Guest Editorial: Apparent Personality Analysis

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AUTOMATIC analysis of videos to characterize human behavior has become an active area of research with applications in affective computing, human-machine interfaces, gaming, security, marketing, and health, just to mention a few. Research advances in multimedia information processing, computer vision and pattern recognition have lead to established methodologies that are able to successfully recognize consciously executed actions, or intended movements (e.g., gestures, actions, interactions with objects and other people). However, recently there has been much progress in terms of computational approaches to characterize sub-conscious behaviors, which may be revealing aptitudes or competence, hidden intentions, and personality traits. Much remains to be done still, but it is essential nowadays to have a compilation of cutting edge work in this direction to identify potential opportunities and challenges involved. In this line, we edited a special issue on automatic methods for apparent personality analysis.

Personality refers to individual differences in characteristic patterns of thinking, feeling and behaving.[1] Hence, personality traits convey critical information that could be used for enhancing everyones life (e.g., for identifying/monitoring mental illnesses, for training ourself expressions/appearance skills, and for personality profiling in security applications). However, characterizing genuine personality automatically from video analysis is far from being a trivial task [1] because perceiving personality traits is not easy even to humans, unless they are professionally trained (psychologists, recruiting specialists). Additionally, many personality traits are not precisely defined and there is no consensus among psychologists about how to capture them accurately, e.g. via standardized tests. Because of these complications, this special issue aimed at compiling the latest progress on automatic analysis of *apparent* personality in images and videos from multimedia information processing, computer vision and pattern recognition points of view. This topic is of genuine interest as it relates to how personality is perceived by other individual or automatic programs, which with applications in self-improvement and coaching.

1. http://www.apa.org/topics/personality/

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The special issue represents the culmination of a number of events and compilations associated to the first stage of the speeds interview project.[2] In 2016 we organized a workshop on personality analysis at the European Conference on Computer Vision (ECCV 2016) [2]. Such workshop was associated to an academic challenge on first impressions that focused on automatically recognizing personality traits from users by processing short videos. A novel data set with 10,000 15-second YouTube videos annotated with personality traits by AMT workers was released. The traits corresponded to the "big five" classification used in psychology and well known of hiring managers using standardized personality profiling: *extraversion*, *agreeableness*, *conscientiousness*, *neuroticism*, and *openness to experience*. In the same year, we organized a workshop with the International Conference on Pattern Recognition (ICPR 2016) focusing on human behavior analysis on non-obviously visual scenarios [3]. A second round of the first impressions challenge was collocated with such workshop. In 2017, we organized a workshop on explainable computer vision with an associated competition on job candidate screening. The workshop was collocated with the Computer Vision and Pattern Recognition Conference (CVPR 2017) and its focus was on methodologies that could explain recommendations, with emphasis of methods in the context of job interviews. Accordingly, the associated challenge aimed at correlating personality traits with job candidate screening with explanatory mechanisms [4]. The special issue is also a natural follow up of a vast number of events and compilations lead by ChaLearn that have been dedicated to the automatic analysis of human behavior, see [5] for details.

This special issue reunites improved and extended works presented at the aforementioned venues as well as high-quality relevant papers contributed by authors that attended the open call for papers. In the following we summarize the contributions. We encourage the reader to read the corresponding papers to get a complete understanding of the ideas/contributions presented therein.

1 Special Issue Published Papers

This section summarizes the contributions of papers included in the special issue on apparent personality analysis. Table 1 summarizes the approached tasks, considered features and modeling frameworks, as well as used data sets for the different articles.

Two articles reporting solutions of participants of the associated first impressions [2], [3] and job candidate screening competitions [4] were included in the special issue. On the one hand, X.S. Wei et al. describe the winning solution of the

2. http://gesture.chalearn.org/speed-interviews

TABLE 1
Overview of Articles in the Special Issue on Apparent Personality Analysis

Ref.	Rank	Task / Model	Features	Model	Dataset
[6]	1^{st}	Personality/ Big Five	Multimodal features (image frames and audio) learned with deep neural networks. The fully connected layers are replaced by pooling operations. Handcrafted audio features (MFCC). Late fusion of features is performed.	Per-modality regressors based on multi-layer perceptrons. Average fusion of per-trait predictions.	ChaLearn's first impressions [2]
[7]	3^{rd}	Personality/ Big Five	Multimodal features learned with a two stream deep residual neural network. Features derived from transcripts of the audio modality.	Fully connected MLP on top of the deep residual neural network used for feature extraction. Late fusion with text-based features.	ChaLearn's first impressions [2]
[8]	–	Personality/ PEN model	Eigen features from thermal and visible images. Emotions recognized by an SVM are used as features for recognizing personality.	SVM for meta-feature extraction and Hidden Markov Model for recognition	Own data set [8]
[9]	–	Emotion/ Ekman's	Ensemble of convolutional neural networks with induced diversity.	Hierarchical stacked CNN.	SFEW2.0 [10]
[11]	–	Recommendation/ Big Five	Social interaction features, trait correlation between subjects.	Thresholding.	Own data set [12]
[13]	–	Human activities/ NA	Wearable sensor readings, including accelerometer, gyroscope, temperature etc.	Visualization model based on concentric spheres	PRIDE [14]
[15]	–	Personality/ Big Five	Preprocessed EEG signals with ICA; short-time Fourier transform for feature extraction based on power spectral features. Feature selection with sparse linear discriminant analysis	Support vector machine (SVM)	Own data set [15]
[16]	–	EUD/ -	Uncertainty of model and correlation among features.	-	Water pipe-HBP [17]

first impressions challenge in their contribution entitled "Deep Bimodal Regression of Personality Traits from Short Video Sequences" [6]. A modified deep convolutional neural network (CNN) was used for feature extraction from frames. In the modified CNN the fully connected layers were replaced with pooling layers followed by l_2 normalization, the output of this process is concatenated and used as input to a multi layer perceptron for regression. Learned and handcrafted features are fused with the visual features, via prediction averaging. On the other hand, Y. Gucluturk et al. describe in "Multimodal First Impression Analysis with Deep Residual Networks"[3] the methodology that obtained the third place in the first impressions competition [7]. The authors proposed a two-stream deep residual network for trait regression and feature extraction/fusion of the audiovisual information in videos. Additionally, features derived from the transcripts of the audios were considered in a late fusion scheme. Finally, the authors describe explanatory/interpretable mechanisms of their methods that allowed them to understand, to some extend, the *reasoning* behind the network's predictions. This method was used as baseline for the job candidate screening competition. Interestingly, both articles report deep learning based methods for representation learning and late fusion of regression results.

3. Please note that although this manuscript is co-authored by the guest editors, it was managed by an independent associate editor. Guest editors had no influence in the acceptance of this article that followed the standard reviewing process of *IEEE Transactions on Affective Computing*.

The link between affect and personality is explored in the article entitled "A Portable Personality Recognizer based on Affective State Classification using Spectral Fusion of Features" by A. Basu et al.. The authors describe a method for personality recognition based on the emotional states as depicted by users [8]. Using a combination of information derived from thermal and visible images, a support vector machine (SVM) predicts the emotional state of a subject (a reduced Ekman's model is adopted). The predictions are feed to a Hidden Markov Model that aims to infer three personality traits: Psychoticism, Extraversion, and Neuroticism. Accuracy rates above 85% are reported by the authors. This article highlights the relevance that emotions may have for recognizing personality, hence research progress on emotion recognition may have a direct influence on apparent personality analysis. In this context, the article "Supervised Committee of Convolutional Neural Networks in Automated Facial Expression Analysis", by Pons and Masip describes a meta ensemble of convolutional neural networks (CNNs) for improving emotion recognition performance from facial images [9]. More than 70 CNNs trained on different settings we considered for the ensemble. The outputs of the individual CNNs were then feed to another CNN that acted as meta ensemble. This last CNN had a similar composition as each of the ensemble members. Improvements above 4% were obtained with the stacked CNN over the standard ensemble strategies. In the same line as the work by Basu et al. (predicting personality from another affective variable), but in the opposite direction,

N. Y. Asabere et al. describe in their article "Improving Socially-Aware Recommendation Accuracy Through Personality", a recommender system for mobile devices that takes into account social and personality information [11]. A smart conference scenario is considered, where information of social interaction is augmented with personality traits data. More specifically, the Pearson correlation among personality traits by users is used to extend a model that recommends users to each other. The goal of the study is to reduce as much as possible the cold start problem. The so called, Personality and Socially-Aware Recommender system outperforms two reference techniques in the considered data set.

An interesting study on the use of electroencephalography (EEG) signals for predicting personality traits is presented by G. Zhao et al. in their article "Emotion Analysis for Personality Inference from EEG Signals" [15]. The authors designed an experiment involving more than 40 subjects. EEG signals were collected from participants while they were exposed to video clips depicting emotional situations. A support vector machine was used to predict personality traits from features derived from the EEG signals (see Table 1). Results from this study reveal that in most cases, high accuracy was observed when using as input clips showing positive/negative emotions for predicting traits with positive/negative charge.

Two articles included in the special issue were oriented to applications. On the one hand, A. Lopez-Cuevas et al. present, in their contribution entitled "FiToViz: A Visualisation Approach for Real-time Risk Situation Awareness", the implementation of a visualization model that takes as input readings from wearable sensors and shows a geometrical visualization of a subject's activity [13]. The Fitness To Visualization application aims at detecting risk-prone situations with the goal of providing decision makers with additional information to consider when evaluating potentially dangerous events. Visualization are based on intuitive concentric spheres. An useful data set (PRIDE) is used for evaluation purposes. On the other hand, J. Zhou et al. focused on an interactive data analytics application. The authors present in their article "End-User Development for Interactive Data Analytics: Uncertainty, Correlation and User Confidence" a study on the influence that correlation and uncertainty visualizations have into user confidence in end-user development (EUD) for interactive analytics [16]. A case study on water pipe failure prediction was considered, where users had access to visualizations of uncertainty of the model and correlation of features. From this study, the authors conclude that transparency is the key for successful EUD involving machine learning.

2 Discussion

From this review, it is clear that the special issue achieved its goal of capturing a snapshot of cutting edge research and applications of apparent personality analysis with automatic methods. Techniques devoted to the prediction of personality traits were presented in most articles [6], [7], [8], [11], [15]. However, each paper focused in a very specific aspect, including, mixing both, learned and handcrafted features [6]; proposing explainability mechanisms [7]; learning from biological signals [15] and affective states [8]. As a result, each of these articles had their own and particular flavor when predicting personality traits. Applications were well represented in contributions to this special issue, comprising applications for risk prevention [13], recommendation [11] and interactive data analytics [16]. Interestingly, the link between affective computing and personality analysis was elucidated in several papers [8], [9], [11], confirming previous research reported elsewhere [18], [19]. Also, it was encouraging that a couple of articles [7], [16] emphasized the importance of explainability of models as their conclusions; explainability being a hot topic across all artificial intelligence [4]. Regarding competitions and events associated to this special issue, we succeeded at including the solutions of two outstanding participants of the first impressions challenges [6], [7]; both of them proposing deep learning based solutions. In the same line, the issue includes the baseline of the job candidate screening competition [7], whose focus is on explainable computer vision [4]. Last, but not least, there was a balance between submissions using learned representations (deep learning) and handcrafted features. Because of these high quality contributions and their interesting findings, we foresee this special issue will become a reference on the automated analysis of apparent personality.

Although research progress in the field is advancing at great steps, much remains to be done in this area. Curated data sets are required, implementing bias-free labeling procedures[4], and covering varied personality traits models (other than Big-five). Likewise, we expect that the community will explore additional settings and data modalities from which apparent personality can be predicted (e.g., from handwritten text[5] or incorporating social information). We anticipate the study of apparent personality analysis will become a multi-disciplinary research field with major achievements in the next few years.

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