CHARACTERIZING THE DESIGN SPACE OF RENDERED ROBOT FACES

ALISA KALEGINA, GRACE SCHROEDER, AIDAN ALLCHIN, KEARA BERLIN, MAYA CAKMAK

HRI2018

工学院　応用物理学専攻
26193030 法花翼

INTRO

- 人間にとって顔というものは重要。
- 最近は画面上に顔をレンダリングするロボットが普及。
  （タブレットの汎用・低コスト・表現の柔軟性）
- レンダリングされた顔をもつロボットの普及に対して、顔の目的別に適したバリエーションの研究は進んでいない

ロボットの顔に対して人々がどのように思うかを研究する

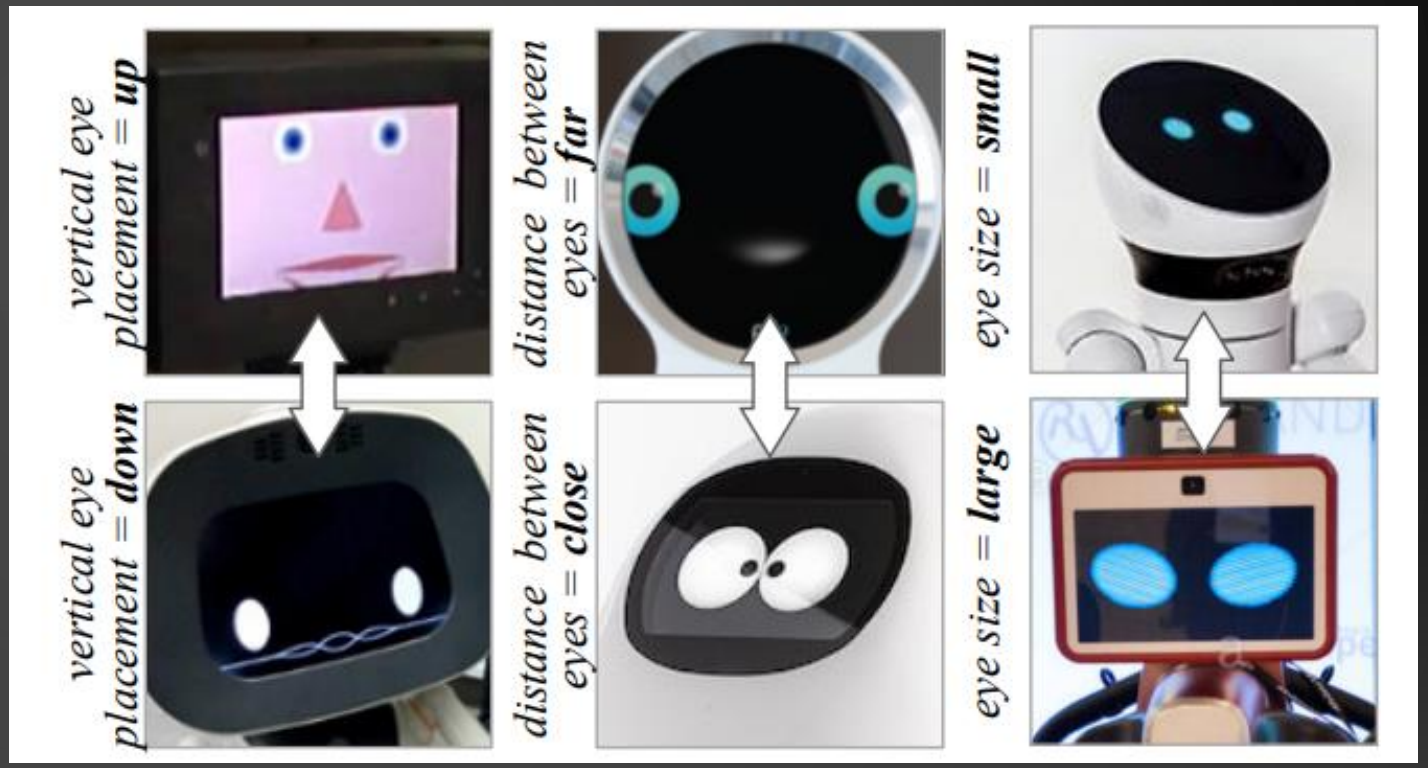
3つの実験

- ランダムに選んだ157のロボットの顔のパーツを76の項目について評価する実験
- 12個のロボットサンプルからどんな印象を受け、どんな仕事に向いているかをアンケートで調査する実験
- あるロボットに17種類の表情をさせて、それぞれからどんな印象を受け、どんな仕事に向いてるかをアンケートで調査する実験

実験１．　顔の寸法

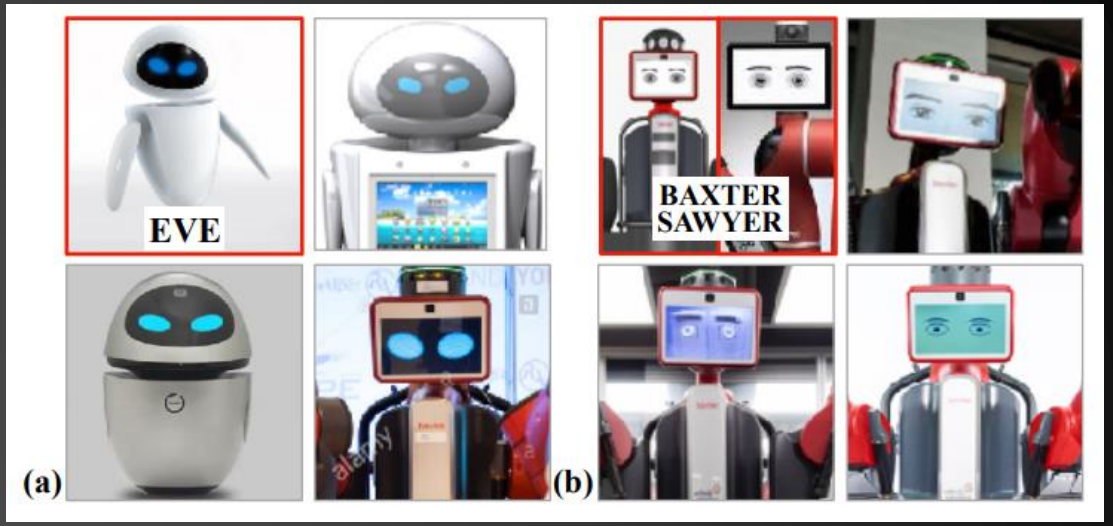
- “robots with screens,” “robot screen faces,” “touchscreen robot,” “smartphone robot,” “telepresence robot.” で画像検索しサンプリング。
- データセット内のすべての顔は、76次元にわたってコーディングされる。

検索



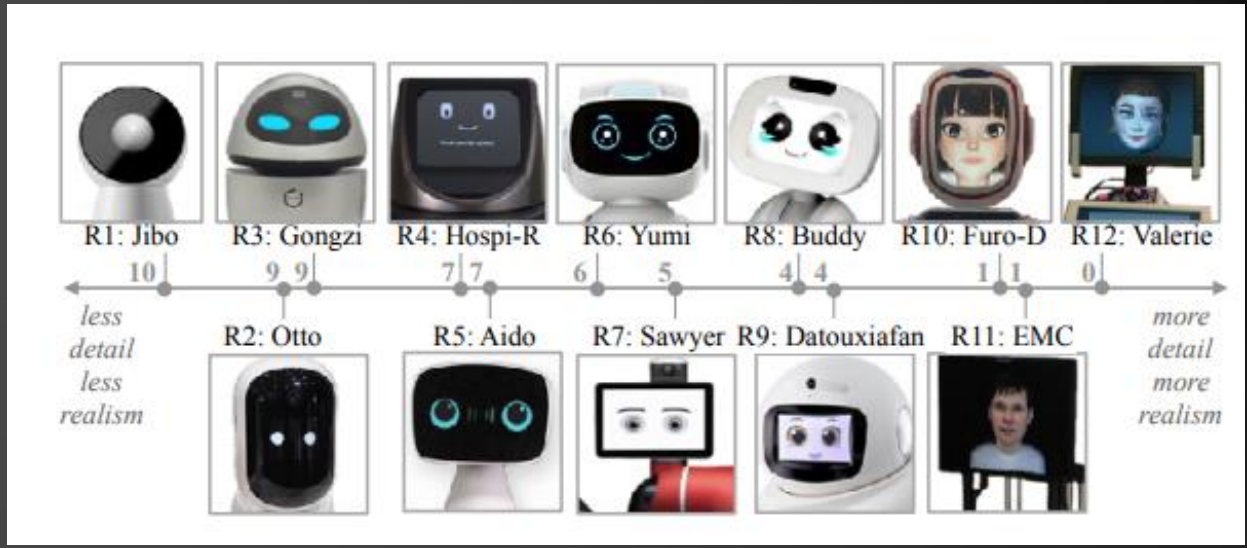
実験１.結果

- それぞれ**EVE**・**BAXTER SAWYER** に似た特徴
- ユニークな特徴

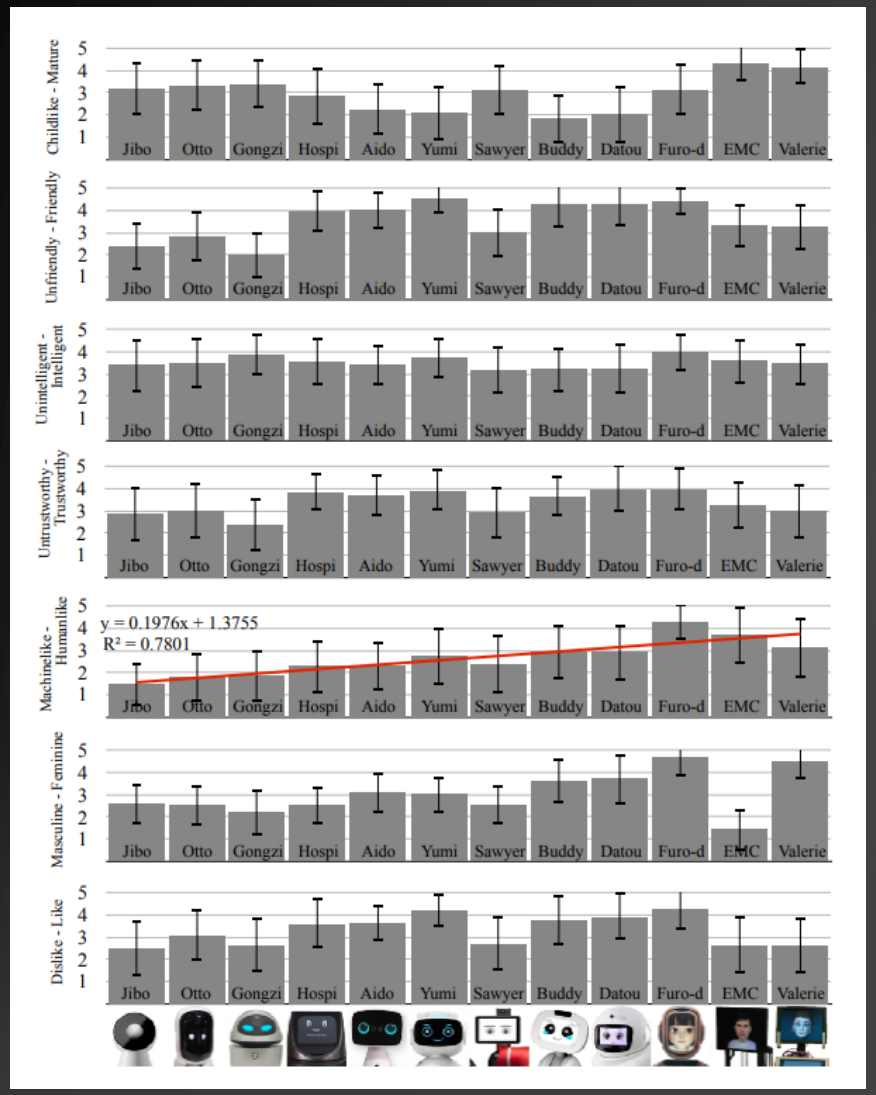


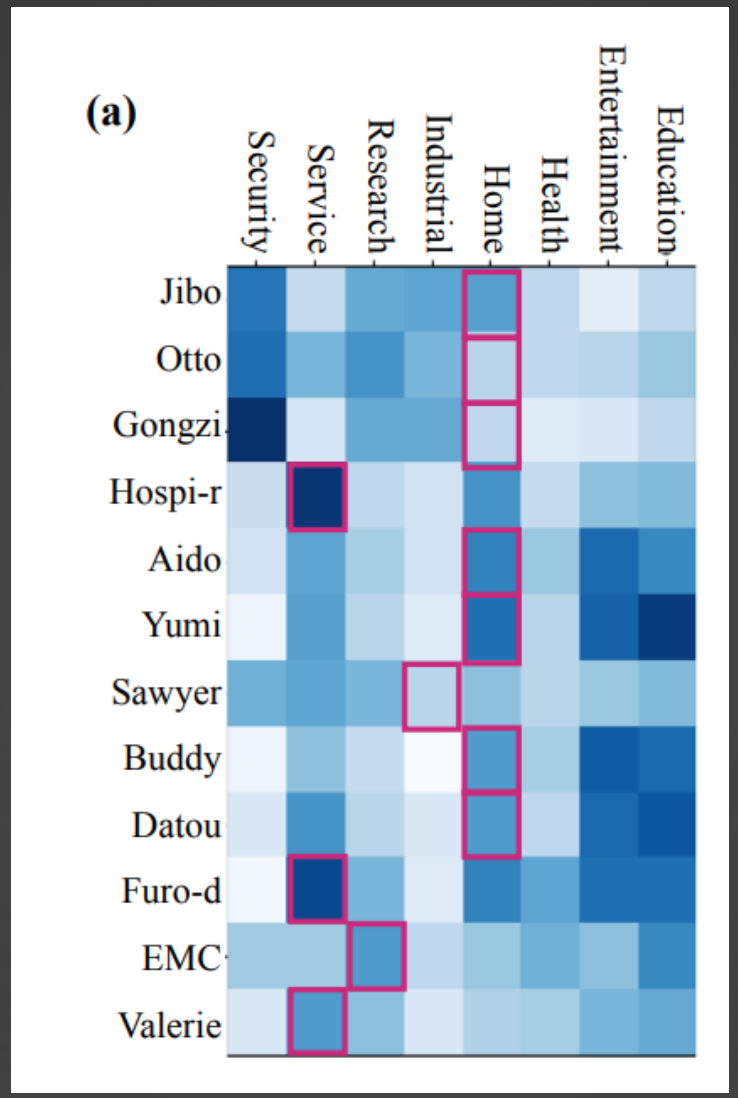
実験2. ロボット別表情、職種

- 右の12サンプルを選択。
- 以下の6項目5ポイントの評価を依頼した。
- 機械的or人間的、友好的or非友好的、知的or非知的、信頼できるor信頼できない、子供っぽいor大人っぽい、男性的or女性的
- 気に入ったかどうかを5段階評価、短い名前をつけよ、最適なジョブは？（選択性）
- 参加者ごと顔の順番がランダム（公平性）



実験２．結果

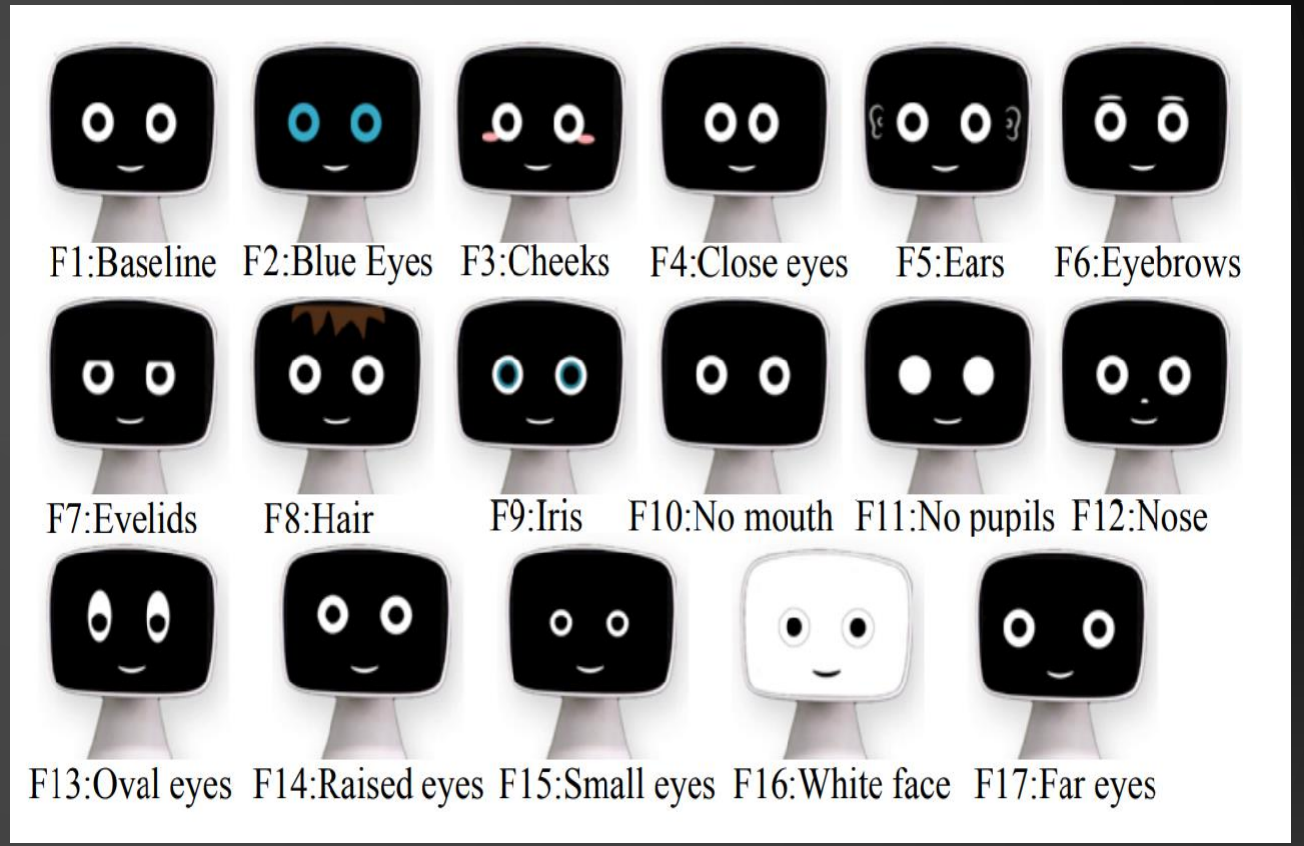




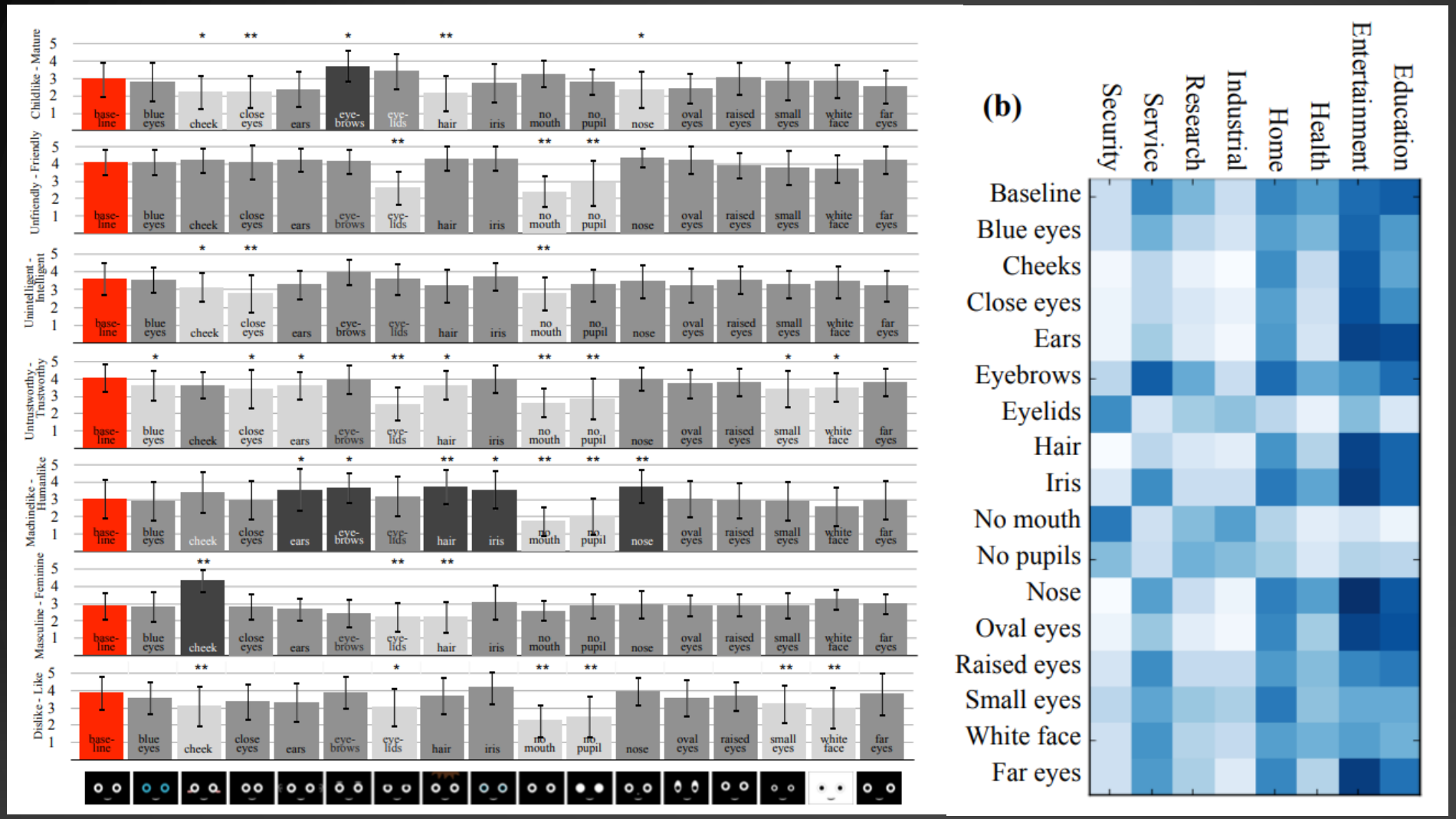
- 親しみやすさ、子供っぽさ→教育
- 娯楽≒教育
- 非友好的→警備

実験３．表情×職種

- 以下の6項目5ポイントの評価を依頼した。
- 機械的or人間的、友好的or非友好的、知的or非知的、信頼できるor信頼できない、子供っぽいor大人っぽい、男性的or女性的
- 気に入ったかどうかを5段階評価、短い名前をつけよ、最適なジョブは？（選択性）
- 参加者ごと顔の順番がランダム（公平性）



実験3.　結果


Childlike - Mature
Unfriendly - Friendly
Unintelligent - Intelligent
Untrustworthy - Trustworthy
Machinelike - Humanlike
Masculine - Feminine
Dislike - Like
base-line
blue eyes
cheek
close eyes
ears
eye-brows
eye-lids
hair
iris
no mouth
no pupil
nose
oval eyes
raised eyes
small eyes
white face
far eyes

(b)
Security
Service
Research
Industrial
Home
Health
Entertainment
Education
Baseline
Blue eyes
Cheeks
Close eyes
Ears
Eyebrows
Eyelids
Hair
Iris
No mouth
No pupils
Nose
Oval eyes
Raised eyes
Small eyes
White face
Far eyes

DISCUSSION

- 瞳孔・口がない→非友好的、機械的、好意的→警備
- ピンク色または漫画風の頬→女風
- 漫画風の頬、リアリティの低い→子供のよう・友好的→娯楽、教育
- 笑顔の形の口→娯楽、教育

まとめ

- 76項目の顔の特徴
- ロボットの顔のセット
- ロボットのここの顔の特徴

の３つに関して、ロボットの顔の人々の印象を特徴付けることができた。

Publication

HCI lab　Hayato Kurosawa

Paper

- Title: Can a Humanoid Robot Engage in Heartwarming Interaction Service at a Hotel?

- Authors: Junya Nakanishi, Itaru Kuramoto, Jun Baba, Ogawa Kohei,Yuichiro Yoshikawa,Hiroshi Ishiguro

Summary

- Today more and more robots are used in the industry. And there is an open question about human-robot social interaction on a heartwarming interaction service.

- The authors mention some research questions about heartwarming interaction of robots and answer them through practical research.

Questions about heartwarming interaction of robots

- Q1 Can interaction with a humanoid robot provide heartwarming experience to a customer at a hotel?
- Q2 Can interaction with a humanoid robot enhance the customer’s satisfaction of the whole service at a hotel?
- Q3 Does an impression of the system differ between single and two robots, male and female customer, or single and group customer?

Questions about heartwarming interaction of robots

- Q4 Is an impression of the system affected by the number of nights, frequency in use of a hotel, or the amount of experience in interaction with a humanoid robot or a voice controlled speaker?

- Q5 Does a customer follow the recommendation from a humanoid robot engaging in a heartwarming interaction service?

About practical research

- The authors made prototype single/double robots system which provide heartwarming service to customer at hotel.
- They gathered participants and executed questionnaire after staying at hotel.
- Then they analyzed that questionnaire and answer above questions.

About robot system

- The system consists of humanoid robot and depth sensor.

- The depth sensor measure distance and moving of customer and the robot react.

Sota
https://www.vstone.co.jp/products/sota/

Comm U
https://www.vstone.co.jp/products/commu/index.html

About questionnaire

- Questions about robot system (“Should the robot be set at a hotel?” or “Did you enjoy interaction with the robot?” etc.)
- Questions about satisfaction of service (“Did feel comfort to your stay?” or “Are you aroused to stay here again?” etc.)
- Question about customer itself (“How often do you use a hotel?” or “How much have you interacted with a humanoid robot?” etc.)

Answer of questions

- Q1 Interaction with robot could provide heartwarming experience to customer. However it couldn’t force customer to feel strong necessity of robot system.

- Q2 Interaction with robot could enhance satisfaction for service.

- Q3 The impression by robot system tend to depend on sex. Female customer tend to feel comfortable than male customer.

Answer of question

- Q4 The impression of robot system tend to be enhanced depending on the how long or how much times customer interact with robot (both positive effect and negative effect).

- Q5 Many customers thought to follow the information received by robot.

Design Strategies for Representing the Divine in Robots

Gabriele Trovato, Cesar Lucho, Alexander Huerta-Mercado, Francisco Cuellar

情報理工学コース ヒューマンコンピュータインタラクション研究室
崔 明根 Choi Myungguen

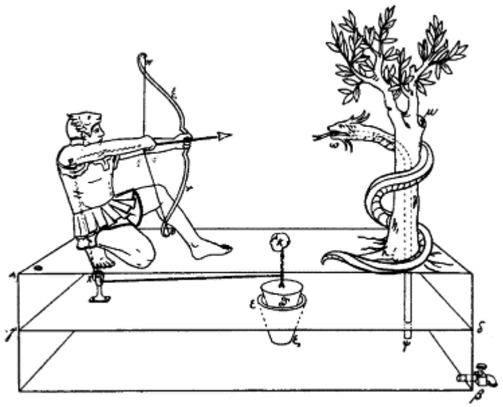
Theomorphic Robots

"*Theo* (Greek god)" + "*morphous* (shape)"

Gabriele Trovato, Francisco Cuellar and Masao Nishimura. 2016. Introducing 'theomorphic robots'. In *Proc .of Humanoids' 16*, 1245-1250.

BACKGROUND

There is a history of intertwinements between automation and religion.



Automaton featuring Hercules and a snake (1st century)

リンゴを持ち上げるとヘラクレスはヘビに向かって矢を放ち，ヘビはそれに応じてシューッという音を立てるオートマトン．

Mechanical monk (16th century)

高さ41cmの機械仕掛けの修道士．様々な動きが可能であり，例としてロザリオに祈り，キスをすることが出来る．

BACKGROUND

The most common **criticism** to the combination of robot and religion.

- The topic of religion is **taboo**
- The topic of religion is too **controversial** to be treated

物議を醸す

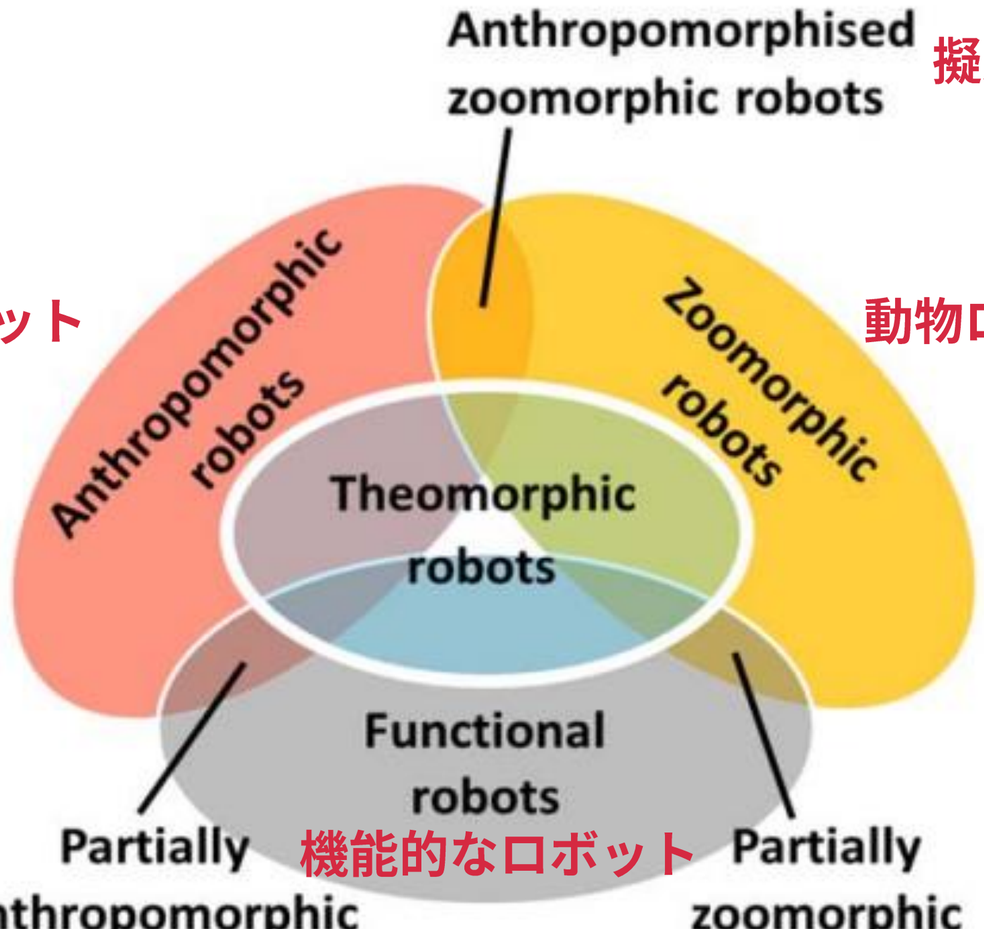
This kind of criticism does not take into account the long history.

BACKGROUND

The **ethical problem** should not be a **burden** for the researchers.

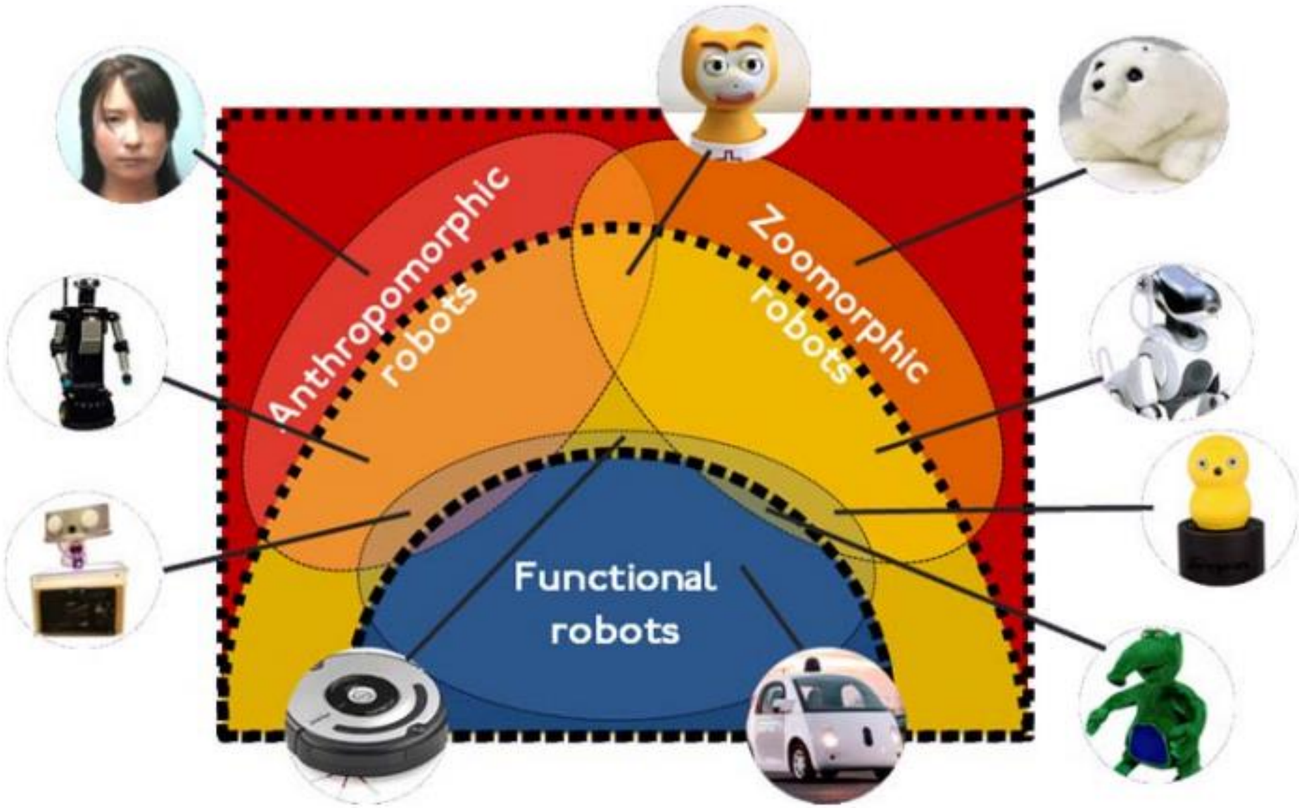
- Because they are not entitled to quibble about theological issues.

CATEGORIZATION



ROBOT-LIKENESS

For theomorphic robots, the space marked in **yellow** (robotic element is revealed) is **less suitable**. [highly subjective]



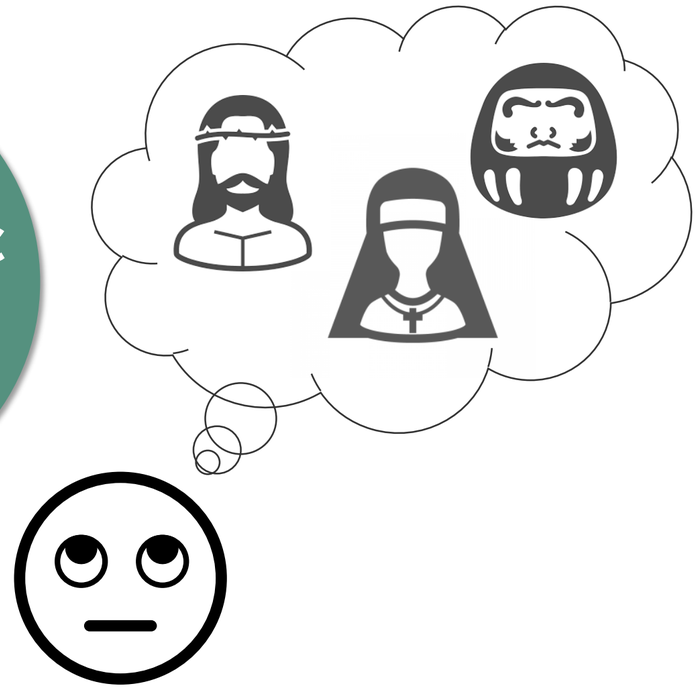
SKEUOMORPHISM

It refers to an object that is designed in a way to retain design inherent to another already existing object.

For theomorphic robots, we cannot help using skeuomorphism.

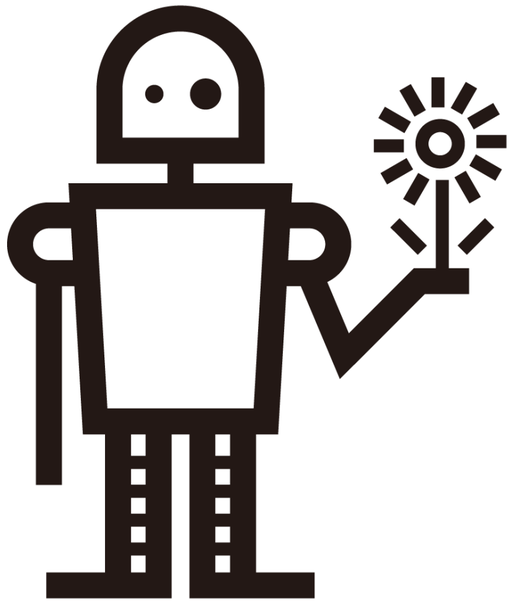
Icon

Theomorphic Robot



DESIGN GUIDELINES

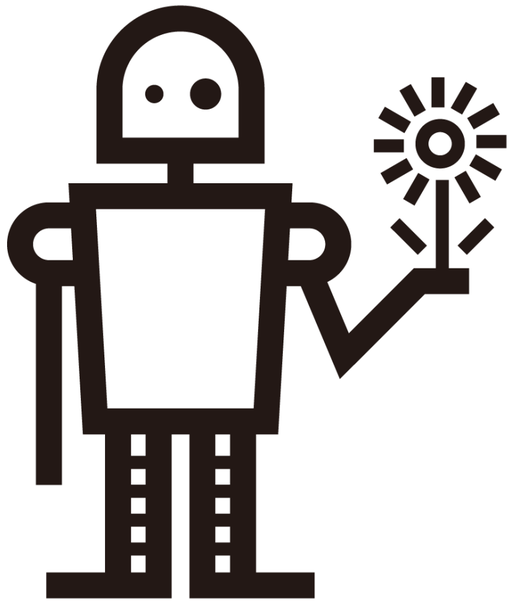
Theomorphic robot's design guidelines



- **Identity issues**
  - Tool on which the divine is projected
  - Sacred object's "enhanced version"
- **Naming issues**
  - The robot name must defined that hides references to the robot.
- **Symbology**
  - Giving protection by physical contact
    加護

DESIGN GUIDELINES

Theomorphic robot's design guidelines



- **Context**
  - Should be placed in a sacred place.
- **Movement**
  - The less movement, the better.
  - Human-like movement makes it feel like a toy.
- **User control**
  - User control should be limited.
- **Use of the light**
  - Communication methods using voice and lights are important

Calibrate My Smile: Robot Learning Its Facial Expressions Through Interactive Play with Humans

DINO ILIĆ, IVANA ŽUŽIĆ , DRAŽEN BRŠČIĆ

UNIVERSITY OF RIJEKA, RIJEKA, CROATIA

46193048

MUKAINAKANO RYO

Introduction

Robots have expressive faces

- Static face
- Actuate parts
- Display

→ How to learn a emotional model

Aisoy

aisoy robotics

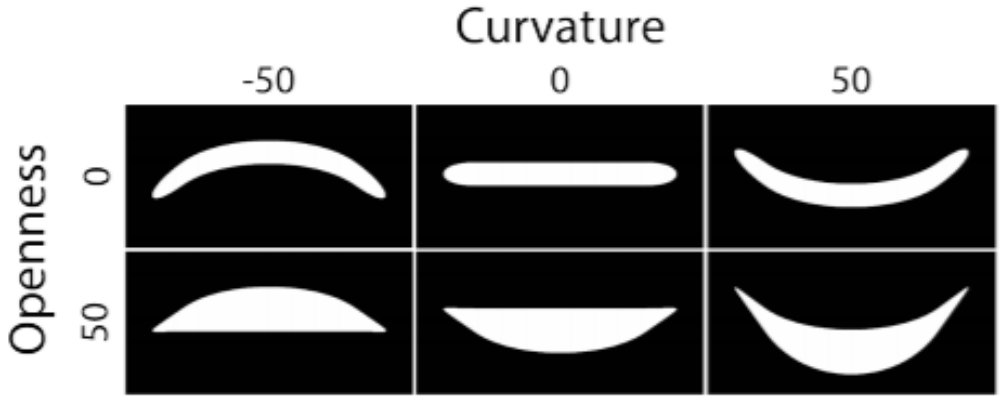
- Les enseñan a **resolver problemas**
- Potencian la relación **entre padres** e **hijos**
- Preparan para **futuros empleos**

Collection data

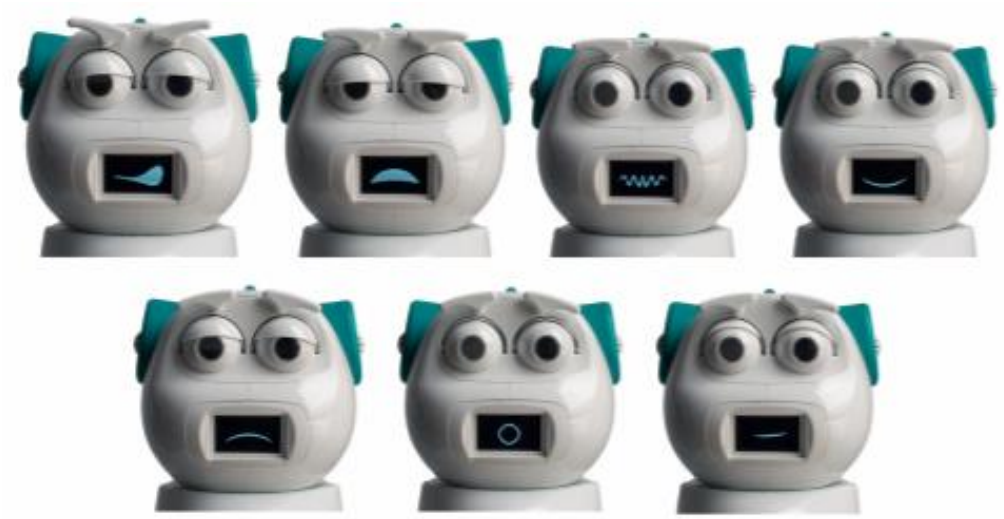
Variable

- Eyebrows
- Eyelids
- Mouth curvature
- Mouth openness

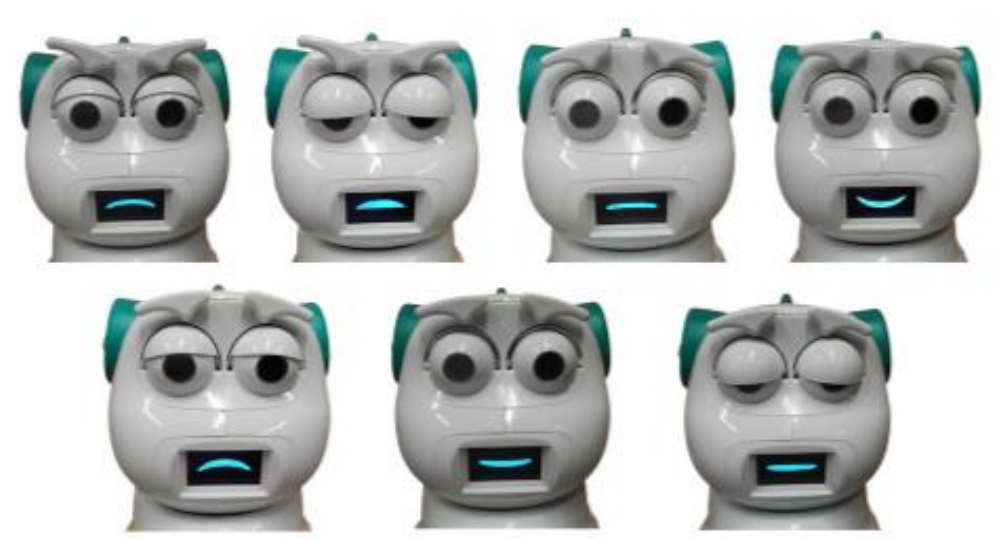
Variable	Description	Possible values
Eyebrows	Slope of Aisoy's eyebrows	{0, 1, . . . , 10, 11}
Eyelids	How open Aisoy's eyelids are	{0, 1, . . . , 10, 11}
Mouth curvature	Curvature of lower lip	{−50, −49, . . . , 49, 50}
Mouth openness	Difference in curvature between upper and lower lip	{0, 1, . . . , 49, 50}



Expressive faces



Default



Learned model

Anger Disgust Fear Happiness

Sadness Surprise Indifference

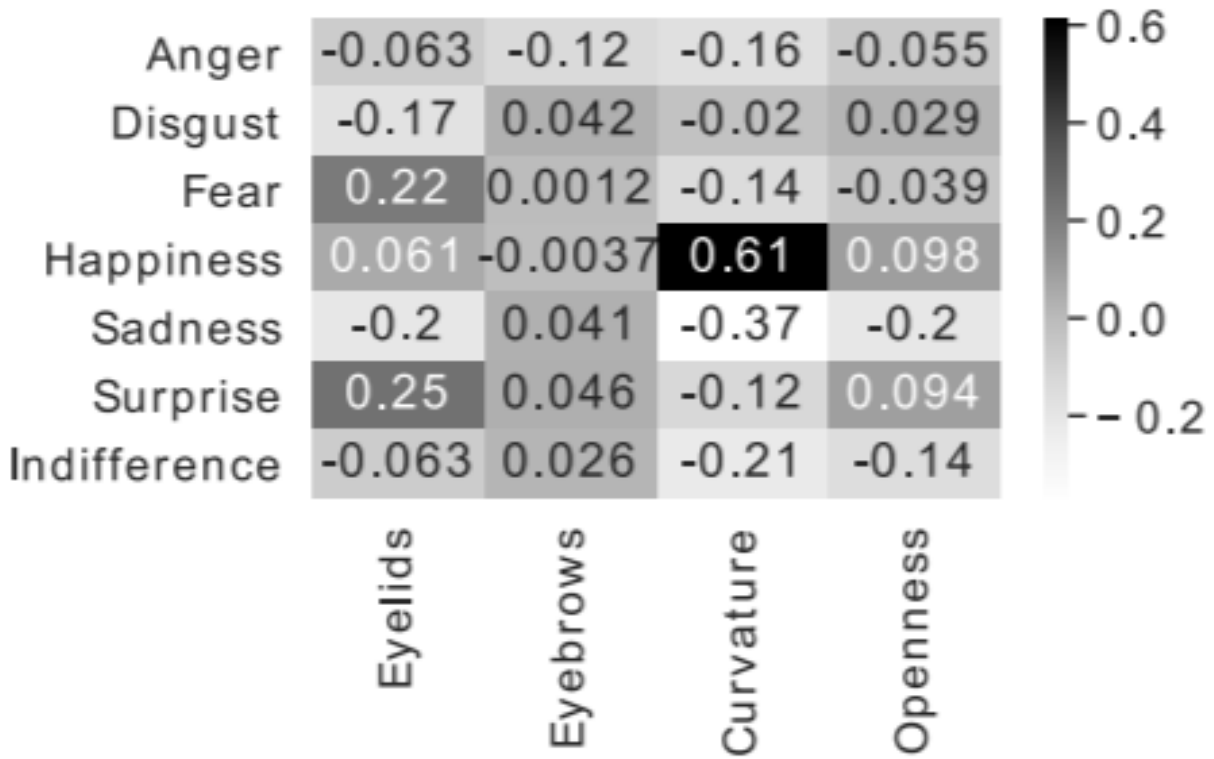
Experiment

imitation game

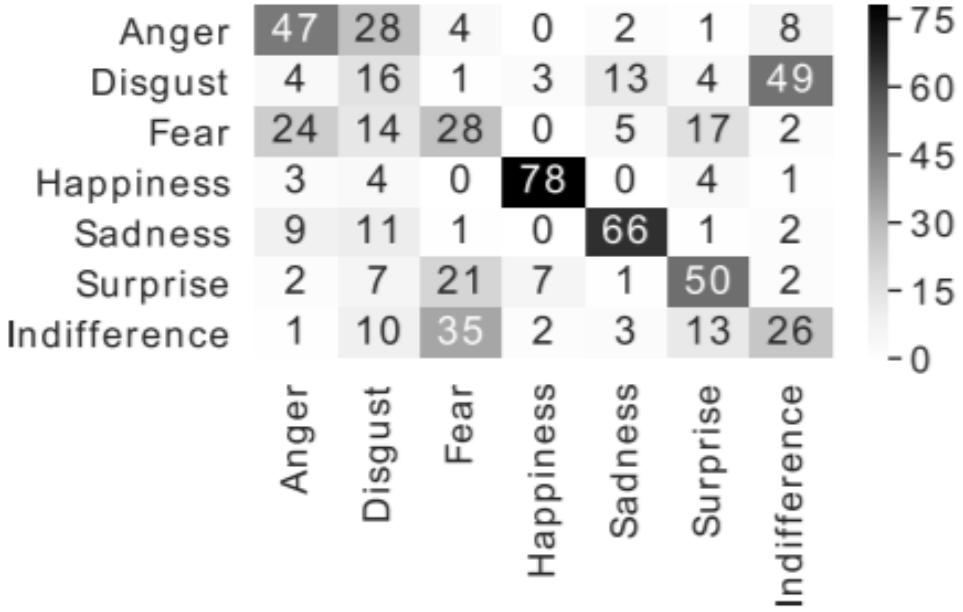
- participants imitate robot
- capturing participants' facial features
- monitor screen which the participants check their own facial expression

Learning model

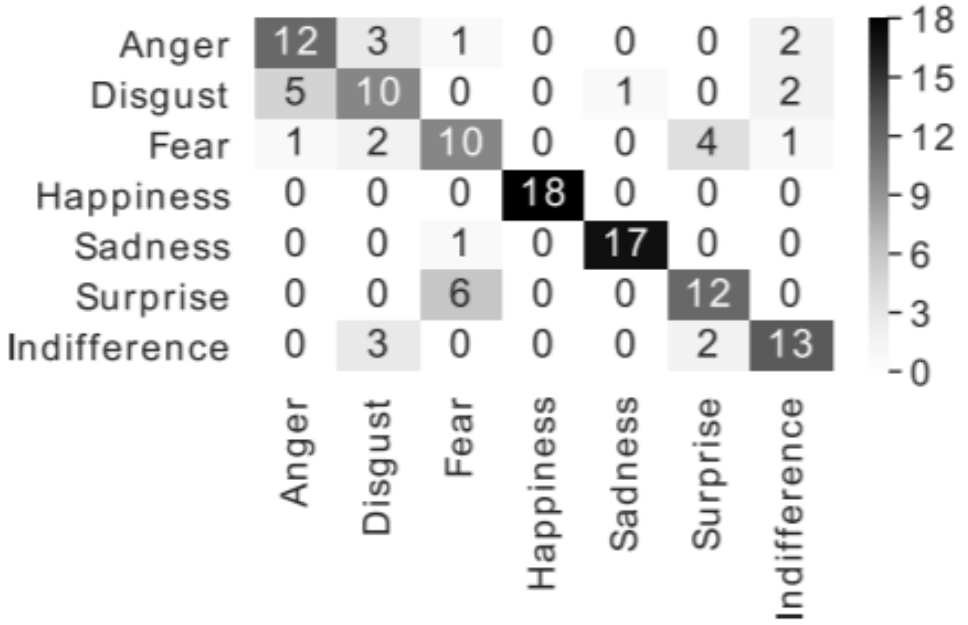
Ten faces for each emotion



Result



Default



Learned model

Conclusion

Happiness and Sadness successfully recognize

Some emotions confused

Only 2 parameters

Different faces for each emotions

Learned model has a low margin

Skill of participants’ imitations

Analyzing Eye Movements in Interview Communication with Virtual Reality Agents

Wang Han
46193130

Process of report

- Introduction
- VR Interview Virtual Agent System Architecture
- Interview Evaluation
- Results of Interview Evaluation
- Conclusion

Introduction

In human-agent interactions, human emotions and gestures ex- pressed when interacting with agents is a high-level personally trait that quantifies human attitudes, intentions, motivations, and behaviors. The virtual reality space provides a chance to interact with virtual agents in a more immersive way.

In the highly competitive globalized economy, it is becoming increasingly important to make accurate assessments during job inter- views. It is still difficult to assess interview performance because of the complicated experimental settings required for the human interviewer

Introduction

This research develops a VR-based interview system using virtual agents and analyzes human eye movements. This would provide insights into human gaze and explore their relationship with interview performance. Empirically, eye contact reveals the effectiveness and delivery of communication and the emotional traits of the interviewee, which play an important role in job interview.

Firstly, a VR headset with an eye-tracking system called FOVE was used to render the interview scene. Secondly, used the Unity 3D engine to build the interview scenario and demonstrated how our system calculates the interviewee's gazed targets by performing collision detection.

VR Interview Virtual Agent System Architecture

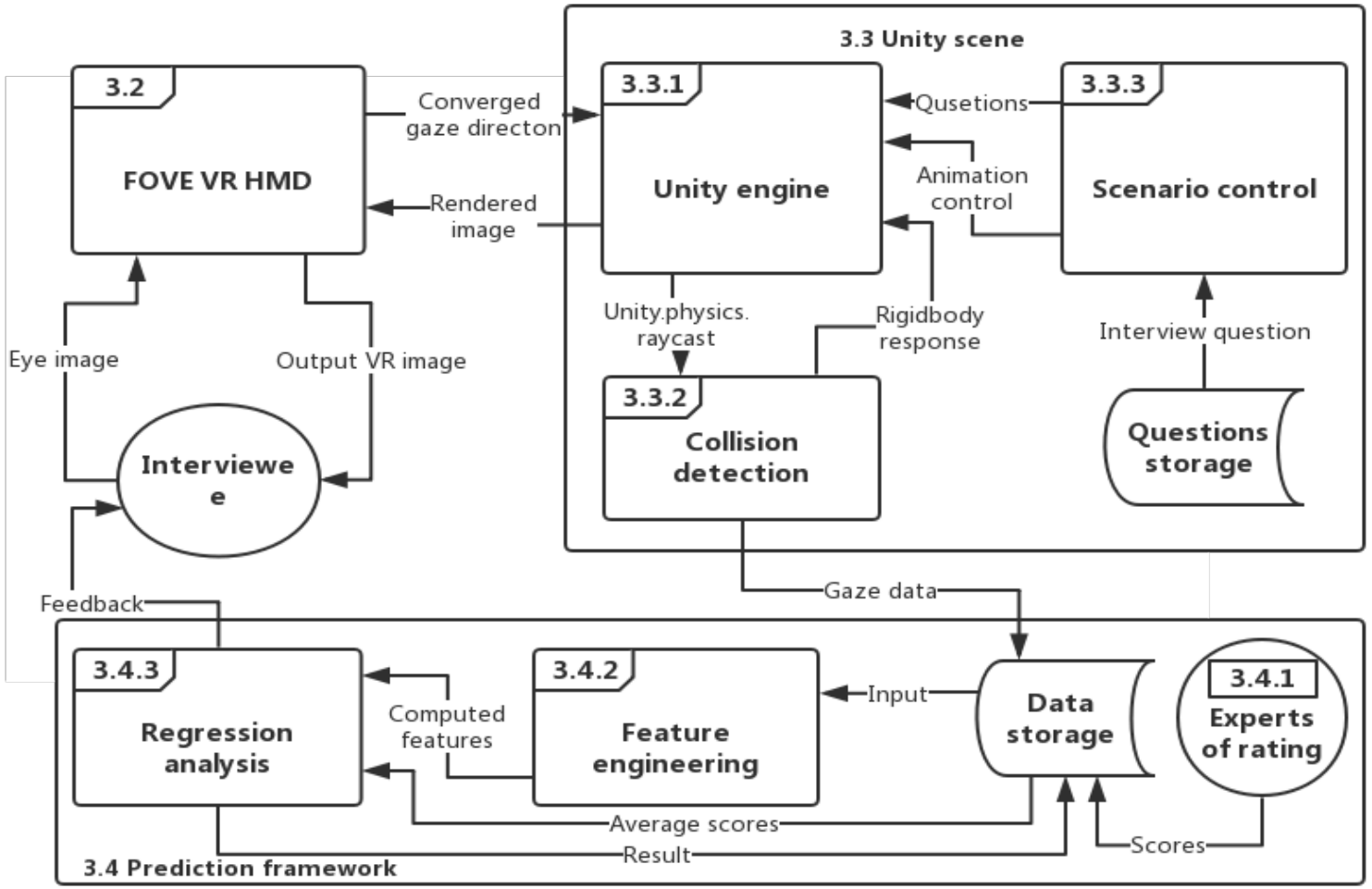


Figure 1: Flow chart of the system image

VR Interview Virtual Agent System Architecture

VR Device

With eye tracking.

Two cameras render images for the person's eyes.

Without eye tracking.

Customize the eye cameras and add infrared LEDs to illuminate the eyes.

VR Interview Virtual Agent System Architecture

Virtual Environment by Unity

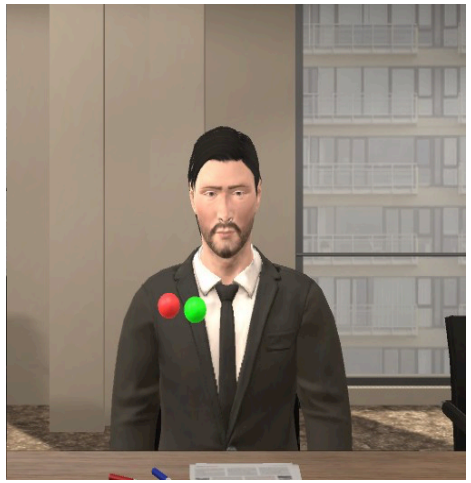
Figure 2: Scene setup in the Unity engine

Figure 3: Collision detection and gaze calculation

Figure 3 shows how this mechanism works. The positions of cameras in the VR scene represents the positions of the eyes; the gaze directions were captured by FOVE. The two spheres in red and green indicate the left eye and the right eye respectively.

VR Interview Virtual Agent System Architecture

Virtual Environment



- Can you introduce me a little about yourself?
- Which industry interests you the most?
- Which company do you want to join?
- Why should they hire you?
- What kind of positions interests you the most?
- Can you explain that in detail? (Linked to the previous question)
- What are your greatest professional strengths?
- What do you consider to be your weaknesses?
- Tell me about a challenge or conflict you've faced at work, and how you dealt with it.
- What would you do if you are underestimated despite your hard work?
- What would you do if you are not getting along with your colleagues?

For example, if the head part of the agent was being looked at and the body part was not, the record would be [True, False] ("TF").

TT, TF, FT, FF ⟶ Neck, Head, Body ,Somewhere else

VR Interview Virtual Agent System Architecture

Virtual Environment

While giving scores to each data clip, to the raters were asked questions to evaluate the interviewee's performance. These questions were divided into five categories: Total, Engagement, Eye Contact, Friendliness, and Logical and Clear Presentation.

Total: An assessment of the overall interview performance: To what extent would you want to hire this person

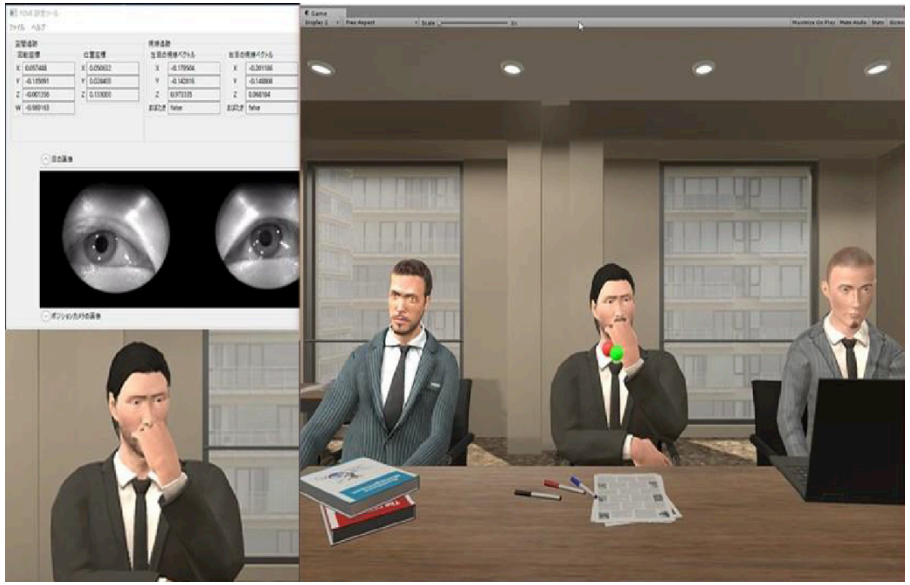
Engagement: Did the interviewee show a positive attitude to- wards the question? Did he/she look encouraged?

Eye Contact: Did the interviewee use proper eye contact to express himself/herself? Did he/she watch the interviewer during interact without looking away?

Friendliness: Did the interviewee show a responsive attitude, and did you feel comfortable with this interviewee?

Logical and Clear presentation: Did the interviewee effectively delivered his/her feelings? Did the interviewee speak neither too fast nor too slow? Were you persuaded by his/her words?

Interview Evaluation



Result found that the participants gazed at the interviewer's head 16% of the total time. For another 51% of the total time, the participants preferred to look at the interviewer's body. No targets were gazed at for 33% of the interview time.

Table 1: Features Computed from Raw Data

Feature	Meaning
HeadTrue	The total frame count for which the interviewee gazed at the interviewer's head
BodyTrue	The total frame count for which the interviewee gazed at the interviewer's body
TT, TF, FT, FF	The total frame count for which the interviewee gazed at various parts of the interviewer's body
TF->FT etc	The count of the gazing state transferred between two frames
Total	The total length of each clip
ContinuousGazing	The total time for which the interviewee gazed at the interviewer
MoveAround	The total time for which the eyes moved around

TT, TF, FT, FF ⟶ Neck, Head, Body ,Somewhere else

Results of Interview Evaluation

Inter-rater agreement

Table 2: Inter-rater agreement between raters

Field	Krippendorff's Alpha
Total	0.71
Engagement	0.53
Eye Contact	0.67
Friendliness	0.62
Logical and Clear Presentation	0.57

Predictions using gaze features

Table 3: Prediction accuracy and correlation using gaze features

Field	Accuracy [%]	Correlation
Total	59.3	0.771
Engagement	38.7	0.383
Eye Contact	73.6	0.822
Friendliness	56.6	0.677
Logical and Clear Presentation	47.5	0.412

Results of Interview Evaluation

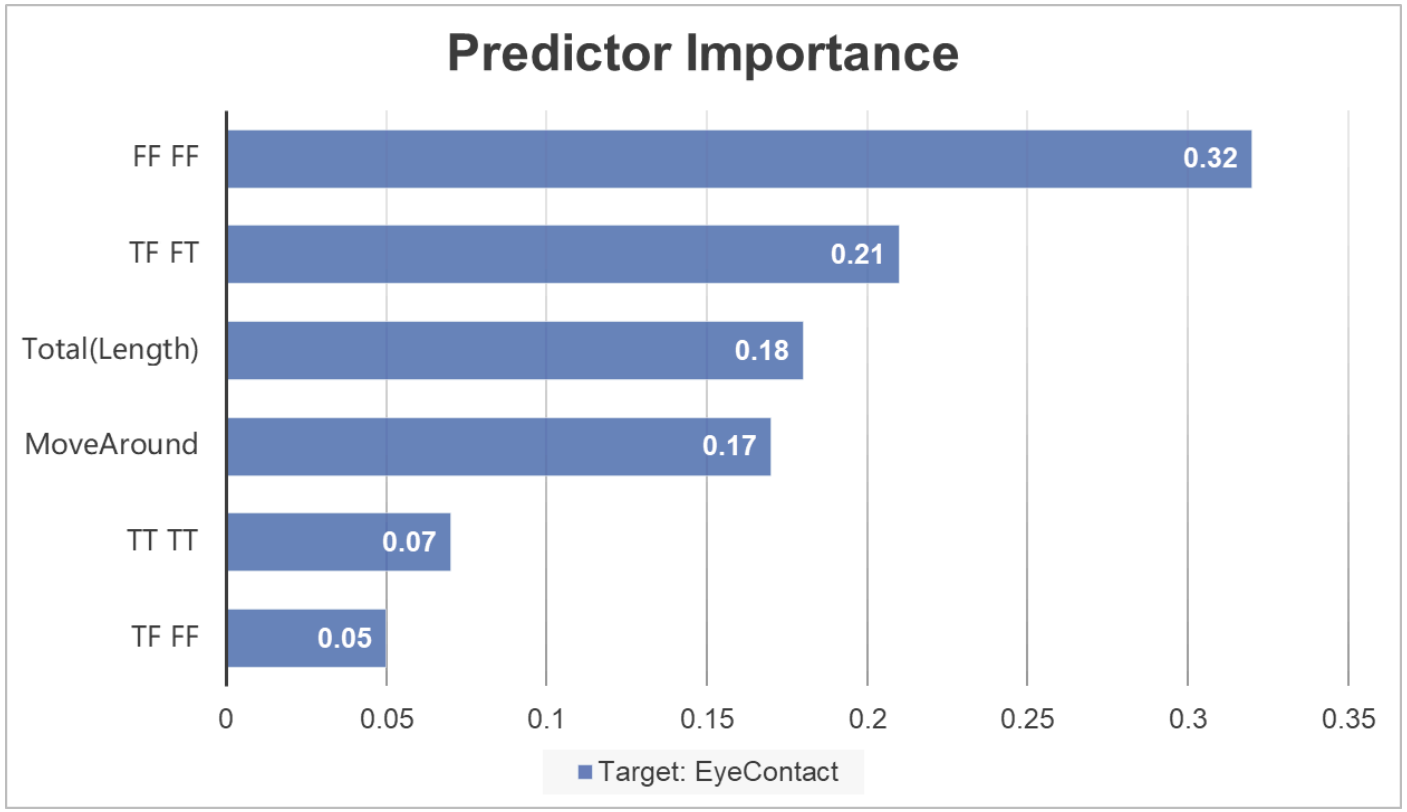


Figure 5: Predictor importance for the field: “Eye Contact”

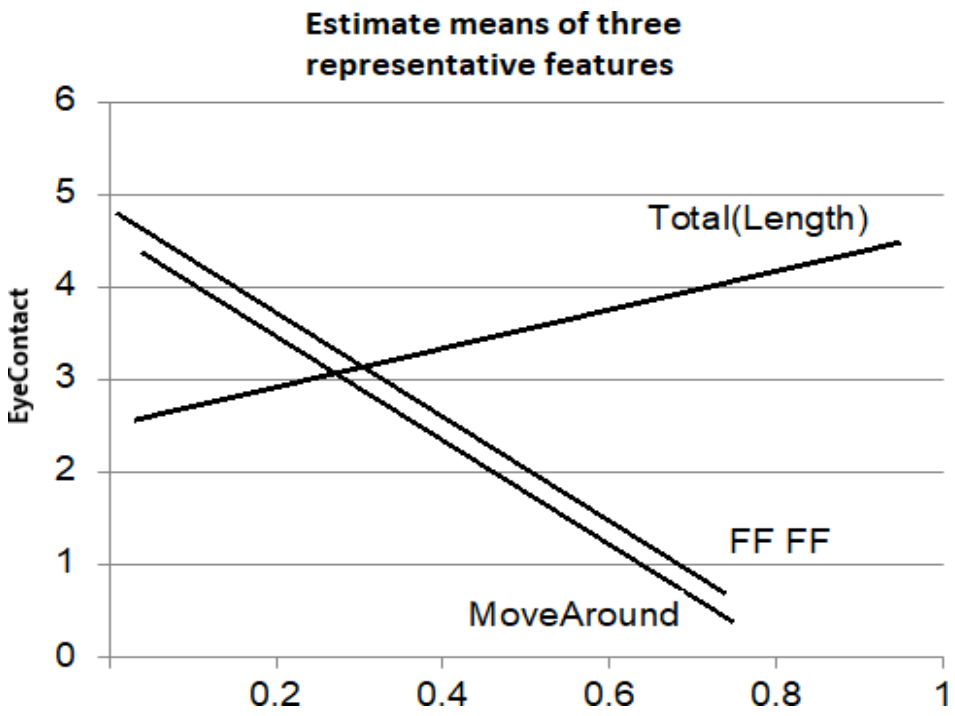


Figure 6: Estimated means of three signifcant features

Therefore, we can conclude that if the participants did not gaze at the interviewer for a while, then the participants were not good at using eye contact communication, and their score of eye contact would below.

Conclusion

This study developed a VR-based interview system capable of recording human eye movements. Then used regression models to perform the automatic prediction of the interview performance. Finally computed the importance of each of our features to determine the kinds of features that affected interview scores the most. The experimental results suggest that this method is not only conceptually easy to understand but also shows its consistency with real-world job offering experience. Also, the automatic evaluation experiments on evaluating interview performance show that gazing at the interviewer and do not look down or look away is an important cue for improving the interview outcomes.

problem

In real life, not only in the field of job interviews, eye contact plays a very important role in many aspects (such as the field of public safety), how to use this technology in these fields to achieve the analysis of the relationship between eye movement and the actual psychological state of the target is still in need of further research.

LEARNING FROM USERS:
AN ELICITATION STUDY AND TAXONOMY FOR COMMUNICATING SMALL UNMANNED AERIAL SYSTEM STATES THROUGH GESTURES

JUSTIN W. FIRESTONE, RUBI QUINONES, BRITTANY A. DUNCAN

46193132

HE HAN

BACKGROUND

the general public will increasingly come across small Unmanned Aerial Systems (sUAS) in everyday life.

It is **important** for sUAS to communicate common states quickly and intuitively with bystanders, because not all users are experts with sUAS.

- Not all sUAS will have hardware to communicate through sound or light due to cost or battery limitations ,
  - Should be able to indicate key states through motions in space (gestures).
- A well-defined set of gestures can improve sUAS user experiences and ultimately increase comfort with their greater prevalence in everyday life.

STUDY AND METHODOLOGY

- Let participants construct a preliminary gesture set for sUAS states, all of which are important to communicate common conditions.
- Participants:
  - In this paper, the researcher asked users who recruited from the general public (N=20) with varying levels of experience with sUAS to create their own gesture set for seven distinct sUAS states.
- Experiment Materials
  - Ascending Technologies (AscTec) Hummingbird
  - A palm-sized model of the Hummingbird

STUDY AND METHODOLOGY

- Experiment Procedure
  - The study took approximately one hour to complete three parts:
    - 1) Pre-interaction; — 15 min
    - 2) Flight Path Design; — 45 min
    - 3) Flight Path Observation. — 45 min
  - Each part included a survey
  - Concluded with an interview
- Result:
  - Elicited 140 gestures

STUDY AND METHODOLOGY

- Classification and Taxonomy for User-Designed Flight Paths
  - Create an objective classification and taxonomy
    - To group the elicited gestures according to specific common characteristics.
  - Classified each gesture along six categories:
    - Categories from Related Work
      - Complexity
      - Space
      - Cyclicity
    - Additional Categories
      - Command
      - Altitude
      - Motion

STUDY AND METHODOLOGY

- User-Defined Gestures for sUAS Communications
    1. Group those gestures with common features according to taxonomy
    2. Use groupings to calculate agreement scores.

Choose the most common gesture for each state

as the representative gesture for that state.

- An Agreement score is designed to determine the level of consensus.

STUDY AND METHODOLOGY

- Inter-rater Reliability for Taxonomy
  - Purpose:
    - assess the usefulness of the taxonomy categories
    - classify the individual states according to common subcategories
- Two raters were obtained to independently assign each of the 140 user-generated flight paths to a single subcategory within each taxonomy category.

State	Complexity	Space	Cyclicity	Command	Altitude	Motion
Attract Attention	Simple (12)	Indirect (9)	Random (10)	**Roll and Throttle (7)**	Stable (8)	Rectilinear (12)
Sensor Lost	Simple (9)	Indirect (11)	Random (10)	**Roll and Throttle (6)**	Stable (10)	Rectilinear (10)
Low Battery	**Compound (12)**	Indirect (12)	Random (11)	**Throttle (13)**	Tie: **Decreasing (8)** and **Variable (8)**	Rectilinear (15)
Signal Lost	**Compound (11)**	Indirect (13)	Random (15)	No Majority	Stable (13)	Rectilinear (9)
Area of Interest	Simple (17)	Indirect (13)	Random (14)	**Roll and Pitch (9)**	Stable (13)	**Curvilinear (10)**
Missed Goal/Target	Simple (14)	Indirect (13)	Random (16)	**Roll and Pitch (7)**	Stable (14)	**Curvilinear (9)**
Landing	Simple (11)	**Direct (10)**	Random (12)	**Throttle (12)**	**Decreasing (16)**	Rectilinear (14)

STUDY AND METHODOLOGY

- After their independent assessments, their results were compared in order to calculate Cohen's Kappa coefficient and assess their agreement according to previous work.
- Result:
  - "Almost Perfect" agreement
    - Complexity (0.881), Motion (0.907), Command (0.92), and Altitude (0.914)
  - "Substantial Agreement."
    - Space (0.79) and Cyclicity (0.641)

Cohen's Kappa coefficient : https://en.wikipedia.org/wiki/Cohen%27s_kappa

RESULTS

- The results indicate relatively strong agreement scores for three sUAS states:
  - Landing (0.455), Area of Interest (0.265), and Low Battery (0.245).
- The other four states have lower agreement scores, however even they show some consensus for all seven states.

State	Agreement Score	Type	Confidence
Attract Attention	0.155	mission	4.4
Sensor Lost	0.125	vehicle	3.2
Low Battery	0.245	vehicle	3.5
Signal Lost	0.125	vehicle	3.2
Area of Interest	0.265	mission	4.05
Missed Goal/Target	0.145	mission	3.5
Landing	0.455	vehicle	4.2

CONCLUSION

- This paper presented an elicitation study to elicit gestures from participants recruited from the general public to communicate seven key sUAS states to operators and especially bystanders.
- The agreement scores showed promise that a common gesture set can be created and implemented for current sUAS.