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Invited/guest lecturer from business or associated partners

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Abstract:	This report outlines the work of UAMD, UPT, UP, UBT, and UoM, partner higher education institutions (HEIs) from Albania, Kosovo, and Montenegro, in organizing Invited/Guest lectures in their HEIs to promote the newly developed six innovative courses as tasks of the Iot-ECO project: "Introduction to Internet of Things" (UAMD), "Internet of Things and Cloud IoT" (UPT), "Advanced Mechatronics Systems" (UoM), "Internet of Things IoT" (UNIMED), "Green Wireless Communications" (UP), and an extra course called "Internet of Things" (UBT). The report contains a summary of all the events, a detailed description of the events in each partner's HEI including location, date and time slot of the event, name, affiliation and short CV of the presenters, title and abstract of the presentation, number and characteristics of the students attending the lecture and feedback. The report is completed with some conclusions and an annex with lectures slides.
Contact Persons:	Assoc. Prof. Dr. Galia Marinova





Table of acronyms or abbreviations

Acronym	Illustration
Al	Artificial Intelligence
ASON	Automatically Switched Optical Network
CERN	European Organization for Nuclear Research
CMOS	Complementary metal–oxide–semiconductor
COTS	Commercial-off-the-shelf
CPS	Cyber-Physical Systems
DC	Direct Current
DWDM	Dense Wavelength Division Multiplexing
EPFL	Ecole Polytechnique Fédérale de Lausanne
EU	European Union
FECE	Faculty of Electrical and Computer Engineering
GPIO	General-Purpose Input/Output
HEI	Higher Education Institution
ICLAB	Integrated Circuits Laboratory
ICT	Information and Communication Technologies
IoT	Internet of Things
IT	Information technologies
ML	Machine Learning
MW	Microwave
PWM	Pulse Width Modulation
ROADM	Reconfigurable Optical Add-drop Multiplexer
STEM	Science, Technology, Engineering, Math
THz	Terahertz

Teaching materials in online format on the IoT-ECO site



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1. Introduction

The partner HEIS UAMD, UPT (Albania), UP, UBT (Kosovo) and UoM, UNIMED (Montenegro) organized to their students presentations delivered by Invited/guest lecturers from business or associated partners. These lectures are connected with the probation of the 6 new courses developed in the framework of the Iot-ECO project, follows:

- Introduction to Internet of Things, developed by UAMD;
- Internet of things and cloud IoT, developed by UPT;
- Advanced Mechatronics Systems, developed by UoM;
- Internet of Things IoT, developed by UNIMED;
- Green Wireless Communications, developed by UP;
- Internet of Things developed by UBT.

The Partner HEIS selected the invited/guest lecturers from the associate partners of the IoT-ECO project or from companies operating in the area of IoT and Green technologies. The lectures were scheduled in the first weeks of the new courses probation in order to promote the new courses and to confirm the interest of associate and business partners to the topics connected to IoT for Green transformation.

2. Coordination of the events with invited/guest lecturers from business and associate partners in the IoT-ECO consortium

The coordination of the events with the invited/guest lecturers from business and associate partners was realized at 2 virtual meetings, as follows:

1) Virtual Meeting on New or updated IoT-ECO based courses/ Invited guest lecturers planning
Here is the link to the Virtual Meeting on New or updated IoT-ECO based courses/ Invited guest lecturers
planning:

Friday, 28 February · 2:00 - 4:00 pm Time Zone: Europe/Sofia/Patras

Friday, 28 February 1:00-3:00 pm Time Zone: CET

Information for joining in Google Meet

Link: https://meet.google.com/dmu-qzeg-ded or dial: (US) +1 218-301-2679 PIN: 949 210 026#

It was decided the presentations of the invited/guest lecturers connected with WP5 D5.3. Invited/guest lecturer from business or associated partners, to be documented as follows:

Guest lecturers – Lecturers (name, affiliation, position, short CV, photo), Topics, Abstracts, Slides, Date, Time slot, Location, Audience (number, gender, course, program of students attendees), Photos with the lecturer and the students, Feedback from the attendees.

The information for the invited/guest lecturers must be provided in a dedicated block in Trello.

2) IoT-ECO Virtual Meeting WP5, D5.2. / 5.3 Friday, 28.03 2025, 11:00 am - 12:00 pm

Here is the link to the Virtual Meeting:IoT-ECO Meeting WP5, D5.2. New Courses and 5.3 Invited lecturers: Friday, 28.03.2025 · 11:00 am – 12:00 pm Time zone: Europe/Sofia / Patras 10:00 am – 11:00 am Time zone: Austria, Albania, Kosovo, Montenegro Info to join in Google Meet

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Link: https://meet.google.com/tgd-wfnn-teu or dial: (US) +1 304-306-0546 PIN: 647 190 439#

The partners from HEIs UAMD, UPT (Albania), UP, UBT (Kosovo) and UoM, UNIMED (Montenegro) reported on the realized invited/guest lecturers presentations in their institutions. They submitted written reports to the coordinator. Based on these reports the current report for the deliverable D11 was prepared.

3. Summary of the events with the invited lecturers in the partners' HEIs

The events with the invited lecturers were organized as summarized in Table I.

Table I. Summary of the events with the invited lecturers in the partners' HEIs

No	Partner's HEI	Number of lecturers	Associate or business partner	Date of the event	Number of students attendees / Gender
1.	UAMD	1	Associate partner	11.03.2025	19 (7F,12M)
2.	UPT	3	3 Business partners	25.03.2025	27 (13F, 14M)
3.	UP	1	Business partner	18.03.2025	20 (11F, 9M)
4.	UBT	1	Business partner	21.01.2025	32 (11F, 21M)
5.	UoM	2	Business partners	12.12.2024	14 (5F, 9M)
				10.03.2025	15 (5F, 10M)
		2	2 Academic	19.12.2024	18 (7F, 11M)
6.	UNIMED	1	Academic/Researcher	06.03.2025	11 (3F, 8M)

4. Invited/guest lecturers' presentations in the Partner's HEIs

In the next sections the reports on the realized invited/guest lecturers presentations in the Partner's institutions are presented.

4.1. Invited/guest lecturer from business or associated partners in UAMD

The scope of Invited Lecture – Knowledge Dissemination and Academic Outreach

Information about the event:

Date of Lecture: 11/03/2025

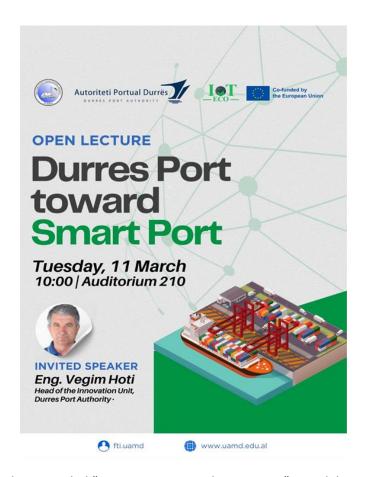
Location: Aleksander Moisiu University, Auditorium 210

Time slot: 10:00-11:20 AM

Here is the poster for the event:







Lecture Overview: The lecture titled "Durres Port toward Smart Port" was delivered by Eng. Vegim Hoti, Head of the Innovation Unit in Durres Port Authority, as part of the project's academic dissemination and engagement strategy. Durres Port Authority is an associated partner in IoT-ECO project. The lecture aimed to enhance knowledge transfer, promote research outputs, and support capacity building among students, academic staff, and industry stakeholders.

Short bio of the invited lecture Eng. Vegim Hoti

Eng. Vegim Hoti is a dedicated professional in the Albanian transport community. He holds a master's degree in Electronic Engineering and boasts a 30-year career in the railway and port industry, specializing in ICT systems. Currently, he serves as Head of the Innovation Unit at Durres Port Authority, mainly focused on implementing new Information and Communication Technologies in Durres Port, focusing on sustainable transport solutions and logistics management.

Vegim has played a crucial role in establishing the IT Department at Durres Port throughout his career. He has led significant IT infrastructure projects, implemented innovative transport policies, and advocated for green transportation. Currently, ongoing IT projects include the Durres Port Community System and the security and ICT systems for the new Porto Romano port.

Vegim is a part-time lecturer at the Department of Engineering and Marine Sciences, Faculty of Professional Studies, "Aleksander Moisiu" University imparting knowledge on Maritime Information Systems and port IT to the next generation of professionals.

Vegim's expertise and commitment to advancing port technology make him a distinguished speaker about strengthening sustainable and digital trade routes between the Eastern Partnership and the EU.

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The objectives of the invited lecture are:

- To present the latest developments in port environment technologies.
- To foster collaboration between academia and industry in emerging technology domains.
- To provide to the students a presentation of some real smart systems that actually operate in the
 port and the possibility for the implementation of other smart systems and green transition
 technologies.

Target Audience: The lecture was attended by:

- Undergraduate students in Information Technology, Computer Science Programs 19 students from bachelor's program in information technology p second and third year. 7 girls (37 %), 12 boys (63 %)
 - Academic staff. 2 academic staff /women.

Abstract of the lecture: Durres Port, Albania's largest maritime hub, is undergoing a transformative journey toward becoming a smart port in line with global digitalization trends in the maritime industry. The presentation explores the current status and operational landscape of Durres Port, highlighting its strategic importance along the Pan-European Corridor VIII and its role in handling over 90% of the country's seaborne trade. The concept of a smart port is examined through technological lenses such as the Internet of Things (IoT), Artificial Intelligence (AI), Blockchain, 5G connectivity, and Digital Twin technology. Emphasis is placed on the port's existing smart systems, including automated check-ins, surveillance with video analytics, GIS systems, and environmental monitoring. The presentation also outlines the 2030 Masterplan for the new Porto Romano facility, emphasizing infrastructure modernization, sustainability, and enhanced connectivity. By comparing international smart port case studies, the presentation provides a strategic roadmap for transforming Durres into a digitally integrated, efficient, and sustainable maritime gateway for the Western Balkans.

Methodology: The lecture utilized a blend of:

- PowerPoint presentations with visuals and real-world use cases.
- Interactive Q&A.
- Feedback collection via online tools, google form.

Key Outcomes:

- Enhanced awareness of the project's research contributions in IoT and Smart Technologies.
- Strengthened networking with local academia and industry.
- Participant interest in follow-up workshops and project deliverables.
- Positive feedback on the pedagogical approach and technical content.

Supporting Materials are available:

- Screenshots/photos of the session.
- List of attendance.
- Poster of the invited lecture.
- Recording of the lecture.

Here is a screenshot from the event:







Feedback summary

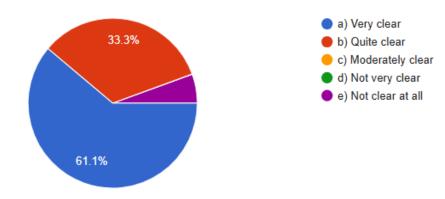
The links of the google form questionnaire and the answers are provided below:

https://docs.google.com/forms/d/1wpe5gqMYpvxgVd_7c3Brmah1VDeQBecCQQ6H3AXt_8o/edit#responses

 $\frac{https://docs.google.com/spreadsheets/u/0/d/1afErqqAFs6DJlpKOCkBOxmVwPZ_UaBqOSPP8MGRmqaw/htmlview\#gid=810468020$

The questions and the pie charts of 18 answers divided in percentage (%) for each question are listed as below:

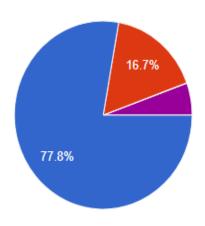
1. How clear was the presentation of information during the lecture?





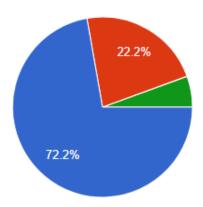


2. How do you rate the structure of the presentation?



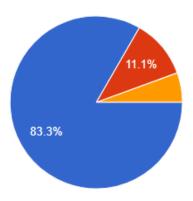
- a) Very well-organized and logical
- b) Well-structured, but with some gaps
- c) Average, with some inconsistencies
- d) Disorganized
- e) I did not understand it at all

3. Was the use of visual aids (graphs, videos, presentations) helpful in understanding the topic?



- a) Yes, very helpful
- b) Yes, somewhat helpful
- c) Moderately helpful
- d) Not very helpful
- e) There were no visual aids used

4. Were there enough practical examples to explain the presented concepts?

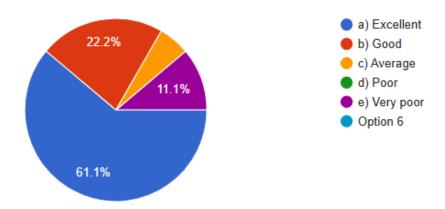


- a) Yes, many clear examples were provided
- b) Yes, but some concepts could have been illustrated better
- c) Moderately, some examples were unclear
- d) No, there were few or no examples
- e) No examples were given at all

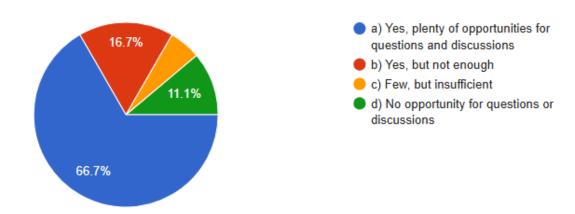
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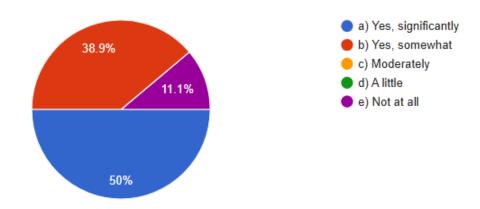
5. How do you rate the speaker's preparation for this topic?



6. Was there an opportunity to ask questions and engage in discussions during or after the presentation?



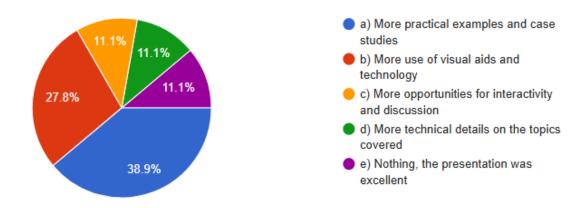
7. Do you think the presentation helped increase your knowledge about smart ports and their technologies?



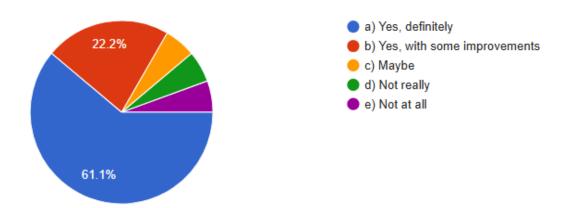




8. What would you suggest to improve future presentations?



9. Would you recommend a similar lecture to other students?



Feedback Conclusions

The lecture had a positive reception overall, according to the UAMD student comments, which highlights the presentation's high level of clarity (more than 94% of students thought it was clear or pretty clear) and its well-structured format. Most respondents found visual aids useful, and 83.3% of respondents said that the use of real-world examples was a major quality. Although some respondents pointed out areas for improvement, the speaker's preparation received good marks overall. Although the majority of students thought there were enough chances for participation, some recommended making things more interactive. Most of the participants felt that the presentation improved their knowledge of smart ports and related technology, and more than 83% of them said they would suggest a similar lecture to others. More real-world examples, visual aids, interactivity, and technical depth were among the suggestions for enhancement.

The invited lecture successfully contributed to the dissemination and impact objectives of the project. It also facilitated knowledge exchange, smart port innovation dialogue, and laid the foundation for future cooperation in teaching and research initiatives aligned with Smart Port developments.

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Dissemination objective:

The activity was posted in social media and website of the IoT-ECO project and in website and social media of Aleksander Moisiu University.

4.2. Invited/guest lecturer from business or associated partners in UPT

For the implementation of WP5 (Deliverable 5.3) of the IoT-ECO project, on March 25th 2025, a promotional event was held at the Polytechnic University, Faculty of Information Technology, featuring three industry speakers on the topic "IoT Applications in the Albanian Industry."

Information about the event:

Date of the 3 Lectures: 25/03/2025

Location: Polytechnic University, Faculty of Information Technology

Time slot: 17:00-19:00 PM

The event was attended by Master students in Computer Engineering and Electronic Engineering, who expressed great interest and appreciation for the initiative!

Total number of participants: 27 (13 Female and 14 Male).

The invited lectures have presented in the same date on 25th of March from 17:00-19:00 PM approximately 20 minutes allocated for each of them followed by questions and answers.

The students that attended the presentations of the three invited lecturers were 27 students (13 girls and 14 boys). An attendance list is available.

Flyers were also printed and distributed to the participants in the classroom, and a presentation of the IoT-ECO project and current results were shown.

Below, information is given on the 3 invited speakers, topics and attendance.

1) Alba Merdani

Company: CCBill - online payment services provider, Albania.

Topic: IoT Systems Integration with Cloud Technology for Data Processes

Short bio

Alba Merdani is a Computer Engineer with a deep passion for research, technology, and science. Since 2017, graduated at UPT as Computer Engineer, she has gained extensive experience in the tech industry in different areas, working in various roles such as Software Engineer, DevOps Engineer, Python & Data Engineer, Systems Engineer, and Platform Engineer, across both large corporations and dynamic startups. Alongside industry work, Alba Merdani is contributing to academia as part time Assistant Lecturer at the Faculty of Information and Technology, mentoring students and supporting the next generation of innovators. Currently, she is pursuing PhD studies at the Faculty of Information and Technology, Polytechnic University of Tirana, focusing on Digital Twin systems, IoT smart technologies, and the integration of Cloud and Artificial Intelligence/ Machine Learning (AI/ML) in the context of Industry 4.0.

Abstract: The lecture presents 2 IoT use cases: An intelligent air/weather quality monitoring system for temperature, humidity, pressure, dust pm2.5, pm 10 integrated with ThingSpeak cloud; An intelligent

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urban air quality system for type of gases in the air: Carbon Monoxide (CO), Methane(CH₄), Smoke integrated with Azure IoT and Azure SQL Data base.

2) Gledis Basha

Company: Montal Sh.p.k, provider of solutions for hospitals, clinics and health care centers, Albania

Topic: IoT in Healthcare in Albania

Short Bio

Gledis Basha has been graduated at Polytechnic University of Tirana as an Electronic Engineer in 2012. Afterwards, in 2014 he got a Master of Science degree in Clinical Engineering from Polytechnic University of Tirana. He has gained experience in industry for 11 years focused on electronic medical devices installing, and maintenance. He is currently enrolled on the PhD program at UPT. His main research field is IoT in healthcare.

Abstract: Gledis Basha made an oral presentation on medical healthcare information system, IoT for healthcare, Security and data privacy issues, IoT vendors in Albania, reliability of IoT business in Albania.

3) Ronild Hako, Transmission and Backhauling Senior Engineer, Vodafone Albania

Company: Vodafone, telecommunications company based in Tirana, Albania

Topic: Exploring IoT Services by Vodafone, Albania

Short Bio:

Ronild Hako holds a Master of Science in Telecommunication Engineering from the Polytechnic University of Tirana. With extensive expertise in transmission network engineering, Ronild Hako is a seasoned Transmission and Backhauling Senior Engineer with a strong background in Dense Wavelength Division Multiplexing - DWDM (Reconfigurable Optical Add-drop Multiplexer - ROADM, Automatically Switched Optical Network - ASON), Microwave (IP MW), and Network Routers (Access and Backhaul) technologies. Currently at Vodafone Albania, Ronild Hako specializes in the operation, maintenance, and troubleshooting of complex transmission systems, ensuring optimal network performance and reliability.

Abstract: The lecture presents the IoT concept and the implementation of IoT by the Vodafone company: The Smart Fleet, Smart Agriculture, Smart Coolers and Smart Price projects are presented. The IoT in the Global Data Service Platform (GDSP) is also described.

Photos from the lectures are available.

Here is the Event evaluation form used to assess the invited lecturers' presentations:

EVENT EVALUATION FORM (Copy)

Dear participant,

Thank you for attending the "IoT Applications in Albanian Industry" event, held at UPT on March 25th 2025. In our effort to improve the impact of project events, we kindly ask from you to fill this questionnaire.

We thank you in advance for your valuable contribution!

Required





This form will record your name, please fill your name.

How satisfied you were with (1 = not satisfied, 5 = very satisfied): *					
	1	2	3	4	5
event programme	\circ	\circ	\circ	\circ	\circ
presentations	\bigcirc	\circ	\circ	\circ	\bigcirc
disscusions	\bigcirc	\circ	\circ	\circ	\bigcirc
event administration	\circ	\bigcirc	\bigcirc	\circ	\circ
the venue and	0	\circ	\circ	0	0

2. A. Please, mark your agreement (1 = strongly disagree, 5 = strongly agree) with the following statements: *

	Option 1	Option 2	Option 3	Option 4	Option 5	
information shared during the event was new, useful and clear	0	0	0	0	0	
the event met my expectations in terms of offered topics	0	0	0	0	0	
interaction with other participants was fruitful	0	0	0	0	0	
distributed material was clear and useful	0	0	0	0	0	



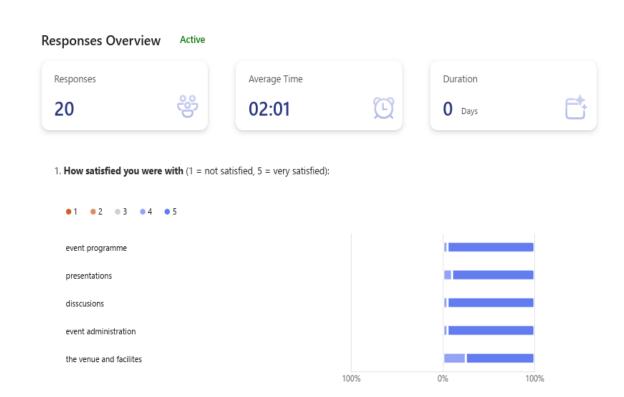


disscusions were relevant for the participants	0	0	0	0	0
time management was fully satisfied	0	0	0	0	0
working methods were appropriate	0	\circ	\circ	\circ	0
the overall organisation was professional	\circ	\circ	\circ	\circ	0

A. OTHER COMMENTS/SUGGESTIONS (please share your feedback):

This content is neither created nor endorsed by Microsoft. The data you submit will be sent to the form owner.









2. A. Please, mark your agreement (1 = strongly disagree, 5 = strongly agree) with the following statements:



3. A. OTHER COMMENTS/SUGGESTIONS (please share your feedback):



Feedback conclusions

The survey was completed by 20 students and relating to the question "How satisfied you were with the event, presentations, event administration, venue and discussions" they rated with the maximal point 5 (very satisfied).

Relating to the details like information shared during the event, the clearance of the material distributed, time management, relevance of discussions, interaction with other participants were all evaluated very good.

There were also very positive comments on the presentations like "Everything explained in details:, "Very useful organization to connect academic researchers and industry".

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4.3. Invited/guest lecturer from business or associated partners in UP

Within WP5 of IoT-ECO project, an invited lecture was held by MSc. Doruntine Berisha at the Faculty of Electrical and Computer Engineering (FECE) on March 18, 2025. The topic of the lecture was "Hands-on demonstration on IoT device configuration and programming with Raspberry Pi".

The event was attended by undergraduate students in their second year of studies at the ICT Bachelor programme at FECE-UP. The goal was to introduce students with hands-on experience with configuring and programming IoT devices with Raspberry Pi hardware. The goal of the activity is to bridges academia and industry, offering students a closer look at the real-world impact of IoT technologies.

Information about the event

Topic: Hands-on demonstration on IoT device configuration and programming with Raspberry Pi

Date: 18/03/2023

Place: Faculty of Electrical and Computer Engineering, University Pristina

Lecturer: MSc. Doruntine Berisha, 3CIS J.S.C, provider of specialized telecom services, Kosovo

Short bio:

Ms. Berisha holds a Master of Science in Telecommunications and is an industry expert with over 10 years of experience at 3CIS J.S.C. She is currently also a PhD candidate at the University of Pristina. Doruntine Berisha, holds a Master of Science in Telecommunications and is an industry expert with over 10 years of experience at 3CIS J.S.C. She is currently also a PhD candidate at the University of Pristina.

The company 3CIS J.S.C is a leading provider of specialized telecom services across the globe. They provide various services to major telecom carriers via their network of partners and also directly. They also regularly host UP-FECE students for mandatory internships within the Information and Communication Technologies (ICT) programme.

Participants: 20 participants (11 F and 9 M), undergraduate students in their second year of studies at the ICT Bachelor programme at FECE-UP.

Feedback:

The students showed great enthusiasm for the chance to obtain hands-on practice on IoT systems. All 20 attendees filled in the feedback forms. They were satisfied with the demonstration and the explanations provided by the lecturer. They generally expressed interest to attend more events like this and the introduction of similar concepts in existing courses. Students were informed for internship opportunities by 3CIS representative and we will further coordinate on details to conduct the internship at 3CIS for some of the participating students.

Some students asked for possibility to also visit industry partners. We are currently considering organizing an industry visit.

The list of participants and photos from the event are available. The slides from the lecture are attached in Annex 1.

The material for the practical work can be seen below.

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4.4. Invited/guest lecturer from business or associated partners in UBT

Information about the event:

Date: 21/01/2025

Place: UBT Dukagjini Campus, Main Lecture Hall

Topic: Introduction to Raspberry Pi

Abstract of the Lecture: This guest lecture served as an introductory session to the Raspberry Pi platform and its applications in Internet of Things (IoT) projects. Students were introduced to the capabilities of Raspberry Pi, its hardware components, General-Purpose Input/Output (GPIO) pins, and real-world use cases. The lecture combined theoretical concepts with a live demonstration, helping students understand how Raspberry Pi can serve as a bridge between software and hardware in IoT systems.

Lecturer Information

• Name: Milot Morina

Affiliation: Engineer at Raiffeisen Bank

Short Bio:

Milot Morina is an IoT engineer with over 4 years of experience in embedded systems and cloud-integrated hardware. He has led multiple IoT deployments in smart cities, agriculture, and environmental monitoring. Milot is passionate about Science, Technology, Engineering, Math (STEM) education and frequently gives lectures and workshops at universities.

Description of the Event

The event was organized as part of the ongoing IoT curriculum at UBT. The guest lecture took place in the main lecture hall, where students from the Computer Science and Mechatronics departments attended. The speaker walked the audience through the basics of Raspberry Pi, explained the boot process, and demonstrated how to light up an Light-Emitting Diode (LED) using Python and the GPIO pins.

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Student Participation

• Type of Students: Undergraduate students in Computer Science

Number of Students: 32 total
 Female Students: 11
 Male Students: 21

Photos from the lecture are available.

Below is the material used for the practical demonstrations.



Feedback from Students

All 33 attendees filled in the feedback forms for the event. Students provided highly positive feedback, expressing interest in incorporating Raspberry Pi into their semester projects. They appreciated the clear delivery of concepts and the real-time demo. Several students mentioned that this session helped them better visualize IoT in practical terms. They also recommended having more hands-on workshops following this introduction.

4.5. Invited/guest lecturer from business or associated partners in UoM

UoM organized 3 events on 3 different dates with 4 invited/guest lecturers. The information about the events is presented in detail further.

Guest Lecture 1. Information about the event:

Date: 12/12/2024

Place: Faculty of Mechanical Engineering, UoM **Topic:** Maintenance of Technical Systems

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On December 12, 2024, Neda Drašković Parović, an esteemed alumna of the Faculty of Mechanical Engineering, delivered an online guest lecture on the topic "Maintenance of Technical Systems". The lecture was organized as part of the course Maintenance, led by prof. Jelena Šaković Jovanović.

During the session, students gained valuable insights into predictive maintenance and modern maintenance approaches.

Here is the poster for the invited lecture of prof. Neda Drašković Parović.



For more information about the event, please visit the Faculty of Mechanical Engineering website at the following link: https://www.ucg.ac.me/objava/blog/1291/objava/190360-odrzano-online-predavanje-na-temu-odrzavanje-tehnickih-sistema

During the session, students gained valuable insights into predictive maintenance and modern maintenance approaches.

For more information about the event, please visit the Faculty of Mechanical Engineering website at the following link: https://www.ucg.ac.me/objava/blog/1291/objava/190360-odrzano-online-predavanje-na-temu-odrzavanje-tehnickih-sistema

Attendees: The number of students attending the lectures was 14 (5 girls and 9 boys). A list of attendance and photos are provided.

Guest Lectures 2. on IoT Systems in Biomedicine Applications

Information about the event:

Date: 19/12/2024

Place: The laboratory of the Faculty of Mechanical Engineering, UoM

Topic: Introduction to Cyber-physical systems and IoT Systems with an Emphasis on Their Application in

Biomedicine

Abstract: The lecturers of the CPS&IoT Academy aims to establish a sustainable informal education platform in Montenegro with a focus on cyber-physical systems (CPS) and the Internet of Things (IoT).

Lecturers Short Bio:

Prof. Dr. Radovan Stojanović, professor at the Faculty of Electrical Engineering, University of Montenegro, and engineer Jovan Đurković is from the same faculty.

Teaching materials in online format on the IoT-ECO site



Attendees: The lecture was delivered to students of the Faculty of Mechanical Engineering. involved in the IoT-ECO project, PhD students of the Faculty of Mechanical Engineering, and students enrolled in the "Maintenance" course, taught by Prof. Dr. Jelena Šaković Jovanović.

Number of attendees: 18 (7 girls and 11 boys).

During the live presentation, it was demonstrated how these devices function and how they are designed.

The lecture was organized in the laboratory at the Faculty of Electrical Engineering, University of Montenegro. The lecture was attended by students from the Faculty of Mechanical Engineering. The course "Maintenance" has been innovated through the IoT-ECO project to include IoT applications in predictive maintenance.

A list of attendance and photos are provided.

Guest Lecture 3. Information about the event:

Date: 10/03/2025

Place: The laboratory of the Faculty of Mechanical Engineering, UoM; Online presentation.

Topic: The Integration of Drones in lot Systems

Lecturer's short Bio:

Mr. Boris Marković, electrical engineer and owner of company M-Code D.O.O, an esteemed alumna of the Faculty of Electrical Engineering, University of Montenegro. Boris Marković earned his bachelor's degree in Electrical Engineering, focusing on Electronics, from the University of Montenegro in 1993. He furthered his education with a master's degree in Computer Science from the University of Belgrade in 1996. Since 2008, he has been pursuing doctoral studies at the University of Montenegro, concentrating on Superconductivity, Nanotechnology, and Terahertz (THz) radiation.

Professionally, Mr. Marković has held various positions, including roles as an Adviser for Information Systems and Development in the public and telecommunications sectors. He has been the owner of M-Code since 2005.

M-Code D.O.O is a company registered in 2005 in Montenegro, owned by Boris Marković. The company specializes in computer programming and provides a wide range of services in the field of information technology. Additionally, M-Code is involved in the design and production of drones.

Abstract: The lecture explores the integration of drones within the Internet of Things (IoT) ecosystem. It covers the ways in which drones can enhance IoT systems by collecting and transmitting data in real-time, enabling more efficient monitoring, automation, and decision-making. The lecture also discusses the challenges and opportunities presented by combining drone technology with IoT, including data management, connectivity, and security concerns. Practical applications of drone enabled IoT systems in industries such as agriculture, logistics, and environmental monitoring are also examined.

The guest lecturer delivered the lecture online. The lecture was organized as part of the course "Industrial Engineering: led by prof. Aleksandar Vujović and offered students a unique opportunity to learn from a practitioner actively involved in the field. Mr. Marković also highlighted the importance of cross-disciplinary knowledge, emphasizing how electrical engineering, data science, and advanced communication technologies converge to drive the future of IoT-enabled systems.





Attendees: The number of students attending the lectures was 14 (5 girls and 9 boys). The attendees were students of the Faculty of Mechanical Engineering. involved in the IoT-ECO project, PhD students of the Faculty of Mechanical Engineering A list of attendance and photos are provided.

Feedback:

Half of the students attending the 3 lectures (7 out of 14 for lecture 1, 9 out of 18 for lecture 2 and 7 out of 14 for lecture 3) submitted feedback on paper forms, collected and provided by professor Jelena Jovanovic.

The feedback from the 3 events with invited lecture is shown in the table (Scale: 5-Strongly agree, 4-Mostly agree, 3-Neutral, 2-Mostly Disagree, 1-Strongly Disagree):

Question of the survey	Answers rating	Answers rating	Answers rating	
	Lecture 1	Lecture 2	Lecture 3	
Lectures				
The lectures were clear and understandable	4.57	4.83	5	
The pace of the lectures matched my learning speed	4.71	4.67	4.71	
The lectures contributed to the development of my knowledge in this field	4.42	4.67	4.5	
The lectures and exercises were well- coordinated	5	4.5	5	
Assignments and Practical Skills				
I fully understood the expectations and requirements for completing assignments	4.85	4.67	4.5	
The assignments were appropriately challenging for my level of knowledge	4.42	4.67	4.67	
The assignments helped me develop practical skills related to the topic of the course	5	4.5	5	
Materials and Equipment:				
The teaching materials cover the course content and are appropriate for mastering the subject matter	4.71	4.83	4.67	
The available equipment and materials were effective for the delivery of instruction	4.57	4.83	4.67	
General Evaluation:	L			
The overall quality of the course	4.71	4.5	4.85	

Teaching materials in online format on the IoT-ECO site



Feedback conclusions:

The students made positive comments "Great course", "Excellent lecture", "The practical tasks were very interesting". A student required a continuation of the course and another one suggested to work on small projects in teams. With these suggestions the lectures can even be improved in future. The overall evaluation of the invited lectures is positive and the students present interest to the topic of IoT technologies and their implementation for the green transformation.

Photos from all 3 events are provided.

4.6. Invited/guest lecturer from business or associated partners in UNIMED

Information about the event:

Date: March 6, 2025, online

Location: University Mediterranean, Podgorica, Montenegro; Online presentation.

Topic: Introduction to Arduino Development Environment; Pulse Width Modulation (PWM), Direct

Current (DC) Motor, Stepper Motor, and Servo Motor Control

Within the new course on IoT, UNIMED invited a guest lecturer, Dr. Amar Kapić, who is currently Associate Researcher at European Organization for Nuclear Research (CERN), former research and teaching assistant at Ecole Polytechnique Fédérale de Lausanne (EPFL). Through our cooperation, dr Kapić will be actively engaged in the course of Internet of things, providing valuable support in students' practical work.

Short bio of the lecturer

Dr Amar Kapić is assistant professor, holding B.Sc. and M.Sc. degree in power systems and automatic control and control engineering, from the University of Montenegro, and Ph.D. in Microsystems and Microelectronics from Integrated Circuits Laboratory (ICLAB) at the Swiss Federal Institute of Technology Lausanne (EPFL). He is an expert in designing hardware and software interfaces for sensor characterization, sensor readout front-end circuits, and the development of embedded software. His current research interests include investigating radiation effects on commercial-off-the-shelf (COTS) electronics, electrochemical biosensors, and Complementary metal—oxide—semiconductor (CMOS) integrated circuits for biomedical systems. Dr Kapić is currently working as an associate researcher in CERN and a guest lecturer at the Faculty of information technology, University "Mediterranean" Podgorica.

So far, professor Kapić had guest lectures on the following topics:

- Introduction to Arduino Development Environment
- Pulse Width Modulation (PWM), Direct Current (DC) Motor, Stepper Motor, and Servo Motor Control

Abstracts of the lectures:

The guest lecture provided students with a comprehensive introduction to the Arduino development environment which will be used in the practical course activities.

The first lecture, Introduction to Arduino, provided a brief overview of Arduino development environments and microcontrollers, focusing on their applications in IoT. Students were introduced to the structure of Arduino programming, fundamental components such as digital and analog inputs, and hands-on examples, including basic LED control and sensor data acquisition. The session aimed to familiarize students with Arduino as a key tool for prototyping IoT applications.

The second lecture, Motors and PWM, explored the concept of Pulse Width Modulation (PWM) and its application in controlling various types of motors. The lecture covered DC motors, stepper motors, and





servo motors, demonstrating their differences and control methods. Practical examples were provided using the Wokwi simulator, where students implemented LED dimming and motor control techniques. Additionally, the use of Arduino libraries for motor control was discussed, giving students insights into efficient hardware interaction.

Both lectures engaged third year students enrolled in the Internet of Things course, introducing them to key IoT and embedded systems concepts. The sessions were organized online, via Zoom, but still interactive, allowing students to gain hands-on experience and deepen their understanding of Arduino-based development. Feedback from students indicated a high level of interest and appreciation for the practical applications demonstrated during the lectures.

Attendees - Student's Participation

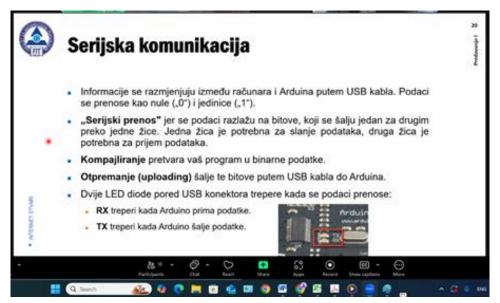
- Number of students: 11 (of 12 enrolled);
- Gender distribution: 3 female, 8 male;
- Student profile: Undergraduate students from IT, third year students enrolled in the Internet of Things course.

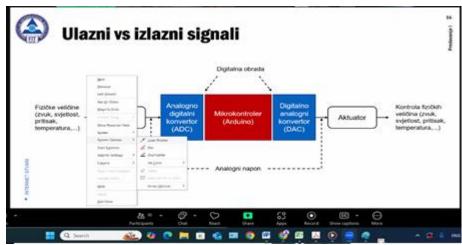
Some screenshot from the meetings follow below:











Event Feedback

All 11 attendees filled in the feedback forms. The lecture received highly positive feedback from students, who appreciated the practical approach and real-world examples provided by Prof. Kapić. According to the feedback form, the results for the given lectures are the following bellow (Scale: 5-Strongly agree, 4-Mostly agree, 3-Neutral, 2-Mostly Disagree, 1-Strongly Disagree):





Question of the survey	Answers rating				
Lectures					
The lectures were clear and understandable	4.78				
The pace of the lectures matched my learning speed	5				
The lectures contributed to the development of my knowledge in this field	4.89				
The lectures and exercises were well-coordinated	5				
Assignments and Practical Skills					
I fully understood the expectations and requirements for completing assignments	5				
The assignments were appropriately challenging for my level of knowledge	5				
The assignments helped me develop practical skills related to the topic of the course	5				
Materials and Equipment:					
The teaching materials cover the course content and are appropriate for mastering the subject matter	5				
The available equipment and materials were effective for the delivery of instruction	5				
General Evaluation:					
The overall quality of the course	5				

Note: The feedback for the overall course will be provided by the end of the course.

5.Conclusion

- On the diversity of stakeholders/lecturers intervening

A total of 11 presentations from invited/guest lecturers from associate and business partners were realized in the 6 Partner's HEIs. They were organized in the period starting from 12.12.2024 to 25.03.2025. One guest lecturer came from an associate partner of the lot-ECO project – The Authority Port of Durres. Seven lecturers are business partners of the Partner HEIs and 3 lecturers came from Academia/Research area. The diversity of lecturers and stakeholders demonstrate a strong commitment to linking academia and





industry. The invited specialists come from a variety of industries, including cloud computing, embedded systems, healthcare, telecommunications, port logistics, and even top research institutes like CERN. Their diverse and consolidated professional backgrounds, which include positions as engineers, academics, entrepreneurs, and policy influencers, provide students with direct knowledge of how IoT technologies are used in the real world. With a balanced representation of gender and academic-industry partnership, the speakers also represent institutional and geographic diversity, hailing from Albania, Kosovo, Montenegro, and worldwide research centers. By introducing students to current issues and solutions in smart systems, sustainability, and digital transformation, this diverse mix of viewpoints and experiences not only promotes interdisciplinary learning but also student motivation, creativity, and engagement. The gender balance from the invited lecturers was 3 ladies and 8 men expressed in % with 27% female and 73% male. The invited/guest lecturers supported the Partner's HEIs with the starting probation of the new courses developed within the IoT-ECO project. The positive feedback obtained from the attendees shows that this good practice should be maintained in future.

- On the feedback of the students

The total number of students who attended the invited/guest lectures in all 6 Partner's HEIs is 156, 62 of them are female, 94 of them are male. In total 125 out of the 156 students-attendees filled in the feedback forms provided by the organizers of the invited/guest lectures This provides feedback from 80% of the attendees, which can be considered as representative.

According to student feedback collected from all 6 partner institutions, the invited lectures were well received, with particular emphasis placed on the content relevance and clarity, the speaker's excellent preparation, and the useful real-world examples. Students at UAMD recommended additional interaction and visual aids for upcoming lectures, praising the lecture's framework and practical relevance. Students at UPT gave the event's organizing a high rating, valued the industry-academic relationship, and gave the entire session a high rating. Students at UP and UBT expressed a great interest in similar future events and hands-on learning, and the Raspberry Pi hands-on workshops expressed strong interest.

Attendees gave UoM's lectures high ratings as well, praising the insights into CPS, predictive maintenance, and drone integration in IoT systems while urging additional industry visits. Students at UNIMED evaluated their Arduino-based lecture with high marks in every assessed category, praising the clarity, organization, and practical focus. All things considered, the guest lectures successfully increased student interest and engagement with IoT technology, bridging the gap between academic knowledge and business practices and advancing the objectives of the IoT-ECO project. There is confirmed the interest to the topic of the IoT technology and its implementation for the green transformation of the Western Balkans.





Annex I. Slides of the presentations from the invited lecturers

Lecture in UAMD

Vagim Hoti, Durres Port toward Smart Port

"Durres Port toward Smart Port" was delivered by Eng. Vegim Hoti, Head of the Innovation Unit in Durres Port Authority, Associate partner in the IoT-ECO project, Invited lecture in UAMD.

Lecture slides



TABLE OF CONTENT Introduction Current status of port · Figures of port Port Operations

Port Terminals

- · What is a Smart Port
- Port Smart Port Systems.
- Key steps to transform Durres port into a Smart Port.
- · Benefits of a Smart Port
- Smart Port Cases
- References









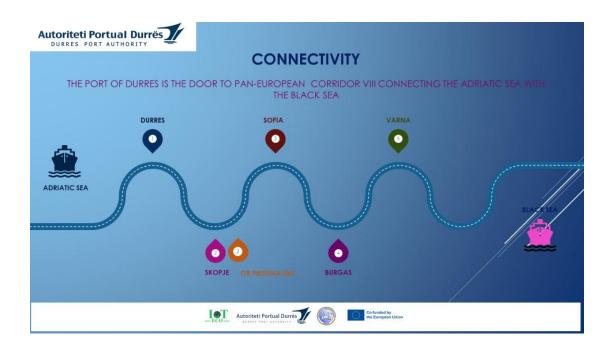






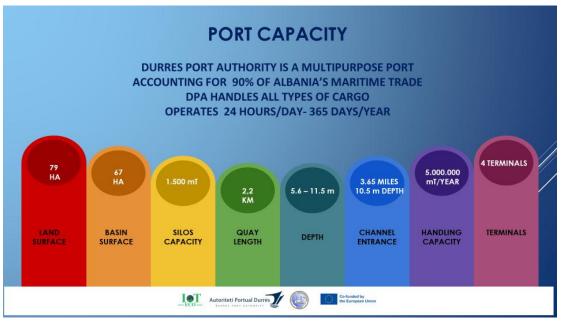
































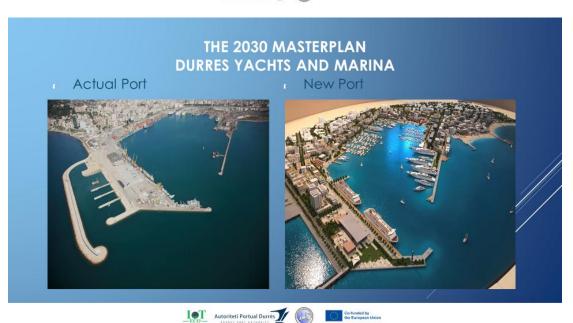


FUTURE DEVELOPMENTS IN PORT INFRASTRUCTURE: THE 2030 MASTERPLAN

- Reallocation Of Cargo Operations In A New Modern Facility Which Will Be Built In Porto Romano
- > Old City Harbour Will Be Dedicated To Passengers, Cruises, Marina And Real Estate Development
- > A Multi-site Port Authority That Will Benefit From The Maritime And Tourism Industries
- Port Services Integrated With A Logistic And Energy Park, As Well As Improved Security And Operations, Are Able To Service Not Only Albania But Also Our Regional Clients In See

The new cargo port is currently in the tender process for the implementation of Phase I.











































Key Features of a Smart Port:

AUTOMATION: USING ROBOTICS (RPA) AND AUTOMATED SYSTEMS FOR FASTER CARGO HANDLING AN REDUCED HUMAN ERROR.

REAL-TIME MONITORING: IOT (INTERNET OF THINGS): SENSORS PROVIDE LIVE DATA ON CARGO AND ENVIRONMENTAL CONDITIONS.

DATA ANALYTICS: USING BIG DATA TO OPTIMIZE LOGISTICS AND PREDICT TRENDS

PREDICTIVE MAINTENANCE: AI-POWERED SYSTEMS PREDICT EQUIPMENT FAILURES AND MAINTENANCE BEFORE ISSUES OCCUR.

EFFICIENT COMMUNICATION: SEAMLESS DATA EXCHANGE BETWEEN SHIPPING

SUSTAINABILITY: INCORPORATING GREEN ENERGY SOLUTIONS, REDUCING

ENHANCED CONNECTIVITY: USING 5G AND IOT FOR SEAMLESS COMMUNICATION BETWEEN STA DIGITAL TWINS: A VIRTUAL REPRESENTATION OF AN OBJECT OR SYSTEM DESIGNED TO REFLECT **OBJECT ACCURATELY**









Benefits:

- Efficiency: Faster cargo handling and reduced turnaround times.
 - Reduced Turnaround Times: Streamlined operations for quicker ship
 - Cost Savings: Optimized resource usage and reduced operational costs.
 - Environmental Impact: Improved energy efficiency, lower emissions and better waste management.
 - · Improved Safety: Reduced accidents through automated and monitored processes.













Big Data

Big Data is a game-changer technology for the shipping industry.

The world is becoming data-driven, and ports are no longer an exception. This is more than just large amounts of inputs. It allows companies to use enormous amounts of data from non-traditional sources. A non-traditional source is time-sensitive inputs, not just past recorded, used to optimize the industry and ports.

Large sets of data exist, and now the questions is: what can be done with it?

Big Data contributes to <u>predictive technology and estimated time of arrival (ETA)</u>

<u>systems</u> that will change the maritime shipping industry. For example, sensors are now attached to vessels that give real-time information.

Big Data systems use this information to track vessels and cargo, including texts, audios, videos, and real-time information.

Precise inputs leads ports to peak efficiency, performance, and growth.



INTERNET OF THINGS OF

Internet of Things (Internet Of Goods IoG) can help smart ports operate more efficiently, safely, and sustainably, providing benefits to both the port operators and the wider community.

Internet of Things (IoT) is a system of "things" embedded with different types of technologies, like sensors. IoT can, for example, identify in detail what each ship is carrying.

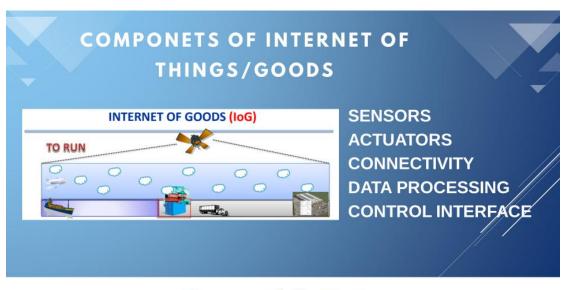
IoT allows port authorities to track arriving vessels in real-time and keep track of gargo.

IoT enables decision—making based on precise input exchange.









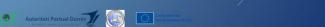


IoT in Ports

- **1.Smart Containers**: Equipped with IoT sensors, these containers provide real-time data on location, temperature, humidity, and other parameters, ensuring cargo safety and security during transit.
- **2.Automated Equipment**: IoT-enabled cranes, straddle carriers, and automated guided vehicles (AGVs) enhance productivity and efficiency by reducing human intervention and optimizing equipment usage.
- **3.Environmental Monitoring**: IoT devices monitor air and water quality, noise levels, and energy consumption, helping ports meet environmental goals and comply with regulations.

IoT in Ships

- Cargo Tracking: Real-time tracking of cargo improves inventory management and reduces the risk theft or loss.
- Predictive Maintenance: IoT sensors monitor equipment health, enabling predictive maintenance and reducing downtime.
- **3. Energy Management**: IoT systems optimize energy consumption, lowering operational costs and supporting green initiatives.







APPLICATION OF INTERNET OF THINGS IN DURRES PORT SYSTEMS

- ACCESS CONTROL SYSTEMS IN RFID READER
- SENSORS IN MEASURE OF AIR POLLUTION
- SENSORS OF LIGHT FOR OPTIMIZATION OF ENERGY EFFICIENCY
- SMART METERS FOR ENERGY
- SENSOR OF MOVEMENT FOR VIDEO ANALYTICS
- SENSORS OF MOVEMENT FOR MINIMIZING CROWD CONGESTION
- SENSORS OF TEMPERATURE IN SERVERS AND SWITCHES
- SMART TAGS IN WEARABLE DEVICES



Blockchain Technology

A blockchain is "a distributed database that maintains a continuously growing list of ordered records, called blocks." These blocks "are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data

- Blockchain technology stores data.
- With blockchain technology, <u>logistics</u> companies can follow each event that
 occurs in the global <u>supply chain</u>. These inputs stored forever and cannot be
 deleted.
- Blockchain technology allows all data to be stored online which could reinvent the shipping sector's decision—making processes.
- For actors would have access to unchangeable real-time data.
- This technology provides an open platform paperwork–free system.







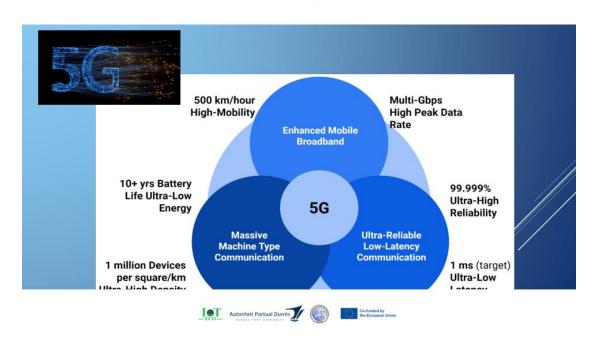


What is 5G? 5G stands for "fifth generation" and is the latest generation of cellular network technology, following 1G, 2G, 3G, and 4G. It promises faster speeds, lower latency (the time it takes for devices to communicate), and the ability to connect many more devices simultaneously.

What is 5G in ports? 5G technology in ports involves using fifth-generation cellular networks to enhance operations and logistics within port facilities. This technology enables faster communication, real-time data collection, and improved automation. Why is 5G important?

- •Speed: 5G can be up to 100 times faster than 4G, allowing you to download movies in seconds with a peak speed of 10 gigabits per second (Gbit/s).
- •Latency: It reduces the delay in communication, which is crucial for real-time applications like online gaming and remote surgery.
- •Capacity: 5G can handle more devices at once, which is essential as we connect more gadget internet, like smart home devices and self-driving cars









How does 5G work?

5G uses higher frequency radio waves, which can carry more data but have shorter range To overcome this, 5G networks use "small cells" – smaller base stations placed closer together than traditional cell towers. This ensures consistent coverage, especially in urban areas

Benefits of 5G:

- Enhanced Mobile Broadband: Faster download and upload speeds for streaming, gaming, and large file transfers.
- •Internet of Things (IoT): Supports a vast number of connected devices, enabling small cities and advanced automation.
- Augmented Reality (AR) and Virtual Reality (VR): Provide the high bandwidth latency needed for immersive experiences.









Challenges:



- · Infrastructure: Building a 5G network requires significant investment in new infrastructure.
- · Security and network resilience:

The rising threat of cyberattacks in an increasingly digitalized port environment. With the integration of advanced technologies, ports are becoming more vulnerable to malicious intrusions that can disrupt operations and comprom

The deployment of 5G enables the creation of more secure systems due to its improved encryption standards, network slicing capabilities, and strong authentication protocols.

5G contributes to a resilient and reliable network that can support disaster recovery efforts by maintaining connectivity

Achieving seamless data exchange between diverse systems and devices, often originating from m

Ports typically operate with a mix of legacy systems and modern technologies, making interoperability a per The high-speed, low-latency capabilities of 5G facilitate real-time communication and data sharing between software solutions, regardless of the manufacturer.

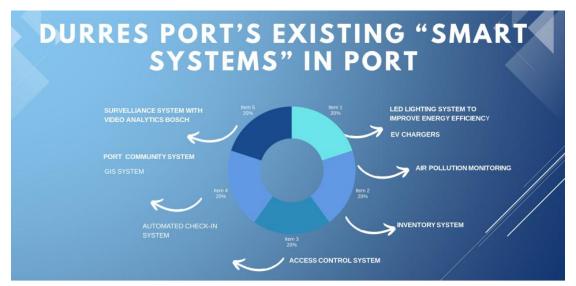




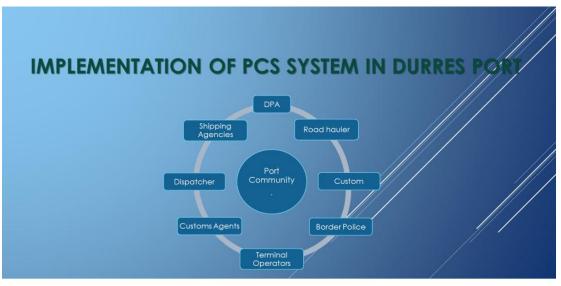


















SHORT TERM DURRES PORT ICT STRATEGY.

- ➤ Improving the cybersecurity framework and upgrading the skills of employees.. ▼
- > Enhancing the Durres port's PCS system by adding new modules.
 - · Enhancing traffic management and discipline at the port.
 - · Enhance cargo tracking.
 - · Customer service.
 - Enhance the efficiency of labor and equipment resources to boost business activities for Port Community stakeholders.
 - · Applying Innovative procedures to increase Port and security efficiency.
- > TOS Fully automate billing operations at the general cargo terminal.



KEY STEPS TO TRANSFORM DURRES PORT IN A SMART PORT

- Infrastructure Modernization: Upgrade port facilities, expand capacity, and implement smart grids
- Digitalization of Operations: Introduce smart cargo handling, Al-driven logistics, and cloud-based systems
- Connectivity & IoT Integration: Deploy real-time tracking, automated gates, and smart sensors
- Sustainability Initiatives: Reduce carbon footprint, implement waste management solutions, and encourage green shipping
- Collaboration & Policy Support: Work with stakeholders, attract investments, and align with EU maritime policies















PORT OF ANTWERP

Digital twin

The digital twin is a **digital copy of the port area** with **real-time information**: which ships are in which locks and docks? Are all the life preservers hanging in their closets? How much energy are our wind turbines producing?

The **Advanced Port Information & Control Assistant** (APICA) is the brain of the application. A **3D interface** with real-time information is the face of the application.

Drone daily flights over the port area covering a range of functions including berth management, monitoring, infrastructure inspections, oil spill and floating waste detection, and to support security partners during incidents



PORT OF ROTTERDAM IMPLEMENTED TECHNOLOGIES Digital Twin loT sensors measuring water movement, turbidity, and pressure.









IMPLEMENTED TECHNOLOGIES

Intelligent solutions for safety, real time navigation, and green electricity from land are implemented into operations

Weather sensors have been installed around the port











PORT OF SHANGAI

IMPLEMENTED TECHNOLOGIES

Automated Container Terminal 5G Network























Invited lectures in UPT

PRESENTATION OF GLEDIS BASHA: Oral presentation on medical healthcare information system, IoT for healthcare, Security and data privacy issues, IoT vendors in Albania, reliability of IoT business in Albania.

RESENTATION OF RONILD HAKO, Exploring IoT Services by Vodafone Albania







Perdorimi i IoT

Qellimi:

- Perdoret per te rritur efikasitetin, per te permiresuar vendimmarrjen dhe per te krijuar mundesi te reja biznesi.
- Lejon monitorimin dhe kontrollin ne kohe reale te pajisjeve, duke çuar ne menaxhim dhe automatizim me te mire te burimeve.

Benefitet:

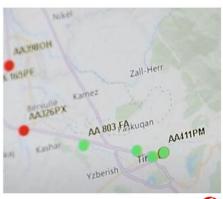
- Efikasiteti: IoT ndihmon ne optimizimin e operacioneve duke ofruar te dhena ne kohe reale, te cilat ndikojne ne permiresim te produktivitetit dhe ulje te kostove.
- Pervoja e klientit: IoT mundeson sherbime dhe mirembajtje te personalizuara, duke rritur kenagesine e klientit.
- Mundesite e biznesit: IoT hap mundesi te reja te te ardhurave permes produkteve dhe sherbimeve inovative, te tilla si smart homes ose connected vehicles.

2 General

26 March 2025

Smart Fleet

- Gjurmim ne kohe reale te vendodhjes se gjithe flotes se automjeteve.
- · Pamje te detajuara per udhetimet.
- Menaxhim dhe raporte mbi konsumin e karburantit.
- Statistika mbi menyren e drejtimit te automjeteve.
- Njoftime te menjehersheme dhe raporte administrative.
- · Opsione shtese me ane te sensoreve.



C2 General

March 2025

0

Smart Fleet



C2 General 6 25 March 202







Smart Agriculture

- Monitorim i mbjelljes, vaditjes dhe aplikimit te pesticideve.
- Parametrat klimatike, shiu dhe temperatura.
- Karakteristikat e tokes: lageshtia, temperatura e tokes dhe perçueshmeria elektrike.
- · Presionin e ujit gjate vaditjes.
- Matje e rrezatimin diellor.
- Mundesi per parashikim te semundjeve dhe monitorimi i tyre online ne kohe reale.
- Integrim me sonda nentokesore (psh: sdi12).





Smart Sens: Smart Coolers

- · Monitorim remote i aseteve.
- Krijimi i kushteve optimale dhe temperatures per produktet e ofruara.
- Kontrolli ne kohe reale i kualitetit te produkteve.
- Monitorimi ne kohe reale i shitjeve dhe iventarit.
- Krijimi i raporteve per specifika operacionale.

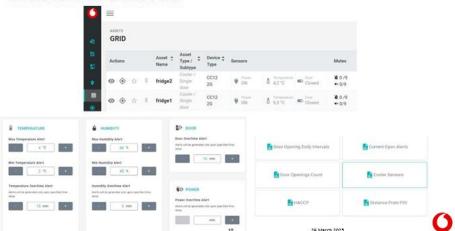


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Smart Sens: Smart Coffee

- Monitorim remote i aparateve dhe gjendjes se tyre teknike.
- · Kontrolli ne kohe reale i kualitetit te kafes.
- Monitorimi ne kohe reale i sasise se kafes, ujit te konsumuar dhe energjise elektrike.
- Dashboard financiar i kostove dhe fitimit.
- Krijimi i raporteve specifike te operimit.



Smart Sens: Smart Coffee

C2 General







Smart Sens: Smart Coffee



Smart Price

- Kontroll i centralizuar i cmimeve te produkteve.
- · Kostumizim i etiketes ne varesi te produktit, cmimit dhe promocioneve.
- · Reduktim i kostove dhe kohes se stafit.
- · Ulje e gabimit njerezor.
- Menaxhim i iventarit.
- · Integrimi me aplikacione ndihmese per lokalizimin e produkeve nga klientet.



C2 General

Vodafone IoT - GDSP

- · GDSP (Global Data Service Platform): Platforme universale per menaxhimin e paisjeve IoT te lidhura ne rrjetin Vodafone.
- GDSP mund te modifikohet sipas aplikimeve specifike dhe kerkesave te klientit.



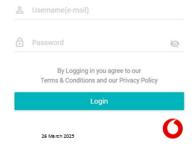
C2 General





15

IoT Asset Control







Aplikime IoT ne Vodafone Group

- · Monitorim ne distance i shendetit te pacienteve .
- · Menaxhim i rrjetit te furnizimit me uje te pijshem.
- Monitorim dhe menaxhim i garazheve.
- · Menaxhim i operacioneve ne hoteleri.
- Menaxhim i mbetjeve.
- Detektimi i droneve.





Invited lecture in UPT

PRESENTATION OF ALBA MERDANI, IoT-ECO: IoT system integration with Cloud technology for data processes









IoT Green Transformation for Academic Society and Business Oriented Ecosystem in Western Balkans

Project number: 101083018 - IoT-ECO - ERASMUS-EDU-2022-CBHE-STRAND-2



"IoT-Eco: IoT systems integration with Cloud technology for data processes"

MSc. Alba Merdani, Supervisor: Prof As. Enida Sheme Department of Computer Engineering Faculty of Information Technology Polytechnic University of Tirana

Tirana, March 2025

The European Commission support for the production of this presentation does not constitute an endorsement of the contents which reflects the views only of the

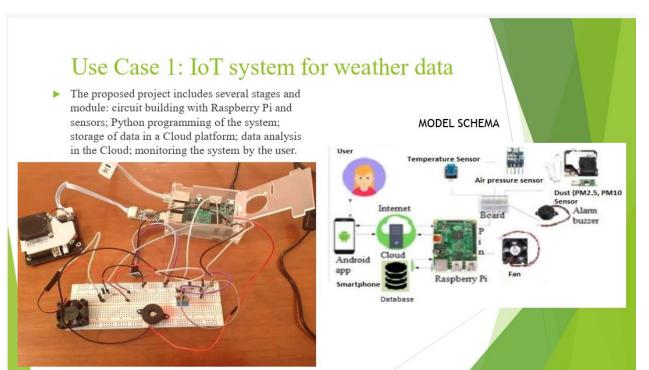


Use cases:

- ► An intelligent air/weather quality monitoring system for temperature, humidity, pressure, dust pm2.5, pm10 integrated with ThingSpeak cloud.
- ▶ An intelligent urban air quality system for type of gases in the air: Carbon Monoxide (CO), Methane (CH₄), Smoke integrated with Azure IoT Hub and Azure SQL database.







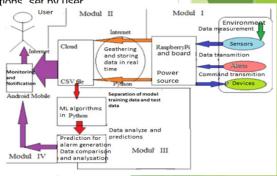
System architecture

This project consists of four modules:

- The first module is the IoT circuit for the project consisting of RPi, sensors and wired board that serve to integrate them.
- The next module includes a Cloud communication channel and program in Python to take the measured values from the sensors and save them in CSV file and Cloud platform in real time.
- ▶ The third module is the data analysis module using models with Machine Learning algorithms. Data analysis is important to make predictions and to understand how accurate the IoT system is.
- User interaction module, monitors in real time through Cloud platform the environmental parameters and see alarm generation when their values are outside the allowed conditions, set by user

These modules include actions on data:

- · Measurement of data.
- · Data transmission.
- · Data collection and storage.
- · Data analysis and prediction.
- · Real-time data monitoring







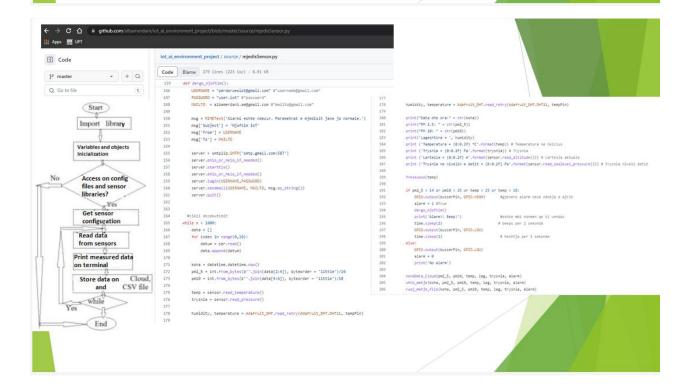
Experimental Environment of Prototype

Hardware

- ► The RPi module uses Raspbian OS, 16 GB SD card and RPi model 3B with RAM, 1 HDMI port, an Ethernet port, a power port, an Audio / Video port and 4 USB ports. Raspberry Pi 3 B with dimensions 85.60 mm x 56.5 mm x 17mm, 1.34 Amps, 6.7W.
- DHT11 temperature and humidity sensor; Atmospheric pressure sensor BMP 180; PM Nova SDS011; sensor for PM 2.5, PM10 pollutants in air; 5 V electronic coolant, 200 mA; Buzzer for alarm.
- Resistance 1 kOhm, NPN type transistors, models 2N2222 or S8050; Board, Female-female wire, male-female, male-male; Monitor, keyboard, mouse;
- HDMI cable, Ethernet cable, Wireless; Smartphone

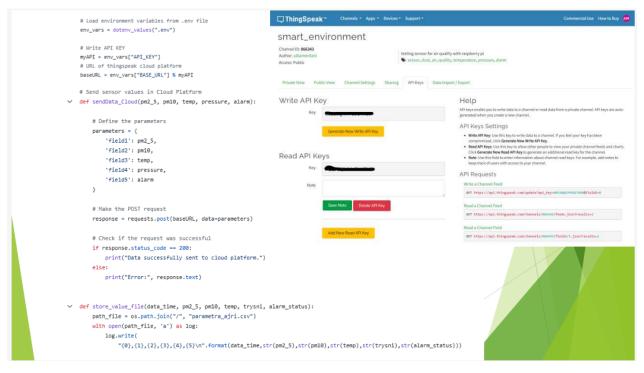
Software

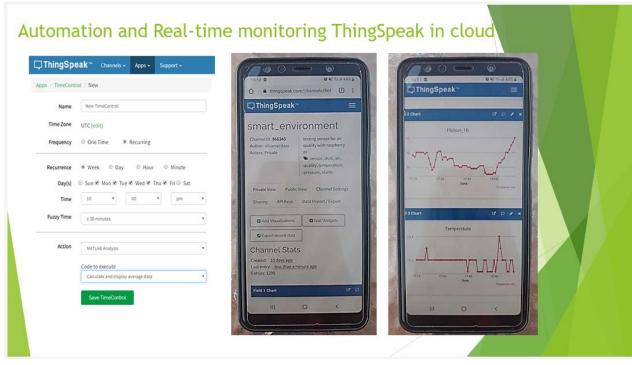
- Raspbian Operating System for Rpi.
- Python 3 as a high-level programming language for sensor algorithm.
- ThingSpeak as a Cloud Platform.
- Libraries / modules used in Python: Pip, Git, RPi.GPIO, time, datetime, sys, serial, urllib, pyplot, matplotlib, numpy, graphviz, pandas, xlrd, sklearn, tensorflow, Adafruit_DHT, Adafruit_BMP.





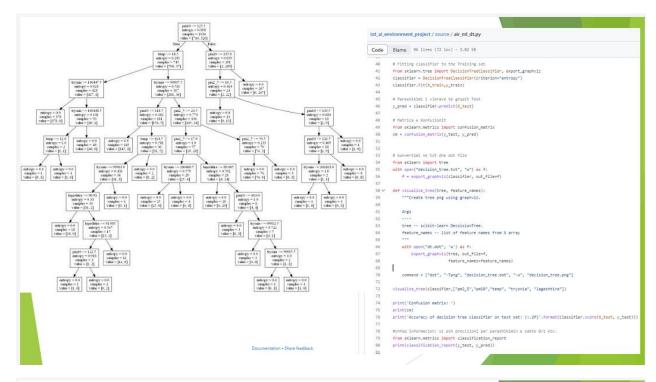












Description of data and ML model with Random Forest

- The data of this study provide us with information on environmental parameters such as temperature, humidity, amount of dust, air pressure.
- Data are measured from 3 different sensors and stored in CSV file and Cloud platform.
- Collected data from sensors are one record per minute. We have 1407 records, approximately records for 24 hours.
- All variables are numeric values.
- ▶ We have 5 independent variables that are: pm2 5, pm10, temperature, humidity and pressure.
- We used Python programming language and several libraries such as Pandas, NumPy, Matplotlib, Sklearn libraries, to build the model, following the steps below:
 - Read data from csv file using the pd.read csv method from Pandas library.
 - Transform the time series dataset into a supervised learning dataset.
 - Split a univariate dataset into train/test sets.
 - Fit a random forest model splitting the train set in two parts and make a one-step prediction for each independent variable.
 - Do walk-forward validation for univariate data and calculate predicted values and Mean Absolute Error (MAE) for each independent variable.
 - Show results and graphs
- Model is trained and tested with the data recorded before.

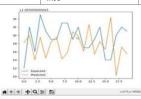


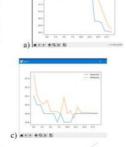


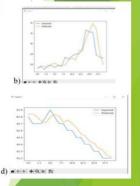
Experimental results for predictions using machine learning

Case 1: The model was tested using a train set of 900 measurements and 20 number of predictions. Predictions and MAE calculation is done for each independent variable separately.

Parameter	MAE	Time Prediction
PM 2.5	0.408	0:21.420
PM 10	0.442	0:31.723
Temperature	0.076	0:18.600
Humidity	0.081	0:23.412
Pressure	4.496	0:32.757





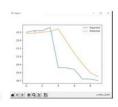


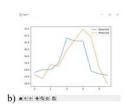
Graph of expected and predicted values for independent parameters a) pm 2.5, b) pm 10, c) temperature, d) humidity, e) air pressure

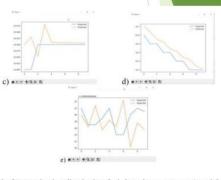
Experimental results for predictions using machine learning

Case 2: The model was tested using a train set of 1000 measurements and 10 number of predictions. Predictions and MAE calculation is done for each independent variable separately.

Parameter	MAE	Time Prediction
PM 2.5	0.721	0:11.763 seconds
PM 10	0.680	0:17.305 seconds
Temperature	0.040	0:10.603 seconds
Humidity	0.079	0:12.852 seconds
Pressure	4 877	0:18:503 seconds







Graph of expected and predicted values for independent parameters a) pm 2.5, b) pm 10, c) temperature, d) humidity, e) air pressure

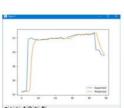


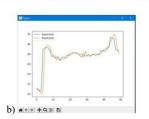


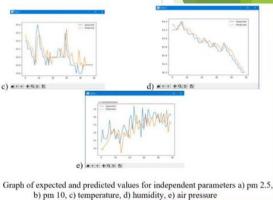
Experimental results for predictions using machine learning

Case 3: The model was tested using a train set of 1000 measurements and 50 number of predictions. Predictions and MAE calculation is done for each independent variable separately.

Parameter	MAE	Time Prediction
PM 2.5	0.577	1:00.203 minutes
PM 10	0.564	1:26.248 minutes
Temperature	0.079	0:51.581 minutes
Humidity	0.073	1:03.757 minutes
Pressure	5.401	1:30.554 minutes

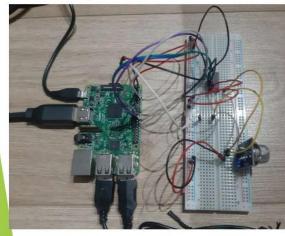


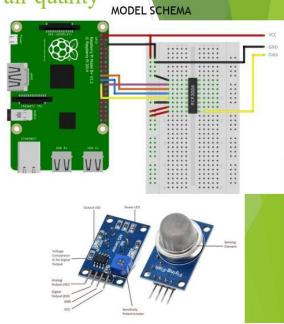




Use Case 2: IoT system for urban air quality

▶ The proposed project includes modules: circuit building with Raspberry Pi and sensors; Python script of the system; storage of data in Azure platform through IoT Hub, Azure Stream Analytics and Azure SQL DB









Experimental Environment

Hardware

- The RPi module uses Raspbian OS, 16 GB SD card and RPi model 3B with RAM, 1 HDMI port, an Ethernet port, a power port, an Audio / Video port and 4 USB ports. Raspberry Pi 3 B with dimensions 85.60 mm x 56.5 mm x 17mm, 1.34 Amps, 6.7W.
- MQ2 sensor;
- Potenciometer; Board, Female-female wire, malefemale, male-male; Monitor, keyboard, mouse;
- HDMI cable, Ethernet cable, Wireless;

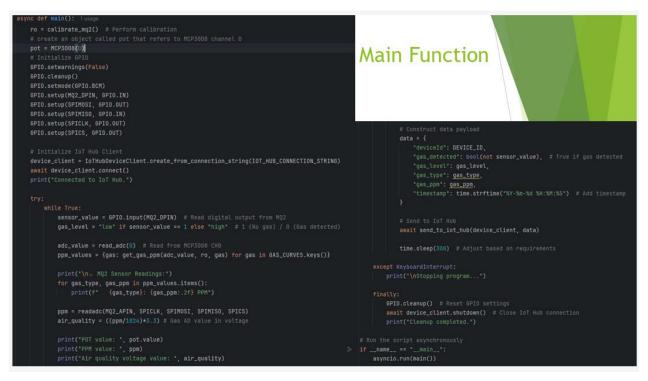
Software

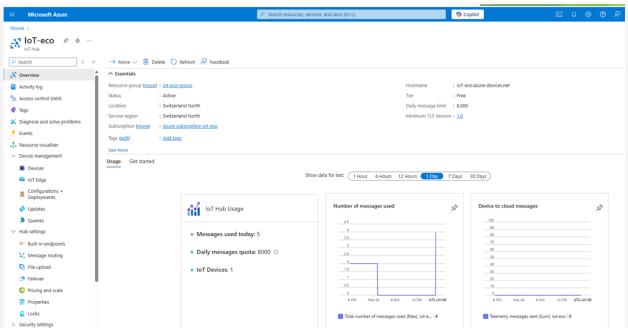
- Raspbian Operating System for Rpi.
- Python 3 as a high-level programming language for sensor algorithm.
- Azure as a Cloud Platform.
- Libraries / modules used in Python: Pip, RPi.GPIO, time, json, math, spidev, gpiozero, azure.iot.device.aio.

Use Case 2 - Python script



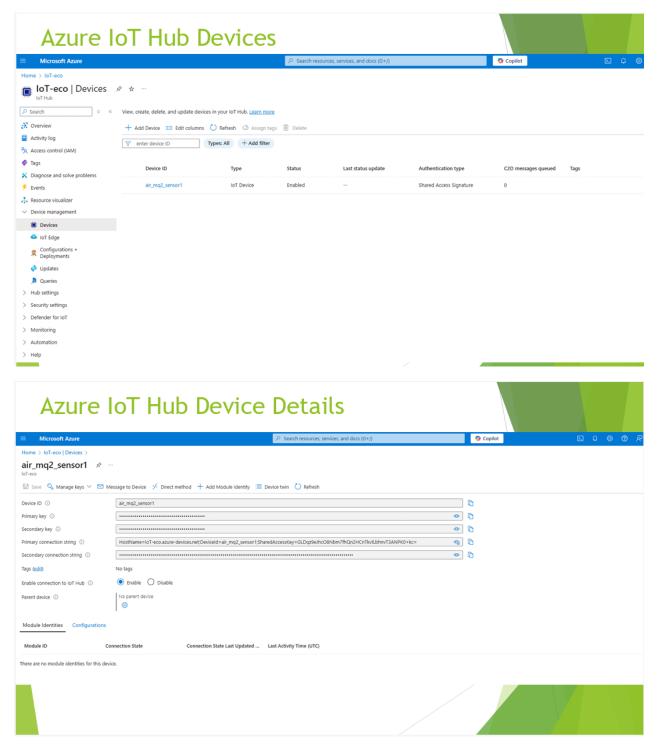






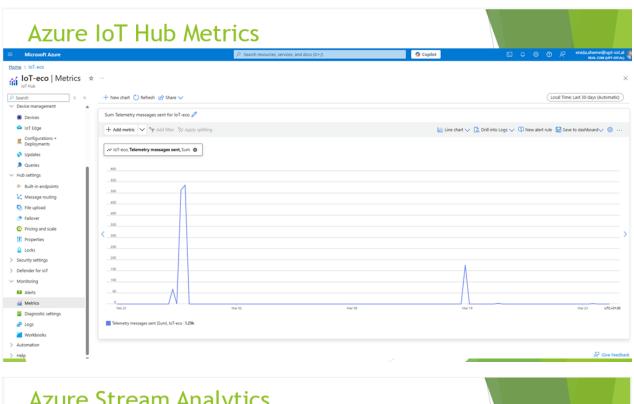


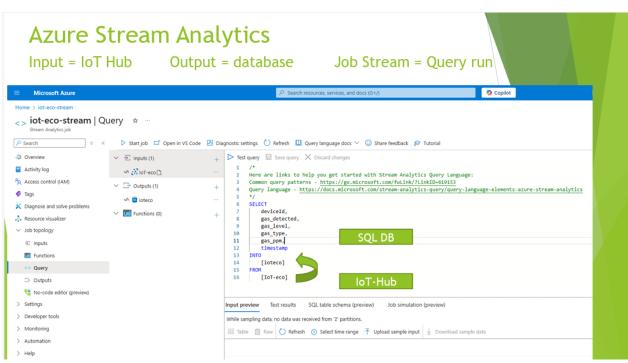






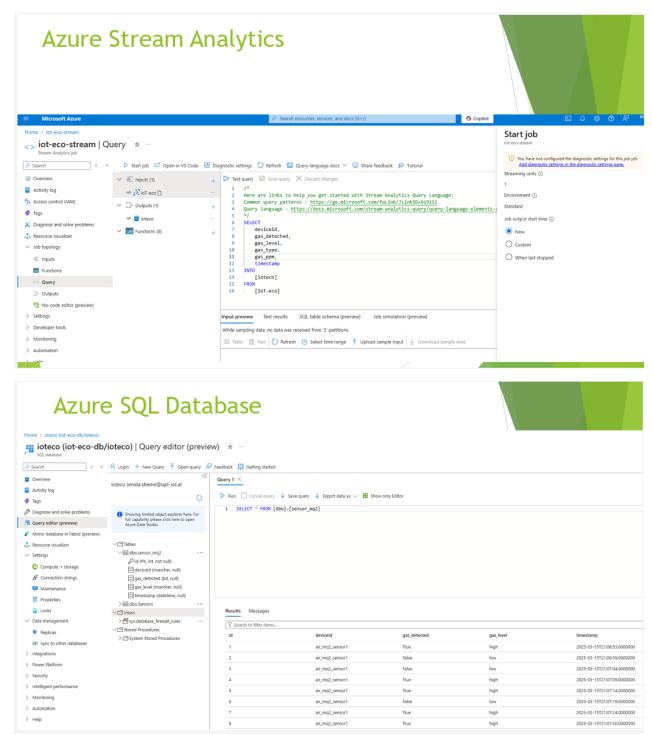






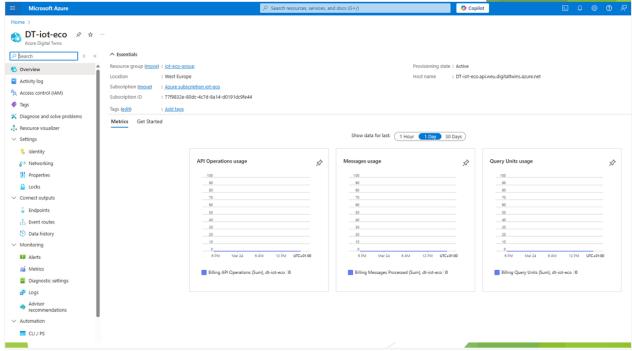


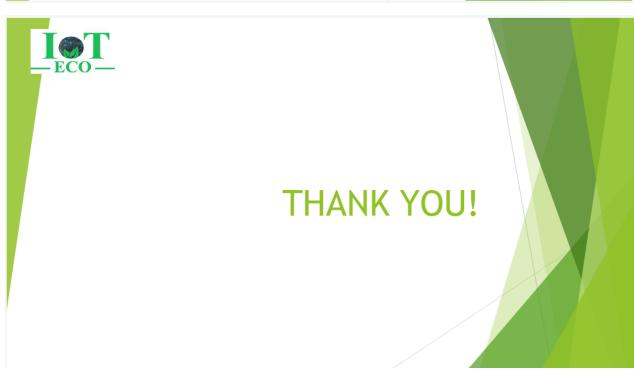
















Invited lecture in UP

Lecture of MSc. Doruntinë Berisha, Hands-on demonstration on IoT device configuration and programming with Raspberry Pi



Co-funded by the Erasmus+ Programme of the European Union

Teaching materials in online format on the **IoT-ECO** site





Introduction to Raspberry Pi Starter KIT

- The Raspberry Pi Foundation is a small charitable organization in the UK that was founded to promote technology rather than selling technology.
- Raspberry Pi is a mini computer for computer amateurs, teachers, elementary school students and small businesses.
- It is pre-installed with Linux system. It is only a credit card size, equipped with an ARM architecture processor, and its computing performance is similar to that of a smart phone.
- On the interface side, the Raspberry Pi provides a USB interface for the mouse and keyboard, in addition to the Fast Ethernet interface, SD card expansion interface and an HDMI high-definition video output interface, which can be connected to the
- It is often used for collecting and processing data from IoT systems and sensor, and presents an affordable alternative for building efficient IoT ecosystems.





Introduction to Raspberry Pi Starter KIT

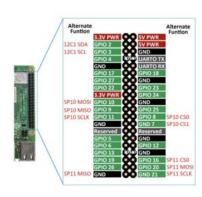
 The Raspberry Pi evolves through many versions including the latest (so far) Raspberry Pi 4 Model B ,3 Model B+ , 3 Model B, 2 model B, 1 Model B+, Zero, and 1 Model A+. Today we will use Raspberry Pi 3 Model B+ as a development board.







Raspberry Pi Pin Name











-ECO- Blinking an LED (GPIO Basics)

- Objective:
 - Learn to control GPIO pins by making an LED blink.





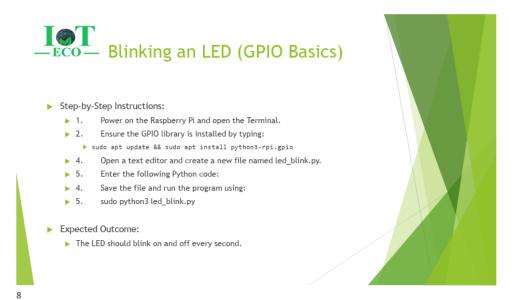
Eco Blinking an LED (GPIO Basics)

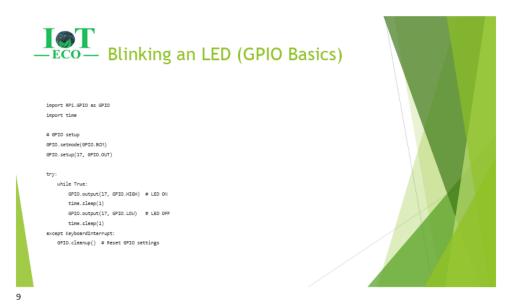
- Materials Needed:
 - ▶ Raspberry Pi 3 with Raspbian OS
 - Breadboard
 - ▶ 1 LED (any color)
 - 1 Resistor (220Ω)
 - Jumper wires
- Wiring Diagram:
 - ▶ 1. Connect the LED's longer leg (anode) to GPIO 17 (Pin 11 on the GPIO header).
 - \blacktriangleright 2. Connect the LED's shorter leg (cathode) to a 220 Ω resistor.
 - > 3. Connect the other end of the resistor to GND (Pin 6).

















- Objective:
 - Learn to read input from a button using GPIO pins.
- Summary:
 - Reading input from a push button using GPIO pin 18. With a pull-up resistor configuration, the Raspberry Pi can detect when the button is pressed, triggering a message on the screen.



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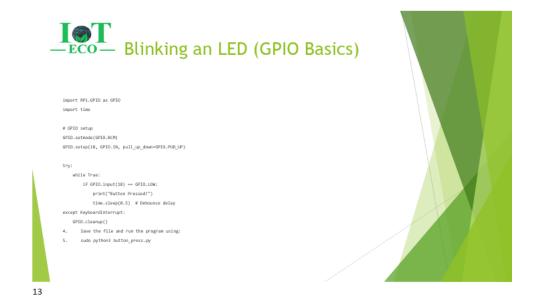
- Materials Needed:
 - ▶ Raspberry Pi 3 with Raspbian OS
 - ▶ Breadboard
 - Push button
 - 1 Resistor (10kΩ)
 - Jumper wires
- Wiring Diagram:
 - ▶ 1. Connect one leg of the button to GPIO 18 (Pin 12).
 - ▶ 2. Connect the other leg to GND (Pin 6).
 - \blacktriangleright 3. Use a 10k Ω resistor between GPIO 18 and 3.3V (Pin 1) as a pull-up resistor.

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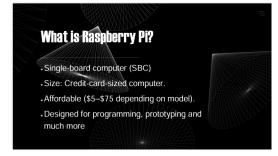
Teaching materials in online format on the IoT-ECO site



Invited lecture in UBT

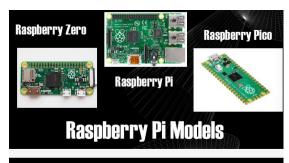
Milot Morina, Raspberry Pi platform and its applications in Internet of Things (IoT) projects

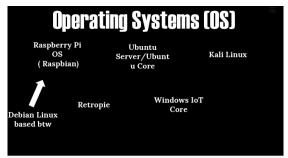


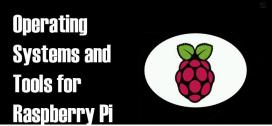


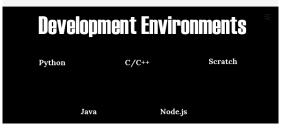






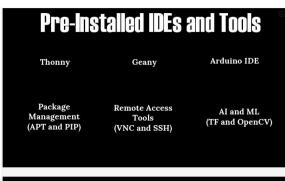




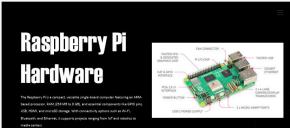






















Invited lectures in UNIMED

Dr Amar Kapić, Introduction to Arduino Development Environment



- Mikrokontroler je u osnovi mali računar koji posjeduje:
 - procesor,
 - memoriju,
 - programabilne ulaze/izlaze opšte namjene.
- Tipično je "ugrađen" unutar nekih uređaja i kontroliše njihov rad
- Ulazi mogu biti upravljani od strane fizičkog okruženja dok izlazi mogu upravljati fizičkim okruženjem.



Teaching materials in online format on the IoT-ECO site





Arduino Uno hardver

- Arduino Uno razvojna ploča sadrži:
 - 14 digitalnih ulaza/izlaza
 - 6 analognih ulaza
 - USB port
 - Napajanje
 - Reset dugme
 - LED za serijsku komunikaciju
 - SCL/SDA pinovi
- Napajanje
 SV/3.3V/GMD

 Analogni
 ulazi

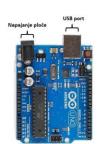
USB port i port za napajanje ploče

USB port:

- USB port se koristi za učitavanje programa iz Arduino IDE-a na Arduino ploču.
- Ploča se takođe može napajati putem ovog porta.

Port za napajanje:

- Arduino ploča može se napajati putem AC-DC adaptera ili baterije.
- Arduino UNO ploča radi na naponu od 5 V, ali može izdržati maksimalni napon od 20 V. Ako se ploča napaja višim naponom, postoji regulator napona (koji se nalazi između potra za napajanje i USB konektora) koji štiti ploču od pregorevanja.





Analogni ulazi

- 6 analognih ulaznih pinova, označenih kao A0,..., A5.
- Čítaju signal sa analognog senzora, poput senzora temperature, i konvertuju ga uz pomoć ADC u digitalnu vrijednost kako bi ga sistem razumio.
- Analogni pinovi mjere samo napon, a ne struju, jer imaju veoma visok unutrašnji otpor. Zbog toga kroz ove pinove prolazi samo mala količina struje.
- lako su ovi pinovi označeni kao analogni i po default-u služe za analogni ulaz, mogu se koristiti i za digitalni ulaz ili izlaz.







- Digitalni pinovi su označeni kao D0,
 , D13
 Moqu da se koriste kao ulazni ili
- izlazni pinovi

 Kada su povezani kao izlazi, ponašaju
- se kao izvori napajanja za komponente koje su povezane na njih
- Kada su povezani kao ulazi, očitavaju signal sa komponenti koje su povezane na njih



Reset dugme

- Kada se pritisne reset dugme, šalje se logički impuls na reset pin mikrokontrolera, nakon čega program ponovo pokreće od početka.
- Veoma korisno ako se vaš kod ne ponavlja, ali želite da ga testirate više puta.





Kvarcni kristalni oscilator

- 16 miliona ciklusa u sekundi.
- Pri svakom ciklusu, mikrokontroler izvršava jednu operaciju (npr. sabiranje, oduzimanje,...)





Programiranje Arduina

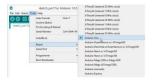
- Potrebno je da preuzmete Arduino IDE (Integrated Development Environment).
- Arduino IDE je dostupan za Mac, Windows i Linux.



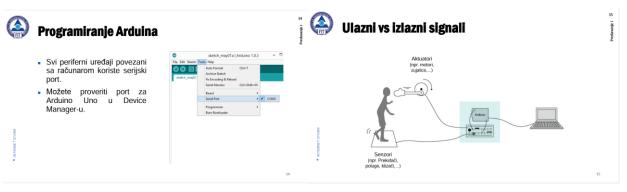


Programiranje Arduina

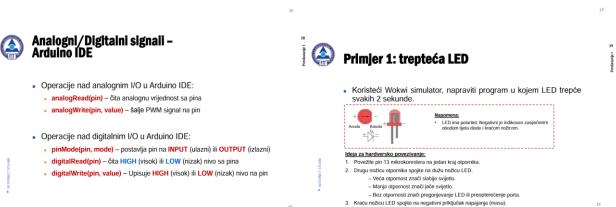
- Prije nego što počnete sa programiranjem, proverite da li je ispravna ploča odabrana u meniju Tools
 → Board (prema mikrokontroleru na vašoj ploči).
- Sada možete početi da radite sa Arduinom!







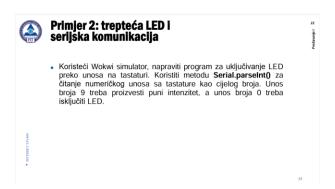




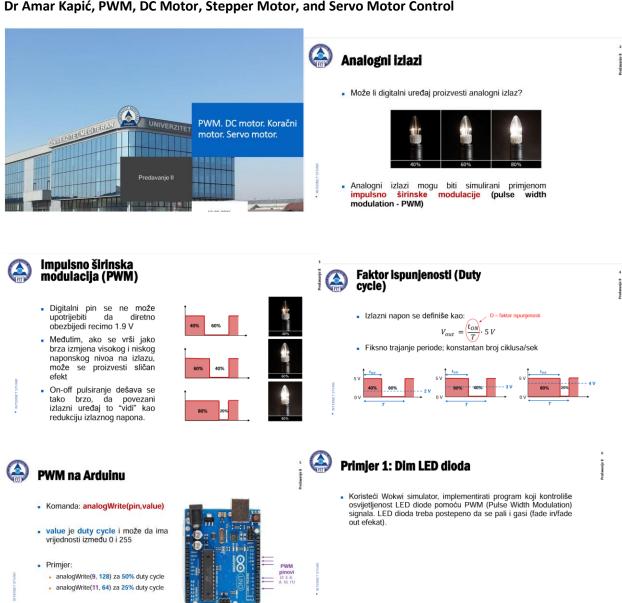








Dr Amar Kapić, PWM, DC Motor, Stepper Motor, and Servo Motor Control









DC motor vs Koračni motor

- DC motor
 - Kontinualno pomjeranje
 - Brzina se kontroliše naponom (strujom)
- Koračni motor
 - Ne treba povratna sprega
 - Potrebno poznavanje početne pozicije motora
 - Potrebna snaga za držanje pozicije



Servo motor

- Servo motor je aktuator sa ugrađenim mehanizmom povratne sprege koji odgovara na kontrolni signal:
 - pomjeranjem na odgovarajuću poziciju i držanjem pozicije ili
 - pomjeranjem kontinualnom brzinom.
- Potrebna povratna sprega
- Nije potrebno poznavanje početne pozicije
- Potrebna snaga samo tokom pomjeranja
- Alternativa koračnom motoru



Komponente servo motora

- DC motor
- Zupčanik sa malim plastičnim zupcima za redukciju brzine obrtanja (RPM) i povećanje obrtnog momenta
- Kontrolna elektronika za tumačenje impulsnog signala i isporučivanje snage motoru.
- Potenciometar kao senzor pozicije

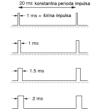




Kontrolni signal servo motora

- Frekvencija impulsa je fiksirana. Tipično: 20 ms
- Širina impulsa određuje poziciju. Tipično: 1 ms do 2 ms







Arduino Servo biblioteka

- Arduino Servo biblioteka može se preuzeti sa linka: https://www.arduino.cc/reference/en/libraries/servo/
- Kreiranje servo objekta
 - Servo myServo:
- Povezivanje objekta sa pinom
 - myServo.attach(servoPin);
- Slanje kontrolnog signala
 - myServo.write(position);

Teaching materials in online format on the IoT-ECO site





 Koristeći Wokwi simulator, implementirati program koji upravlja servo motorom pomoću PWM signala. Servo motor treba da se postepeno pomjera od 0° do 180°, a zatim da se vraća nazad od 180° do 0°.

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