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DELLE MARCHE

Sustainable and Safe Built Environments through User-Centered approaches supported by Immersive Virtual Environments

February / 2024 - www.univpm.it

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Prof. Marco D'Orazio

Research Group Description: the Supervisor

Prof. Marco D'Orazio, MD, PhD.

Engineer and Architect, **Full Professor in Architectural Engineering**, DICEA UNIVPM **Coordinator of the DICEA section of Construction - Architectural Engineering** – Ancona, Italy.

Vice-Rector UNIVPM from 2019 till today. Previously Dean of the Engineering Faculty and member of the board of directors. President from 2013 to 2017, Board Member from 2018 to 2021 and responsible for PhD activities of the Architectural Engineering Scientific Society. Coordinator of UNI GL 33 and member Technical Group (national standardization body), member of UNI GL2 Italian delegate at TC 128 SC3 (European standardization body). Editor of international editorial series and journals.

More than 350 publications, focusing on the improvement of building construction and management and on the development of building components, considering people behaviour.

https://orcid.org/0000-0003-3779-4361 (Publication List, H-index = 28)

Last five years

- European fundings:
  - RIBUILD (H2020) – univpm coordinator
  - SUPERHERO (LIFE Climate Action) – univpm coordinator
  - NEW TRENDS (H2020) – unit member
  - BIMSPEED (H2020) – unit member
- National funding
  - B2SECURE (PRIN)
  - Vautereco
  - ENEA
  - Vitality
  - TAV Shell

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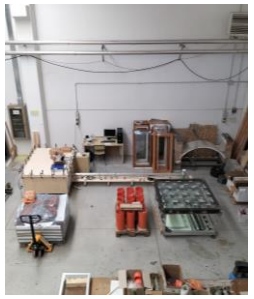
Research Group description: Group and Labs



Building components & Material LAB

Components & Materials

Human building interaction

High Calculation

Real scale

Lab

VR/AR LAB

VR, AR, Eye-Tracking, ECG, Physiological sensing

Immersive environment LAB

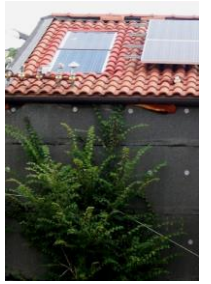
CAVE Automatic Virtual Environment

High calculation cluster

7 node calculation cluster to perform high calculations (ML training, etc…)

Real scale LAB

2 real scale building mock-ups



Research Group

Marco D'Orazio (Full Professor)
Enrico Quagliarini (Full Professor)
Elisa Di Giuseppe (Associate Professor)
Gabriele Bernardini (Researcher)

Labs

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Head of the Department: prof. Enrico Quagliarini

Department Description

The Department of Construction, Civil Engineering and Architecture (DICEA) is among the mostly active departments of construction and civil engineering, as well as, architecture, in Italy, generating (*research*) and transferring (*training*) knowledge and value of the highest quality on such topics.
DICEA is arranged in 4 main sections: Architecture, Constructions, Infrastructures and Structures.
DICEA was ranked first in 2017 among the best University departments of Italy (Department of Excellence) and awarded with a grant of 6,6 M€ in the period 2018-2022. In 2022 the DICEA was again ranked first and then awarded with a new Department of Excellence grant (about 6,5 M€) for the period 2023-2027.
DICEA brings together a wide range of disciplines, being leading contributor to the undergraduate programmes in civil and environmental engineering, building engineering, architectural engineering. DICEA also offers postgraduate programmes in civil, environmental, building engineering and architecture.
In the last 5 years, DICEA gathered resources >23 M€ (about 1M€/y from the third mission), of which: 2 EU HE MSCA-DN, 2 EU Interreg, 1 EU Internal Security Fund, 1 EU LIFE, 3 EU Erasmus+, 1 USA DoD and 9 National projects of Relevant Interest.
Coherently with the current global challenges, DICEA has individuated 4 main development axes for the next 5 years: Heritage Science; Safety of structures, infrastructures and natural systems; Digital management of constructions and built environments; Climate change, and constructions and transportation sustainability.

AT A GLANCE

2023

15 Scientific Area
ICAR 01, ICAR 02, ICAR 04, ICAR 06, ICAR 08, ICAR 09, ICAR 10, ICAR 11, ICAR 14, ICAR 17, ICAR 18, ICAR 19, ICAR 21,
MAT 05, IUS 07

229 Publications

72 Staff

>2.7 mln € Research income

71 PhD, Post-doc, Research fellows

Teaching programs for FIRST CYCLE DEGREE (Building Engineering, Civil and Environmental Engineering), PROFESSIONAL DEGREE COURSE (Technics for Territorial Design and Management), MASTER DEGREE (Civil Engineering, Building Engineering, Environmental Engineering) & SINGLE CYCLE DEGREE (Building Engineering-Architecture)

Research laboratories 9

Department of Excellence (from Italian National Agency for the Evaluation of Universities and Research Institutes)
- 2018-2022
- 2023- 2027

1 Digital Education Lab

https://www.dicea.univpm.it/

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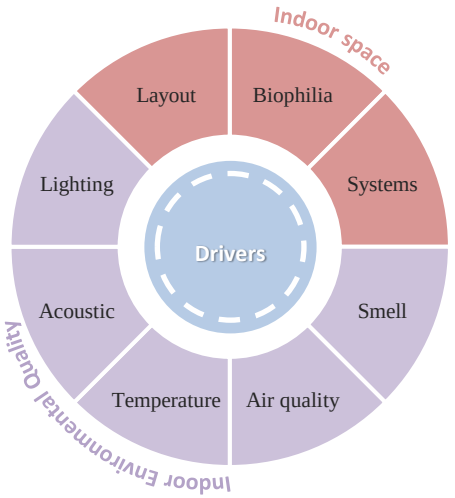
Project Idea: *Sustainable and Safe Built Environments through User-Centered approaches supported by Immersive Virtual Environments*

Highlights

- People spend about **90%** of **time indoors**, thus buildings shape our comfort, behaviour, work efficiency, perception and physiology (dependent variables)
- **Complexity of human-building relationship** due to the presence of several indoor environmental factors (independent variables) at a time.
- A **user-centered approach** to building design is needed to establish a sustainable and conducive indoor environment for individuals
- **Oversimplified** comprehension of human responses in the scientific sector due to the difficulty in testing different stimuli in lab studies
- **Virtual reality** is a useful research tool in terms of speed of execution and possibility of tests replication by easily varying the environments design.

Independent Variables



Research methods

- Physiological measurements
- Questionnaires
- Cognitive tasks
- Actions

Ecological Validity of **Virtual Reality**:

- Immersion and Presence
- Cybersickness

Dependent Variables

Perceptions of the environment
Visual perception
Acoustic perception
Thermal perception
Perceived restoration

Physiological parameters

Psychological aspects
Emotions and mood
Stress reduction

Cognitive functions
Task performance
Perceived productivity

Behaviour
Adaptive behaviour
Energy-related training

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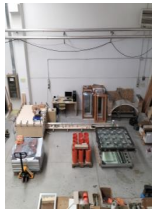
Obectives:

- **Supporting the definition of standardized and consolidated protocols** for design, testing and training in immersive virtual environments
- **Designing building (interactive) components and systems** according to users' needs, perceptions and experiences, thus improving human-building interactions
- **Developing decision-support and control frameworks** for built environments based on users' experience and interactive elements
- **Developing training tools to improve users' awareness and interaction** with the built environment

Support by labs on components & materials and high calculation



Designing building components & systems

Users' needs & perceptions

Developing decision-support and control frameworks

Interacting with users

Optmizing the developement process using immersive environment

Testing activities

Developing training tools to improve users' awareness and interaction

Testing activities

Supporting the definition of protocols