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IOT GREEN TRANSFORMATION FOR ACADEMIC SOCIETY AND BUSINESS ORIENTED ECOSYSTEM IN WESTERN BALKANS

STUDENT NEWSLETTER

ISSUE no. 5 - DECEMBER 2025

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Dear reader,

Welcome to the 5th issue of the IoT-ECO Newsletter, covering student projects and activities.

What Have Our Students Been Working On?
Over the past months, students across partner universities have been actively involved in project tasks, hands-on workshops, and collaborative learning activities. They have contributed to:

- Developing IoT prototypes and experimenting with real-life environmental and energy-monitoring use cases
- Participating in training sessions and capacity-building events, gaining practical skills in IoT, cloud systems, AI, and digital innovation
- Engaging in cross-institutional teamwork, connecting with peers

Their dedication and enthusiasm have significantly strengthened our vision for a more connected, sustainable, and digitally empowered region.
To all our students **thank you for your hard work**, passion, and commitment. Your contributions are at the heart of IoT-ECO, and your growth represents the long-term impact of this project.

We hope you enjoy this issue and feel inspired by the talent and innovation showcased within it. Here's to even more creativity, collaboration, and success in the months ahead!

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RESULTS FROM POLYTECHNIC UNIVERSITY OF TIRANA FOR THE INVOLVEMENT OF STUDENTS ON IOT-ECO PROJECT

1. Two master thesis are implemented by Klajdi Berdufi and Rondi Corbaxhi “Developing a Cloud-based IoT system to manage the sustainability of Port of Durres”. The diploma is presented on July 2024 to academic staff and students of Computer Engineering Department, Polytechnic University of Tirana. The thesis was developed during academic year 2023-2024.

2. Two master thesis are currently working on IoT for healthcare and Digital twin for smart cities, during academic year 2024-2025. Olti Hamamxhiu defended his diploma thesis in July 2025 and Moralba Shima is still implementing the thesis.

3. Two PhD students (Eduart Torba and Alba Merdani) are allocated to the PhD project titled **"Integrating Digital Twin, Industry 4.0 and Machine Learning to build efficient and green intelligent systems**, Supervisor Prof. Assoc. Enida Sheme, initially inspired by IoT-Eco studies and results.

4. One PhD student (Ergion Kopani) is allocated to the PhD project titled **"Implementation and Management of innovative techniques for the energy efficiency on wireless networks based on IoT",** Supervisor Prof. Dr. Aleksander Biberaj", initially inspired by IoT-Eco studies and results.

5. One national research project titled "Smart Pollution Monitoring:
A digital platform for Urban pollution Monitoring", funded by the National Agency for Scientific Research and Innovation, coordinated by Prof. Asoc. Enida Sheme, is written and proposed by 3 PhD students (Eduart Torba, Alba Merdani, Megi Tartari) aiming to advance their practical knowledge on IoT, Cloud Computing and Digital Twin; topics they were presented by IoT-Eco project.

6. 2 Publications at the 20th International Conference on System of Systems Engineering (SoSE25)
a. Eduart Torba, Enida Sheme "Integrating Digital Twins and Machine Learning for Enhanced Predictive Maintenance, Real-Time Analytics, and Cost Savings: A Review"
b. Alba Merdani, Enida Sheme, Klajdi Berdufi, Dorian Minarolli: "Digital Twin and IoT-Cloud System: Case Study on Durrës Port"

STUDENT PROJECT DEVELOPED BY ALEKSANDER MOISIU UNIVERSITY

CONSTRUCTING VIRTUAL PROTOTYPES IN A PORT ENVIRONMENT WITH ADOBE AEREO

As part of their coursework at Aleksandër Moisiu University of Durrës (UAMD), students from the Faculty of Information Technology successfully designed and tested an innovative IoT-based application that demonstrates the practical use of Digital Twins and data-driven energy management. Developed as a course project, the solution allows users to access and analyze historical and real-time energy consumption data through an augmented reality (AR) interface. By scanning a QR code, users can instantly visualize energy usage indicators, explore consumption trends from previous years, and gain insights into system performance in an intuitive and interactive way. The project highlights how IoT technologies combined with Digital Twins can support smarter infrastructure management by enabling predictive analysis, identifying inefficiencies, and reducing energy losses. Through hands-on development, students applied theoretical knowledge to a real-world scenario, strengthening their skills in IoT systems, data visualization, and smart energy concepts.

This course project reflects UAMD's commitment to practice-oriented learning and innovation, empowering students to design solutions that bridge academia and real-world challenges while aligning with modern digital and sustainability goals.

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RESULTS FROM UCG UNIVERSITY OF MONTENEGRO

IOT GREEN PARK FROM UCG UNIVERSITY OF MONTENEGRO

STUDENTS: TATJANA DUBLJEVIĆ, ANES BERIŠA, ERMIN MEHOVIĆ, ANDREA MEDIN, VIDOSAVA VILOTIJEVIĆ

IoT Green Park, an eco-focused concept that uses Internet of Things technologies to promote sustainable agriculture, smarter energy use, and community engagement. Examples such as smart irrigation and e-bike energy-harvesting systems show how IoT can optimize resources and improve environmental performance in both academic and urban areas.
Using the Business Model Canvas, the project is broken into key components: defining customer groups (producers, cyclists, schools, eco-minded citizens), outlining value through automation and resource efficiency, and identifying communication channels like fairs, websites, and social media. It also covers customer support, revenue opportunities, required resources and activities, strategic partnerships, and projected costs.
The conclusion highlights that the Canvas model provides a structured path for developing the IoT Green Park from idea to functional eco-technology space. By addressing each business element, the project strengthens sustainability efforts, community involvement, and the adoption of IoT innovations in the Western Balkans.

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IOT GREENHOUSE: SMART TECHNOLOGY FOR SUSTAINABLE AGRICULTURE

STUDENTS: ANES BERIŠA, ERMIN MEHOVIĆ

The IoT Greenhouse project, developed within the IoT Green Transformation for Academic Society and Business-Oriented Ecosystem in the Western Balkans, demonstrates how modern Internet of Things (IoT) technology can enhance agricultural efficiency and sustainability. The project focuses on designing and testing a smart greenhouse system that monitors key environmental parameters—air temperature, air humidity, and soil moisture—to support timely and data-driven irrigation decisions.

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Students built a physical greenhouse prototype and integrated sensors with an Arduino MKR 1010 microcontroller featuring built-in Wi-Fi connectivity. Data collected by the sensors is transmitted in real time to the Arduino IoT Cloud, where it is stored, visualized, and accessed through a user-friendly dashboard on computers or mobile devices. Testing confirmed the system's reliability and suitability for real-world application.

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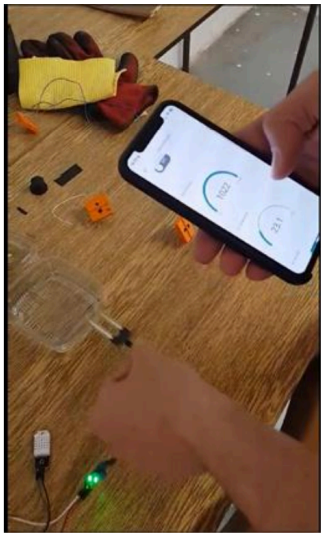
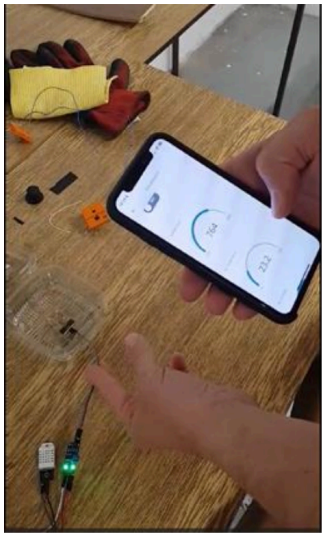
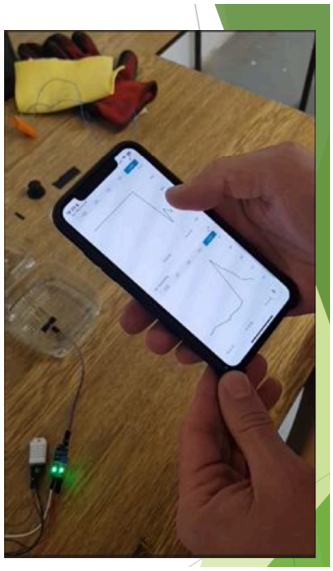
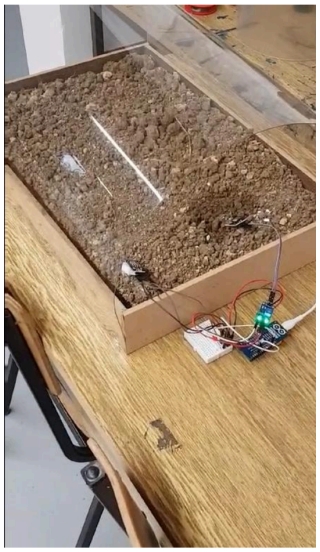
The project's ultimate goal is deployment in a full-scale greenhouse (12 × 6 meters) currently under construction. Future development plans include expanding the system to monitor soil pH and nutrient levels (nitrogen, phosphorus, potassium), further supporting precision agriculture. Beyond technical innovation, the project provides valuable hands-on experience for students and promotes smart farming solutions aligned with sustainable development goals.







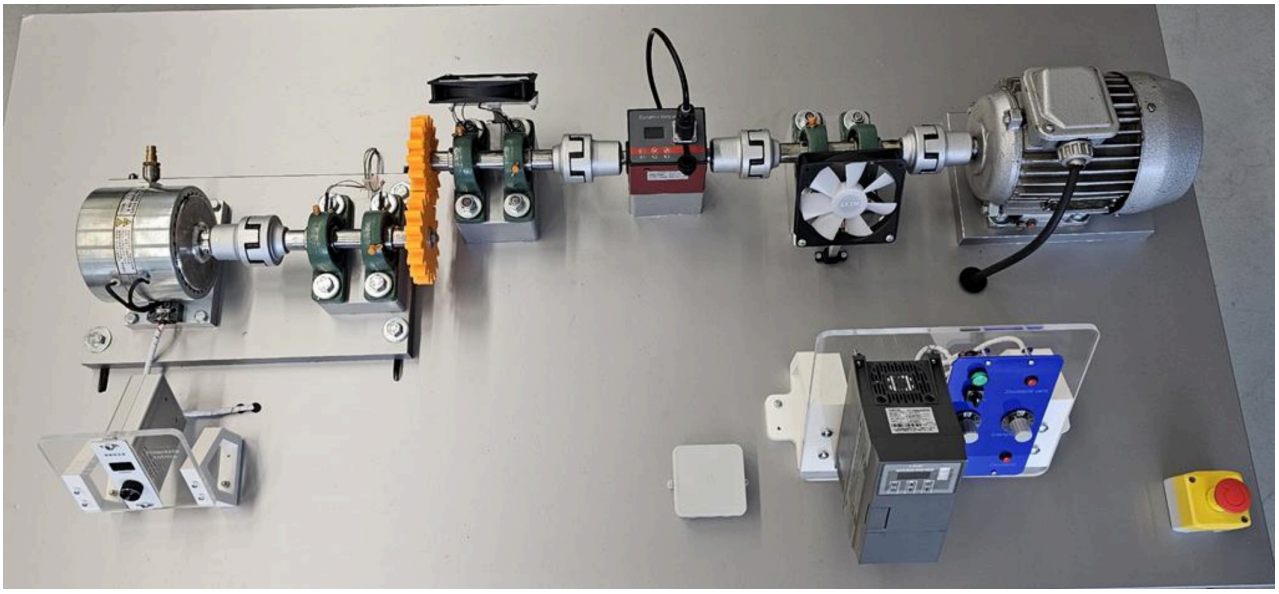


SMART TEST RIG FOR EVALUATING 3D-PRINTED GEARS WITH IOT

STUDENTS: OGNJEN MIJANOVIĆ, MIRJANA KOPRIVICA

The Test Rig for Evaluating 3D-Printed Gears project was developed within the IoT Green Transformation for Academic Society and Business-Oriented Ecosystem in the Western Balkans initiative. The project introduces a practical, IoT-enabled testing platform designed to assess the performance, durability, and thermal behavior of 3D-printed gears under realistic operating conditions.

The system combines a 1.5 kW electric motor, variable-frequency drive, torque sensor, and hysteresis brake to apply controlled mechanical loads to 3D-printed gears made from materials such as PLA, PETG, and ABS. Six bearings support the shafts, each equipped with DS18B20 temperature sensors to monitor heat generation during operation. Active cooling fans help maintain safe bearing temperatures during high-load tests.



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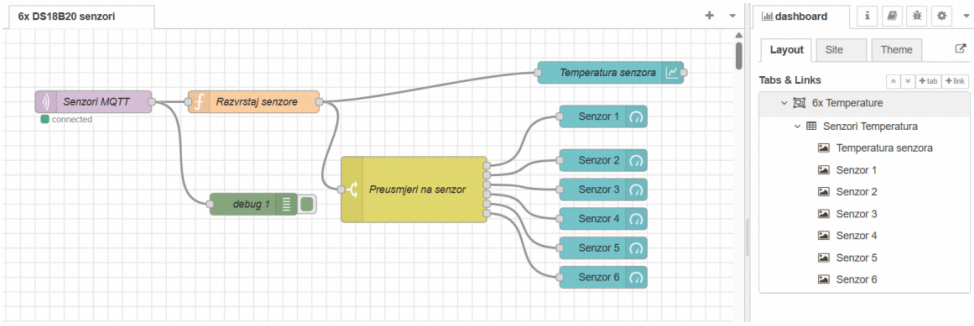
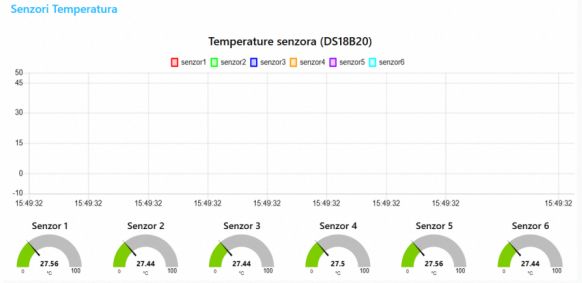
An ESP32 microcontroller collects real-time temperature data and transmits it wirelessly in JSON format to a Node-RED dashboard, where temperatures and trends are visualized live. This setup enables continuous monitoring, data logging, and future expansion with additional sensors or predictive maintenance tools. The project demonstrates how IoT technologies can enhance mechanical testing, support design optimization of 3D-printed components, and provide students with hands-on experience in smart manufacturing and digital engineering systems.

Software Architecture Diagram (ESP32 ⇄ Node-RED)



- ESP32: DS18B20 readings → JSON → HTTP POST →
- Node-RED: HTTP In → JSON parse → Dashboard & Alarms →
- Data Logging: Write to file or database (e.g., InfluxDB + Grafana) for historical analysis

Example Dashboard Output



- **Real-time gauge view** of all six bearing temperatures
- **Trend chart** showing temperature rise as load increases
- **Data table** of last 10 readings with timestamps

JSON Payload Structure (Example)

```
{
  "T1": 52.3,
  "T2": 51.8,
  "T3": 50.9,
  "T4": 53.1,
  "T5": 52.7,
  "T6": 51.2,
  "timestamp": 1625234875123
}
```

Field Descriptions:

- T1-T6: Temperatures (°C) on Bearings 1-6
- timestamp: Milliseconds since ESP32 start (used for time axis)

STUDENT PROJECT DEVELOPED BY FECE-UP STUDENTS

Students of Faculty of Electrical and Computer Engineering at University of Prishtina have developed a project within updated course empowered by IoT-Eco project. The project “Implementation of IoT concepts via Azure services” outlines a centralized system designed for monitoring healthcare devices, specifically focusing on MRI and EKG technologies. By leveraging Azure Digital Twin technology, developed system aims to predict maintenance requirements and detect defects in a timely manner. The ultimate goal is to enhance healthcare outcomes, ensuring that medical equipment remains reliable and efficient in supporting patient care. By integrating real-time monitoring, predictive maintenance, and AI-driven insights, this project directly addresses the challenges of medical equipment failures and operational inefficiencies. In conclusion, this project demonstrates how combining IoT, AI, and digital twins can pave the way for the next generation of smart hospitals. The same was presented by FECE-UP students at the final event at Sofia and was very well received by the participants.

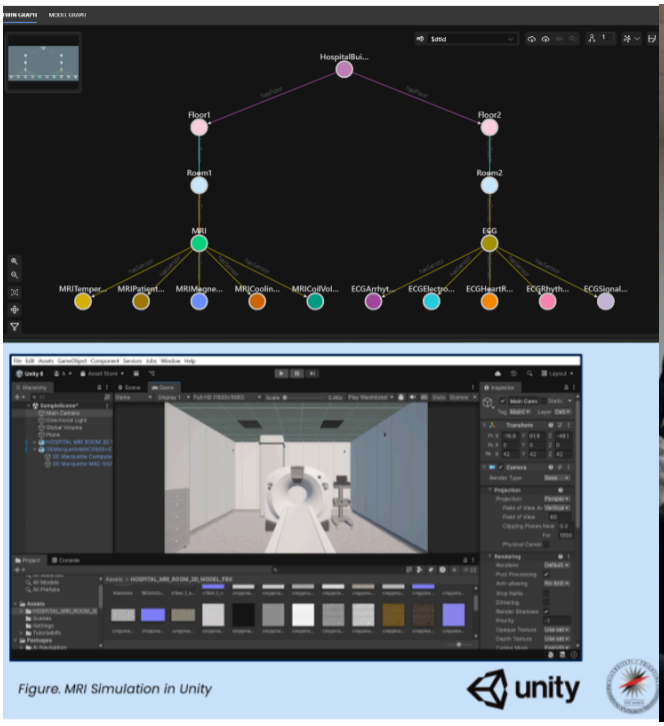
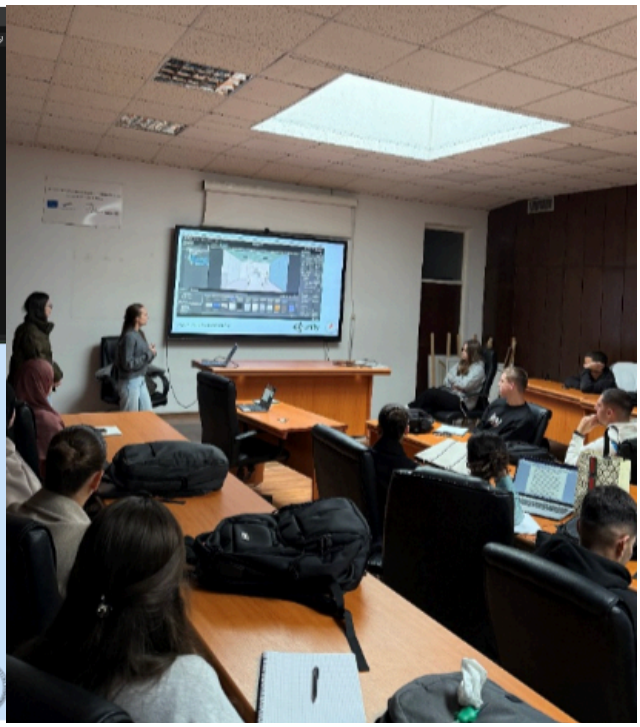


Figure. MRI Simulation in Unity



101083018 (IOT-ECO)ERASMUS-LS, ERASMUS-EDU-2022-CBHE-STRAND-2

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PROJECT DURATION:
1.12.2022-30.11.2025
Overall budget:780,951.00 Eu

>>> OUR PARTNERS AND ASSOCIATED PARTNERS

Universiteti Politeknik i Tiranës

CREA-KO SHPK

CONTACT US

@ gim@tu-sofia.bg
www.iot-eco.eu