

After You: Social Door Navigation for Human-Robot and Robot-Robot Interaction

Jack Thomas and Richard Vaughan
Autonomy Lab, Simon Fraser University
jackt@sfu.ca

Introduction

- Robots moving into public spaces creates a need for socially compliant navigation.
- Negotiating deadlocks at doorways is instinctively familiar to most humans (**Fig 1**). How can robots achieve this with both humans and other robots?
- We propose a behaviour for resolving doorway navigation deadlocks by participating in this human social interaction using only motion and standard navigation sensors.

System Outline

- Based on the previous “aggressive” system for robot-robot interaction[1], the “assertive” system (**Fig 2**) has a robot take a short (15cm) half-step backward when detecting an interlocutor at a door and waiting. This signals acknowledgement without immediately conceding right of way.
- If the interlocutor approaches, the robot will retreat. If the interlocutor clears the way, the robot will advance. Otherwise, the robot waits according to its assertiveness level before trying to approach.
- If the interlocutor moves too slowly, the robot will wait for them. If made to wait too long, the robot will switch to retreating.



Fig 1: Examples of Human-Human, Human-Robot and Robot-Robot doorway passing behaviour

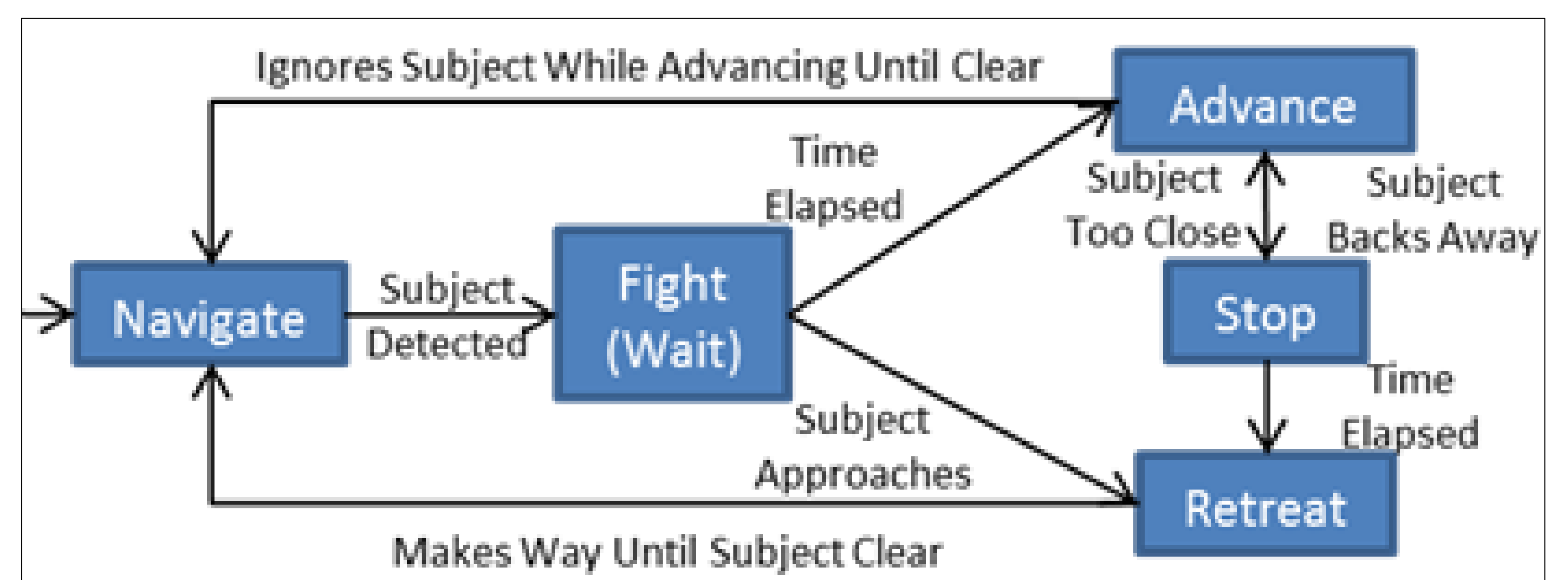


Fig 2: Assertive behaviour flowchart

Initial Results

- A human-robot interaction user study and robot-robot interaction experiment were conducted for evaluation using the Pioneer-3DX and a SICK laser rangefinder.
- Of 49 robot-robot interactions, 40 trials completed correctly as intended, 4 completed as intended on their second attempt, 5 failed from unrelated navigation errors.
- 20 humans participated in the study. Of 120 human-robot interactions mediated by the assertive system, all but one succeeded, where human right-of-way was respected in 58 of 60 cases and 30 of 60 cases for robot right-of-way.

Conclusion

- The assertive system is shown to successfully resolve doorway deadlocks for both humans and robots using only motion and common sensors. The resulting behaviour is qualitatively similar to human-human social interaction in the same setting.



Fig 3: Study participant deferring to robot's right of way