Humanoid Eyes: Perspective & Challenges

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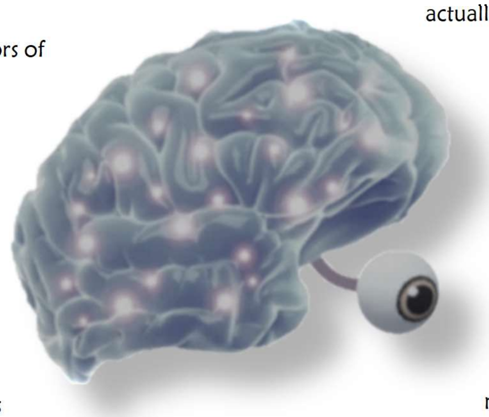
Abstract- This proposal offers perspective and challenges aiming to optimize and socialize the humanoid eyes. The main purpose of this proposal is to bring the readers' attention to the importance and the sophistication of the human eye and its four dynamics continuum, namely, the continuum that may include saccadic eye movements, pupil variations, blinks along with duchenne markers. We suggested that the robotics' designers to work collaboratively with neuroscientists to mathematically estimate the aforementioned continuum, and therefore, humanoid eyes/cameras can be perfectly invented; invention that we try to register its essential elements in the present study. The aforementioned collaboration will be very beneficial for an additional purpose, namely, because human vision indeed activates very many cortical areas that extended to the prefrontal cortex; the collaboration may effectively flourish the eye trackers to be good replacements of the expensive brain imaging in certain circumstances.

Fulsome Discussion

We initially have to understand the behaviors of human eye to comprehend its social importance. Four dynamics (dimensions) distinguish human eyes: pupil variations, saccadic eye movements, blinks, in addition to duchenne markers (that is mainly produced by orbicularis oculi pars lateralis). Each of these dimensions represents significant amount of psychological and cognitive [1 - 7], and their corresponding neurophysiological information [8 - 12]. Interestingly, the cones in the retinal peripheries signal the brain 30 milliseconds faster than the central cones (Masland, 2017). Accommodated lens which is associated to dilated pupils allows the light rays to access a bigger area of the retinal peripheries; in which humans will have 'faster' visual awareness (see reference 8). Faster perceptual awareness assist in creating faster actions; as if it is an evolutionary defensive mechanism to allow humans to act timely in unexpected situations. The vice versa could be true; namely, constricted pupils are associated to flattened lens which might disallow the light rays to access the retinal peripheries, thus, slower visual awareness and therefore slower actions. Noticeably, psychology may have better explanations of these situations, in another word, pupil dilation has the ability to estimate emotional arousal and autonomic activation, (Bradley, 2008). It also betrays the timing of decisions, (Einhäuser, 2010); represents the surprising events, (Preuschoff, 2011); and it can reflect individual upcoming choices and biases, (Gee, 2014). We now may know why when the pupil dilates, the lens become more rounded, likely, to gives the external stimuli greater accessibility to the retinal peripheries, and thus, faster visual awareness that seems to be very important for all of the aforementioned situations; situations that may require faster action. Blinks, however, can estimate the cognitive workload; namely, Blink Rate Variability can determine the IQ-test scores for human subjects, (Paprocki, 2017). Namely, blink rate variability is positively correlated with the intelligence of human subjects. The aforementioned information should be utilized in building up optimal humanoid eyes, namely, in the processing time of the humanoid, the blinking rate variability should be increased. Needless to say, Duchenne markers noticeably represent significant amount of emotions (Darwin, 1872); it just say what the mouth cannot say! The Duchenne marker has been suggested as a universal marker of smile, happiness, sincere, and sadness authenticities. It therefore should be considered in the design of humanoid eyes for perfect humanizing effects. The last dimension which actually tells us a lot about the person's interests is saccadic eye movements. Namely, Saccade and microsaccades had been representing the visual exploration and search, (Otero-Millan, 2008). Certain patterns of saccadic eye movements also represent significant signs of imaginations and creativity. We can now see the importance of including the 'four dimensions' continuum in the humanoid eyes aiming for perfect socialization. Humanoids are mainly made for socialization purposes; and to humanize them, their eyes (visible brains) should be perfectly designed. Robotics Engineers should therefore understand the importance of the eyes. Namely, they should take the four previously mentioned dynamics into their design considerations. Humanoids might be very important in assisting vulnerable and elderly people in their daily tasks. Needless to say, without humanized eyes, the social relationship between the owners and their humanoids may be impaired. Importantly, psychiatrists also might not rely on humanoids with imperfect humanized eyes to treat their patients, again this shows how the aforementioned eye continuum is extremely important. Importance that can be revealed when trying to cure children with autism spectrum condition who had been suffering from eye contact avoidance. Those patients, however, might accept to deal with a humanoid and might look at its eye quiet often, but not at a human eye. Humanoid eyes should be therefore perfectly humanized, to promote the recovery of the condition through near-natural eye contacts. Engineers therefore should collaborate with their colleagues' psychologists and



neuroscientists more intensively to figure out the precise continuum of the dynamic of the human eye. Clearly, the biggest challenge for humanoid eyes is to understand the human eye precisely. We are now planning for precise calibration of the aforementioned continuum that allow us to mathematically model the humanoid eyes. Engineers can afterwards implement the aforementioned algorithmic continuum which will assist the humanity to move towards better consciousness machines, (see reference 13). We had proposed the aforementioned 'four dimensions' continuum to have certain degree of motivation to achieve proper analysis of these four spatiotemporal eye dynamics along with their corresponding neural activities (as responses to various perceptual and multisensory stimuli along with their corresponding decisions and possible actions). These analyses of the aforementioned continuum may additionally but not eventually allow us to partially read the neural activities of the brain. Detailly speaking, inverse operation can achieve the aforementioned mission after careful matching of the 'eye continuum' with its corresponding cortical and subcortical neural activities. Operation that requires simultaneous data collection through various brain imaging techniques, and eye trackers; data which are triggered by different external stimuli for finetuning purposes. Ultimately, we hope to gather additional evidences to confidentially say; the eye may be considered as a visible brain. Until several fine-tuned psychophysical experiments are achieved, our thoughts still have sensible credibility, by reviewing the current available literature. Eventually, we hope to say it confidentially, the eye might be exhibited as the most valuable visible organ for socialization. Needless to mention, however, neuroscientists, after having the aforementioned computational model, might be able to read the human brain with cheaper tools; namely, by eye trackers or professional cameras, which is not only assumed to ease cheaper research, but to flourish the entertainment industry, reaching to this level will allow us to invent the best humanoid eyes! Inside the humanoid eyes, however, the retina should be also humanized, and this suggestion might not only ease the central computations of the humanoid vision, but it may outstandingly improve the quality of humanoid "wide-angle" cameras. Cameras that receive timely copied signals of the dynamics of the human-user eyes by specialized eye tracker installed in the other side & exactly follow them. Important to mention, the densities, and the processing units' characteristics of the photoresistors 'the pixels', the lens and its hole of the current advanced cameras do not respect neither the anatomy nor the physiology of the human retina, namely, the photo-resisters' board is neither curved, nor as wide as the retina is; the lens is not flexible to accommodate/disaccommodate the external images; and there is very limited dynamics between the lens' hole (the artificial pupil) and the lens itself. Humanoid "wide-angle" cameras might be revolutionary not only to humanoids but to the portable devices, eventually, the net results could be an inception towards 'natural conscious images'. Humanoid "wide-angle" cameras might be achieved by implementing an extremely high density of RGB photoresistors in a very small area in the central 'photoresistors -curved-board'; approximately 14% of the total area of the board (the relative size of the macula compared to the entire retina in human); whereas the photoresistors must be connected to high-end processing units for optimal output; in order to mimic the delayed processed high-quality outputs of the human central retina. In the peripheral areas of the photoresistors board, however, RGB photoresistors should be way lesser dense; co-exist with high density of grayscale photoresistors and attached to fast processing units. The aforementioned cameras should also consider flexible lens, and more importantly, the dynamics between pupil and lens, see reference, 8. Eventually, this should result in changing the present industry of the cellphones' cameras, namely, we expect not to see several cameras installed, but one humanoid camera instead.

Essential Notification

Scholars with facilitations to high density EEG machines, professional eye trackers; or who are interested in further details of the humanoid retina are welcome to collaborate. Enquiries should be sent to the author.

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