UNIVERSITÀ
DI PAVIA

Computer Vision and Multimedia Lab

Summary of recent research activities

Department of Electrical, Computer and Biomedical Engineering
University of Pavia

Introduction

- Active since the early 70s the group's initial research activities focused on ***image enhancement*** and ***restoration techniques***
- Since the early 80s the research topics extended to include ***parallel architectures for vision*** *and* advance techniques for ***image and video processing***
- The laboratory currently carries out research in the fields of ***computer vision***, ***human-computer interaction***, ***3D modeling*** and ***machine learning***
- The more recent activities can be grouped into three main tracks:
  - **Eye Tracking**
  - **Digital Humanities**
  - **Deep Learning**

Staff members and courses

STAFF

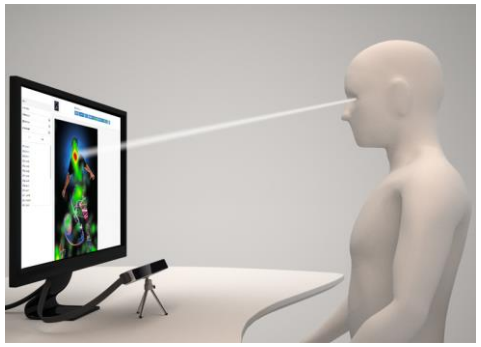
- *Associate professors* – Luca Lombardi (*director*), Marco Porta
- *Researchers* – Piercarlo Dondi, Mauro Mosconi, Mirto Musci
- *Contract professors* – Roberto Marmo, Marco Piastra
- *Emeritus professor* – Virginio Cantoni
- *Technician* – Alessandra Setti

COURSES

- Informatica
- Sistemi di Elaborazione delle informazioni
- Sistemi Operativi
- Tecnologie digitali per la comunicazione
- Algorithms and Data Structures
- Artificial Intelligence
- Computer Vision
- Deep Learning
- Digital Media
- Human-Computer Interaction
- Parallel Programming
- Pervasive Design
- Web Design and Technologies
- Web and Multimedia Technologies

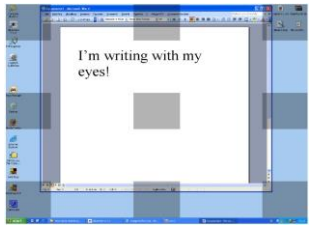
Eye Tracking

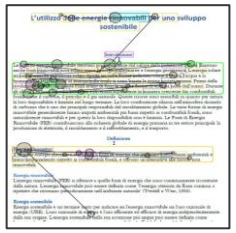
Explicit and Implicit Gaze-Based Communication

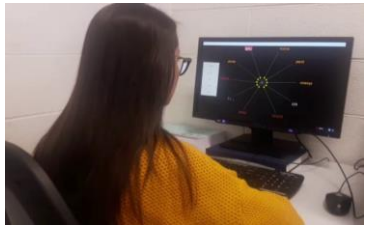


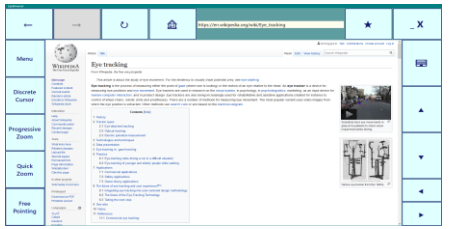
Gaze Input

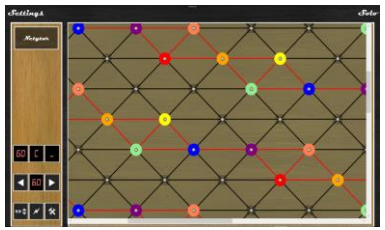
Using eye tracking as an assistive technology or as an additional input channel (besides keyboard, mouse, etc.) to write, surf the Web, play music, etc.





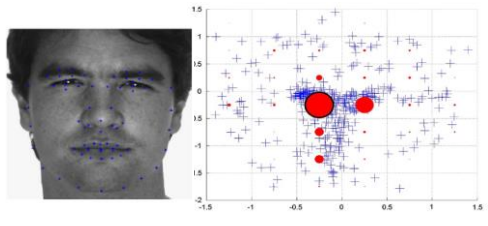






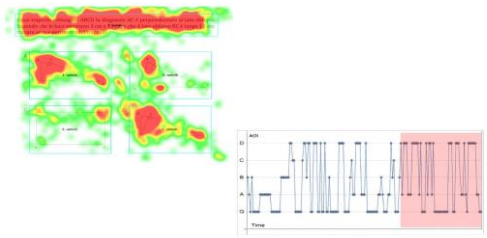
Soft Biometrics

Identifying or verifying the identity of people from the way they look at specific stimuli (e.g., faces)



E-Learning

Understanding learners' behavior and detecting possible comprehension problems

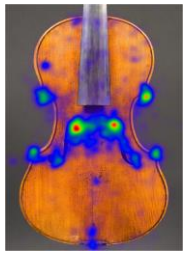


Automotive

Studying the driver's performance using remote and wearable devices

Study of Gaze Behavior

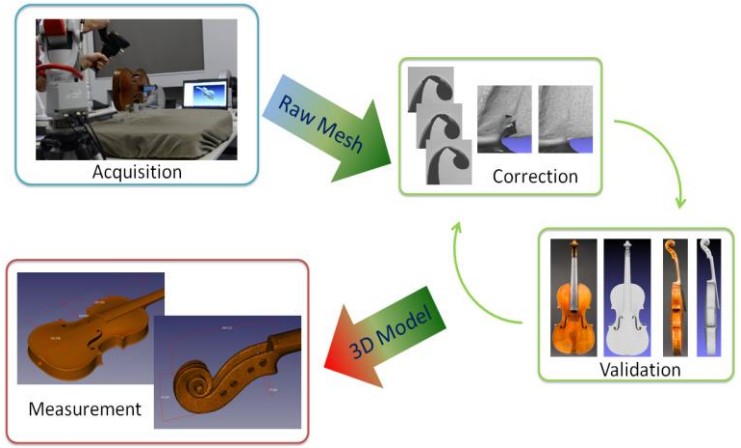
Analyzing the user's gaze behavior while inspecting different kinds of visual stimuli



Digital Humanities

3D scan and modeling

Historical violins



The ark of St. Augustine

The city of Pavia in the

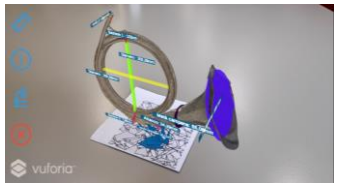
3D printed tactile images

Make artworks accessible for visual impaired and blind people

Interactive applications for museums

Gestural interaction

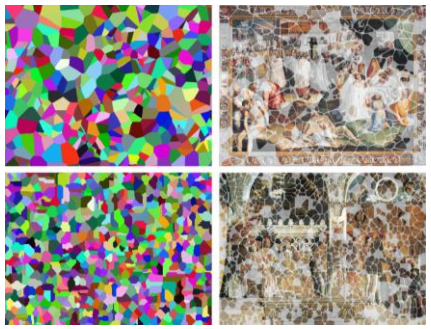
Augmented reality



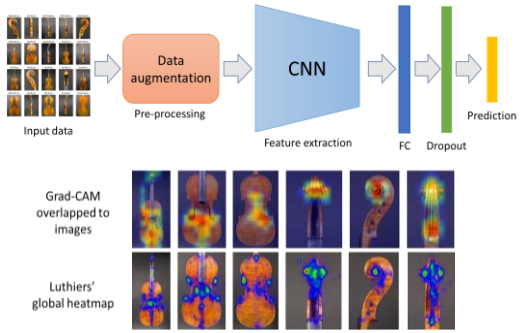
Gaze-based interaction

Image processing

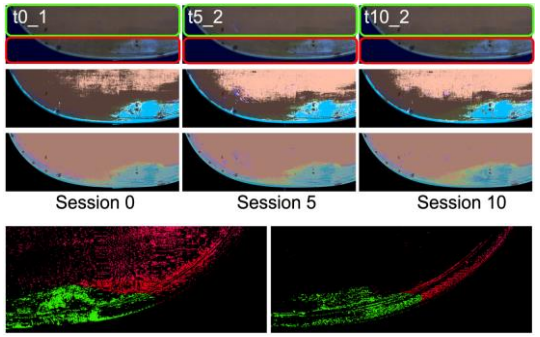
Digital anastylosis for frescoes reconstruction



Stylistic analysis and comparison with human behavior



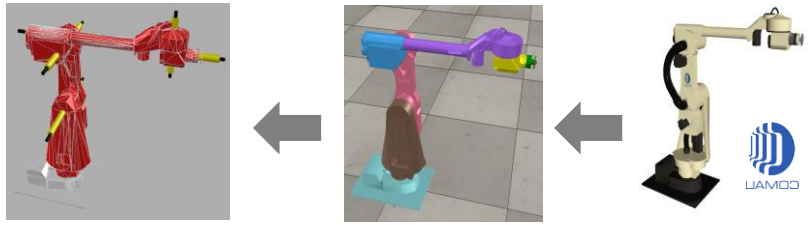
Monitoring of the state of conservation of artworks



Deep Learning

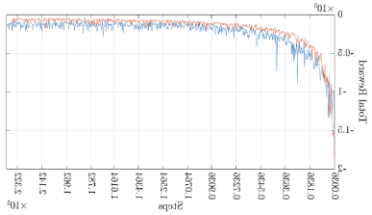
Deep reinforcement learning for collaborative robotics

Virtualization of a real-world robot

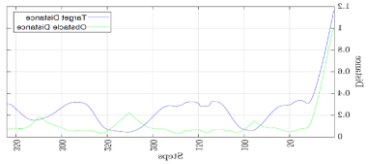


Joints and direct kinematic chain | *Movable parts* | *3D mesh*

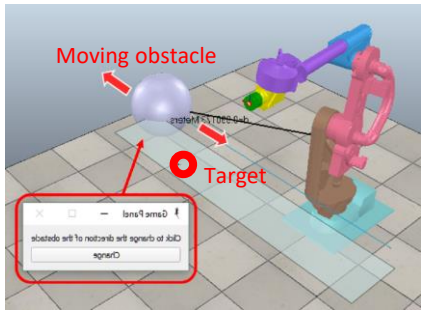
Learning to reach a target while avoiding obstacles in a simulation environment



Experience transfer



Robust avoidance strategy

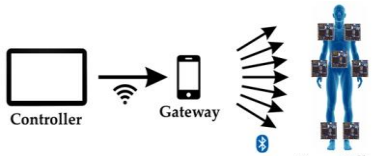


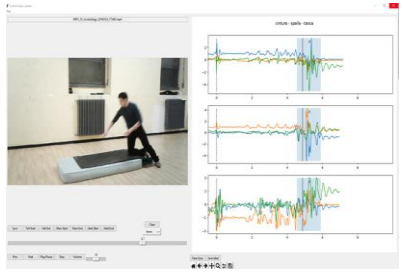
Incremental autonomous learning

Fall detection with recurrent neural networks

Accidental falls: an enormous human cost, especially for elderly people
Need for automatic fall detection techniques for timely warnings
Use of "smart" wearable devices

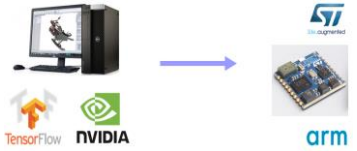
Collection of datasets with simulated falls by volunteers:
Seven carry positions, 17 different activities, 40 volunteers, over 5000 tracks
Manual annotations on videos, basic for training





Innovative technique: deep learning on embedded

Implementation challenge: limited computing and memory resources battery life for continuous use 24x7



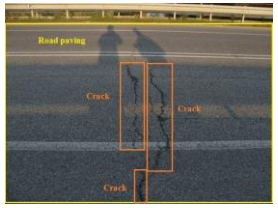
Automatic inspection of buildings and civil structures with CNNs

Photos acquired by drones

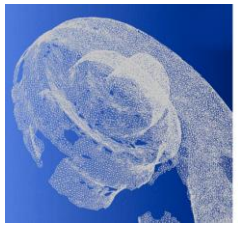
3D model creation and elaboration

Creation of an artificial dataset of simulated damages to train the neural networks

Automatic detection of damaged areas



Collaborations



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