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8. **Improving wellbeing through app-based positive interventions**
9. **To feel at ease or not to feel at ease? automatic detection of feeling comfortability in human-robot interaction**
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THESIS/INTERNSHIP PROPOSAL

Subject:	**Analyzing social interactions in commensal setting**
Supervisors and Co-supervisors:	**Radoslaw Niewiadomski**
Field of research:	**Social Signal Processing / Computer Vision**
Motivations and general objectives:	Gathering around a table, conversing, and sharing food are some of the most common, widespread, and universal social experiences. The 2-

years project *COmputational Models of COmmensality for artificial Agents (COCOA)* aims to investigate human-human interactions in a commensal setting using state-of-the art machine learning techniques and develop artificial commensal companions (e.g., social robots) capable of engaging with human commensals.

The aim of this thesis is to investigate nonverbal interactions among human commensal partners during commensal events, such as social dinners. These events are characterized by intense social interactions where the act of consuming food serves as an occasion to exchange ideas, reinforce social bonds (e.g., friendship), or conclude business affairs.

The main goal of this study is to expand existing datasets of commensal interactions [1] and **perform an analysis of nonverbal behaviors at the group level using state-of-art methods of computer vision**. To achieve this, a collection of videos will be gathered containing synchronized data of facial expressions and body movements, of several individuals sharing meals.
Subsequently, the student will develop **models of interaction dynamics.** Such models typically consider sequences of nonverbal behaviors exhibited by each interaction partner, such as gaze movements, start/end of utterance, interruptions, hand gestures, etc., and their regularities (repetitions, patterns) in the behavior of others. One example is measuring the degree of synchronization of nonverbal behaviors between the interaction partners. The nonverbal behavior synchronization can be an indicator of social relations between the two interaction partners, e.g., dominance or cohesion. Various methods exist for measuring interpersonal synchronization, such as Event Synchronization [2] and MECS [3]. As the intermediate step, the student will use existing techniques of computer vision to extract the information about nonverbal behaviors from the videos (e.g., to extract gaze movements).
In the final step, the student will develop models that link features extracted from the synchronized videos (e.g., degree of synchronization) with self-reported high-level information such as social bonds (e.g., the degree of intimacy between the interaction partners), satisfaction with the meal, and other related aspects.

The expected outcome of the thesis is a computational model able estimate some aspects of social interaction in commensal setting (e.g. social bonds) from automatic analysis of nonverbal behaviors

The student will have opportunity to develop innovative solutions and consequently be involved in scientific publications. The thesis will be developed within a large collaborative project. The student will have

	opportunity to work with interdisciplinary and international team of researchers.
Required skills:	• basic techniques of computer vision
Work Plan:	The student is expected to carry out the following tasks: • conduct a literature survey on nonverbal interaction models • participate actively in data collection and annotation • extract meaningful nonverbal features from the videos and perform the analysis of inter-personal synchronization or apply other models to study interaction dynamics • compare the results of the analysis with participants' self-reports • write thesis report
References:	[1] R. Niewiadomski, G. De Lucia, G. Grazzi, M. Mancini, Towards Commensal Activities Recognition. In Proceedings of the 2022 International Conference on Multimodal Interaction (ICMI '22). Association for Computing Machinery, New York, NY, USA, 549–557. 2022. https://doi.org/10.1145/3536221.3556566 [2] R. Quian Quiroga, T. Kreuz, and P. Grassberger, Event synchronization: A simple and fast method to measure synchronicity and time delay patterns, Phys. Rev. E 66, 041904. 2002 [3] P. Alborno, G. Volpe, M. Mancini, R. Niewiadomski, S. Piana, A. Camurri, The Multi-Event-Class Synchronization (MECS) Algorithm. https://arxiv.org/abs/1903.09530
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THESIS/INTERNSHIP PROPOSAL

Subject:	***Multimodal emotion recognition using iCUBE - novel tactile interface***
Supervisors and Co-supervisors:	***Radoslaw Niewiadomski***
Field of research:	**Human Computer Interaction / Affective Computing**
Motivations and general objectives:	Significant effort was made in last two decades in the field of automatic emotion recognition from nonverbal signals. The main focus, however, is on visual (e.g., full body movements, facial expressions) and audio (e.g., prosody) cues of affective behavior while other modalities, and, in particular, touch are very rarely considered. The aim of this thesis is to develop an **emotion classification** model for the data is collected with a **novel multimodal interface** [1], which has a form of a small cube covered with **tactile sensors**, and embedded with **accelerometer**. It generates combination of tactile (i.e., 2D tactile maps) and kinematic (i.e., angle rotations) data. The expected result of this thesis is a classification model for emotion detection/recognition for touch gestures. The research challenges include creation of experimental protocols for data collection and model validation, detection/recognition models. The work will consist of two main stages: 1) data collection in an ecological setting, 2) development of machine learning algorithms for emotion classification from mono- and multimodal data. Regarding item 1, the particular focus will be given to elicit spontaneous emotional reactions in participants that result in a combination of emotion specific touch patterns and movements, while avoiding to collect conventional touch gestures. Several techniques of emotion induction in the lab settings will be considered including both passive (e.g., emotion elicitation videos) and active (e.g., interaction with other human, social games) ones. Regarding item 2, the preference will be given to using deep learning techniques, e.g., 3D Convolutional Neural Networks or other models that can deal with spatiotemporal information. It is also expected that

	the student will carry out a set of experiments to compare the mono- (e.g., tactile only) and multimodal models. The student will have opportunity to develop innovative solutions and consequently be involved in scientific publications. The thesis will be developed in the collaboration with CONTACT Unit (Istituto Italiano di Tecnologia) directed by ERC winner Alessandra Sciutti. The student will have opportunity to work with interdisciplinary and international team of researchers.
Required skills:	• programming in Matlab and/or Python • basic notions of (deep) machine learning
Work Plan:	The student is expected to carry out the following tasks: • conduct a literature survey on machine learning applied to tactile data • Participate actively in data collection experiments, which result in a new dataset • Develop mono- and multi- modal classifiers • Write thesis report
References:	[1] R. Niewiadomski, C. Beyan and A. Sciutti, "Affect Recognition in Hand-Object Interaction Using Object-Sensed Tactile and Kinematic Data," in *IEEE Transactions on Haptics*, vol. 16, no. 1, pp. 112-117, 1 Jan.-March 2023, doi: 10.1109/TOH.2022.3230643.
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THESIS/INTERNSHIP PROPOSAL

Subject:	**Commensal Activities Recognition**
Supervisors and Co-supervisors:	***Radoslaw Niewiadomski*** ***Cigdem Beyan***
Field of research:	**Social Signal Processing/ Machine - Deep Learning**
Motivations and general objectives:	The 2-years project *COmputational Models of COmmensality for artificial Agents (COCOA)* aims to investigate human-human interactions in a commensal setting using state-of-the art machine learning techniques as well as to develop artificial commensal companions (e.g., social robots) capable of engaging with human commensals. The aim of this thesis is to apply recent machine/deep learning and computer vision techniques to develop computational models, for commensal activities' recognition. The thesis is composed of two stages. First step includes extending the existing multimodal dataset [1] containing the videos of dyads and small groups sharing meals. The student will actively participate in the data collections, the data pre-processing and manual annotation the data. Next the student will investigate recent machine learning techniques for the classification of commensal activities in the annotated videos (e.g. chewing, speaking, smiling, food intaking…) and develop mono- (i.e., using the data of facial expression) and multi- modal (i.e., using the data of facial expressions and upper body movements) classifiers. The student will have opportunity to develop innovative solutions and consequently be involved in scientific publications. The thesis will be developed within a large collaborative project that involves several researchers in Italy. The student will have opportunity to work with interdisciplinary and international team of researchers.
Required skills:	• introduction to deep / machine learning • programming skills: Python

	• basic techniques of computer vision
Work Plan:	The student is expected to carry out the following tasks: • participate actively in data collection and annotation • develop mono- and multi- modal classifiers of commensal activities • write thesis report
References:	[1] R. Niewiadomski, G. De Lucia, G. Grazzi, M. Mancini, Towards Commensal Activities Recognition. In Proceedings of the 2022 International Conference on Multimodal Interaction (ICMI '22). Association for Computing Machinery, New York, NY, USA, 549–557. 2022. https://doi.org/10.1145/3536221.3556566
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THESIS/INTERNSHIP PROPOSAL

Subject:	**Multimodal dataset for emotion recognition in video games context**
Supervisors and Co-supervisors:	**Radoslaw Niewiadomski**
Field of research:	**Affective Computing / Psychology of emotions**
Motivations and general objectives:	Several techniques for emotion recognition from facial expression, speech, full-body motion have been studied intensively for at least two decades. Independently of the chosen method, all of them require creation of appropriate datasets. Therefore, several approaches exist for affect-related data collection and annotation. Building datasets to train such models is often performed in laboratory setting by purposely inducing emotions to subjects at specific time intervals. This allows experimenters to control the stimuli and reduce the number of contextual factors that may influence the subjects' reactions. More rare are studies that have attempted to build real-life emotions datasets, i.e., collections of affect-related data, where experimenters do not have direct control over the emotion elicitation process. The aim of this thesis is to explore a novel approach to gather video segments depicting emotional human reactions by utilizing available online video repositories, with a specific focus on publicly accessible video game streaming platforms. These platforms often provide synchronized video streams of the game and the accompanying nonverbal behaviors of the player. This streaming medium enables the investigation of facial expressions, bodily posture, and auditory cues while concurrently accessing the currently played sequence within a video game. The student will investigate existing online materials, primarily analyzing popular video games to identify significant in-game events that may elicit specific emotional reactions in players, such as surprise or fear. The primary objective of this exploratory study is to identify clusters of situations within video games [1] that may lead to emotional reactions, subsequently consequently gather video segments of cooccurring players' nonverbal reactions.

	A key advantage of this approach is that the collected video segments do not require manual annotation, which is time consuming. The expected outcome of the thesis is a set of videos featuring players' nonverbal reactions corresponding to specific in-game situations. This dataset can then be utilized in the final step to develop baseline machine learning models for emotion recognition.
Required skills:	• No specific technical skills needed, but interest in computer video games and psychological theories
Work Plan:	The student is expected to carry out the following tasks: • conduct a literature survey on novel techniques of data collection in affective computing • investigate the popular video games in terms of emotion elicitation • collect the relevant video segments on online platforms • provide the dataset of relevant videos • develop baseline classifiers • write thesis report
References:	[1] Bassano, C., Ballestin, G., Ceccaldi, E., Larradet, F., Mancini, M., Volta, E., Niewiadomski, R., A VR Game-based System for Multimodal Emotion Data Collection, 12th annual ACM SIGGRAPH conference on Motion, Interaction and Games 2019 (MIG 2019), October 28-30, 2019, Newcastle Upon Tyne, United Kingdom. *doi: 10.1145/3359566.3364695*
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THESIS/INTERNSHIP PROPOSAL

Subject:	**Survey on data-driven multimodal approaches for non-basic emotion recognition**
Supervisors and Co-supervisors:	***Radoslaw Niewiadomski***
Field of research:	**Affective Computing / Machine / Deep Learning**
Motivations and general objectives:	Significant progress has been made in the last two decades in the field of automatic emotion recognition from audio, visual, and physiological signals. The recent surveys published in international journals (e.g., [1-4]) serve as clear evidence of this. It can be observed that the primary focus has been on the recognition of six emotions, often referred to as "basic emotions": anger, sadness, disgust, fear, happiness, and surprise. The visual modality, involving recognition from facial expressions and body movements, has received the most attention, while other emotional states have received comparatively less emphasis. The aim of this thesis is to conduct a comparative bibliographical research and analyze existing methods of non-basic emotions recognition (i.e., emotions different from the six mentioned above) from multimodal data (facial expressions, body movements, prosody of the voice, touch). This systematical survey has two means: 1. to collect innovative methods of data collection used in these studies for creating datasets, 2. to conduct a critical review of the data-driven approaches applied in these works. The student will perform a thorough review of the literature, identifying and highlighting the weaknesses and limitations of existing works. The student will also have the opportunity to be involved in scientific publications.
Required skills:	• basic notions of (deep) machine learning • interest in psychological theories

References:	[1] S. Li and W. Deng, Deep Facial Expression Recognition: A Survey, in *IEEE Transactions on Affective Computing*, doi: 10.1109/TAFFC.2020.2981446. [2] M. Karg, A. Samadani, R. Gorbet, K. Kühnlenz, J. Hoey, and D. Kulic, Body movements for affective expression: A survey of automatic recognition and generation, IEEE Trans. on Affective Computing, vol. 4, no. 4, pp. 341–359, 2013. [3] C. Corneanu, F. Noroozi, D. Kaminska, T. Sapinski, S. Escalera, and G. Anbarjafari, Survey on emotional body gesture recognition, IEEE Transactions on Affective Computing, no. 01, pp. 1–1, oct 55. [4] Oh Yee-Hui, See John, Le Ngo Anh Cat, Phan Raphael C.-W., Baskaran Vishnu M., A Survey of Automatic Facial Micro-Expression Analysis: Databases, Methods, and Challenges, Frontiers in Psychology, 9, 2018, DOI=10.3389/fpsyg.2018.0112
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THESIS/INTERNSHIP PROPOSAL

Subject:	**Automatic emotion recognition from the audio of respiration signal**
Supervisors and Co-supervisors:	**Radoslaw Niewiadomski**
Field of research:	**Affective Computing / Machine - Deep Learning**
Motivations and general objectives:	Significant effort was made in last two decades in the field of automatic emotion recognition from nonverbal signals. The main focus is on visual (e.g., full body movements, facial expressions) and audio (e.g., prosody) cues of affective behavior while other modalities are rarely studied. The aim of this work is 1) to design data collection protocol 2) to capture a new dataset of spontaneous affective reactions and 3) to develop models of automatic emotion recognition Regarding the items 1) and 2) a new dataset need to developed that contains the audio of breath recorded with a microphone positioned between the mouth and the nose. The dataset should contain spontaneous affective reactions; thus several data collection protocols are considered e.g., people playing video-games or watching emotion elicitation content on a PC/smartphone/tablet. When creating the dataset, several issues need to be addressed, e.g., the choice of the stimuli (e.g., video-games) that can cause specific emotional reactions in players in the controlled conditions, creation of methods for emotional self-assessment, multimodal data registration and data annotation. Regarding the item 3, the student will propose a baseline model for signal analysis and classification of affective states from audio of breath [1].
Required skills:	• notions of audio and signal processing • basic notions of deep/machine learning
Work Plan:	The student is expected to carry out the following tasks:

	• make a short survey of the literature on emotion elicitation in the lab conditions and on emotion recognition from the respiration signal, • design a set of experimental protocols (e.g., the choice of appropriate video stimuli) to collect the physiological data of spontaneous emotional reactions of the players, • collect the data recordings and self-assessments and deliver the dataset, • develop machine learning models.
References:	[1] Lussu, V., Niewiadomski, R., Volpe, G., Camurri, A., The role of respiration audio in multimodal analysis of movement qualities, Journal on Multimodal User Interfaces, Volume 14, February 2020. *doi: 10.1007/s12193-019-00302-1*
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THESIS/INTERNSHIP PROPOSAL

Subject:	**Recognition of social interactions from gait**
Supervisors and Co-supervisors:	***Radoslaw Niewiadomski***
Field of research:	**Social Signal Processing/ Machine / Deep Learning**
Motivations and general objectives:	
Work Plan:	Write to Radoslaw.niewiadomski@unige.it
References:	
Contacts:	

THESIS/INTERNSHIP PROPOSAL

Subject:	**Improving wellbeing through app-based positive interventions**
Supervisors and Co-supervisors:	***Radoslaw Niewiadomski***
Field of research:	**Positive Computing**
Motivations and general objectives:	
Work Plan:	Write to Radoslaw.niewiadomski@unige.it
References:	
Contacts:	

THESIS/INTERNSHIP PROPOSAL

Subject:	**To feel at ease or not to feel at ease: automatic detection of feeling comfortability in human-robot interaction**
Supervisors and Co-supervisors:	***Radoslaw Niewiadomski*** ***Alessandra Sciutti*** ***Cigdem Beyan***
Field of research:	**Affective Computing / Social Robotics / Deep – Machine Learning**
Motivations and general objectives:	
Work Plan:	Write to Radoslaw.niewiadomski@unige.it
References:	
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