modern vehicles and supports the development of both their theoretical knowledge and practical skills.

Г 7.4 A. H. Chekichev, D. A. Shehova, **S. M. Asenov** and K. K. Asparuhova, "Research and Teaching of Amplitude Modulation Using Matlab and Emona Instrument Trainer in Engineering Education," *2021 XXX International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2021, pp. 1-4, doi: 10.1109/ET52713.2021.9579626.
URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9579626&isnumber=9579476, https://www.scopus.com/inward/record.uri?eid=2-s2.0-85119021367&doi=10.1109%2FET52713.2021.9579626&partnerID=40&md5=ec6a673008ac44e50cd1b3cdb9065057 **(Scopus)**

The article discusses the use of the Matlab development environment and the Emona Telecoms ETT-101 laboratory trainer to research and teaching amplitude modulation to help students to support the foundational theoretical concepts and the bases mathematical dependencies on engineering study programs. The results of the simulation and experimental tests are also presented.

Г 7.5 N. Toshev, H. Kanevski, **S. Asenov** and A. Parushev, "Study of the Automatic Emergency Braking Active Safety System of a Passenger Car," *2024 XXXIII International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2024, pp. 1-4, doi: 10.1109/ET63133.2024.10721506.
URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10721506&isnumber=10721478 https://www.scopus.com/inward/record.uri?eid=2-s2.0-85209227716&doi=10.1109%2FET63133.2024.10721506&partnerID=40&md5=157f320da16a86d009905cc6b2a3ec0e **(Scopus)**

This article reports on a study of the automatic activation of the "Automatic Emergency Braking" (AEB) active safety system. The study includes an experimental determination of the probability of operation of this system in critical situations and determination of the deceleration of a TOYOTA CH-R passenger car, as well as the braking time at different speeds. A modern method for determining the braking delay is presented, using experimental measurements carried out with the non-contact system for measuring speed and braking delay EnergoSM 4.0. The results of the study provide valuable information on the efficiency and

reliability of AEB systems, while demonstrating the applicability of new measurement technologies in real-world conditions.

Г 7.6. K. K. Asparuhova, **S. Asenov**, A. Chekichev and D. A. Shehova, "Implementation of harness testing device using microcontroller," *2022 XXXI International Scientific Conference Electronics (ET)*, Sozopol, Bulgaria, 2022, pp. 1-5, doi: 10.1109/ET55967.2022.9920320.. ISBN:978-1-6654-9878-4 URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9920320&isnumber=9920204 **(Scopus)**

The paper describes the developed microcontroller device for testing and controlling the production of cable harnesses in the automotive industry. Based on the results of the testing, a decision is made as to how and whether the work process can continue through logical management of the implemented mechanisms in the system. The device has been implemented in production at the plant of the Hronovski company in the town of Smolyan. The cable harnesses are used in the production of automotive lighting systems, such as taillights, front lights, daytime running lights and auxiliary lights. The tester is suitable for use in engineering education and training of industry professionals. It is used to teach microcontrollers, programming, and testing and diagnostics in the mass production at Plovdiv University "Paisii Hilendarski" - Faculty of Physics and Technology. Modern production requires high expert potential from those working in it, direct interaction between universities and industry, and this is done with the use of modern effective environments, methods and tools.

- **According to Criterion Г8: Scientific publications in non-refereed journals with scientific peer review or in edited collective volumes (group of indicators Г8)**

Г 8.1 Станислав Асенов, Димитър Токмаков, „СОЛАРНИ ХАРВЕСТЪРНИ СИСТЕМИ ЗА СЕНЗОРНИ ВЪЗЛИ“, Студентска сесия за научно и художествено творчество, ПУ „Паисий Хилендарски” - филиал Смолян, Пловдив, 2021, с.1010-1020, ISSN 2738-8026 (НАЦИД ID № 3383) http://hdl.handle.net/20.500.12641/64397

In the last few years, IoT devices have multiplied their number and functionality. These devices are located all over the world, and the batter ies are their main source of energy. It is extremely important to reduce the energy consumed by the sensor nodes in order to prolong the life of the batter ies and replace them whit supercapacitors and energy harvesters. Following this trend, we have integrated in the practical classes of students laboratory exercises in the engineering discipline „Design of microcontrollers” and „Microprocessor technology“, software and hardware methods to reduce the con sumption by wireless sensor nodes and using solar energy harvesters as power sources for sensor nodes. The students can design an autonomous wireless sensor nodes just power them whit solar energy harvesters. In this way, they acquire skills and knowledge for the implementation of low-energy wireless sensor nodes without harmful chemical batteries.

Г 8.2 Станислав Асенов, Веселин Кичуков, „ПРОЕКТИРАНЕ И ИЗРАБОТВАНЕ НА МОБИЛНА И АВТОНОМНА ЗАХРАНВАЩА СИСТЕМА ЗА МОБИЛНИ УСТРОЙСТВА“, Студентска сесия за научно и художествено творчество, ПУ „Паисий

Хилендарски" - филиал Смолян, Пловдив, 2021, с.1021-1031, ISSN 2738-8026, http://hdl.handle.net/20.500.12641/64402 (НАЦИД ID № 3383)

The paper presents a successfully designed and implemented autonomous mobile power system for mobile devices. An ESP32 microcontroller was used in the development. Techniques and methods studied in the disciplines "Programming", "Power supply devices" as well as "Microprocessor technology", studied in the engineering specialty „Hardware and software systems" at Plovdiv University "Paisiy Hilendarski", Faculty of Physics and Technology, were used for the implementation of the software.

Г 8.3 Станислав Асенов, Алексей Дренчев, „РЕИНЖЕНЕРИНГ НА МОНЕТОБРОЯЧНА МАШИНА", Студентска сесия за научно и художествено творчество, ПУ „Паисий Хилендарски" - филиал Смолян, Пловдив, 2021, с.1032-1041, ISSN 2738-8026, http://hdl.handle.net/20.500.12641/64431 (НАЦИД ID № 3383)

The article presents a realized project of reengineering of a coin counting machine. Additional functionalities to the existing coin counting machine have been implemented, such as touch control, implemented multi-touch display, etc. Software has been implemented to control the machine and its microcontroller. For the implementation of the hardware and software, techniques and methods studied in the disciplines "Programming", "Creation of a graphical user interface" as well as "Sensors and actuators", studied in the engineering specialty "Hardware and software systems" at Plovdiv University "Paisii Hilendarski" Faculty of Physics and Technology.

Г 8.4 Станислав Асенов, Йордан Балталийски, „ПРОЕКТИРАНЕ И РАЗРАБОТВАНЕ НА СОФТУЕР ЗА АВТОМАТИЗИРАНО ПОПЪЛВАНЕ ФИРМЕНИ ДОКУМЕНТИ", Студентска сесия за научно и художествено творчество, ПУ „Паисий Хилендарски" - филиал Смолян, Пловдив, 2021, с. 1001-1009, ISSN 2738-8026 http://hdl.handle.net/20.500.12641/64428 (НАЦИД ID № 3383)

The article presents a completed software project for automated filling and generation of internal company documents and forms. The implemented software product successfully integrates functions and a database aimed at the management of small and medium-sized businesses. For the implementation of the software, techniques and methods studied in the disciplines "Programming", "Creating a graphical user interface" as well as "Software technologies and architectures", studied in the engineering specialty "Hardware and software systems" at Plovdiv University "Paisiy Hilendarski" were used. Faculty of Physics and Technology.

Г 8.5 Станислав Асенов, Димитър Токмаков, "РЕВЮ И ИЗГРАЖДАНЕ НА LORAWAN HELIUM МРЕЖА", Трета национална научна конференция с международно участие "Човекът и Вселената"- СУБ Смолян, Научни трудове, Том III, част 3, стр.660-665, ISSN:1314-9400, 2022 (online) (НАЦИД ID № 2496) http://hdl.handle.net/20.500.12641/64421

The article discusses the main features of the LORAWAN HELIUM network. A comparative analysis was performed between the classic LORAWAN and LORAWAN HELIUM networks.

The construction of the LORAWAN HELIUM network at the Faculty of Physics and Technology at the Paisii Hilendarski University of Plovdiv in the town of Smolyan is presented. The authors aim to acquaint students with the opportunities provided by the innovative LORAWAN HELIUM network.

Г 8.6 Станислав Асенов, Димитър Токмаков, "ИЗПОЛЗВАНЕ НА МИКРОКОНТРОЛЕР SEEEDUINO XIAO, ПРИ ОБУЧЕНИЕ НА СТУДЕНТИ ПО "МИКРОПРОЦЕСОРНА ТЕХНИКА", Трета национална научна конференция с международно участие "Човекът и Вселената"- СУБ Смолян, Научни трудове, Том III, част 3, стр.672-676, ISSN:1314-9400, 2022 (online) http://hdl.handle.net/20.500.12641/63064 (НАЦИД ID № 2496)

The article presents the possibility of using the SEEEDUINO XIAO microcontroller, with an integrated powerful 32-bit microprocessor, in order to train students majoring in "Hardware and Software Systems" in the discipline "Microprocessor Technology". The main parameters of the microcontroller are analyzed, as well as the main communication interfaces used for communication with various sensors and actuators are presented. A set of three methodical exercises for working with the SEEEDUINO XIAO microcontroller is offered, which can be used by students in engineering specialties. The introduction of the microcontroller in the education of students inevitably leads to an increase in their experience in the field of microprocessor engineering and technology.

Г 8.7 Добромир Бозов, **Станислав Асенов**, Анатолий Парушев, "РЕАЛИЗИРАНЕ НА ИНТЕРАКТИВНО СМАРТ ОГЛЕДАЛО", Трета национална научна конференция с международно участие "Човекът и Вселената"- СУБ Смолян, 2022 г., Научни трудове, Том III, ISSN:1314-9490, 2022 (online); http://hdl.handle.net/20.500.12641/64406 (НАЦИД ID № 2496)

The article presents a realized and fully functioning project of an interactive smart mirror, allowing the use of sensors and actuators to achieve interactivity and innovation. Development boards and single-board computer systems were used, providing the software of the smart system. The project is characterized by innovation and interactivity, combining knowledge and skills acquired by students trained in engineering specialties at the Faculty of Physics and Technology of PU "Paisii Hilendarski".

Г 8.8 Станислав Асенов, Слави Любомиров, Снежа Шотарова , "TYPE-C" ТЕХНОЛОГИЯТА ПРИ ОБУЧЕНИЕ НА СТУДЕНТИ ПО КОМПЮТЪРНА ПЕРИФЕРИЯ В ИНЖЕНЕРНОТО ОБРАЗОВАНИЕ", Трета национална научна конференция с международно участие "Човекът и Вселената"- СУБ Смолян, 2022 г., Научни трудове, Том III, ISSN:1314-9490, 2022 (online); http://hdl.handle.net/20.500.12641/64398 (НАЦИД ID № 2496)

The desire to unify the communication wired ports used has led to the introduction of the "type-c" standard. Guided by the innovations, the author's team presents the possibilities and specifications of the technology, in order to train students in engineering specialties "Hardware and Software Systems" and "Computer and Communication Systems", trained at PU "Paisii Hilendarski" Faculty of Physics and Technology, in the discipline "Computer hardware". The article presents the possibilities for communication, data transfer and existing technologies for

fast charging through the "type-c" port. The study of this technology by students will lead to in-depth knowledge and skills to work with "type-c" technology.

Г 8.9 H. Kanevski, S. Lyubomirov, **S. Asenov** (2022) SIMULATION OF ENGINE MALFUNCTIONS AND THEIR IMPACT ON EMISSIONS WITH AN EMPHASIS ON ENGINEERING EDUCATION, 15th annual International Conference of Education, Research and Innovation, ICERI2022 Proceedings, pp. 7525-7532, ISBN: 978-84-09-45476-1, ISSN: 2340-1095, doi: 10.21125/iceri.2022.1917

Vehicle emissions are the most important source of air pollution in urban environments worldwide, and their detection and control are critical to protecting public health. It is common for vehicle owners and mechanics to focus primarily on faults that affect safety, drivability, and fuel economy, but lack knowledge or interest in emissions-related faults. In addition, most emissions-related damage is invisible, except smoke problems, which are rare on modern vehicles, making them difficult for vehicle owners and mechanics without emissions testing equipment to find. In this context, it is of particular importance in the training of students of these specialties to emphasize this global problem, namely to make several engine malfunction simulations and track their impact on harmful emissions. It is necessary to study which engine faults have the greatest impact on each pollutant so that mechanics can identify possible faulty parts and repair them quickly when a high-emission vehicle is found. The purpose of this research presented in the report is to simulate the various faults in a car engine and show their effect on vehicle emissions. An experimental methodology was implemented and tested for the study of various engine malfunctions during the education of students from engineering majors directly corresponding to automotive technology. A total of 10 different worst-case failures are presented. The obtained tabular data give the students a reason to form knowledge and skills for a better understanding of the material. Graphical results are aggregated and analyzed to provide information on the emissions performance of motor vehicles. The data can be used to estimate the effect of parameters such as engine load and ambient temperature on vehicle emissions. The students performed tests that were simulated and grouped into the following functional areas: air intake, fuel delivery, ignition, and exhaust after-treatment systems. Deterioration of spark-ignition engine emission control systems has been found to be primarily a gradual wear process occurring as vehicle mileage accumulates. In order to identify the impact of hardware degradation and failures, a Volkswagen Golf passenger car with a gasoline engine was used, on which the students during the experiments demonstrated simulated failures of the engine's hardware systems. To measure the impact on emissions, professional equipment was used to measure the composition of harmful emissions in the exhaust gases from the car. After the tests, it was found that at first glance, insignificant issues can worsen the composition of harmful emissions many times. From an educational and scientific perspective, this study provided essential knowledge and skills to automotive repair and maintenance students to effectively identify and repair emissions-related damage in gasoline vehicles. Therefore, students must be trained to correctly perform these procedures, based on the analysis of objective control data. This leads to a better understanding of the specifics of the material taught in the field and of modern fuel controllers and their application to improve the environmental situation in cities.

Г 8.10 A. Chekichev, R. Popov, **S. Asenov** (2021) USE OF THE LABVIEW VIRTUAL INSTRUMENT IN THE ENGINEERING EDUCATION, 14th annual International

Conference of Education, Research and Innovation, *ICERI2021 Proceedings*, pp. 9428-9432.ISBN: 978-84-09-34549-6, doi: 10.21125/iceri.2021.2175

The rapid development of computer and communication technologies and the widespread use of personal computers, including mobile phones with Internet connectivity, determine new directions in the development of information-management technologies. This aspect is also conditioned by the created pandemic situation, in which the rapid adaptation and incorporation of technologies and environments are necessary for distance learning of the students in engineering education. Students need to study in-depth the features and principles of virtual tools to develop skills and competencies necessary for their engineering development. The dynamic development of computer technologies determines the mass use of computer-based systems for data collection (DAC) and control, built based on specialized PC boards, modules, and components. Through them, with the help of appropriate software, the PC becomes a virtual instrument (VI) with wide functional possibilities and great flexibility, providing students with efficiency and quick adaptability in mastering the difficult conceptual theoretical material. Virtual instruments consist of an interactive user interface, a data flow diagram (program code), and a link icon that allows the VI to be called as a subroutine from other VIs. The VI's interactive user interface is called the front panel because it resembles the panel of a physical device. The front panel may include buttons, sliders, graphic display, and other input fields and indicators. Information can be entered using the keyboard or mouse and then the results can be seen on the screen. The LABVIEW virtual instrument needs to be studied by students because it is extremely easy and accessible for them. It includes libraries for receiving, analyzing, presenting, and storing data. It also provides the ability to use a wide range of libraries to perform various analyzes. The LabVIEW software environment allows you to load data that can be processed in different ways; data pre-entered into the program (directly or generated by some signal or other data generator), data received from an external doc or excel file (received for example from a file server) or data received in real-time from an external measuring or DAQ device. Students at any time can make an impact on the model created by them, which is a prerequisite for building abstract and logical thinking. They can create and monitor different types of charts, which helps them to quickly analyze the processing of a large set of data. The virtual tool LABVIEW also allows differentiating individual sections of a given graph and to change the number of experiments for which the respective research is made. This virtual tool enables students to develop their talents in the field of programming by creating program code that manages the respective virtual components or models. The use of virtual instruments in the conditions of COVID-19 is necessary for engineering education, which allows students to better understand the basic scientific and engineering concepts by performing experimental research from a distance. This is extremely useful and necessary for their development in this field of science.

Г 8.11 A. Chekichev, R. Popov, **S. Asenov** (2021) THE VIRTUAL LABORATORIES AS A MEANS OF TRAINING STUDENTS IN ENGINEERING EDUCATION IN THE CONDITIONS OF COVID-19, 14th annual International Conference of Education, Research and Innovation, *ICERI2021 Proceedings*, pp. 9234-9238.ISBN: 978-84-09-34549-6, doi: 10.21125/iceri.2021.2128

The article aims to consider the use of virtual laboratories as a tool for training, teaching, and research of various simulation schemes and models in university courses in electronic measuring technology in the conditions of COVID-19. Existing modern university engineering

education must quickly and adequately adapt to the conditions of the COVID-19 pandemic, which requires the use of adaptive and universal tools and means for accessible teaching of engineering disciplines at a distance. For this purpose, virtual laboratories can be used effectively in bachelor's and master's courses. This type of laboratory is aimed at increasing students' interest and easier perception of the fundamental theoretical concepts by performing observations, research, and experiments from a distance. Virtual labs provide students with unlimited access to certain models, as well as their effective participation and remote control of experiments. These laboratories also provide students with effective interaction with a real object of research. Virtual labs are an effective graphical user interface through which during the work students can observe what is happening on the screen, simulate impacts on existing virtual buttons, switches, controls, and in certain libraries to use various measuring instruments needed to perform the specific task. With the help of measuring instruments, students can immediately make the necessary analytical and graphical analyzes of the results obtained. In this way is created the logical and abstract thinking of the students. Various environments can be used as virtual laboratories, such as analog circuit modeling environments - Spice, Gnucap and their derivatives, as well as HDL environments. Although these are more design tools, HDL can also be used for teaching and experimentation by students. Modern Spice derivatives offer a wide range of components and libraries. At the same time, they have an intuitive interface for quick and easy assembly of circuits and their simulation. During the simulation in the virtual laboratory, students have the opportunity to observe voltage diagrams at each point of the simulation circuit, as well as currents in each circuit. Another environment is LabView, which contains a large set of tools and libraries and is easy for students to use. All environments that can be assigned to virtual laboratories are a kind of complex development environment, but can also serve as a good tool for studying the characteristics and characteristics of the relevant elements in the simulation scheme or model. Students regularly use this type of environment to find answers to their questions. This is a pandemic situation, but not always a good option, but the use of virtual laboratories - solves this problem. The use of virtual laboratories in electronic measuring equipment in the conditions of COVID-19 is necessary for engineering education, which allows students to better understand the basic scientific and engineering concepts by performing experimental research from a distance. This is extremely useful and necessary for their development in this field of science.

Г 8.12 S. Asenov, D. Shehova, H. Kanevski (2023) A SYSTEM FOR REPORTING AND ANALYZING LIVE DATA FROM INTERNAL COMBUSTION ENGINE EMISSIONS WITH APPLICATION IN ENGINEERING EDUCATION, EDULEARN23 Proceedings, pp. 3995-3999

The article presents an integrated engineering education, a successfully implemented stand-alone system for measuring and reporting harmful gases from internal combustion engines, studied by the students in the "Automotive Technology" and "Automotive Electronic Systems" majors at the Faculty of Physics and Technology of Plovdiv University "Paisiy Hilendarski" Bulgaria. Together with the students, a low-cost prototype of a system for "live" measurement of exhaust gases from car engines was designed and implemented, which allows for every second measurement and monitoring of exhaust gases, as a result of the operation of internal combustion engines - (LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, Carbon Monoxide (CO), NH3, NOx, Benzene, CO2, etc.). The sensors MQ-2, MQ-7, and MQ 135 were used to implement the prototype, which measures the levels of exhaust gases released into the environment by cars. A dual-core, 32-bit ESP32 microcontroller is used, which processes and

displays the measured values from the gas sensors promptly. The system enables the storage of the estimated data, their visualization in real time on an LCD, as well as their serial transmission to a computer. Students are introduced to the basic concepts and principles of using sensors to monitor the flow of harmful emissions that are emitted during the operation of the car engine. The goal is to observe the changes in the indicators where new and worn-out automotive sensors - MAS (mass air flow) and lambda sensors, which directly affect the environmental indicators and characteristics of internal combustion engines, are used. A methodology has been developed for conducting experimental research by the students, who in real-time monitor the consequences arising from the use of old and exploited car sensors (Lamda, MAS) and replacing them with new ones, in which the harmful emissions released from the car are significantly reduced. In addition, students can perform a both quantitative and qualitative analyzes of the amounts of harmful gases in the different modes of operation of gasoline and diesel engines - idling, loaded, and others. After the conducted experiments, the trained future engineers perform an analysis of the obtained data, thereby acquiring permanent knowledge and skills that favor and help their future improvement in the field of automotive electronic systems affecting the flow of harmful emissions released into the environment from cars.

Г 8.13 Савина Хайдушка, **Станислав Асенов**, Ангел Чекичев, Даниела Шехова, "ИЗГРАЖДАНЕ НА СМАРТ СИСТЕМА ЗА ОТГЛЕЖДАНЕ НА РАСТЕНИЯ", Трета национална научна конференция с международно участие "Човекът и Вселената"- СУБ Смолян, 2022 г., Научни трудове, Том III, ISSN:1314-9490, 2022 (online); http://hdl.handle.net/20.500.12641/64403 (НАЦИД ID № 2496)

The idea of the author's team in the development of the article is related to the consideration of new ideas and technological solutions in the construction and implementation of a smart system for growing plants. Attention is paid to the main elements - sensors, controllers, power supplies and others needed in the implementation of the smart system. An analysis of the main factors influencing the development of plants under different environmental conditions has been made. Based on this analysis, an algorithm was created and a smart system for growing plants in both pots and greenhouses was designed.

Г 8.14 Мая Симеонова, **Станислав Асенов**, Слави Любомиров, Анна Токмакова, "МЕТОДИКА НА ОБУЧЕНИЕТО НА СТУДЕНТИ В ОБЛАСТТА НА ИНФОРМАЦИОННАТА СИГУРНОСТ", Трета национална научна конференция с международно участие "Човекът и Вселената"- СУБ Смолян, 2022 г., Научни трудове, Том III, ISSN:1314-9490, 2022 (online); http://hdl.handle.net/20.500.12641/64418 (НАЦИД ID № 2496)

The idea for the development of this article is related to the lack of methodological guidelines for the training of students in "Information Security" at the University of Plovdiv "Paisii Hilendarski", Faculty of Physics and Technology. A methodological guide has been developed, combining eight basic topics in information security. Different types of software tools and products necessary for the implementation of the respective experimental tasks are considered. The methodology considers basic concepts, terms and positions in ensuring the protection of personal data and information when working with cloud technologies and various types of network attacks.

Г 8.15 A. Chekichev, R. Popov, D. Shehova, **S. Asenov** (2022) THE ARTIFICIAL INTELLIGENCE AND VIRTUAL LABORATORIES IN THE TRAINING OF STUDENTS IN ENGINEERING EDUCATION, 16th International Technology, Education and Development Conference, INTED2022 Proceedings, pp. 6333-6336, ISBN: 978-84-09-37758-9, ISSN: 2340-1079, doi: 10.21125/inted.2022.1612

The introduction of e-learning in universities at the beginning of the pandemic proved to be a serious obstacle but provided an opportunity to create additional skills, competencies in teachers and students. The use of this type of student training was not known to them and teachers until before the pandemic. In the application of the traditional method of teaching to a greater extent, various means and methods are used to present the relevant theoretical and practical material. This type of equipment is the use of various information and communication technologies and the corresponding laboratory models and stands. Of course, this would be logical to use in such a case of teaching, but in the situation in which there is an inability of students to directly use the relevant models or stands, it would be rational and appropriate to apply the distance learning method or various virtual laboratories in the relevant subjects. This method in such an unfavorable epidemiological situation is the only opportunity to organize and conduct the educational process in the relevant areas and disciplines in higher engineering education. Over the past year and a half, a pandemic that has led to the distance between teachers and students has created conditions for analyzing and building new approaches, methods, and tools for teaching relevant material. It also provided opportunities to make an objective assessment of the computer interaction between the individual subjects in the educational process and to identify the relevant risks and losses from the lack of direct communication. The construction of virtual laboratories using artificial intelligence is an important moment in the development of this publication by the author's team. The idea of this publication is to consider the main trends and situations related to the possibilities of integrating artificial intelligence in virtual laboratories, thus providing a wider range of opportunities for students studying various engineering disciplines in higher education. Also, to create interest and provoke curiosity and desire in students to use modern technological means to perceive complex theoretical material, through which to solve a set of tasks, such as image recognition, design of elements or details, reading sound and text, and others. The creation of knowledge and skills in the field of coding and artificial intelligence in general, and its timely use by students in virtual laboratories would help to create and build various project-based developments in the real world. This would be a prerequisite for their timely integration in the development of new educational programs, STEM modules, and others that can be used to train students at the Faculty of Physics and Technology of Plovdiv University "Paisii Hilendarski". The article presents the analysis of the main provisions related to the incorporation of artificial intelligence in the construction of virtual laboratories for training students in engineering. Gaining experience in the field of artificial intelligence and its incorporation in virtual laboratories in various disciplines is important for creating specialized skills, competencies, and capabilities of students in the field of computer science, mechanical engineering, and others. In this way, the goal is to increase the qualification of students and gain more confidence on their part.

Г 8.16 D. Shehova, A. Chekichev, S. Lyubomirov, **S. Asenov** (2022) ONLINE TEACHING OF STATIC PARAMETERS AND DYNAMIC CHARACTERISTICS OF OPERATIONAL AMPLIFIERS, INTED2022 Proceedings, pp. 3581-3589 ISBN: 978-84-09-37758-9, ISSN: 2340-1079, doi: 10.21125/inted.2022.1004

The situation with the COVID-19 Pandemic has posed new challenges for university professors around the world when developing sets of e-learning tools that allow students to carry out research resembling experiments carried out in university laboratories as closely as possible. Mastering of the material related to Op Amps requires practical work on their implementation, use of measuring instruments such as generators and oscilloscopes as well as subsequent processing of the measurement results. The use of the free version of the NI Multisim Analog Devices Edition software environment provides the opportunity to create models for the simulation of the parameters of a wide variety of circuits with Op Amps using virtual measuring instruments. The circuits created and the experimental settings can be reconfigured easily using switches. The authors of this article share their experience in teaching disciplines in the field of analog electronics. The simulation models which were developed and examined allow the lecturers to set individual assignments for each student, and the students to independently conduct the research for each assignment. This research precedes the experiments students carry out using the models available in university laboratories. Op Amps are present in the production of key units in electronics, communications and industry. In the process of designing and verifying devices implemented with Op Amps, a number of simulation procedures and laboratory experiments are combined, with the aim of creating lasting knowledge, which is a prerequisite for the design of new circuits and devices. The authors of the article have developed a set of electronic tools (simulation circuits and educational videos) for the study of the static parameters and the dynamic characteristics of Op Amps. The report presents a model for using a simulation to determine the DC parameters of the operational amplifiers LM 741CH (National Semiconductor) and OP07CH (Linear Technology), namely: Input Offset Voltage (Uio), Input Bias Current (IiB), Input Offset Current (Iio). It was created in Multisim as this environment provides a measuring probe to perform circuit analysis in all nodes and branches during the simulation. The simulation values for the main parameters of the Op Amps which were examined are tabulated and compared with their catalogue counterparts. An analysis was performed of the results obtained. The report presents models for using a simulation to determine basic dynamic characteristics and parameters of integrated Op Amps VFA (Voltage Feedback Amplifier): transmission, amplitude frequency characteristics (voltage gain), phase-frequency characteristics, gain bandwidth product / width - GBW, slew rate - SR. The results obtained are presented in tabular and graphical form and are analyzed. The proposed simulation models, accompanied by specially created educational videos and used for conducting simulation research allow the students to use them at any time and anywhere, which results in the improved motivation of the students when studying the content. The developed models and the research conducted with them, presented in the article, have been tested in the online training of students during the COVID-19 lockdown in the discipline "Analog electronics" in the specialties "Computer and Communication Systems" and "Hardware and Software Systems" at the Faculty of Physics and Technology of Plovdiv University "Paisii Hilendarski".

Г 8.17 Анатолий Парушев, Владислав Кедиков, Христо Каневски, **Станислав Асенов**, Милена Бундева, “СИСТЕМА ЗА ДИСТАНЦИОННО УПРАВЛЕНИЕ НА ЗАКЛЮЧВАНЕ И ОТКЛЮЧВАНЕ НА АВТОМОБИЛНИ ВРАТИ И ПРИБИРАНЕ НА ОГЛЕДАЛА С ПОМОЩТА НА АРДУИНО МИКРОКОНТРОЛЕРИ” том 4, 2024, pp. 35-45 на "Научни трудове на СУБ клон Смолян" ISSN: 1314-9490 (НАЦИД ID № 2496)

This paper presents the development and implementation of a system for remotely locking and unlocking car doors, as well as retracting side mirrors, using Arduino microcontrollers. The system uses the Arduino Pro Mini and Arduino Nano platforms, combined with 433 MHz RF modules, to create an economical and compact solution. The details of the design and implementation are discussed, including the hardware configuration, software logic, and system integration. The results demonstrate the efficiency of the system in remote control, offering practical applications in automotive control systems.

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