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## Abstract

## 論文内容の要旨 (博士)

Title of Thesis 博士学位論文名	A Socially Aware Guide Robot with Illumination Invariant Face Recognition and Self Learning of Guiding Behavior
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(Approx. 800 words)

(要旨 1,200 字程度)

In recent decades, robots have entered into daily human life. Robot has penetrated wider areas of human life with the main purpose of assisting and facilitating human works, ranged from home appliances until industrial areas. Today, one of the most rapidly growing areas is service robots. The functional of robots is expanded for many purposes which emulate human behaviors and activities. Along with the development of social needs, a robot is expected to be used as a companion or assisting or serving people activities in a wider range. However, the implications of the presence of a robot as a new entity in the human social environment is still continuously studied.

To be able to further interact with humans, a robot that runs a particular function with a social awareness capabilities and is able to behave by obeying social norms will be highly accepted rather than a robot which has goal-oriented only. In regard to emulate what human do by a robot, we focus our work on a social guide robot by arguing that this kind of robot has a unique task and can be used to show the usefulness of social awareness when interacting with human.

The functions of guide robots has been studied in many previous works, ranged from museum, mall, office, and helping a disable people. In their study, a guide robot is equipped with many features which may useful for interacting with humans. However, the responsibility on the human side is still greater than the robot. There is a kind of obligation for the partner to always be aware of the robot states. In some cases, the partner is required to understand the rules or commands if he/she wants to interact with the robot, i.e., using gestures, voices, and other tools. This approach may be acceptable, but we think that it needs participants who are set in advance.

In this thesis, we design our socially aware guide robot from two basic tasks, namely coordination and navigation. Coordination task is a task or process of monitoring human partner awareness and acting a necessary response to ensure the human partner completing ongoing guiding task, while navigation task is a task or process of monitoring and controlling the movements of robot from

starting position to goal position. By actively monitoring and appropriately responding human partner awareness, the robot will be more responsible than the partner. We also consider the robot's behavior that can meet all situations to deal with smoothness, safety and comfort. We use a Q-Learning based Social Force Guiding Model, our motion planning and control method that is specifically designed and optimized for guiding purpose using a differential drive mechanism mobile robot under social force framework.

We also complete our guide robot with an illumination invariant face recognition system that is robust for identifying person even under harsh illumination condition to prevent loss of target. With this addition, the function of the robot can be extended for indoor and outdoor use. We validate our proposed method by performing experiments using simulator and real robot implementation. The experimental results show that our system is very promising and robust enough to perform guiding task in any situations. This work can be a stepping stone towards a socially aware guide robot that is fully responsible to the user.