How Much Do You Perceive This? An Analysis on Perceptions of Geometric Features, Personalities and Emotions in Virtual Humans

Victor Araujo, Rodolfo Migon Favaretto,
Paulo Knob and Soraia Raupp Musse
Graduate Program in Computer Science
Pontifical Catholic University of Rio Grande do Sul
Porto Alegre - RS, Brazil

Felipe Vilanova and
Angelo Brandelli Costa
Graduate Program in Psychology
Pontifical Catholic University of Rio Grande do Sul
Porto Alegre - RS, Brazil

ABSTRACT

This work aims to evaluate people's perception regarding geometric features, personalities and emotions characteristics in virtual humans. For this, we use as a basis, a dataset containing the tracking files of pedestrians captured from spontaneous videos and visualized them as identical virtual humans. In addition to tracking files containing their positions, the dataset also contains pedestrian emotions and personalities detected using Computer Vision and Pattern Recognition techniques. We proceed with our analysis in order to answer the question if subjects can perceive geometric features as distances/speeds as well as emotions and personalities in video sequences when pedestrians are represented by virtual humans. Regarding the participants, an amount of 73 people volunteered for the experiment. The analysis was divided in two parts: i) evaluation on perception of geometric characteristics, such as density, angular variation, distances and speeds, and ii) evaluation on personality and emotion perceptions. Results indicate that, even without explaining to the participants the concepts of each personality or emotion and how they were calculated (considering geometric characteristics), in most of the cases, participants perceived the personality and emotion expressed by the virtual agents, in accordance with the available ground truth.

KEYWORDS

User perception, geometric features, personalities, emotion

ACM Reference Format:
Victor Araujo, Rodolfo Migon Favaretto,, Paulo Knob and Soraia Raupp Musse, Felipe Vilanova and, and Angelo Brandelli Costa. 2019. How Much Do You Perceive This? An Analysis on Perceptions of Geometric Features, Personalities and Emotions in Virtual Humans. In *ACM International Conference on Intelligent Virtual Agents (IVA '19), July 2–5, 2019, PARIS, France.* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/3308532.3329454

1 INTRODUCTION

The study of human behavior is a subject of great scientific interest and probably an inexhaustible source of research [11]. Due to its importance in many applications, the analysis of human behavior has been a popular research topic in the last decades [1]. In literature, there are some work involving the visualization and analysis of cultural characteristics, such as analysis of the impact of groups on crowds through human perceptions [15], simulation of crowds through behaviors based on personality and emotions traits [4], visualization of interactions between virtual agents in crowd simulation and pedestrians in real video sequences [12] among others.

Recently, studies have used geometric features to analyze cultural aspects in crowds. Favaretto et al. used group behaviors to detect cultural aspects according to Hofstede [5], comparison of spontaneous videos from various countries [6], Big-Five personality [7] and OCC emotion [8] models. However, there are not many methods in the literature that investigate people's perceptions regarding geometric information [15]. Thus, the goals of this work are: to evaluate if different points of view influence people's perceptions of geometric characteristics (for example, density data, distances and velocities), and to investigate how people perceive non geometric characteristics (for example, cultural characteristics such as personality traits and emotions). For the experiment, we use the videos of *Cultural Crowds* (Available at: http://rmfavaretto.pro.br/vhlab/) dataset, which contains videos and tracking files of crowds from different countries. We use the track position in a simulated environment where agents were visualized as identical virtual humans. The goal is to focus on their behavior and not being distracted by other features.

2 RELATED WORK

This section discusses some work related to pedestrian and crowds behavioral analysis focusing on personality traits, emotion and perception. Knob et al. [12] presented a work related to visualizations of interactions between pedestrians in video sequences and virtual agents in crowd simulations. Durupinar et al. [4] used OCEAN [3] to visually represent personality traits. Yang et al. [15] conducted a study on analysis perception to determine the impact of groups at various densities, using two points of view: top and first-person view. The work of Ardeshir and Borji [2] shows experiments and graphs made between two points of view (first-person and top cam view), thus helping in the integration and use of the types of cameras used in this present work.

Regarding personality, emotion and cultural aspects analysis in pedestrian from crowds, we find some work. [5] proposed a method to identify groups and characterize them to assess cultural differences through the mapping of the Hofstede's dimensions [10]. A similar idea, however using computer simulation is proposed by

IVA '19, July 2–5, 2019, PARIS, France

ACM ISBN 978-1-4503-6672-4/19/07.
https://doi.org/10.1145/3308532.3329454

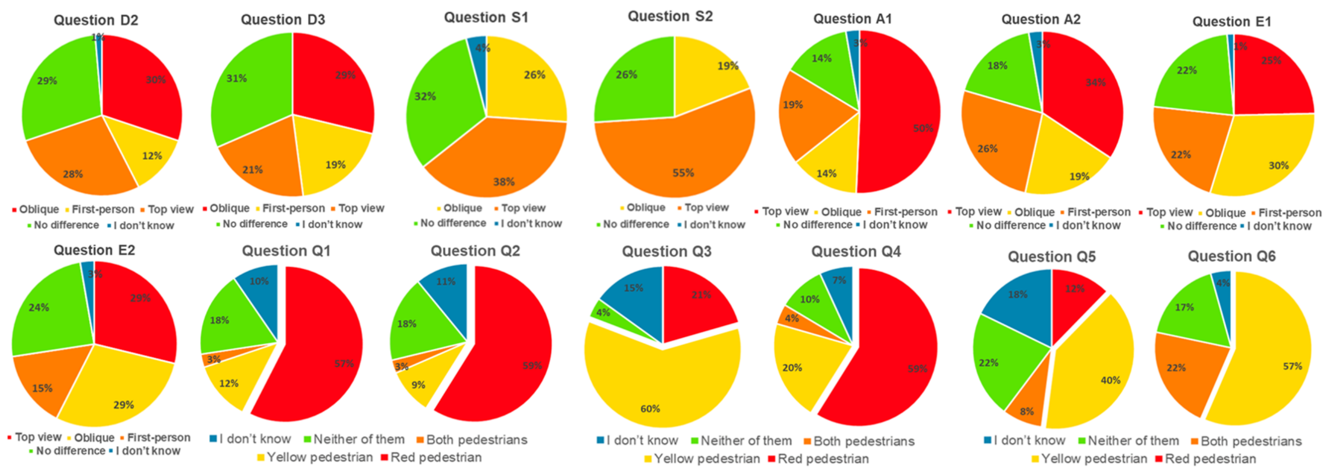

Figure 1: Perception concerning density: questions D1 to D6.

Lala et al. [13]. Gorbova and collaborators [9] present a system of automatic personality screening from video presentations based on visual, audio and lexical cues. [7] presents a model to detect personality aspects based on the Big-five personality model using individuals behaviors automatically detected in video sequences. In [8], the authors aimed to detect pedestrian emotions in videos, based on OCC model, using OCEAN as inputs, as proposed by Saifi [14]. In our approach, we proceed with an analysis in order to verify if subjects can perceive geometric features as distances/speeds as well as emotions and personalities in video sequences when pedestrians are represented by virtual humans. Next section present how we performed the analysis.

3 METHODOLOGY

To perform our analysis, we extracted data from the Cultural Crowds dataset [5]. The geometric features were calculated using the pedestrian trajectories. Personality and emotion traits are also calculated based on that, through psychological hypotheses. All these information are available in the dataset.

In our analysis the participants were asked to answer questions to identify if they can perceive geometric features as distances/speeds as well as emotions and personalities in video sequences when pedestrians are represented by virtual humans. Our focus is on perception of information always related to the space and geometry, even when we talk about emotion and personality. To visualize the pedestrian information as avatars in a 3d environment, a viewer was developed using the Unity3D[1] engine, with *C#* programming language. Regarding the participants, an amount of 73 people volunteered for the experiment: 45 males (61.6%) and 28 (38.4%) females and 47.9% have some undergraduate degree. Next section presents the main results.

4 RESULTS

We organized the results in two analysis: geometric and non-geometric features perceptions.

[1]Unity3D is available at https://unity3d.com/

Geometric features perception: Here, we present an analysis of subjects perception regarding density, velocity, direction variation of pedestrians and distance among them using three camera's points of view (first-person, oblique and top-view).

The first questions D2 and D3 asked the same aspect: "In which video do you perceive the higher density?". Figure 1 shows the questions and percentage of answers. In those questions we presented scenes of videos with same density but displayed with the different points of view. We asked to the subjects to select the scene where the higher density was observed. Our goal was to check if the subjects could perceive the same density or if density perception changes due to the camera point of view. In question D2, 70% chose one of the scenes, while 29% of the participants marked the option "I did not notice density difference", so for this small group it seems that the camera does not change the perception. In question D3, 69% chosen one of the scenes, while 31% of the participants marked the option "I did not notice density difference".Regarding speed perception, we analyzed two questions: S1 and S2. Question S1 presented two scenes of videos with velocity=running and cameras=oblique and top. As shown in Figure 1, 32% of subjects do not perceive any difference in velocity while 64% chosen one of the scenes. Same process for question S2 but using velocity=walking and 26% does not perceive difference while 74% chosen one of the scenes.

Concerning angular variation we analyzed questions A1 and A2. For this, we asked the same question "In which video do you observe more angular variation performed by the agents?". In A1, as shown in Figure 1, only 14% of subjects do not perceive difference in the angular variation while 83% chosen one of the scenes and the top view camera was more selected. Similar process for A2, 18% of subjects did not perceive difference while 79% selected one of the scenes. Regarding the perception of distance between the avatars, questions E1 and E2 asked "In which video do you observe the largest distance among agents?". Indeed, results were very similar in both question. In E1, as shown in Figure 1, 22% of subjects do not perceive differences, while in E2 24% also do not perceive changes. On the other hand, 77% and 73% of subjects, respectively, selected one of the scenes in a approximately uniformly distributed way.

Personality and emotion perceptions: Here we present the part of this study focused on perception of personality and emotion. In each video sequence we highlighted two individuals with different colors (red and yellow) and we asked to the subjects about them. We use as ground truth the results obtained by the approach proposed by Favaretto et al. [8]. In the questions $Q1$ and $Q2$ we asked about which pedestrian (yellow or red) was, respectively, neurotic and angry (Figure 1 presents the plots of these questions). It was interesting to see that a little bit more than half of participants (57% in $Q1$ and 59% in Q2) answered according to the ground truth. Only a few participants answered that the pedestrian highlighted in yellow was neurotic and scared (12% in question $Q1$ and 9% in question $Q2$) and 18% answered that "neither of them" was neurotic. As proposed by [8], geometrically, a neurotic person remains isolated and few collective. So, subjects who do think that no agent was neurotic was certainly thinking about the psychological point of view, while we are analyzing based on space relationship. The red pedestrian is angry: isolated, low speed, low socialization and low collectivity.

Following the analysis, Questions $Q3$ and $Q4$ asked participants about which highlighted pedestrian was, respectively, openness to experiences and afraid. The results plotted in Figure 1 shows that most of the participants perceived the same personality (in case of question $Q3$) an the same emotion (question $Q4$) when compared to ground truth, i.e. 60% of the participants correctly chose the pedestrian in yellow as the most opened to experiences in question $Q3$ and 59% correctly chose the pedestrian in red as having fear. In the model of [8], a pedestrian opened to new experiences is related to a high value for the angular variation feature. Geometrically speaking, according to what has been proposed in our model, a person who allows himself/herself to change objectives (direction) while walking is more subject to new experiences. Fear, in turn, is linked to the fact that the person is isolated from others and walks at lower speeds.

Finally, questions Q5 and Q6 and asked, respectively, about happiness and sociability. Regarding question $Q5$ (plotted on the right side of Figure 1, in the second line), 40% of participants answered according to the ground truth. Geometrically, a happy person is not isolated and can present high levels of collectivity and socialization. Pedestrian highlighted in yellow presented that characteristics in the video and was correctly identified by the participants in the survey. When asked which pedestrian appeared to be more sociable, in question $Q6$, most of the participants (57% of them) seemed to be more convinced that the pedestrian highlighted in yellow is the most sociable, in accordance with the model proposed by [8].

5 FINAL CONSIDERATIONS

This work evaluated people's perceptions with respect to geometric features, such as: density, speed, angular variation and distances among pedestrians. We also evaluated subjects perception regarding other subtle parameters as personalities and emotions traits in crowds. We proposed and implemented a survey that has been answered by 73 participants through a questionnaire that featured visualizations of scenes taken from videos of the *Cultural Crowds* [5] dataset and propose questions regarding variation of visualization parameters. Regarding the results of the people's perceptions about the geometric data, in the general analysis of the cameras, it was noticed that the way agents are displayed and the camera point of view interfere in the parameters perception. In particular, the greater the distance from the camera to the environment (oblique and top cameras), the better seem to be the perception of density, speed and angular variation. Concerning speed parameter, subjects perceive better the speed variation of the avatars running through the oblique camera than in the top camera. We also performed an experiment to evaluate if people can perceive different personalities and emotions performed by pedestrians in crowds. It was interesting to see that, even without explaining to the participants the concepts of each personality or emotion and how they were calculated in our approach (considering the geometric characteristics), in all the cases, more than half of the participants perceived the personality and emotion that the agent was expressing in the video, in accordance with our approach. Of course, this last aspect is much more intangible and the missing explanations that we were interested about spatial manifestation and not trying to "figure out" if the person is social or open in a psychological point of view is certainly one aspect we want to deal in a future work.

ACKNOWLEDGMENTS

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. Thanks also to Office of Naval Research Global (USA) and Brazilian agencies: CNPQ and FAPERGS.

REFERENCES

[1] X. Alameda-Pineda, E. Ricci, and N. Sebe. 2018. *Multimodal Behavior Analysis in the Wild: Advances and Challenges.* Elsevier Science, London, UK.

[2] Shervin Ardeshir and Ali Borji. 2018. Egocentric Meets Top-view. *IEEE Transactions on Pattern Analysis and Machine Intelligence* (2018).

[3] J. M. Digman. 1990. Personality Structure: Emergence of the Five-Factor Model. *Annual Review of Psychology* 41 (1990), 417–440.

[4] F. Durupınar, U. Güdükbay, A. Aman, and N. I. Badler. 2016. Psychological parameters for crowd simulation: From audiences to mobs. *TVCG* 22, 9 (2016), 2145–59.

[5] R. M. Favaretto, L. Dihl, R. Barreto, and S. R. Musse. 2016. Using group behaviors to detect hofstede cultural dimensions. In *ICIP*. IEEE, 2936–2940.

[6] R. M. Favaretto, L. Dihl, and S. R. Musse. 2016. Detecting crowd features in video sequences. In *SIBGRAPI*. IEEE Computer Society, 201–208.

[7] R. M. Favaretto, L. Dihl, S. R. Musse, F. Vilanova, and A. B. Costa. 2017. Using big five personality model to detect cultural aspects in crowds. In *SIBGRAPI*. 223–9.

[8] R. M. Favaretto, P. Knob, S. R. Musse, F. Vilanova, and A. B. Costa. 2018. Detecting personality and emotion traits in crowds from video sequences. *Machine Vision and Applications* (2018), 1–14.

[9] J. Gorbova, I. Lusi, A. Litvin, and G. Anbarjafari. 2017. Automated Screening of Job Candidate Based on Multimodal Video Processing. In *CVPRW*.

[10] Geert Hofstede. 2011. Dimensionalizing cultures: The Hofstede model in context. *Online readings in psychology and culture* 2, 1 (2011), 8.

[11] J.C.S. Jacques Junior, S. R. Musse, and C.R. Jung. 2010. Crowd Analysis Using Computer Vision Techniques. *IEEE Signal Processing Magazine* 27 (2010), 66–77.

[12] P. Knob, V. F. de Andrade Araujo, R. M. Favaretto, and S. R. Musse. 2018. Visualization of Interactions in Crowd Simulation and Video Sequences. (2018).

[13] D. Lala, S. Thovuttikul, and T. Nishida. 2011. Towards a virtual environment for capturing behavior in cultural crowds. In *6th ICDIM*. 310–315.

[14] L. Saifi, A. Boubetra, and F. Nouioua. 2016. An approach for emotions and behavior modeling in a crowd in the presence of rare events. *AB* 24, 6 (2016).

[15] Fangkai Yang, Jack Shabo, Adam Qureshi, and Christopher Peters. 2018. Do you see groups?: The impact of crowd density and viewpoint on the perception of groups. In *IVA*. ACM.