Codebook

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Project description

This project aims to determine how transparency that facilitates understanding of a robot by a human interacting with the said robot is ensured in literature.

Selection of libraries

Papers were retrieved from

1. The ACM digital library
2. IEEE

These contain a majority of publications of venues that are relevant for HRI. This facilitates comparison between different publication venues and allows for high chances that relevant publications are included in the analysis. Due to keywords used to retrieve the papers, only English publications were used.

Coding Instructions

Please read each article attentively. Please use the provided excel sheet for the coding. Some formal variables are retrieved automatically and do not need to be manually extracted from the full text. These are marked as such.

Formal variables

Citation

The citation used in the latex bibliography, containing all relevant publication details. This is used to identify each piece of analysis. Does not need to be manually extracted.

Year

Year when the piece was published. This is automatically extracted via script.

Venue

The conference or journal where the piece was published. This is automatically extracted via script.

Example: The venue is listed as *2021 IEEE 16th Conference on Industrial Electronics and Applications (ICIEA).* Here the coded venue is *Conference on Industrial Electronics and Applications (ICIEA)* – without the specification of year.

Venue Type

Here, document whether the venue of publication is a journal or conference. The aim is to determine who is generally interested in the topic of transparency in HRI. This information is extracted from the venue, not from the full text.

1. Journal
2. Conference

Variable Type of Transparency

Here, it is documented in which way transparency or synonyms thereof appear in the paper. Here it is important what role transparency plays for the given research.

1. Dependent Variable in the study
2. Independent Variable in the study
3. Transparency is ensured but not listed as an independent variable
4. No study

Terminology

For the keyword search, different synonyms of the concept of transparency were utilized. Here, we document which words are the most prevalent. Despite chances being low, given that we did not include further keywords for the concept, document if further synonyms appear in the text.

1. Transparency
2. Explainability
3. Understanding
4. Intelligibility
5. Interpretability
6. Scrutability
7. Other – please list (legibility)

Transparency Definition

Please document whether or not the piece defines the concept of transparency. This may be by citing other papers or by creating their own definition. Here, it is not important whether the authors properly set up a formal definition, but more so whether they specify explicitly what concept they are talking about.

1. Definition provided
2. No definition provided (0 and will return later)

Human-related Covariables / Dependent variables

Document in combination with what concept transparency appeared. I.e., if transparency was the independent variable, what was the dependent variable? This code is meant to capture what concepts are associated with transparency.

1. Trust
2. Emotions
3. Stress
4. Decision making
5. Closeness
6. Perception of robot

9. Other – please list
0. None

Robot-related Covariables / Dependent variables

Document in combination with what concept transparency appeared. This code is meant to capture what concepts are associated with transparency, i.e.robot factors that possibly influence transparency.

1. Performance
2. Explanation content
3. Robot ability / reliability
4. Accountability
5. Usability
6. Safety
9. Other - please list
0. None

Robot Form

Document what type of robot the authors consider in their work. The aim of documenting this is to record if there are different approaches on how to ensure transparency in different domains. The different forms are derived from Schaefer et al.[1]

1. Robots in general (all types considered)
2. Entertainment
3. Industry
4. Medical
5. Military
6. Service
7. Social
8. Therapy
9. Other - please list
0. None

Example by Natarajan et al.[2] that would be classed as 3 Industry:

Sawyer: Sawyer is an industrial robot arm from Rethink Robotics with seven degrees of freedom. Being an industrial arm, Sawyer can play back different trajectories with high precision but its movements are more rigid as compared to a humanoid. Sawyer also comes with a display, which is used to portray different emotions while providing feedback.

Content variables

The core aim here is to document HOW transparency (understanding) was ensured in the paper.

Modality

Document with which modality or modalities the transparency is created. The modalities were extracted from McNorgan[3]. Haptic feedback types were further split into three types as per related work on haptic feedback[4][5]. Auditory feedback was divided into intelligible speech and other audio feedback to ensure clarity.

1.1	Visual – form
1.2	Visual – color
1.3	Visual – motion
1.4	Visual - text
2.1	Auditory – speech
2.2	Auditory – sounds
3.1	Haptic – Vibrotactile
3.2	Haptic – Pressure
3.3	Haptic – Thermal
4	Motor
5	Gustatory
6	Olifactory
0	Not specified

Multimodality

Document whether the method they applied in the piece to make a robot transparent is mono- or multimodal. This applies if more than one modality from the previous question is present.

1. Monomodal
2. Multimodal
0. Does not apply

Example: The robot gives verbal explanations of its next move and its path is highlighted with a projection on the ground. Here, we code multimodality.

Integration

Document here whether transparency is integrated into the robot design or ensured by other external means for the study.

Example: The experimenter verbally provides explanations of the robot. This would be marked as external.

1. Inherent transparency through design
2. Integrated transparency added to the robot
3. External explanations
0. Does not apply

Item of explanation

While this is not the main focus of our work, please still document *what* is explained to make the robot transparent.

1. Robot intentions / purpose
2. Robot behavior
3. Robot capabilities
4. Robot decision making
5. Robot beliefs (e.g., of the environment)
6. Robot tasks (sub-goals, task assignment in teamwork)
7. Cause of failure (after error)

Explanation generation

Document *what* is explained to make the robot transparent and whether the transparency manipulation is predetermined.

1. Dynamically generated (xai)
2. Predetermined
3. Placebo
0. No explanations

Measurement of Understanding

Record whether or not the piece verifies that their transparent robot is transparent i.e., is understood (better) by the human user. E.g. via a questionnaire.

1. Yes (understanding measured)
0. No (understanding not measured)

Changes after the Pilot

- In *Modality* added a code for text-based explanations
- Split the *Covariable* Code into human-related and robot-related attributes

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[1] Schaefer, K. E., Sanders, T. L., Yordon, R. E., Billings, D. R., & Hancock, P. A. (2012, September). Classification of robot form: Factors predicting perceived trustworthiness. In *Proceedings of the human factors and ergonomics society annual meeting* (Vol. 56, No. 1, pp. 1548-1552). Sage CA: Los Angeles, CA: SAGE Publications.

[2] Natarajan, M., & Gombolay, M. (2020, March). Effects of anthropomorphism and accountability on trust in human robot interaction. In *Proceedings of the 2020 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 33-42).

[3] McNorgan, C. (2012). A meta-analytic review of multisensory imagery identifies the neural correlates of modality-specific and modality-general imagery. *Frontiers in human neuroscience*, *6*, 285.

[4] Maeda, T., & Kurahashi, T. (2019, March). Thermodule: Wearable and modular thermal feedback system based on a wireless platform. In *Proceedings of the 10th Augmented Human International Conference 2019* (pp. 1-8).

[5] Suhonen, K., Väänänen-Vainio-Mattila, K., & Mäkelä, K. (2012, September). User experiences and expectations of vibrotactile, thermal and squeeze feedback in interpersonal communication. In *The 26th BCS Conference on Human Computer Interaction 26* (pp. 205-214).