IIIT-DELHI

INDEPENDENT PROJECT SUMMER-2023

THE UNCANNY VALLEY EFFECT

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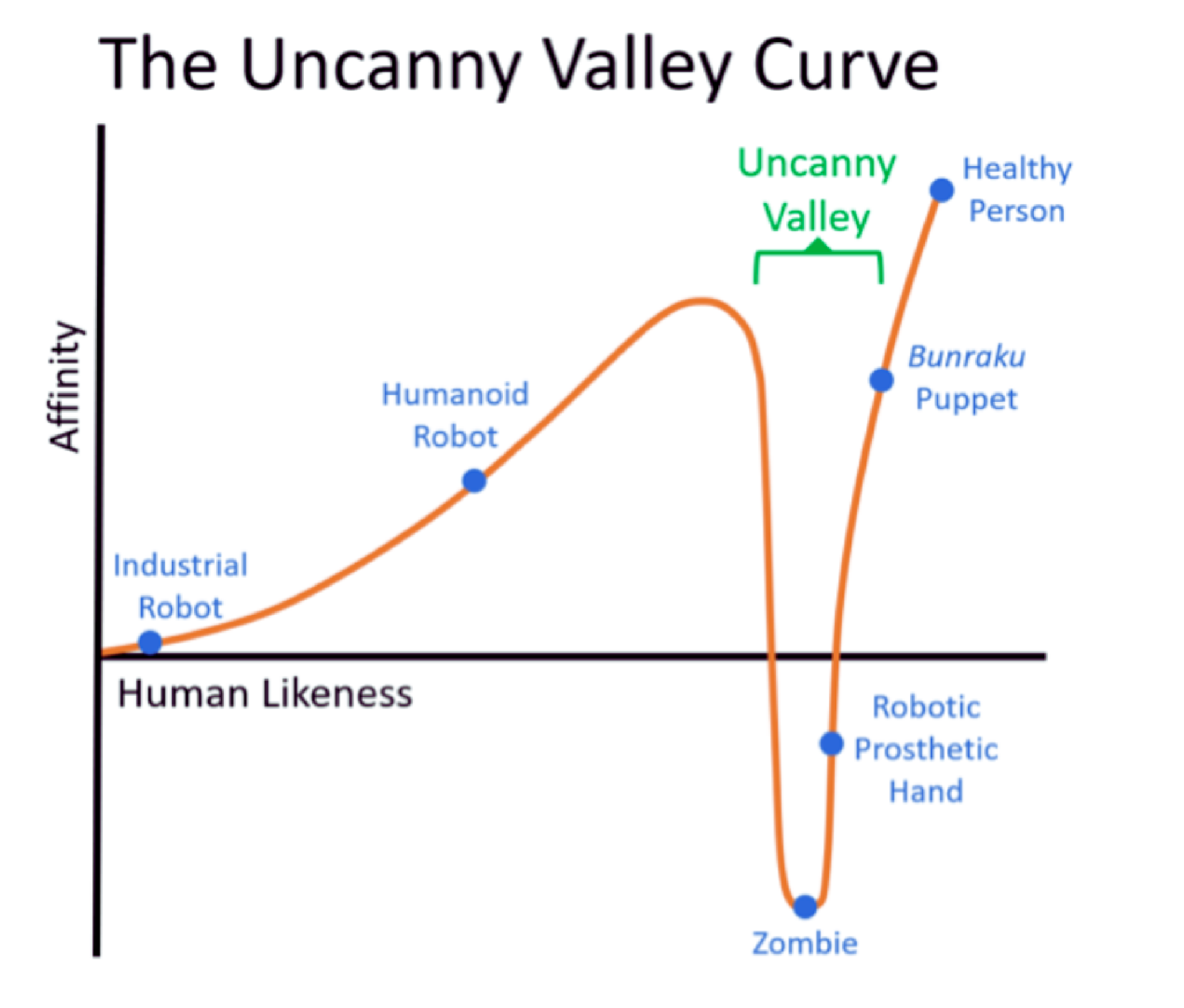
INTRODUCTION

The Uncanny Valley effect is a strange feeling we get when we see something that looks almost human but not quite. For example, robots or digital avatars that almost look like real people can make us feel uneasy or creeped out. It's like they are close to being human, but there's something a little off that makes us uncomfortable. The more they resemble humans, the stronger this strange feeling becomes.



OUR RESEARCH

- Previous researches showed that human-like objects that fall in the middle of the scale between mechanical and human-like appearances are more likely to make people feel uncomfortable (Uncanny Valley effect).

- Our research looks at how people pay visual attention to different parts of the face in human, robot, and human-like images by using gaze fixation density to measure.

- To quantitatively understand the eeriness evoked by human and mechanical faces by letting participants rate the faces.

- To understand if the participants find it difficult to categorize the human-like image as either robotic or human because in the process how does the gaze distribution change.

METHODOLOGY

PARTICIPANTS & TOOLS

- The experiment involved 26 students who had no prior knowledge of the research topic and objectives. None of them had any ocular, mental or neural problems. Before starting the experiment, all participants gave their consent by signing an approved statement from the institute ethics committee.

- In our study, we employed Eye Tracking technology to capture participants' behavioral responses to the images. Specifically, we utilized Pupil Core, a product developed by Pupil Labs, for conducting the experiments.

- We have used PsychoPy (an open source software) to present the visual stimuli, in conjunction with eye-tracking device, allowing us to incorporate eye movement data into our research.

STIMULI AND PROCEDURE

- The visual stimuli data are from online repositories and made modifications to align with our experimental objectives. The visual data fall into three categories: Human, Mechano-Human and Robotic.

- Each image inside every category have three variants : High Spatial Frequency Image, Low Spatial Frequency Image, Broad Spatial Frequency Image.

- Participants took part in four experiments to evaluate the Likeability and Mechano-Humanness of human and mechanical stimuli. Before starting the experiments, participants received clear guidance and underwent Eye Tracker calibration.

- During each trial, a fixation point ('+' sign) appeared at the screen's center for 1000 ms, followed by the stimulus displayed for 1000 ms. Subsequently, participants used a slider to rate the Mechano-Humanness score (ranging from 0 to 100) representing the degree of mechanical or human characteristics of the stimuli, from "Least" to "Most" and they also rated the likeability (ranging from -100 to 100) of each stimulus, indicating how much likable the image is to the participant. (-100 being least likable and 100 for most likeable).

ANALYSIS

The gaze data of participants were collected by doing 4 sessions of stimuli presentation per participants, the sessions were namely:

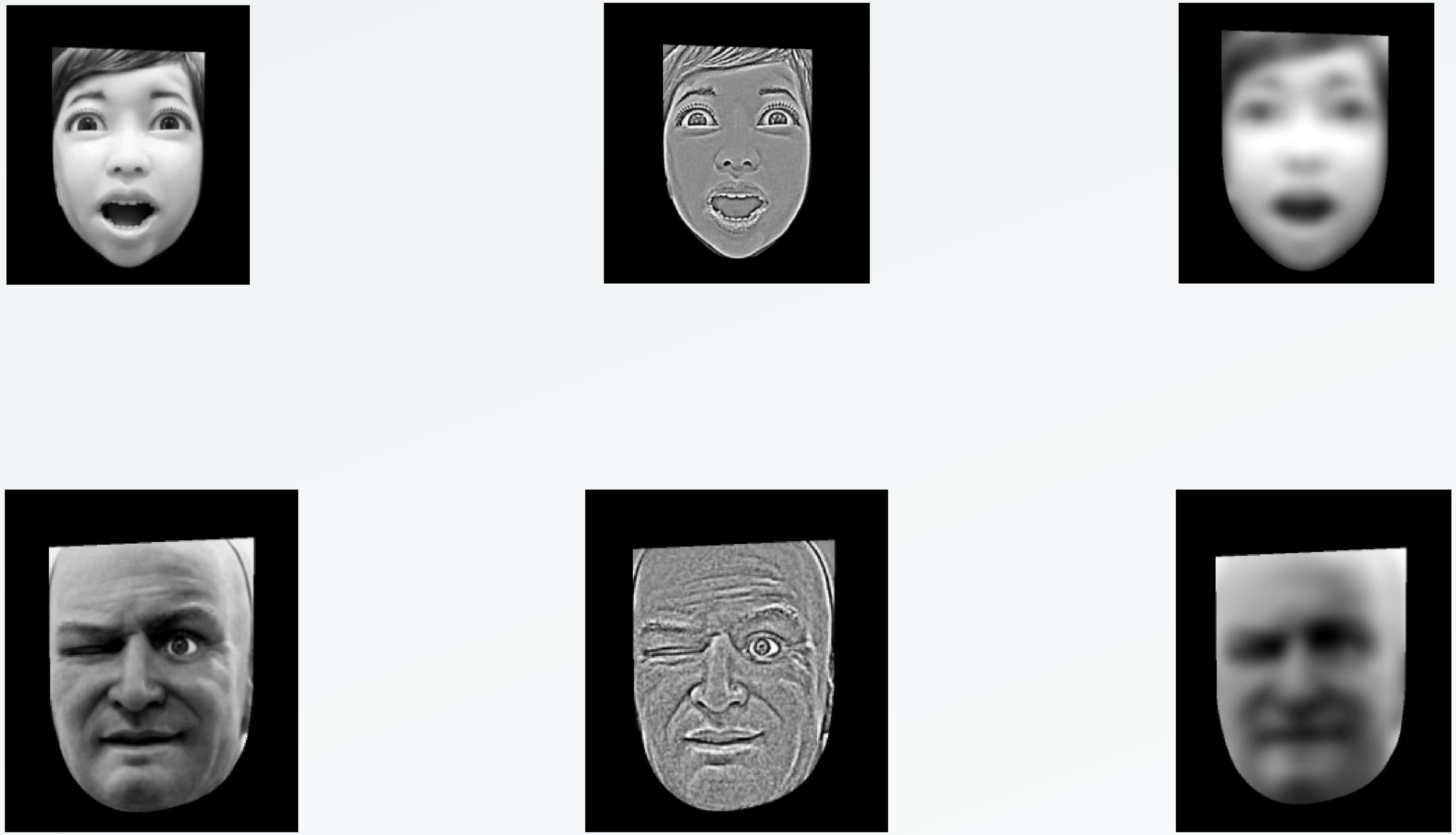
- Human Likeability
- Human Mechano-humanness
- Robot Likeability
- Robot Mechano-humanness

Each session presented visual stimuli belonging to HSF,LSF and BSF..
The collected gaze data for a particular participant was stored in CSV file, where gaze coordinates throughout the presentation of an image was stored against the image name.

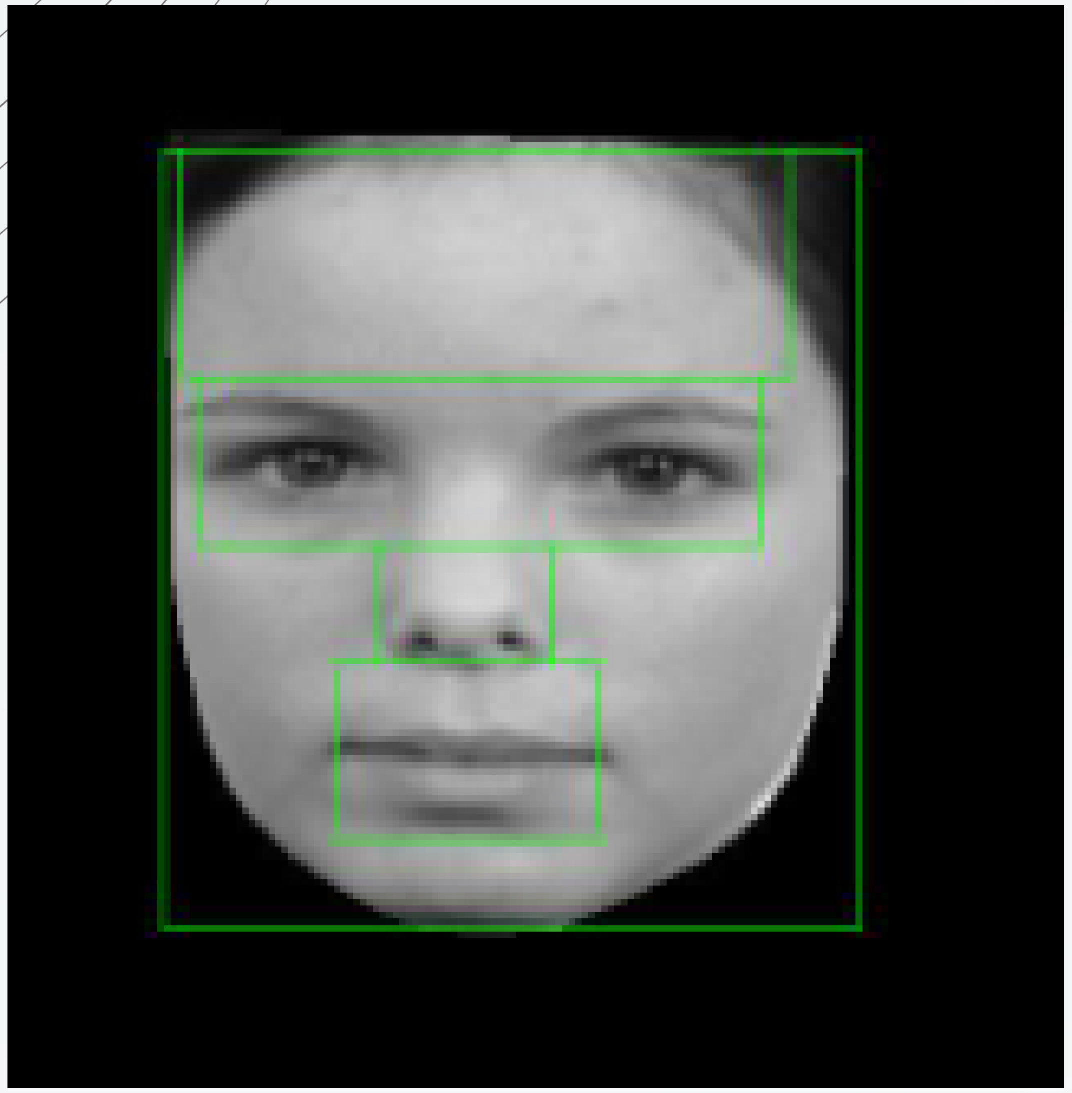
Finally, we combined the gaze data across all the participants for each image and scatter plotted them on the respective image.

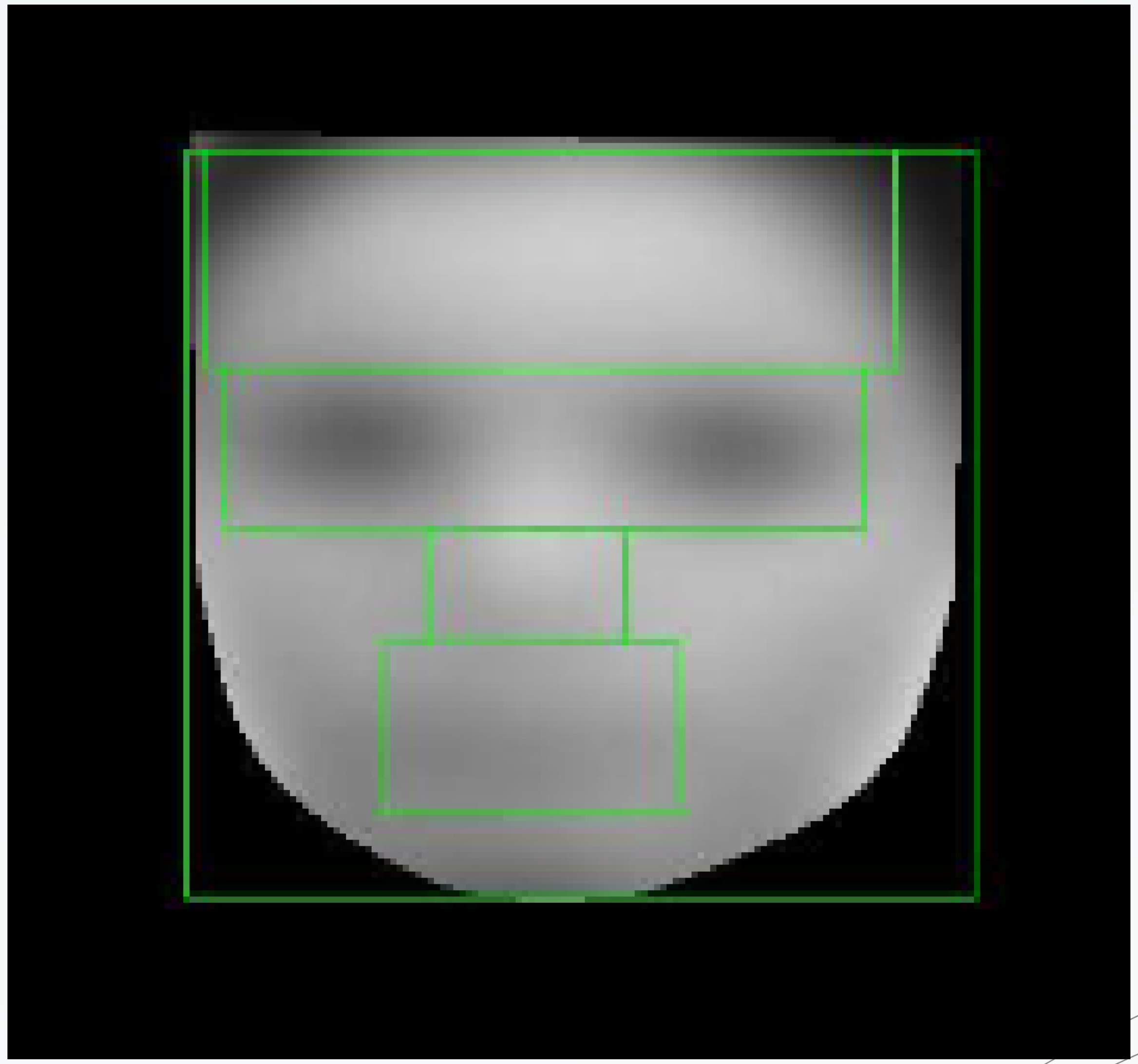
Using DLIB library in Python we were able to filter out the facial region (Fig 1) of human and humanoid images, scatter plots falling outside of this facial region were neglected.

Images of filtered facial region of a human image



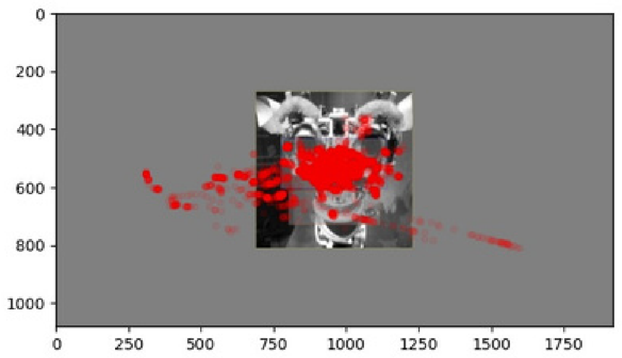
Images of filtered facial region of a humanoid image

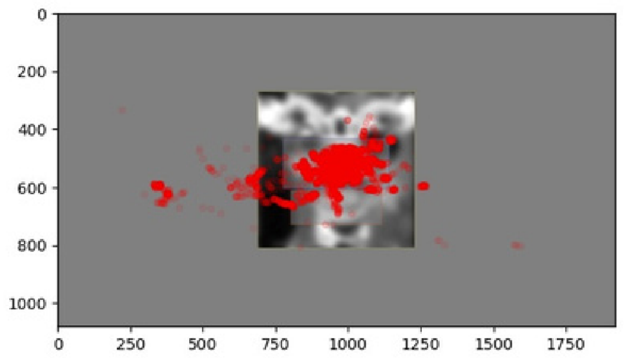


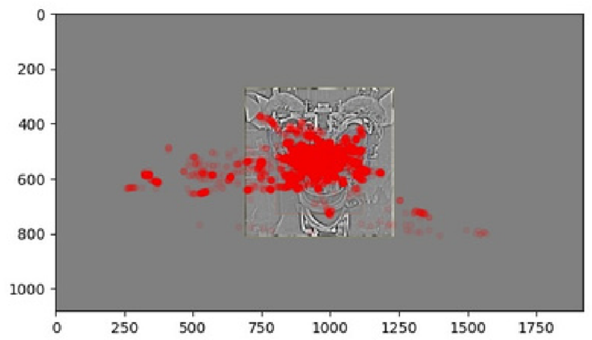


Creating Region of Interest for Forehead, Eyes, Nose & Mouth in human image

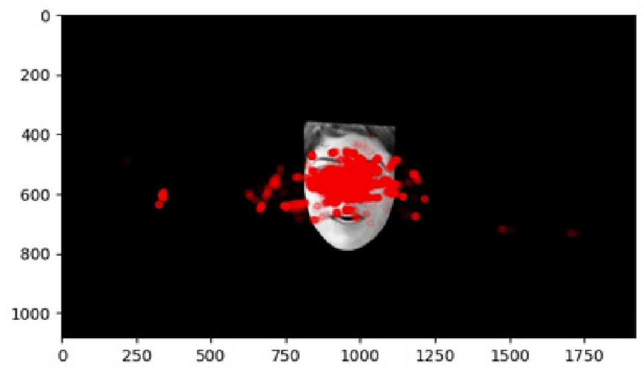
Creating Region of Interest for Forehead, Eyes, Nose & Mouth in humanoid image

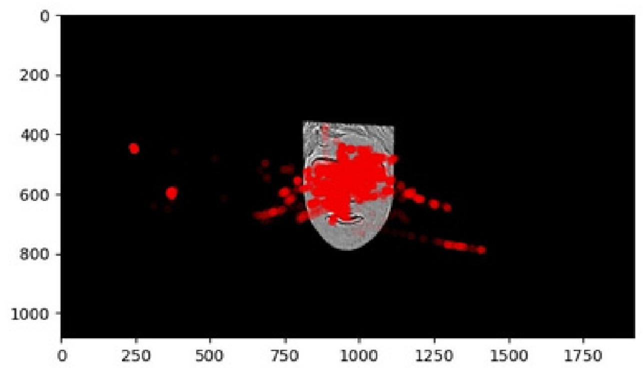


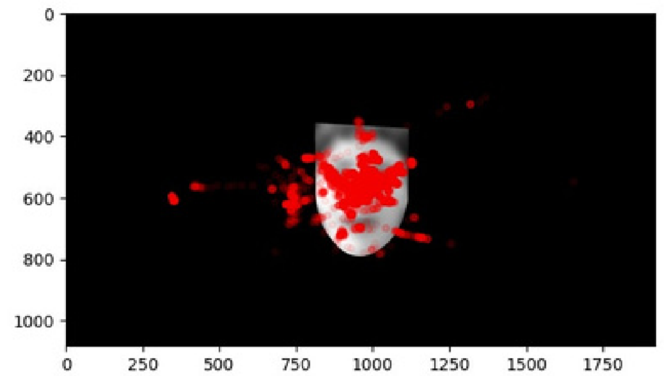




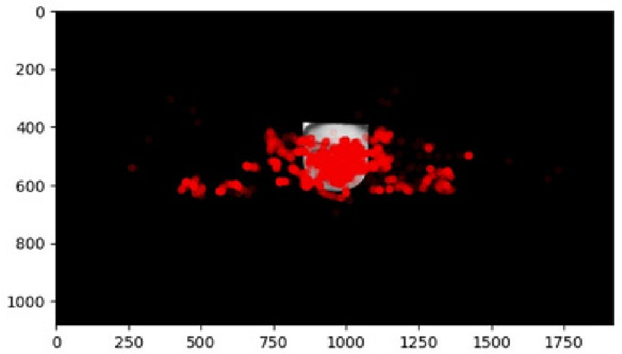
Robot gaze plots

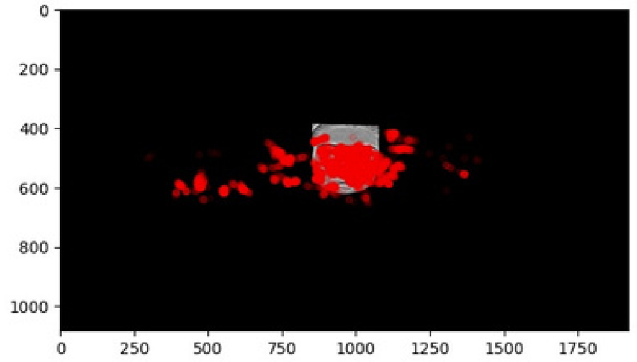


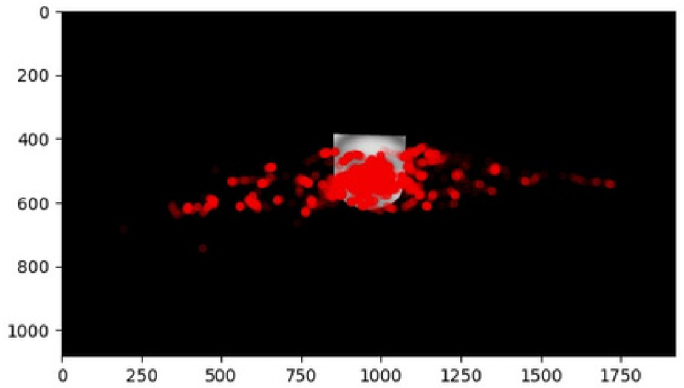




Humanoid gaze plots







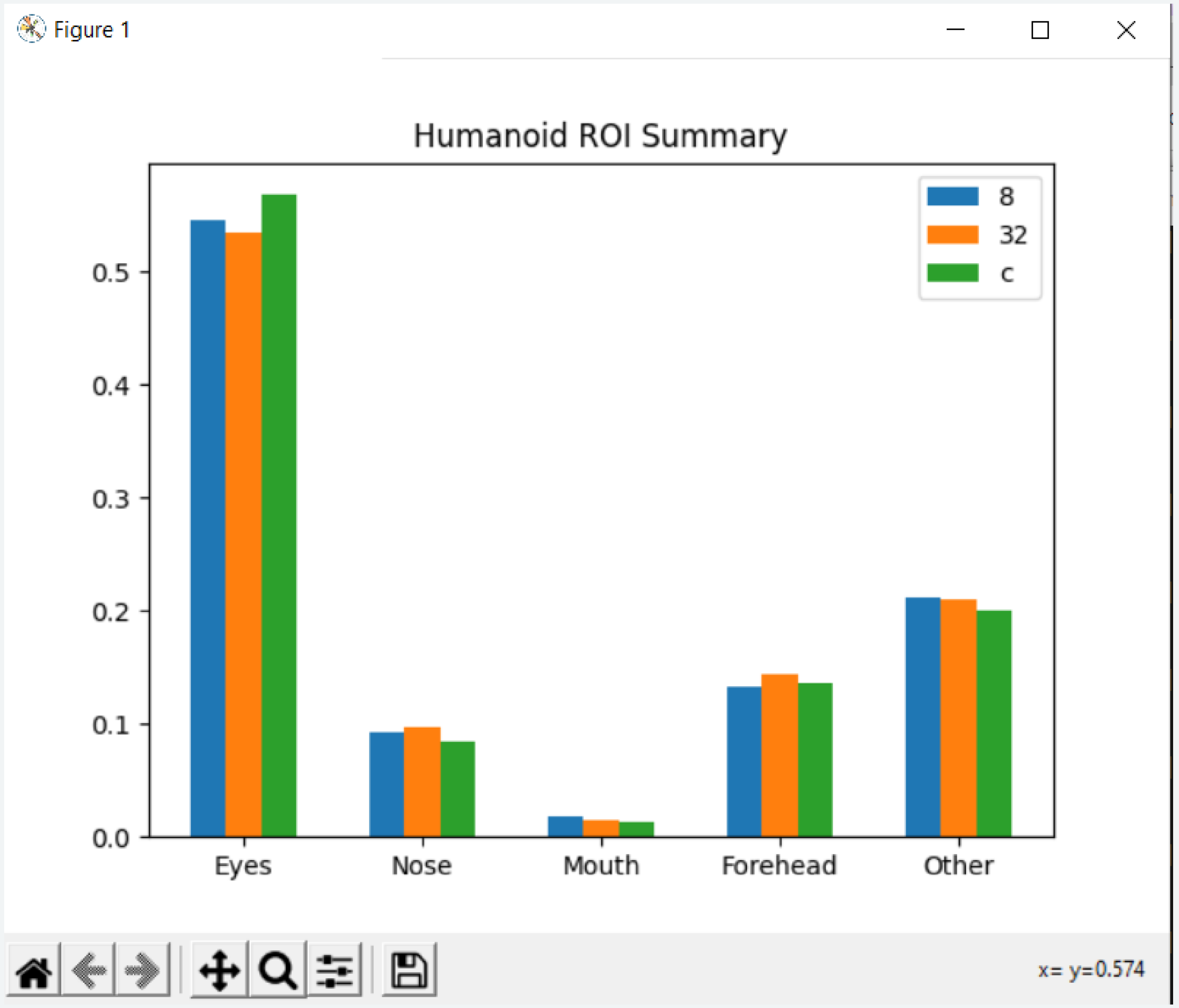
Human gaze plots

RESULTS

HUMANOID ROI SUMMARY

The plot shows averaged count of gaze lying in the eyes, nose, mouth, forehead and other regions respectively of humanoid images.

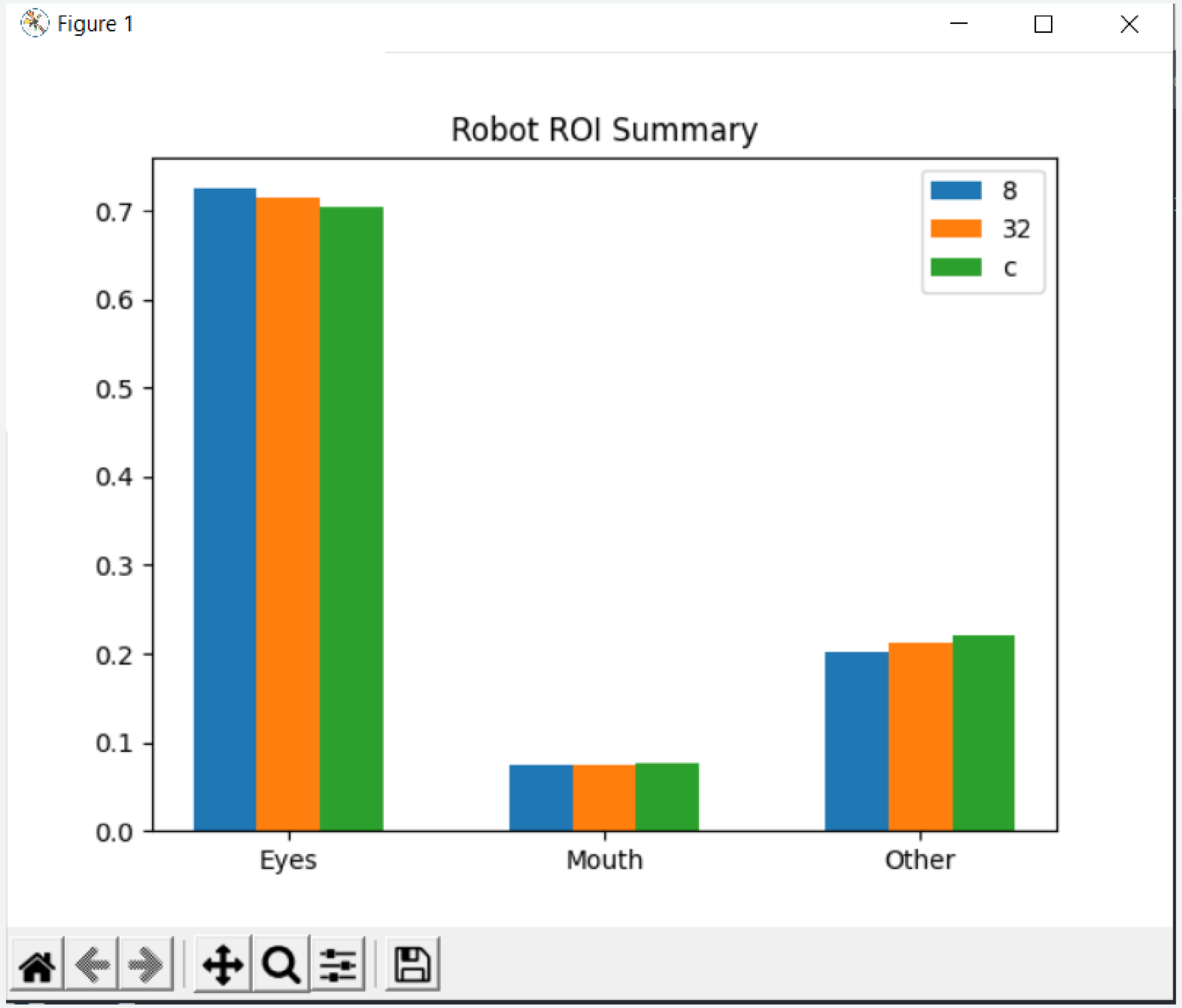
From the plot we can see that eye is the most gazed region followed by forehead among the ROIs (excluding "others").



ROBOT ROI SUMMARY

The plot shows averaged count of gaze lying in the eyes, mouth and other regions respectively of robot images.

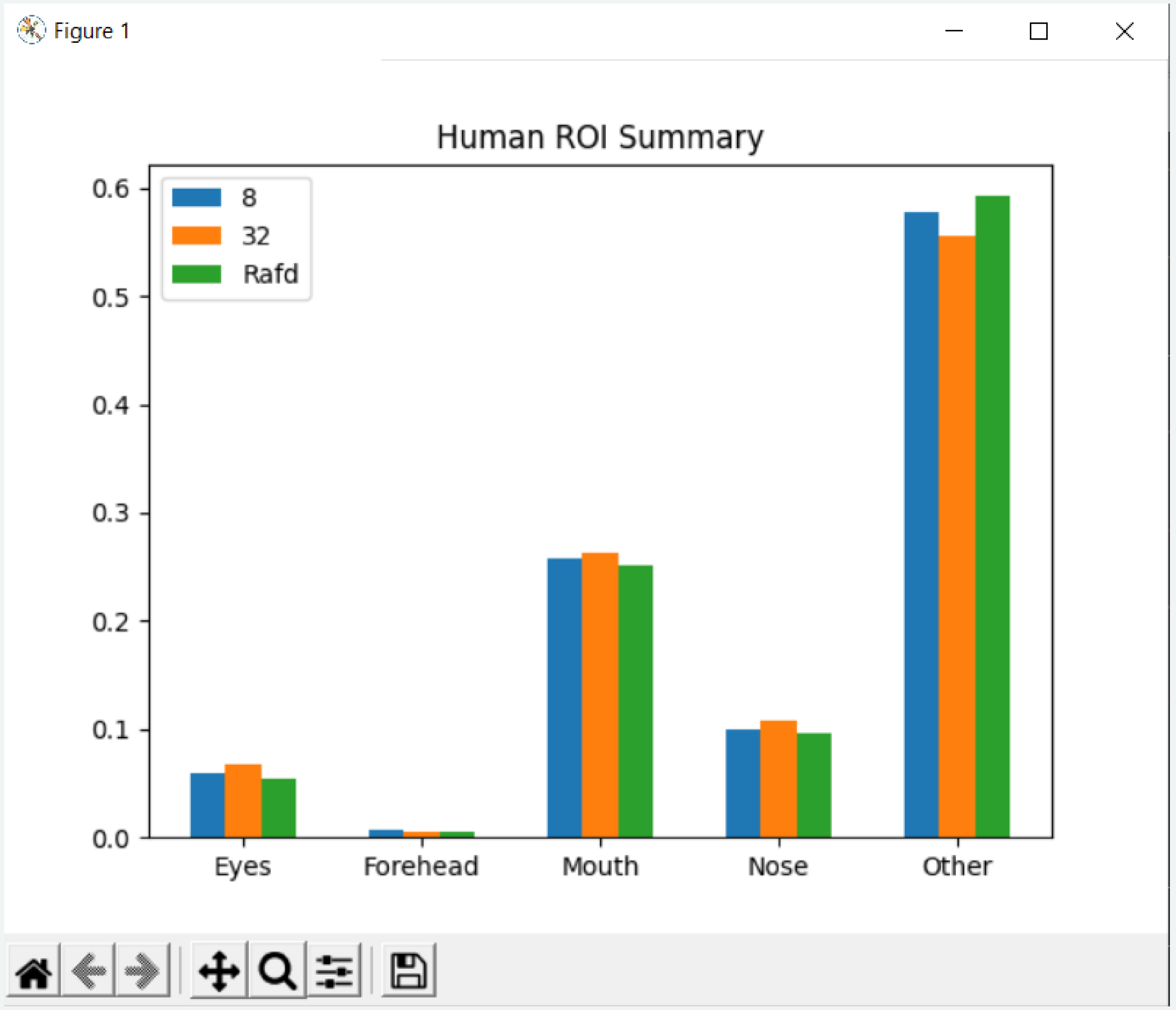
From the plot we can see that eye is the most gazed region.



HUMAN ROI SUMMARY

The plot shows averaged count of gaze lying in the eyes, nose, mouth, forehead and other regions respectively of human images.

From the plot we can see that maximum gaze concentration has been on the "other" followed by the mouth region.



DISCUSSION

From the plots, we observed that participants gazed more at the eyes and forehead region for humanoids among the ROIs(excluding "others"). In robots, gaze at eye region was very dominant as compared to mouth and other regions. And in case of humans, among the defined ROIs the mouth region exhibited highest gaze distribution followed by nose and then eyes.
This suggests that in determining the likeability and mechano-humanness of human-like stimuli, facial features play a very important role.

CONCLUSION

From the experiment we found that the eyes were the focal point of attention, suggesting a fundamental human tendency to connect with the 'humanity' in any entity, even in case of non-human ones. Interestingly, the forehead also received considerable gaze among humanoids, possibly indicating that participants were attempting to determine the intrinisic emotions or intent, further reinforcing the notion that humans instinctively seek familiar emotional cues in all beings they encounter.

The high density of gaze in "Other" region followed by mouth region in human images might be because the participant is not affected by the uncanny valley effect and is more interested in focusing on other regions so as to rate the image based on likability and mechano-humanness.

The findings offer compelling evidence for the importance of visual perception and its impact on how we interact and interpret the world around us.

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