Socially-Aware Navigation: Action Discrimination to Select Appropriate Behavior

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DURIP

Introduction

- For human-human interaction, significant social and communicative information can be derived from interpersonal distance between two or more people.
- Interpersonal distance between a human and a robot may contain similar social and communicative information.
- An effective robot's actions, including actions associated with interpersonal distance, must be suitable for a given social circumstance.
- We use autonomously detected features to develop such an interpersonal model using Gaussian Mixture Model (GMM) and demonstrate that such a learned model can discriminate different human actions.

Problem

Problems caused by inappropriate human navigation can also be caused by inappropriate robot navigation.

"Well, it almost ran me over... I wasn't scared... I was just mad... I've already been clipped by it. It does hurt." - Participant [1]

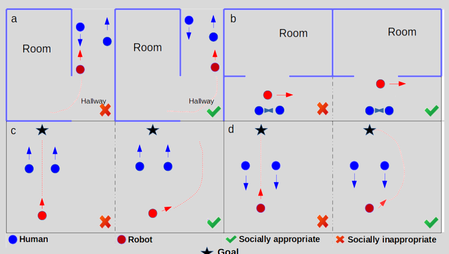

Figure 1: Appropriate and inappropriate scenarios.

Methodology

- Environment and people detection using laser
- Distance based features
- GMM Model
- Appropriateness score
- Modified local trajectory planner

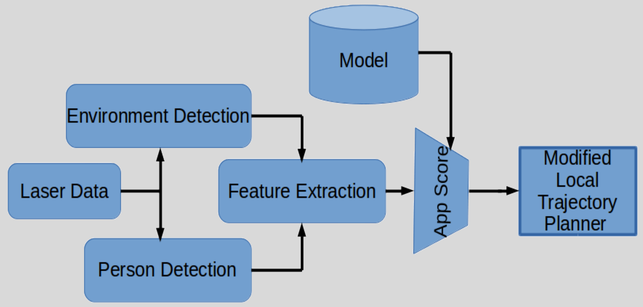

Figure 2: Block diagram of our approach.

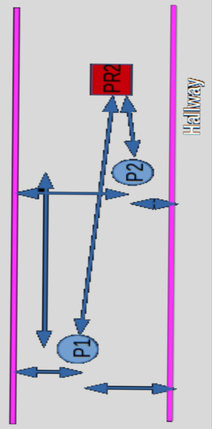

Figure 3: Features.

Results

*	S1	S2	S3	S4
D1	100.00	0.00	0.00	0.00
D2	0.00	100.00	0.00	0.00
D3	0.00	0.00	91.61	8.39
D4	0.00	0.00	12.77	87.23

Table 1: Confusion matrix.

- S/D1: Passing scenario
- S/D2: Meeting scenario
- S/D3: People walking towards a goal
- S/D4: People walking away from a goal

Action Discrimination

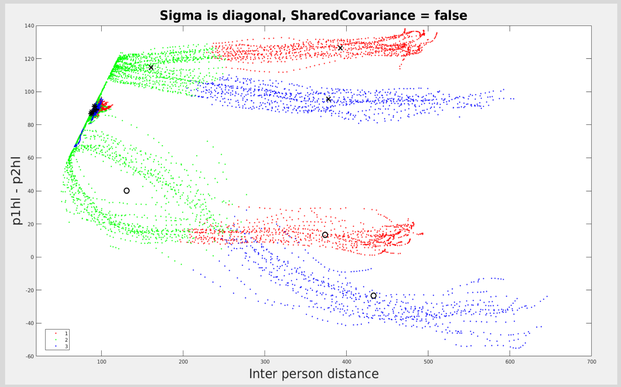

Figure 4: GMM plot of two features.

On-going work

- In-person experiments
- Observer experiments (Heider & Simmel-style videos [2])

- Main experimental insights - Comfort, Sociability and Naturalness [3]

Conclusions

- Model build using distance based features can quickly discriminate between different human actions related to navigation.
- Such a system will be comfortable, sociable and natural [3].
- Will increase the acceptance of robots.

References

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[2] Heider, F., and Simmel, M. 1944. An experimental study of apparent behavior. The American Journal of Psychology 57(2):243–259.

[3] Kruse, T.; Pandey, A. K.; Alami, R.; and Kirsch, A. 2013. Human-aware robot navigation: A survey. Robotics and Autonomous Systems 61(12):1726–1743.