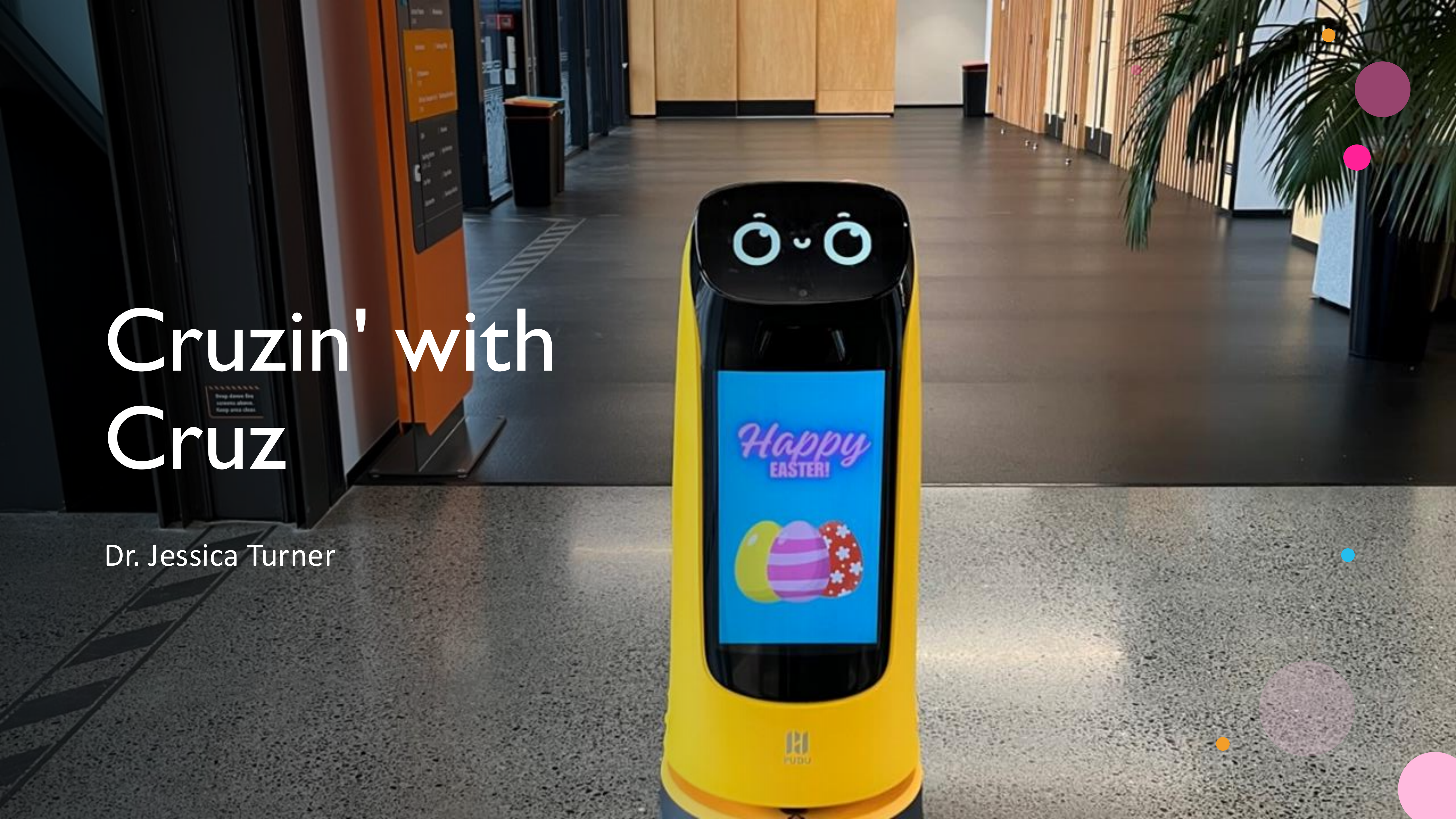
Cruzin' with Cruz

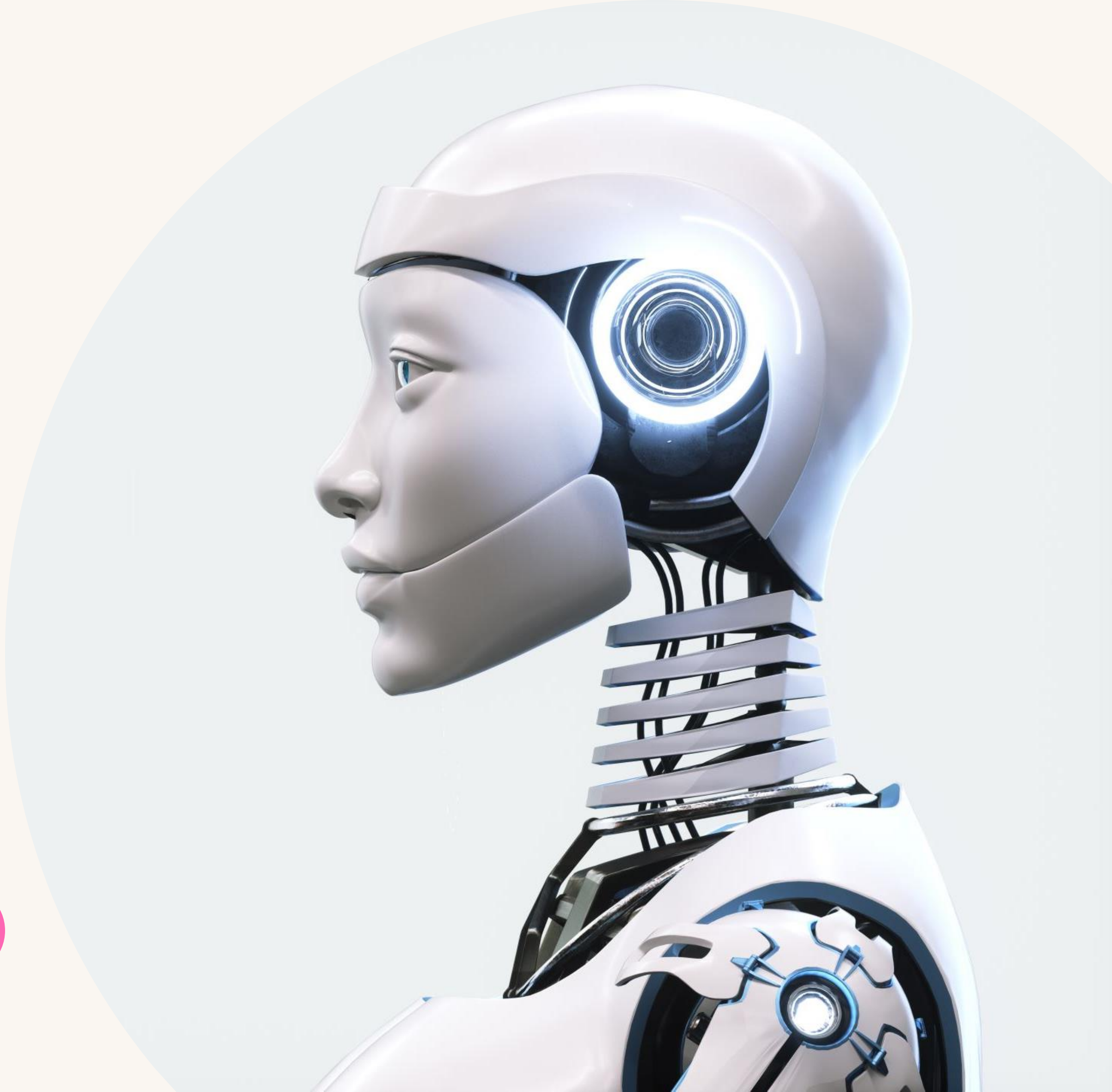
Dr. Jessica Turner



What is HRI Research?

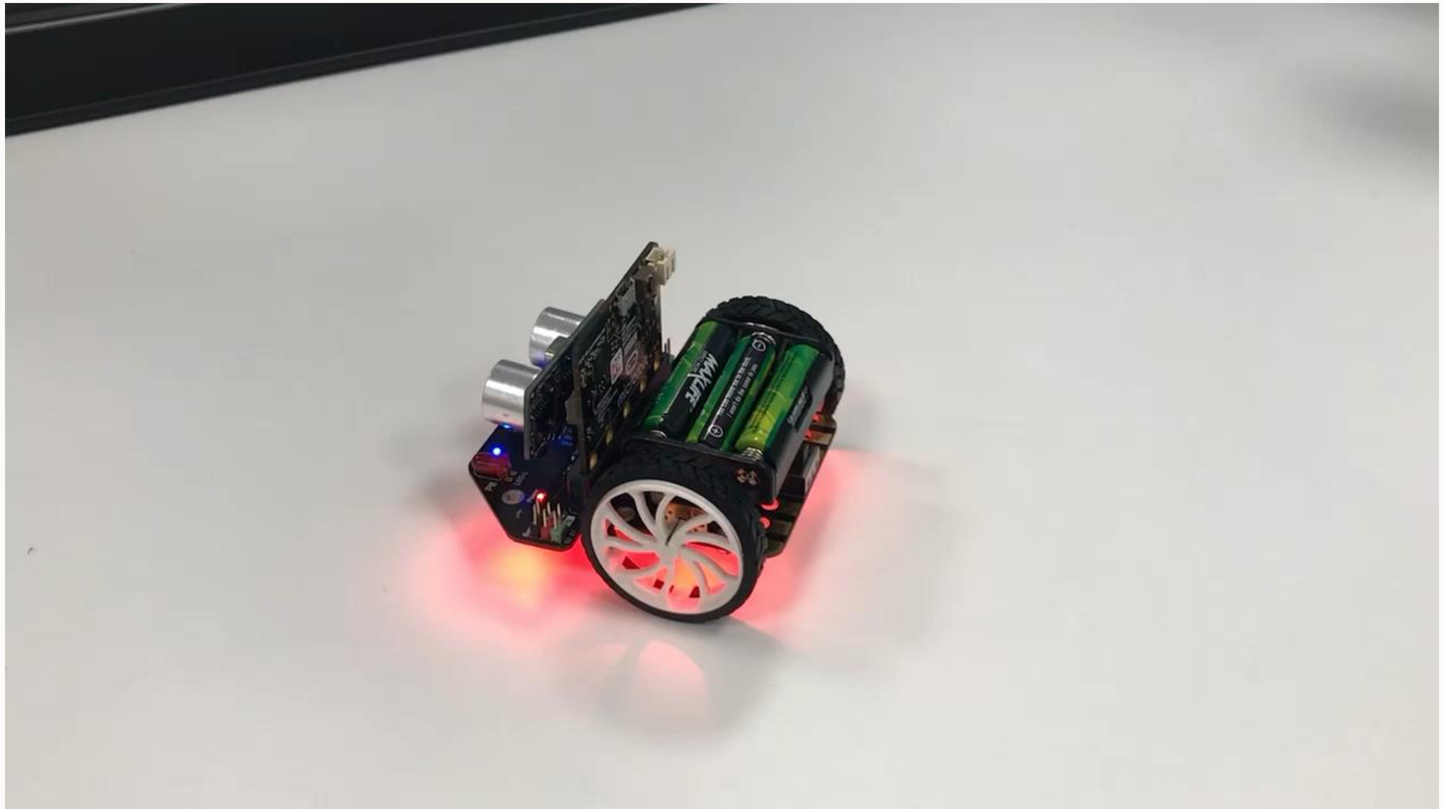
"HRI is a field of study dedicated to understanding, designing, and evaluating robotic systems for use by or with humans."

Kanda. (n.d.). 1: Introduction | Human-Robot interaction. https://humanrobotinteraction.org/1-introduction/



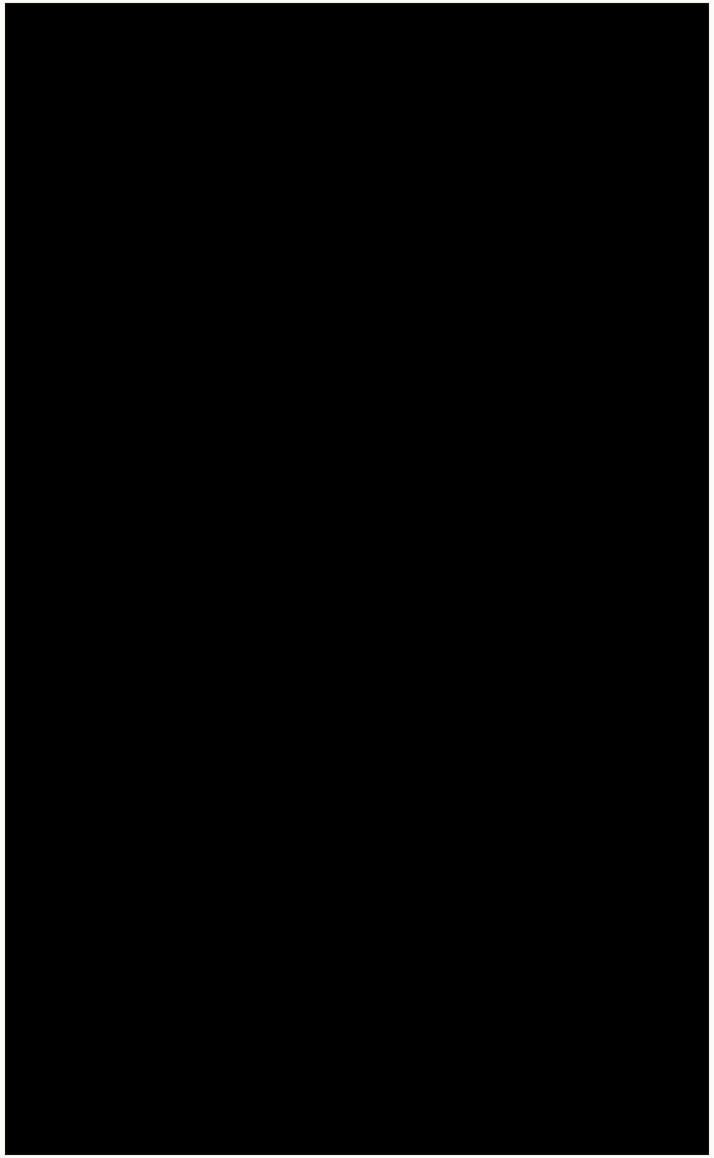
Maqueen

https://wiki.dfrobot.com/micro_Maqueen_for_micro_bit_SKU_ROB0148-EN



Cruz the KettyBot

https://www.pudurobotics.com/product/detail/kettybot

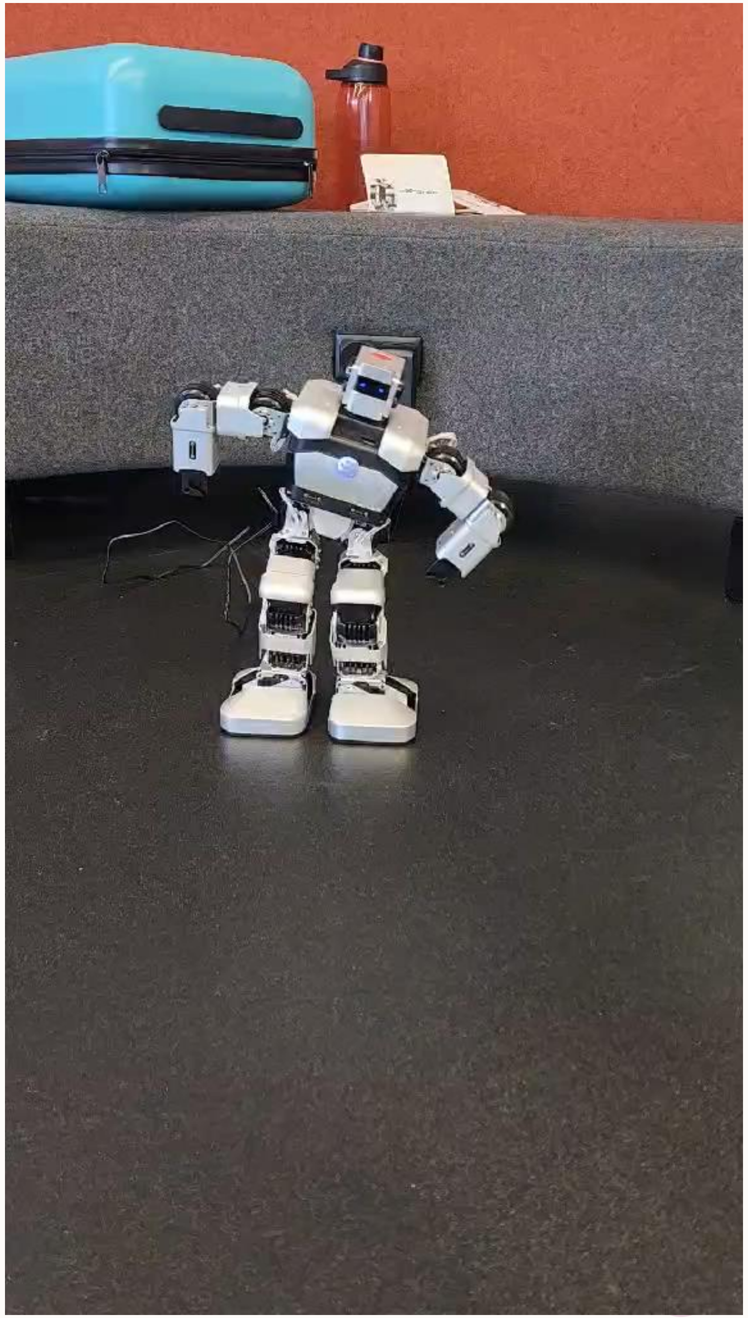


Norbert the Bittle

https://www.petoi.com/pages/bittle-open-source-bionic-robot-dog

Buddy the Yanshee Robot

https://ubtecheducation.com/yanshee/



Miro-Es

https://consequentialrobotics.com/miroe

Create3s

Robotic Vacuums that don’t vacuum!

Spike Kits

https://spike.legoeducation.com/

HRI
@Waikato

Human-Robot Interaction in Education
Design and Application of User Experience Studies

By Hannah Carino
University of Waikato
ENGEN582 - Honours Project
Supervisors: Jessica Turner, Jemma König & Nic Vanderschantz

Introduction

Human Robot Interaction (HRI) is an emergent technological field that explores the complexities of interaction dynamics between humans and robots with respect to their environment.

From industrial robots performing repetitive tasks to autonomous systems embedded in daily life, the rise of intelligent robots highlights the complex interplay between technology, user experience, and psychology—capturing the essence of human-robot interaction.

While backed by a large body of modern research, a gap exists within the application of HRI in secondary school contexts.

Thus this project aims to explore Human-Robot Interaction in Education: Design and Application of User Experience Studies

Collaborative, community involvement.

Methods

This project empowered communities of secondary school students to share their voices through the employment of self-reported surveys. Research instruments were thoroughly validated using an agile, iterative approach to improve outcomes and insights between the two core studies: Pilot and Principal.

Research Instruments

Instrument	Description	Pilot	Principal
Godspeed Questionnaire	Created by Christoph Bartneck in 2009 [1], it is the most highly cited and used questionnaire in the field of human-robot interaction. Allows scientists to observe the reality of robot features and draw conclusions based on observations.	✅	✅
System Usability Scale	Developed by John Brooke in 1996 [2], the System Usability Scale is a 10-item like rat scale giving a global view of subjective assessments of usability. It's wording was altered to cater towards robotic interfaces to suit research needs.	✅	〰
Unified Theory of Acceptance and Use of Technology Survey	A technology acceptance model forumlated by Venkatesh et. al. [3], to explain user intentions towards acceptance, adaptation, and usage of an information system along with subsequent usage behaviour.	〰	✅

Direct interaction in a safe environment

Activities

Students participated in an agenda of activities to interact with and learn about the Kettybot.

Instrument	Description	Pilot	Principal
Brainstorm	After interacting with the Kettybot, participants engaged in an ideation phase to explore and discuss potential applications, focusing on creative concepts rather than detailed designs.	✅	✅
Storyboarding	Participants selected an idea from the brainstorming sessions and developed it further through storyboarding, a common UI/UX technique. This process visualises a sequence of events or interactions, prompting consideration of context, user environment, and stakeholders.	✅	✅
Re-engineering	With a clear grasp of potential applications, participants were encouraged to explore further possibilities for redesigning or enhancing the Kettybot. They employed visualisation techniques to propose modifications and innovative use cases.	✅	〰

Discussion

Students empowered to speak their truth in confidence.

Two distinct studies were conducted, each with the informed and voluntary consent of participants, in accordance with ethical research guidelines. The Pilot Study was designed to assess the relevance and applicability of state-of-the-art measurement tools for evaluating perceptions of human-robot interaction. The primary goal was to determine the feasibility and effectiveness of these methods for capturing participant responses and attitudes. Building upon the findings of the pilot, the Principal User Study expanded the participant pool to validate these preliminary insights while further investigating refined concepts that emerged during the pilot phase. These included environmental factors influencing interaction quality and the impact of preconceived attitudes, such as performance expectancy, anxiety or skepticism toward artificial intelligence.

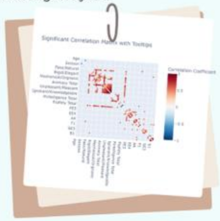
Both studies utilised fully anonymised user survey data to ensure the privacy and confidentiality of participants. The surveys captured qualitative information, including prior experiences with robots, and integrated modern HRI frameworks to provide structured insights into user perceptions. Notably, the pilot study employed a pre-and post-interaction evaluation of participant perceptions, a methodology that was subsequently refined and excluded from the principal study to streamline the analysis based on initial findings.

Fully anonymised, safe data.

Technical analysis with significance.

To derive meaningful insights from the collected data, two primary analysis methods were utilised; *statistical analysis* and *machine learning*. These techniques were not only instrumental in identifying overarching trends and patterns within the dataset, but also in uncovering more nuanced insights. The latter aims to discover underlying psychological dimensions and subtle cognitive preconceptions that may not be immediately apparent through surface level analysis. This dual approach ensures a comprehensive understanding of the explicit and implicit factors that contribute towards the participants' perceptions of the interacting Kettybot.

Descriptive analysis revealed key trends, including the insight that *users believe robots could enhance their educational experience* (scored 0.8 on a scale where 0 represents "No" and 1 represents "Yes"). Correlation analysis further identified relationships between robot features, cognitive preconceptions, external influences, and the interaction environment. These findings provide essential guidance for design decisions aimed at fostering more positive user perceptions.



Machine learning, using both supervised and unsupervised techniques, was employed to identify key features influencing behavioral intention and acceptance—chosen for their impact on user-robot interaction. A random forest classifier was applied to uncover hidden patterns, account for variance, and mitigate overfitting, ensuring accurate feature assessment. Additional methods included K-Nearest Neighbors clustering, Principal Component Analysis for visualization, Decision Tree classification, and XGBoost algorithms.

Key Findings

- Animacy, Perceived Safety, Self Efficacy, Social Influence and Attitudes towards robots play the biggest role in predicting whether students want to see robots in their educational environments.
- Using the measurement tools, a "Yes" or "No" answer can be predicted with 87.5% accuracy.

Results

The results uncovered in this project reveal a positive outlook on attitudes towards robot acceptance in the modern educational context.

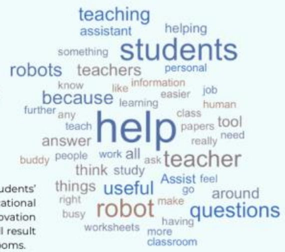
- The KettyBot scores similarly to Nao in the GQS, a social robot with a wide range of applications in the educational domain.
- Using the prescribed research instruments, students' interest in having a robot in school can be predicted with 87.5% accuracy based on their responses to the GQS and UTAUT surveys.
    - Users think robots are best suited for being a teaching assistant rather than any other role in the classroom.
    - Users think robots could enhance their educational experience.
    - Users want to see robots in school - averaging a score of 0.89 where 1 represents "Yes" and 0 represents "No".

Limitations

This study faces several limitations. A key limitation is the sample size, with only seven participants in the pilot study and 36 in the principal study, limiting the generalisability of the findings. Additionally, participants were secondary students from digital media classes, potentially skewing results towards a more tech-savvy, receptive audience. The cross-sectional nature of the study only captures perceptions at a single point in time, making it difficult to assess long-term behavioural changes. Self-reported surveys, while efficient, may not always align with real-world actions. Lastly, the results are tied to specific environmental contexts, limiting their broader applicability. These limitations open exciting opportunities for future research to explore long-term interactions, more diverse participant groups, and the evolving role of robots in education.

Conclusion

Robots have advanced from monotonous tools to autonomous machines that can help evolve the quality of education, and students are ready for it.



The word cloud displayed on the right demonstrates the students' readiness towards robots being introduced in their educational environments. In general, students are eager to accept innovation and believe these emergent developments in technology will result in helpful, useful, teaching assistants in their every day classrooms.

Perceptions collected showcase that the Kettybot in particular is positively perceived amongst secondary aged students with its friendly zoomorphic features, ability to speak, and capability to deliver objects. The strongest contributing factors towards acceptance and behavioural intention include the feeling of safety students feel towards the robot, their surrounding influences, pre-existing attitudes towards innovation, and the level of support provided by educators and peers. These discoveries are powerful insights that can inform future design decisions in the architecture and behavioural programming of robots chosen to be applied in pedagogy.

References
[1] Bartneck, C. (2023). Godspeed questionnaire series: Translations and usage. In International handbook of behavioral health assessment (pp. 1-35). Cham: Springer International Publishing.
[2] Brooke, J. (1996). SUS-A quick and dirty usability scale. Usability evaluation in industry, 189(194), 4-7.
[3] Venkatesh, V., Thong, J. Y., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. Journal of the association for Information Systems, 17(5), 328-376.

Applying the Perceived Creepiness of Technology Scale to Social Robots

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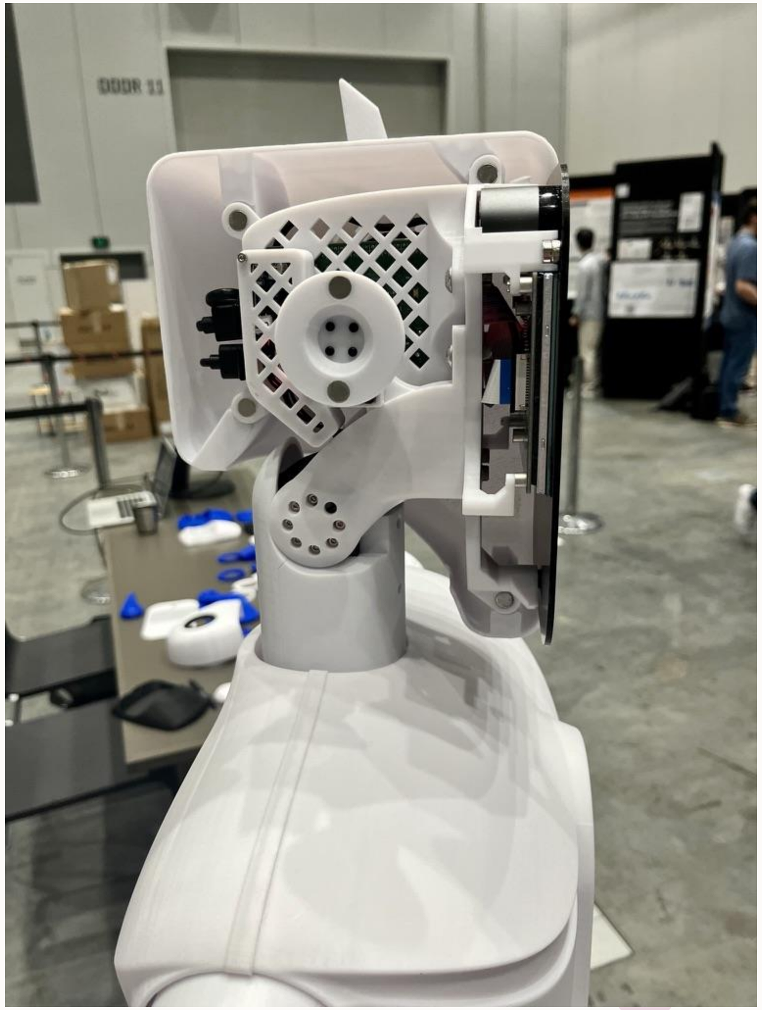
Robot Design



Robot Design

Grandia, R., Knoop, E., Hopkins, M. A., Wiedebach, G., Bishop, J., Pickles, S., ... & Bächer, M. (2025). Design and control of a bipedal robotic character. arXiv preprint arXiv:2501.05204.

Droids in Training

Brainstorm!

Storyboard!

Future Work

- Ontology of Creepiness!
- Cute vs. Creepy Project
- Voice Perceptions & Morphology
- Rapid Prototyping Robots