Kyabo

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Domain and Why

- Domain:
  - Substantive
    - Actors and context (Information Exchange)
- Why:
  - Interested in developing ideas related how different modes of exchanging information affects the retention and ability for a human to complete a task

Previous Work

- **Human-aware robot navigation: A survey** Thibault Kruse a,* , Amit Kumar Pandey b,c , Rachid Alami b,c , Alexandra Kirschd

  For navigation, the presence of humans requires novel approaches that take into account the constraints of human comfort as well as social rules.

- **Multi-Modal Interaction of Human and Home Robot in the Context of Room Map Generation** Saeed Shiry GhidaryYasushi NakataHiroshi SaitoMotofumi HattoriToshi Takamori

  Human teaches objects about places through hand gestures and linguistic description

- **A review of verbal and non-verbal human–robot interactive communication** Nikoaloas Mavridis

  Ten desiderata are examined in detail :
  (D1) Breaking the “simple commands only” barrier.
  (D2) Multiple speech acts.
  And so forth

Previous Work - Intermediate

- **Using gesture and speech control for commanding a robot assistant** O. Rogalla, M. Ehrenmann, R. Zollner

  Architecture for handling inputs: User Observation and Tracking, Gesture Recognition, Interactive Systems and Event Management & Verbal Input.

- **An approach to learning mobile robot navigation** Sebastian Thrun

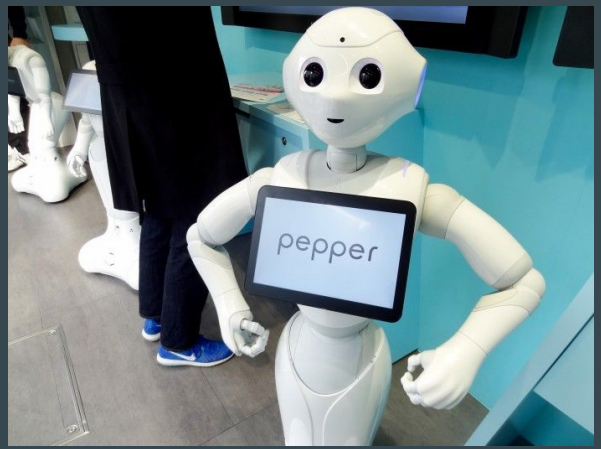
  Explanation-based neural network learning algorithm (EBNN). EBNN initially leams function purely inductively using neural network representations. Domain knowledge. Reinforcement learning.

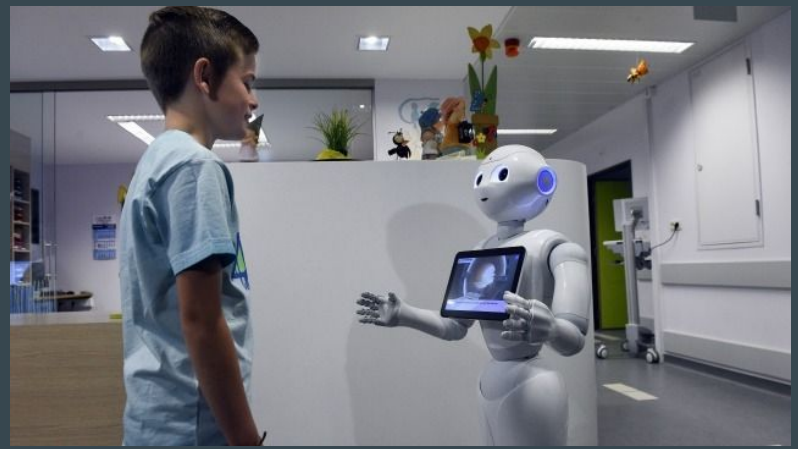
- **Directions Robot: In-the-Wild Experiences and Lessons Learned** Dan Bohus, Chit W Saw, Eric Horvitz

  Open-world human-robot interaction in dynamic, multi party environments, where people come and go, and interleave their interactions with the system and each other.

Specific Research Question

“In Respects to Indoor Navigation, what is the most Effective way to Receive Directions?”





Why Novel?

- How different modes of navigation directions (including physical guidance, gestures, voice, visual map, and textual) can affect the efficiency of communication hasn't been explored in depth.
- How perception, affordance of robots could affect the communication for indoor navigation?
- The involvement of robots in navigation aren't yet commonplace in the "wild".
- Learning navigation based on both environment and human's multimodal has not been explored in depth.

Why this Question?

- Includes interesting sub questions and possible discoveries:
  - How can the robot learn better ways of communicating?
  - How does unexpected robot behavior affect the human?
  - Which combination of feedback works best? Does it work best for all people?
  - How best can a robot deal with unexpected ambiguity or instructions?
  - How can the robot improve the navigation from both human and environment based on previous communication?
  - Do people like being navigated by a robot?
  - How does human do with instructions?
  - . . .

How?

Wizard of Oz

Field Study - Scenarios

1. Robot only displays directions (text or map)
2. Robot provides directions with only gesture
3. Robot provides directions with only voice
4. Robot provides directions with both voice and gesture
5. Robot provides directions with both an interactive map and voice
6. Robot provides directions by physically guiding the human to destination. (Might be a sidekick to humanoid robot)

Note: Experiment with Different kind of Robots

Data Collection

Qualitative:

Observations, Open-ended interviews

Quantitative:

- Duration to finish the task.
- Number of question for verification
- User's feedback from scale 1 to 10
- Binary data whether human reaches the destination or not
- User Preference to use Robot for directions on their next visit on the scale 1 to 10
- Sensor Data
- Survey

Limitations

- Effective test space
  - Stairs
  - Large enough space
  - Complexity of area
- Sufficient number of participants to test all scenarios effectively

Resources

- Robot
  - Humanoid Robot - NAO
  - Ground Vehicle - Turtlebot
  - Drone - HoverCamera, Bebop Drone 2.0
  - Rumba
  - Raspberry Pi
- Sensors
  - Kinect V2 Sensor
  - LeapMotion/Myo Armband
  - Speakers/Mic/iPad
  - IR/Ultrasound/LIDAR
  - Video Cameras/GoPro

Validity

- Ensuring Validity
  - Monitoring through video cameras unknown to the user
  - Only having the robot and subject in the test environment (no researchers)
  - Unbiased subject feedback
  - Controlled environment(s)
- Threats to Validity
  - Participant number may not be generalizable to a larger population
  - Controlled environment may not be replicated towards to real scenario
  - Results may not be generalizable to 3D navigation

Contribution

- Provide a stepping stone for further research into how robots in a navigation setting can better the ability to reach a destination.
- Provide a novel learning approach to improving communication and navigation from both the environment and human’s behaviors.

Allocating Work

- Literature Review - AG, BBC, KW
- Experiment
  - Design - AG, BBC, KW
  - Survey - AG, KW
  - Recruit Participants - AG, BBC
  - Conduct Experiment - AG, BBC, KW
  - Robot Coding - BBC, KW
- Data Analysis
  - Organize Data - KW
  - Find significant relation via ANOVA - AG, BBC, KW
- Paper - AG, BBC, KW

Questions

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