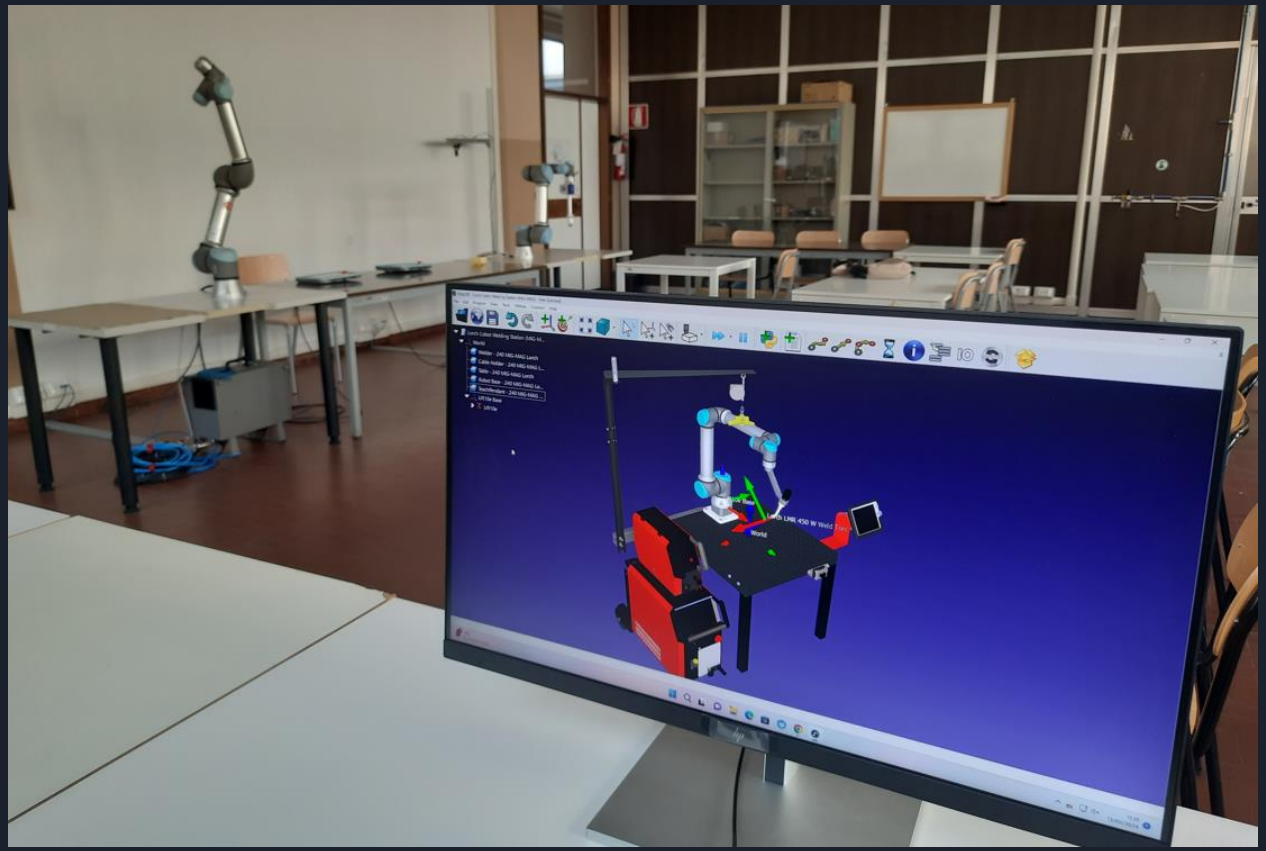
ARTIFICIAL INTELLIGENCE & ROBOTICS LAB

ISII MARCONI PIACENZA - ITALY

AIR-LAB in figures

- n. 2 UR5 Universal Robots cobots
- n. 2 high power workstations
- n. 2 NVIDIA V100 to train neural networks
- n. 30 PC with RoboDK software installed
- Machine learning course with 20 students
- Deep learning & Robotics course with 30 students
- Develop of Erasmus+ K210 and K220 projects

AIR-LAB in figures



AIR-LAB

Mission

- Develop an Artificial Intelligence and Robotics Laboratory
- Prepare students on innovative subjects
- Manage projects with a strong interdisciplinary (Mechanic, Computer Science, Automation, Logistic)
- Create an international network of laboratories
- Spread reusable best practices
- Act as a training centre for near industries

AIR-LAB courses

AIR-LAB courses: machine learning

- Introduction to AI : Types of AI - How do machines learn? - AI state of the art
- AI@school: Code.org, Appinventor, Experiments by Google - Teachable machine - ML 4 kids
- Theory: Machine Learning: Supervised, unsupervised, reinforcement learning - ML algorithms
- Arduino Nano 33 BLE Sense: Board overview - Tutorial: measure sounds, humidity & temperature
- Welcome to TinyML: ML on the edge - What is TinyML?- Arduino TinyML kit installation & test
- Get started with machine learning on Arduino: Audio & Gesture recognition - Color classification
- Introduction to deep learning: Backpropagation, CNN, RNN: examples - AI Ethics
- TinyML Cookbook: Voice recognition - Object classification - Gesture-based interface for Youtube
- Edgeimpulse: Object detection with Edgeimpulse - Predictive maintenance with Edgeimpulse
- Develop of a project: Final presentation

AIR-LAB courses: deep learning

- Section 1: OpenCV Basics
  - Loading and Displaying Images
  - Getting and Setting Pixels, Drawing with OpenCV
  - Translation, Rotation, Resizing, Flipping, Cropping
  - Image arithmetic, Bitwise operations, Masking,
  - Splitting and merging channels
- Section 2: Basic Image Processing Operations
  - Morphological operations, smoothing and blurring,
  - Color spaces, Basic & Adaptive thresholding,
  - Kernels, Image gradients, Edge detection, Automatic
  - Edge detections
- Section 3: Deep Learning
  - What is Deep Learning?
  - Image classification basics
  - The deep learning classification pipeline
  - Your first image classifier
  - Parameterized learning and neural networks
  - Introduction to neural networks
  - Feed forward neural networks with keras
  - The 4 key ingredients when training neural networks
  - Convolutional Neural Networks
- Section 4: Basic Real-world projects
  - Documents scan (edge detection)
  - Smile detection & Traffic sign recognition
  - Fashion-mnist
- Section 5: Siamese Networks
  - Building Image Pairs for Siamese networks
  - Implementing Your First siamese network
  - Compare images with siamese networks
- Section 6: OBJECT DETECTION
  - Shape detection
  - OpenCV template matching
  - OpenCV Haar cascades
  - Object detection deep learning
  - Real time object detection
- Section 7: FACE detection and recognition
  - Deep learning face detection
  - Dlib face detection
  - Facial landmark & OpenCV eigenfaces
  - Deep learning face recognition

AIR-LAB courses: robotics

- Robot structure and applications
- Robot cinematics
- Universal Robot UR5e introduction
- Polyscope use
- Polyscope operator programming
- UR Interfaces
- Scripting language
- I/O management
- Python programming of UR5e (SDU library)
- AI applications for robotics

Final course projects

MACHINE LEARNING

- Animal noise recognition
- Bicycle crash detector
- Forest fire recognition
- Rock, paper, scissor game
- Vacuum cleaner anomaly detection
- Morse signal recognizer
- Plant classification
- Speed limit recognition

DEEP LEARNING

- Custom Object Detection
- Siamese Neural Networks
- Face detection
- Face recognition
- Reinforcement Learning
- Unsupervised Learning
- Melanoma detection
- Covid detection (X-Ray)

AI ROBOTICS

- Face Tracking
- Gesture Commands
- Voice Commands
- Pick and Place with DNN
- Schmalz grippers management
- OAK Camera (2D/3D) Apps
- Computer Vision projects

AIR-LAB courses

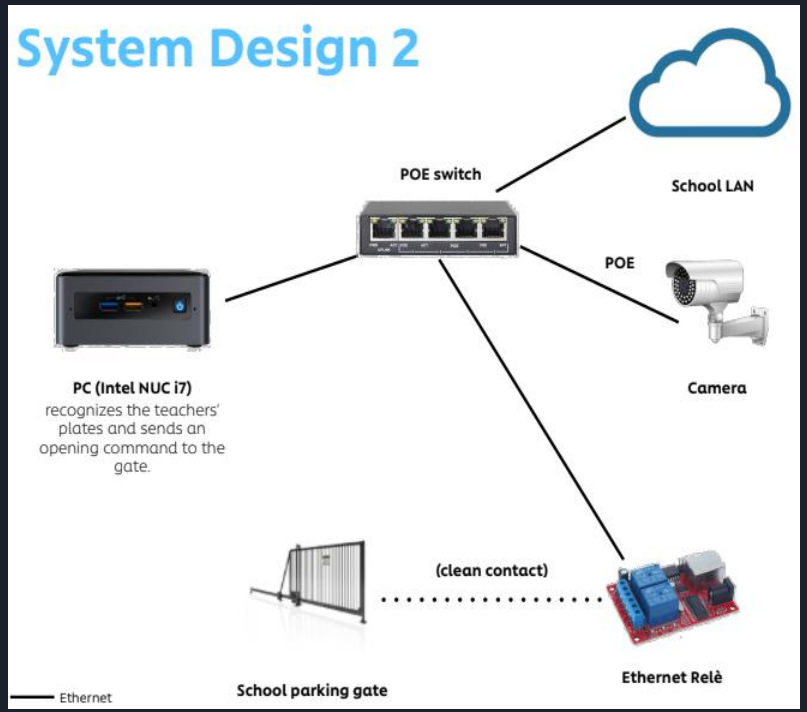
Erasmus projects: ANPR

- Erasmus+ K229 project with Croatia and Sweden
- The system recognizes automatically the license plate of a teacher's vehicle, by means of artificial intelligence and opens the school parking gate accordingly.
- The goal of the ANPR (Automatic Number Plate Recognition) project had two main sides:
  - Increase the soft and technology skills of our students.
  - Establish a best practice to be spread among European peer schools.

Erasmus projects: ANPR

Area	Skills	Knowledge
Artificial intelligence and computer vision	Train a Neural Network Use openCV Library	CNN, SVM, papers, opencv, virtualenv
Hardware	Implement software on Raspberry PI Interface with a camera Use of a wireless relay switch	Raspberry PI, Shelly 1, Router, Camera
Software	Software development	Python, Django, Bootstrap, Tkinter, Restful, Vscode, C#, Access, ADO, RTSP protocol, Linux VM
Design	Know UX design techniques	Learn UX design
Marketing	Know basic marketing elements	Learn basic marketing plan and competitive analysis
Management	Use of a project management software	Trello
European project	How to disseminate a project	Dissemination

Erasmus projects: ANPR



Erasmus projects: PYTHON (in progress)

- Erasmus+ KA210 project
- The goal of this project had three main sides:
  - Allow the students to learn Python language by challenges
  - Link Python with STEM (especially maths)
  - Establish a best practice to be spread among European peer schools.

Erasmus projects: AIR Course (to do)

- KA220 Erasmus project
- Three years course
- Main subjects: Computer Vision, Programming, Artificial Intelligence, Robotics
- Learning by challenges based on real life
- Courses projects based

Erasmus projects: AIR Course

Contents (First Year)

Python Language:
Data structure basics
Comparison and logical operators
Statements
Lists, Tuples, Sets, Dictionaries
Functions
I/O & DB management
Object Oriented Programming
Modules and Packages
Errors and Exceptions
Decorators/Generators
GUI
Scraping
E-mails
Sockets
Threading & Multiprocessing

Contents (Second Year)

Computer Vision:
Morphological operation
Feature detection and matching
Motion estimation
Depth estimation

Artificial Intelligence:
AI introduction
What is deep learning?
The mathematical building blocks of neural networks
Introduction of Keras and Tensorflow
Classification and regression
Fundamentals of machine learning
Workflow of machine learning
Working with Keras
Simple ConvNet

Erasmus projects: AIR Course

Contents (Third Year)

Robotics:
Robots and their applications
Kinematics of robotic manipulator
Trajectory planning
Actuator & Sensor
Control Architecture
Dynamics
Motion control
Robotic vision

Universal Robots:
Collaborative robots
Universal robot 5e
Hardware description
Manual instruction
Polyscope
UR Interfaces
Scripting Language
First programming
Remote control

References

- https://www.isii.it/pagine/ai-e-robotica-allisii-1
- https://www.piacenza24.eu/dalla-svezia-allisii-marconi-per-studiare-lintelligenza-artificiale/
- https://www.liberta.it/news/cronaca/2023/03/17/lintelligenza-artificiale-e-il-futuro-sessanta-studenti-dellisii-tra-i-robot-del-domani/
- https://www.ilpiacenza.it/economia/il-futuro-della-meccatronica-applicato-alla-sanita-diventa-robotica-sensibile.html
- https://www.deenova.com/it/deenova-e-isii-marconi-insieme-per-la-formazione-dei-giovani/

Partners


THE FINE ART OF MECHATRONICS SAFETY

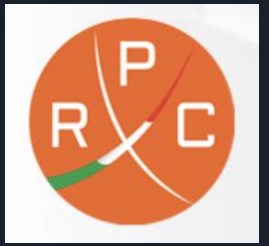

UNIVERSAL ROBOTS


AMADA


EDGE IMPULSE


RILHEVA
IIoT Platform


JOBS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