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# Chernihiv Polytechnic National University

**Erasmus+ project 609557-EPP-1-2019-1-LV-EPPKA2-CBHE-JP**

**“Development of practically-oriented student-centred education in the field of modelling of Cyber-Physical Systems", Acronim “CybPhys”**

Monitoring Mission
November 25, 2022, Riga

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# Project team

| | | |
|---|---|---|
| 1. | **Kazymyr Volodymyr,** Dr., prof.,professor of information and computer systems department | CPNU coordinator Manager |
| 2. | **Novomlynets Oleg,** Dr., prof., rector, professor of information and computer systems department | Researcher |
| 3. | **Zaitsev Sergey,** Dr., as. prof., professor of information and computer systems department | Researcher |
| 4. | **Ivanets Sergey**, PhD, as. prof., director of electronic and information technology institute | Teacher |
| 5. | **Prystupa Anatoliy ,** PhD, as. prof., head of Information Measuring Technologies, Metrology and Physics department | Teacher |
| 6. | **Veligorsky Oleksandr,** PhD, as. prof., head of Biomedical Radio-Electronic Devices and Systems department | Teacher |
| 7. | **Voitenko Volodymyr, PhD, as. prof.,** department of Electronics, Automatics, Robotronics and Mechatronics | Teacher |
| 8. | **Yakimenko Iryna**, PhD student , information and computer systems department, QA manager | Trainer |
| 9. | **Sysa Dmitryi** , Director of the educational-scientific information and computer center, technical manager | Technical Staff |
| 10. | **Gaydaiy Natalia**, leading accountant, financial manager | Technical Staff |

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# WP2: our outcomes

2.1. New Education Program and Curricula accreditation

2.2. Development of teaching materials for the bachelor- and master-students study programs, courses and e-books

2.3. Creation a new CPS Modelling & Simulation laboratory

2.4. WSs, Teaching staff and students training on curricula topics

2.5. Teachers training on professional English languages skill

2.6. Testing and validation of the developed education programs, courses and lab practices

2.7. Measuring of a feedback of stakeholders

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# 2.1. Accreditation of new educational program "Computer Engineering and Industrial Automation"

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

ЧЕРНІГІВСЬКИЙ НАЦІОНАЛЬНИЙ ТЕХНОЛОГІЧНИЙ УНІВЕРСИТЕТ

ОСВІТНЬО-ПРОФЕСІЙНА ПРОГРАМА

«Комп'ютерна інженерія та промислова автоматизація»

другого (магістерського) рівня вищої освіти

за спеціальністю 123 Комп'ютерна інженерія

галузі знань № 12 Інформаційні технології

Кваліфікація: магістр з комп'ютерної інженерії

- Second (master's) level of higher education (FQ-EHEA - second cycle, EQF-LLL - 7 level)
- Specialty - “Computer Engineering”
- areas of knowledge - “Information technologies”
- Qualification: master's degree of Computer Engineering
- 90 credits
- term of study - 1 year 4 months
- Accredited by Academic Council of CPNU on April 27, 2020 according to Certificate of accreditation of the specialty “Computer Engineering” master degree, Series ND № 2685401 from June 27, 2017. The certificate is valid until July 1, 2024
- Accredited according to CE standard by Academic Council of CPNU on April 26, 2021
- https://op.stu.cn.ua/files/op/OPP%20123%20KIPA%20magistr_2020.pdf
- Students graduation: 2021 - 13, 2022 – 14 (planned)

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# 2.2. Development of teaching materials

1. Development of 5 new master's courses for new master's educational program "Computer Engineering and Industrial Automation“: credits
   - Programming of automation systems 5
   - Modeling and measurement of physical processes in robotics 5
   - Model-oriented control in digital manufacturing 5
   - Design and modeling of power electronics components 5
   - Simulation of Manufacturing Environment 5

   Total: **25**
2. Upgrading of two bachelor's courses for bachelor’s program "Electronics of robotic systems and complexes":
   - Introduction to electronic systems 6
   - Development of electromechanical robotic systems 4

   Total: **10**

3. Syllabuses for new and modernized courses (published in CPNU CybPhys pages):
   - https://stu.cn.ua/wp-content/uploads/2021/04/new-courses20-1.pdf
   - https://stu.cn.ua/wp-content/uploads/2021/11/updated-courses_2.pdf

4. Teaching materials in Moodle: https://eln.stu.cn.ua/login/index.php

# 2.2. E-books activities

## 1. *Development of e-book 3 (jointly with RTU and V. M. Glushkov Institute of Cybernetics of NASU )*

**Model-oriented control in Intelligent Manufacturing Systems**


1 Intelligent Manufacturing Systems and Industry 4.0 Concept
2 The principles of Model-oriented control
3 Implementation Models of Control Algorithms
4 Predictive Models and Dynamic Model Checking
5 Recovery Models and their Construction
6 Software and Hardware Tools for MOC
7 Examples of MOC application

Published by RTU Press
Riga Technical University, 2022. – 258 pages.
https://ebooks.rtu.lv/product/model-oriented-control-in-intelligent-manufacturing-systems/?lang=en

## 2. *Participation in developing of e-books:*

- e-book 2- **Mathematical Modelling of Mechatronic Systems** (leader – KU Leuven)
- e-book 6 - **Cyber-Physical Systems modelling and simulation** (leader - UCY)

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# 2.3. Creation a new CPS Modelling & Simulation laboratory

1. Purchase of Equipment and software (November, 2020):
- Hardware Complex on 12 places
- Software - Wolfram System Modeler
2. Fully renovate of laboratory room (April, 2021)
3. The opening of the laboratory with the presence of the Minister of Science and Education of Ukraine (June 8, 2021)


https://stu.cn.ua/en/international-activity/international-programs-and-projects/project-cybphys/new-laboratory-for-modeling-cyberphysical-systems/

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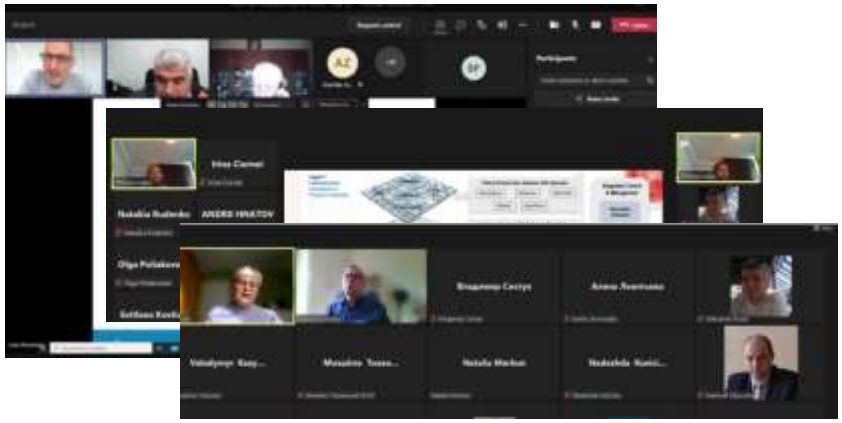
# 2.4. WS, Teaching staff and students training and on curricula topics

1. Workshops for curricula and study programs development

2. Teaching staff trainings on curricula topics, new ICT tools, advanced educational technologies (2021, on-line):

- September 7-8 (RTU)
- September 9-10 (KU Leuven)
- September 23-24 (UCY)



3. Training School for Students (2022, off-line)

- January 27-28 (RTU)
- February 7 – 18 ( KU Leuven)


https://stu.cn.ua/wp-content/uploads/2022/09/cooperation-agreement-rtu-cpnu-signed-27-jan-2022_eng.pdf

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# 2.5. Teachers training on professional English languages skill

- Participation of 4 teachers from CPNU in online KU Leuven lessons on January 11, February 22, March 15, 2021
- Participation of 4 teachers from CPNU in off-line KU Leuven lessons on September 13th - 17th

https://eln.stu.cn.ua/mod/folder/view.php?id=198247

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# 2.6. Testing and validation of the developed education programs, courses and lab practices

The testing of new developed programs was carried out in form of questionnaire survey in two stage :

1. In the end of autumn semester 2021/2022 educational year:

- 4 new master course under the program “Computer engineering and Industrial Automation” in group МКІАр-211 (14 students)
- 1 upgraded bachelor course under the program “Electronics of robotic systems and complexes” in group ІЕ-181 (12 students)

Students were trained in period from September, 2021 to January, 2022. Survey was conducted from 10 to 20 January , 2022 in mixed mode.

2. In the end of spring semester 2021/2022 educational year:

- 1 new master course under the program “Computer engineering and Industrial Automation” in group МКІАр-211 (14 students)
- 1 upgraded bachelor course under the program “Electronics of robotic systems and complexes” in group ІЕ-181 (12 students)

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# 2.6. Course testing results

Elaboration of courses testing results was done based on the consolidated results of students answers about tested courses and feed-back from academic/teacher staff involved in teaching of for every courses separately. Five teachers were involved in the survey.

1. More common students suggestions included:
- Create a YouTube channel with video materials
- More attention to practical work in laboratory
- Using the Python programming language

2. More common teaches suggestions included:
- Using the latest software
- Students will have competences in programming
- Develop a textbook and YouTube channel
- Develop a remote access to the laboratory equipment

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# 2.7. Measuring of a feedback of stakeholders

The survey of representatives of academic and scientific staff, as well as representatives of potential employers was conducted in September 2022 in online mode.

The selection of stakeholders for course evaluation was carried out taking into account their basic education, work experience and professional competencies. Five academic staff and six employers took part in survey. They have such experience status:

| Teaching experience | 3-7 years | 7-15 years | 15-20 years | >20 years |
|---|---|---|---|---|
| | 3(27%) | | 2(18%) | 4(36%) |
| **Work experience in science** | 3-7 years | 7-15 years | 15-20 years | >20 years |
| | 1(9%) | 1(9%) | 2(18%) | 5(45%) |
| **Work experience in production** | 3-7 years | 7-15 years | 15-20 years | >20 years |
| | | 1(9%) | | 6(55%) |
| **Position in production** | | Developer | | CEO<br>Director<br>Developer<br>Tester<br>Researcher |

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# 2.7. Stakeholders feedback results

The average assessments were as follow:

- *necessary for the learning of course* - *100 %*
- *the wording of the purpose and tasks of course* - *96 %*
- *the formulation of the core competencies* - *98 %*
- *the ratio of the number of hours* - *94 %*
- *the content of the training material* - *94 %*
- *the educational-methodical map* - *91 %*
- *the List of basic literature* - *98 %*
- *the list of software for laboratory works* - *90 %*
- *monitoring the quality of learning* - *100 %*
- *most important for mastering* - laboratory works

*Suggestions for further improvement:*

- *More detailed consideration of software tools*
- *Implement more different software*
- *To conduct surveys with a greater reference to the national educational standard*

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# WP4: Developing the Shared Modelling and Simulation Environment (SMSE)

**List of performed works from September 2021 (instead of Belarusian partners):**

1. Design of SMSE
2. Purchase of equipment
3. Development of software
4. Development of documentation
5. Testing of SMSE
6. Training partners

| | |
|---|---|
| **Neywork Equipment:** | |
| Router Cisco 3560 Series | 1 |
| **Server's : Equipment:** | |
| Server Dual Xeon GOLD series 2U | 1 |
| Server Single Xeon Silver series 4U | 2 |
| SSD Samsung 860 Pro series 512GB | 1 |
| HDD Western Digital 4TB | 1 |
| Notebook HP 250 G8 | 1 |
| APC Smart-UPS SRT 1000VA | 1 |

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# SMSE main features

1. Universal authorized access
2. Availability of  multiple simulation tools
3. Convenient way to joint work
4. Own user's virtual laboratory


**SMSE scope&features:** https://stu.cn.ua/wp-content/uploads/2021/11/smse-proposal.pdf
**SMSE equipment:** https://cs.stu.cn.ua/wp-content/uploads/2021/11/ogoloshennya_2_3.pdf
**SMSE acting version:** https://eln.stu.cn.ua/login/index.php

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**The purpose of SMSE is to provide educational participants with shared, controlled access to modeling course materials and modeling tools using Moodle EMS and Jupyter Notebook documents through the Jupyter Virtual Lab.**

## SMSE teacher's functions support

- Creation Jupyter Lab server from a template
- Creation and upload kernels to Jupyter Lab server
- Creation and upload course documents to Jupyter Lab
- Testing and estimation of student practice work in Jupyter Lab

## SMSE students's functions support

- Learning course materials and execution of practice task in virtual laboratory
- Creation testing report for course tasks and upload them to Moodle
- Using additional course documents in Jupyter Lab

## SMSE integration functions support

- Authorization via Moodle services
- Creation the course structure in Moodle
- Using Jupyter Notebooks as base of teaching materials
- Remote shared access to course documents and modeling tools in own Jupyter Lab

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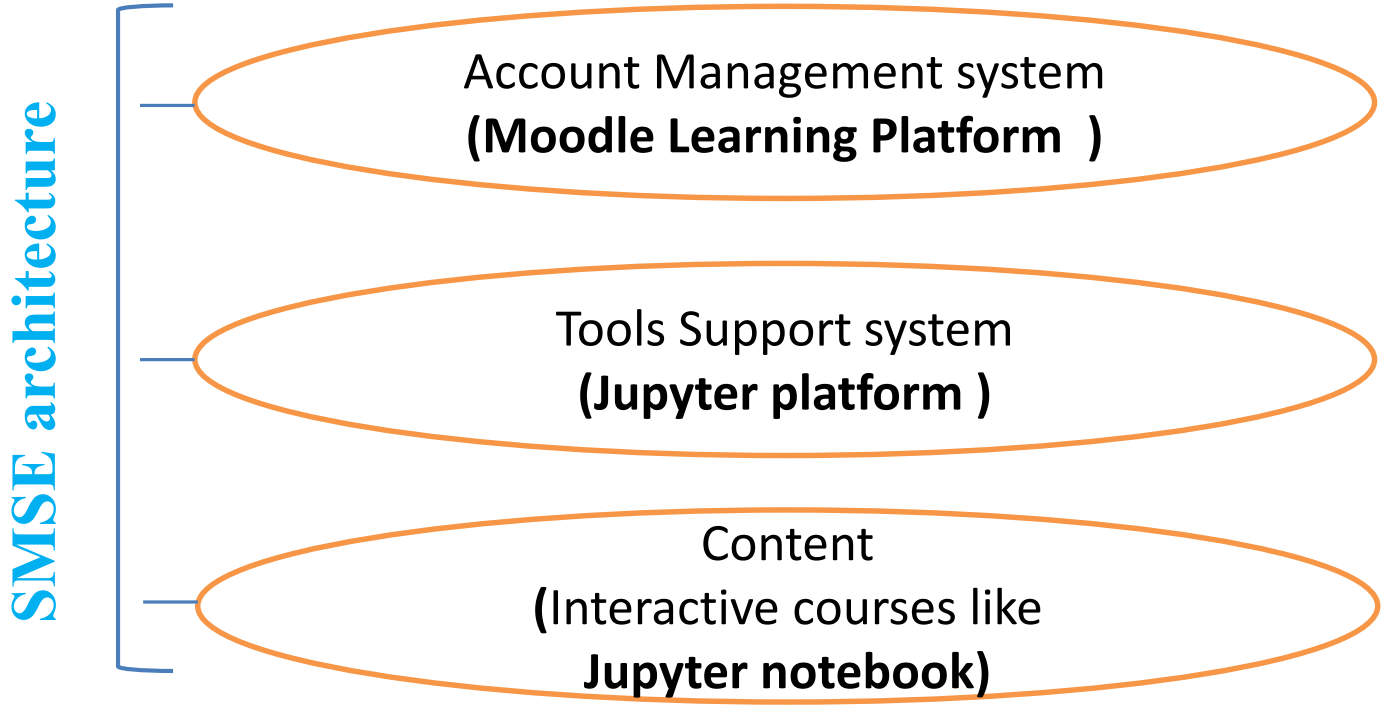
# SMSE architecture

## Main idea and task – embedding Jupyter platform to Moodle



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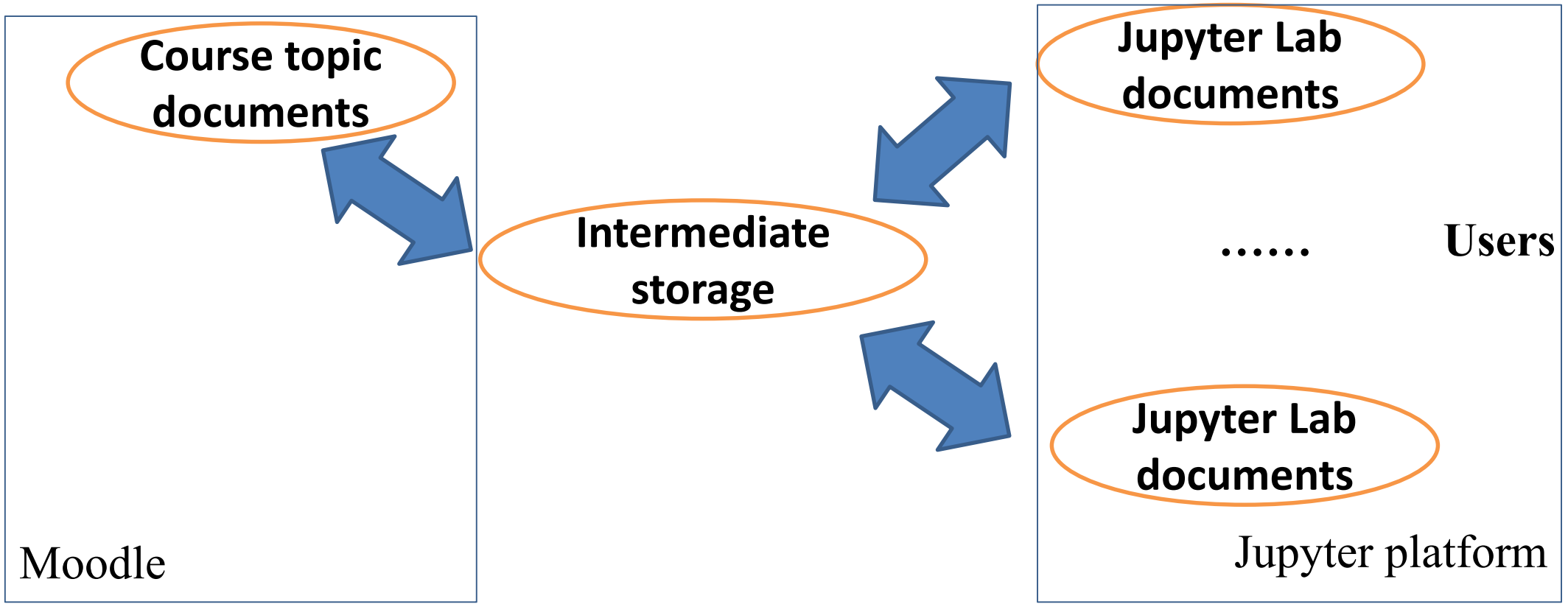
# SMSE data flow diagram



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# SMSE manual

1. SMSE  architecture description
2. SMSE User's Guide
3. Jupyter Notebook manual
4. Model and  Course Creation Examples

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