Preface to the First Workshop on Artificial Intelligence for Human Machine Interaction (AIxHMI)

Aurora Saibene[1,2], Silvia Corchs[2,3] and Jordi Solé-Casals[4]

[1]University of Milano-Bicocca, Viale Sarca 336, 20126, Milano, Italy
[2]NeuroMI, Milan Center for Neuroscience, Piazza dell'Ateneo Nuovo 1, 20126, Milano, Italy
[3]University of Insubria, Via J. H. Dunant 3, 21100, Varese, Italy
[4]University of Vic-Central University of Catalonia, C de la Laura 13, 08500, Vic, Barcelona, Spain

Abstract

The latest advances in wearable devices and sensing technologies have enriched the potential of human-machine interaction (HMI), enabling the development of new applications especially in real-life environments. Artificial intelligence plays a significant role within new scenarios that suffer from noise, are strongly human-centered and often require severe constraints in terms of computational costs and real-time processing.

The main motivations and relevance of the Artificial Intelligence for Human Machine Interaction (AIxHMI) workshop regard (i) translating AI to pervasive technologies based on wearable sensing, (ii) focusing on a human-centric approach/perspective, and (iii) highlighting how AI can extract knowledge from heterogeneous data sources that describe human environmental interaction in real-life scenarios. Eight papers have been submitted to the first edition of AIxHMI. Out of these, five have been accepted for this volume, four as regular papers and one as a short paper. A submission has been accepted as an abstract. Diverse fields of HMI were touched by these authors as well as by the four invited speakers.

The Human Machine Interaction (HMI) field is particularly interested in providing a bidirectional way of communication between humans and machines. The sought interaction is benefitting from the continuous advancement of technologies, which are designed to be centered on their users and thus with a human centered perspective. This is especially true when considering the recent advances in wearable sensing technology, whose main aim is to provide more flexible, comfortable and personalized wearable HMI systems, that could be accepted with more ease by their users and provide reliable data collection and feedback.

It is then necessary to question whether these technologies could be really up to this challenge, having that besides the technological concerns regarding the development and design of such sensors and devices, it is necessary to consider how the interaction could be effectively made. This could be also translated into understanding how Artificial Intelligence (AI) influences the HMI system development and what kind of challenges arise when having to face wearable devices and sensing technologies in real-time, instead of wired ones that are usually handled off-line.

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aurora.saibene@unimib.it (A. Saibene); silvia.corchs@uninsubria.it (S. Corchs); jordi.sole@uvic.cat (J. Solé-Casals)
0000-0002-4405-8234 (A. Saibene); 0000-0002-1739-8110 (S. Corchs); 0000-0002-6534-1979 (J. Solé-Casals)

A practical example may be represented by wearable Brain Computer Interfaces (BCIs). By collecting human-users' brain activations through wearable sensors, they provide specific feedback according to specific brain responses. However, managing wireless data and on-line applications presents a series of issues that are different from the ones arising from the use of their wired and off-line counterparts, e.g., the data transmission could be less safer, the data may be of lower quality, and the feedback needs to be almost instantaneous and extremely reliable, especially when related to health and humancentered applications.

These issues can be expanded and translated to other control and sensing devices, by also considering their interaction. Open challenges are in fact present when considering the integration of heterogeneous data, especially the ones coming from multimodal sensing and the ones depending on the environment a HMI user lives in.

A key aspect may be also represented by the emotional involvement of the users when dealing with HMI systems, thus giving space to the fields of emotional intelligence and affective computing. In fact, having machines that are able to adapt to the emotional states of their users may provide better communication between them. For example, being able to detect frustration could allow the re-modeling of a specific control system to the necessities of a single user. This observation highlights the tendency towards human centered computing and sensing to provide a better user experience. It is again necessary to provide a good data quality, organization and management, considering that these data come from multiple sources.

Therefore, the Artificial Intelligence for Human Machine Interaction (AIxHMI)[1] workshop is organized to provide interactions between multidisciplinary fields that pertain but that are not limited to HMI, BCI, control systems, wearable sensing and devices, emotional intelligence, affective computing, human centered sensing and computing, human factors and ergonomics, user experience, interface and sensor design, and ethics and security in AI, having that the AI is a transversal discipline that influences all these aspects.

Eight submissions have been sent by Dutch (2), Italian (8), Latvia (2), and Norwegian (2) authors to the AIxHMI workshop and five have been accepted in this volume.

Accepted papers mainly pertained to the fields of human-gaze related to tabular data summarisation, AI applied to electroencephalographic (EEG) signals for brain-computer interfacing, emotion and inner speech recognition, and facial expression transfer.

Amianto & Cremaschi [1] discuss the user centric research related to reading behaviours especially concerning linear text and tabular data reading, and suggest exploiting eye-movement data to insert users' characteristics in table summarisation models.

Saibene et al. [2] investigate the evolution of AI techniques and their influence on the EEG-based BCIs considering motor imagery experimental paradigms.

Upenieks & Urtans [3] aim at transferring human facial emotions using generative adversarial network based models. Their results could be exploited in the field of HMI especially concerning virtual assistants and avatar generation.

Another research related to human emotion is proposed by Kumar & Molinas [4], who propose an automatic emotion detection model to use in EEG-based experiments. In particular, they apply multi-layer perceptron and and convolutional neural network models to handcrafted

[1] https://aixhmi.unimib.it/

1D and 2D EEG features.

Inner speech recognition through EEG signals is instead analysed by Gasparini et al. [5]. The authors focus on both traditional machine learning and deep learning techniques to recognise different unspoken words.

Papalia discussed the bias of artificial intelligence within the justice field, providing insights on this topic from a law-expert perspective.

Besides the oral presentation of the aforementioned papers and abstract, four invited speakers participated to the AIxHMI workshop.

Marta Molinas (Professor at the Norwegian University of Science and Technology) invited talk "Evolution of EEG systems from high density to wearables: opportunities for expansion", focused on the history of EEG technologies and discussed a methodology to evaluate the performance of systems considering a low number of electrodes. Assessing this information would especially provide a better validation of consumer grade technologies.

Slobodan Tanackovic (Sales manager at g.tec medical engineering GmbH) discussed "Current and future applications of brain-computer interfaces". In particular, he presented different applications of g.tec products from BCI speller to rehabilitation technologies.

Daniel Rodríguez-Martín (COO at Sense4care) gave us an insight on "STAT-ON: Monitoring mobility in Parkinson's Disease. From research to market". He pointed out the very high number of people affected by Parkinson's disease and presented STAT-ON, wearable solution for patients monitoring, providing the roadmap that has brought this product from a research environment to the market.

Evangelos Niforatos (Professor at the Delft University of Technology) invited talk "Head-Mounted Displays and Physiological Sensing for Human-Machine Interaction" provided a clear explanation on the field of human-computer interaction and focused on diverse wearable technologies from smart glasses to digital intelligent assistants.

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