UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Advanced Human-System Interfaces

2627-1-F9103Q043-F9103Q04301

Aims

Knowledge and understanding

The student will understand how to model human-computer interaction by exploiting data originating from different sources.
In particular, the student will learn more about different types of signals acquired with contact sensors, or sensors in the environment, such as sensors that acquire physiological or electrophysiological signals, physical (speech, face, ...) and motion signals.
The student will learn how to integrate these signals into advanced human-machine interfaces, such as brain-computer interfaces.

Applied knowledge and understanding

Students will be stimulated for discussion during frontal and laboratory activities. The main focus during these interactions is to increase the ability to clearly, consciously and unambiguously communicate technical content, ideas, and problems. These skills fostered in itinere will be assessed through an oral examination.

Making judgements

Students through laboratory activities and required assignments will be able to assess their own preparation and level of understanding of theoretical aspects.

Communication skills

Students will be stimulated to discussion during frontal and laboratory activities. The main focus during these interactions is to increase the ability to clearly, knowledgeably and unambiguously communicate technical content, ideas, problems. These skills fostered in itinere will be assessed through an oral examination test.

Learning skills

The structure of teaching in which theoretical lectures, and laboratory experiences alternate in parallel, guides in learning an effective study and learning method.

Contents

The course contents are:

1. Affective Computing
2. Physical, Physiological and Electrophysiological Signals
3. Sensing Technologies
4. Pose and motion estimation
5. Soft and hard multimodal biometric systems
6. Brain Computer Interfaces

Detailed program

Affective Computing

- History and definition of affective computing
- Theories of Emotions, emotion models and Measurements
- Emotion recognition and affective computing
- Design of proper experiments

Physical, Physiological and Electrophysiological Signals

- External Signals: voice, gesture, face, behaviour, eye movement
- Internal signals: heart beat, perspiration, respiration, muscle activity and brain waves

Sensing Technologies:

- Overview of sensing technologies
- Wearable sensing
- Processing and analysis of sensing data

Basics of pose and motion estimation

- Modeling body segments
- Modelling joints across body segments

Pose estimations based on cameras

- Marker-based and markerless methods
- Feature extractions and fitting a body model

Pose estimation based on Inertial Measurement Units (IMUs)

- Basics of IMUs
- Filtering and integration

Motion estimation based on Electromyography (EMG)

- Basics of EMGs
- Filtering to estimate muscle activity

Brain Computer Interfaces

- EEG signals
- BCIs from research labs to real life applications
- Real-Life Wearable EEG-Based BCI

Lab Activities:
Data collection using different devices (EEG, GSR, PPG, EMG, IMU, etc.);
pre-processing and feature-extraction;
emotion recognition;
implementation of a simple arm model and its animation based on IMU tracking.

Prerequisites

no prerequisites

Teaching form

The course consists of lectures (32 hours of didactic teaching DE), and practical activities (24 hours of interactive didactic DI).
Several exercises will be carried out during the practical activities to verify the new expertise acquired. Lectures and practical activities will be held in presence.

Textbook and teaching resource

Slides and material uploaded on the eLearning platform
Review papers on the presented topics
Journal and conference articles, relevant for the state of the art
Codes and exercises of the practical activities

Semester

Second semester

Assessment method

The exam is composed of two parts:

1. The evaluation of assigments administered at the end of the practical activitie. Those who are not able to follow the lessons in presence will be able to do the assigments, beneffiting of the data and contente shared in the e-learning platform.
2. An oral exam to verify the preparation on all contents of the course, including the assignments.

The final score is attributed during the oral exam and will take into account also the assignments.

Office hours

send email for arranging an appointment

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE