Supporting the Education of Homebound Children Through Semi-autonomous Telepresence Robots

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Homebound Children

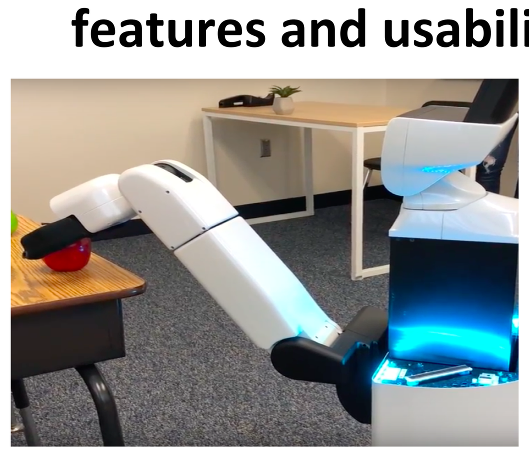
- Children that are homebound due to illness:
  - Often feel socially isolated and physically segregated from their peers.
  - Can fall behind in school due to extended absences.
- Typical education services consist of only 4-5 hours of home instruction per week.
- 2016 US Census and NHIS data estimate the size of the US child population who experience significant disruption to school attendance due to illness at 2.5 million.

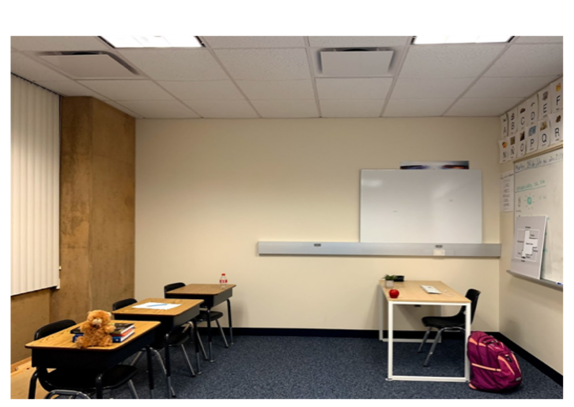
Background Studies

- Existing telepresence robots lack many desired features, such as mobility, autonomy, and manipulation.
- Homebound children use telepresence robots to overcome isolation.
- Classmates attribute human characteristics to the robot

Present Study

- We used the Toyota Human Support Robot (HSR) to be an advanced telepresence robot with object manipulation, autonomous navigation, and an intuitive user interface.
- We tested the telepresence HSR with homebound children who have used other types of telepresence robots to compare the features and usability.





Acknowledgments

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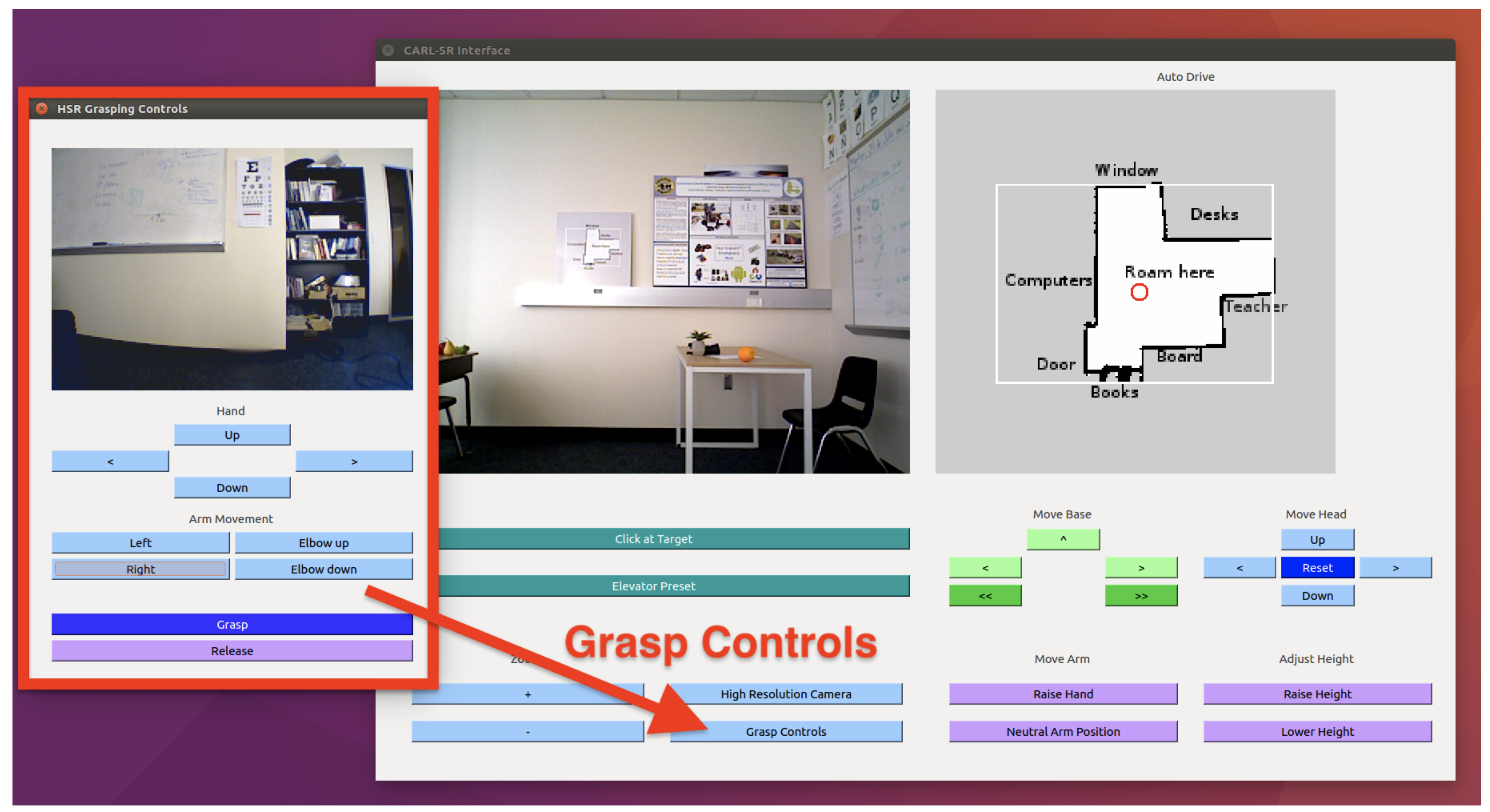
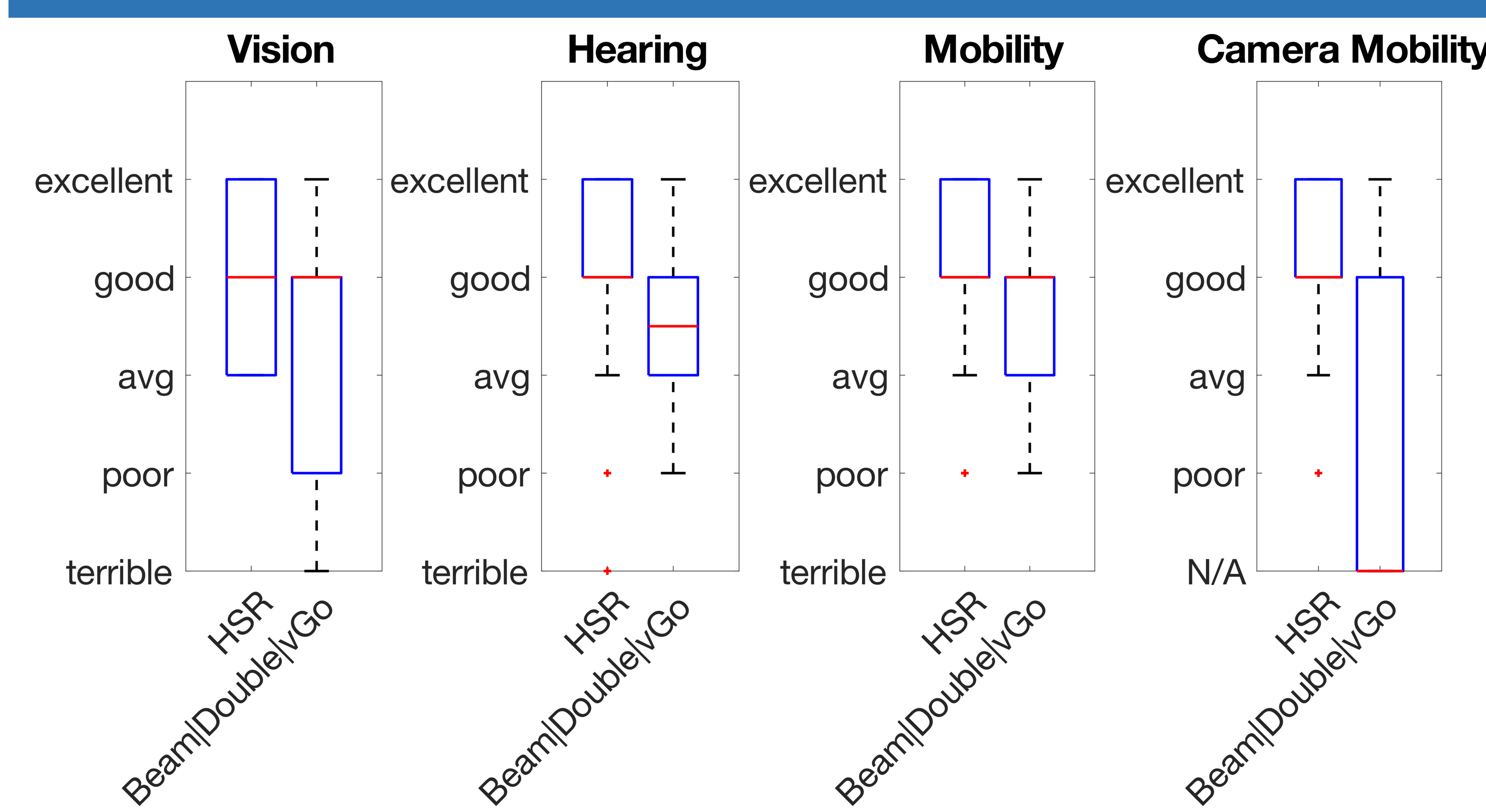
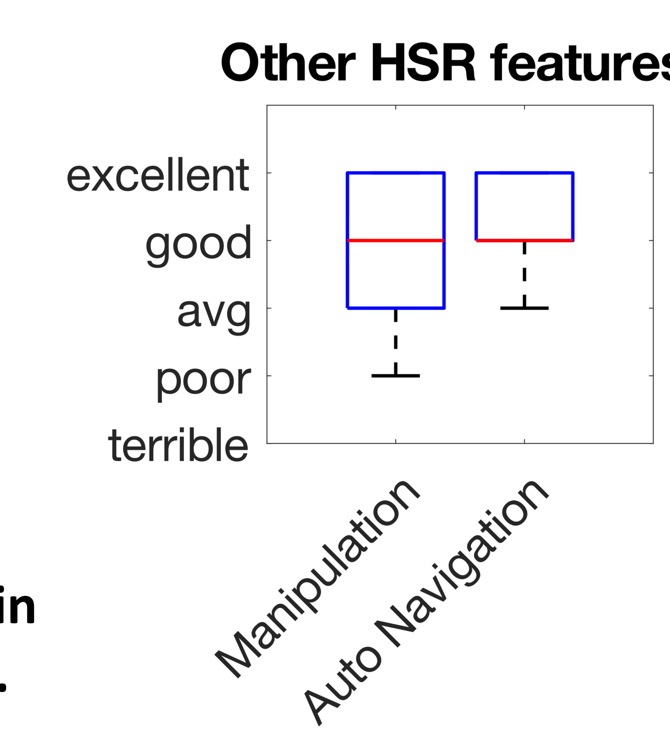
Interface



HSR Experiments with Homebound Children



- Nine homebound children participated in a Spanish lesson using the HSR in a remote classroom.
- Subjects took a survey comparing HSR features to those in other telepresence robots.
- Subjects found that HSR features improved the telepresence class participation experience.
- Subjects rated the HSR manipulation and autonomous navigation, which is not available in other telepresence robots, as good to excellent.



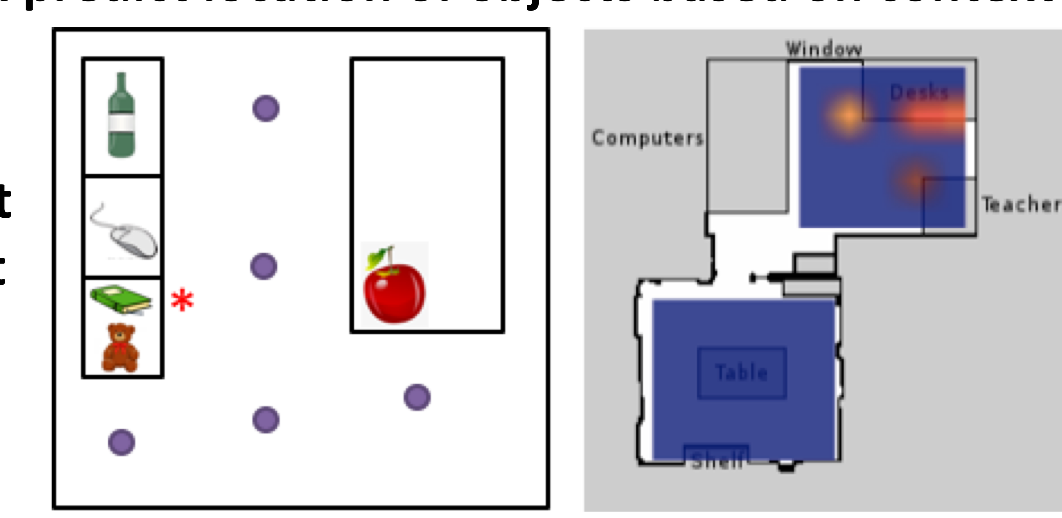
Toyota's Human Support Robot (HSR) and other robots

Toyota HSR Double VGo

Neurorobotics Research to Improve HSR Autonomy

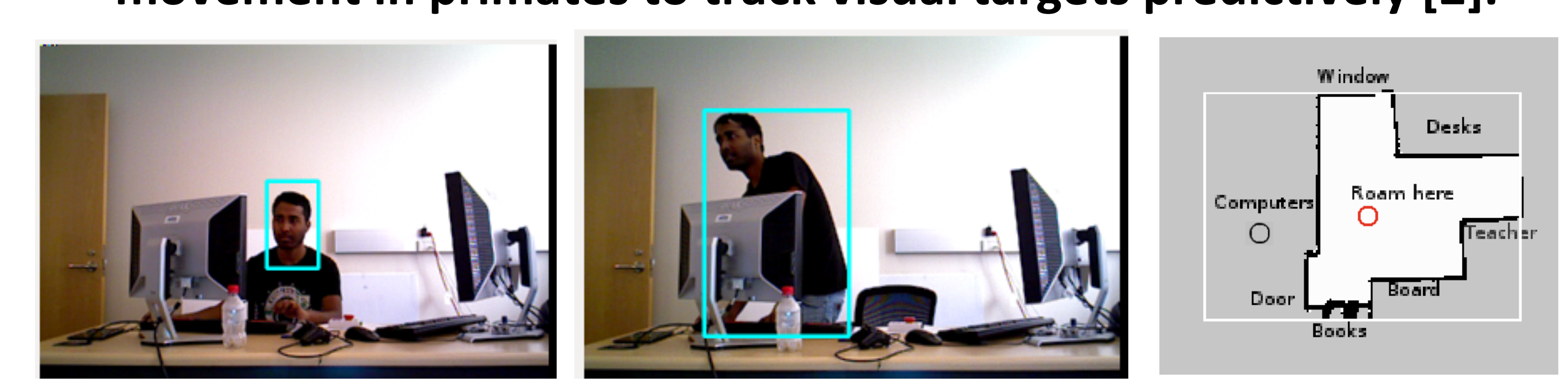
- A brain inspired network of schema consolidation helps the HSR predict location of objects based on context [1].

Object layout



Predicted book location

- A recurrent neural model inspired by the smooth pursuit eye movement in primates to track visual targets predictively [2].



Time: t Time: t + δt Target Localization

References

1) Hwu, T. J., & Krichmar, J. L. (2018). A Neural Model of Schemas and Memory Consolidation. *bioRxiv*, 434696.
2) Kashyap, H. J., Detorakis, G., Dutt, N., Krichmar, J. L., & Neftci, E. (2018). A Recurrent Neural Network Based Model of Predictive Smooth Pursuit Eye Movement in Primates. In *Proceedings of IJCNN* (pp. 5353-5360).

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