論 文 の 内 容 の 要 旨

論文題目　System Architecture for Task Execution Robots with Interpersonal Situation Scenting Capability
（対人状況察知機能を備えた作業実行ロボットシステムの構成法）

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To achieve a robotic system that is capable of both task execution and interaction behaviors in our society, the research proposes a system architecture under the theme of ″scenting″ the human interaction willingness from non-verbal behaviors at the beginning of an interaction. The scenting capability is applicable to different task and social situations, and solves the problems of current social robots not having control over human-robot conversations, or problems where current task robots do not have a way of initiating a task.

In chapter 1, we point out the current failures of social robots, what is currently being requested in society, and argue that, for social robots to better benefit our society, social capability should be discussed with other robotic skills e.g. manipulation and navigation.

In chapter 2, we discuss the different focuses in interaction research and explain the novelty of understanding interaction at an initiating stage under different task context. Typical human-robot interaction focus on robot behaviors, dialogue research focus on speech behaviors, however, both target mainly on what happens during a conversation *after* an interaction has been initiated. Previous systems with interaction functions do not consider the interaction willingness of the person.

In chapter 3, to achieve the scenting capability, we propose a computational method using sequential data on human behavior in relation to robot behavior. We categorize the relationship between the interaction willingness of two agents, and explain that there are nine interpersonal situation patterns. Then, we formalize the situations into a hidden Markov based probabilistic graph model.

The model is then trained using human-robot interaction recordings or on runtime. We evaluate the advantages of our method in scenting interaction willingness.

In chapter 4, we summarize the type of skills that are requested in business today and the skills that are requested in near-future settings such as in robot competitions. We explain the importance of heuristic-based manipulation, constraint simplifying hardware designs, task-finite scenarios, and software minimization. This is the basis of our task system for discussion in the other chapters.

In chapter 5, we explain the detailed implementation of our proposed system architecture. Based on general-purpose dialogue patterns, we explain that for action required interactions, we must consider a task scheduler that resolve constraints in the physical context. The task scheduler is combined with the scenting capability and takes into account when and whether the person is willing to interact, listen to the person's dialogue purpose, schedule actions depending on the purpose, postpone interactions if a primary context such as *first-come-first-served* exists between the human and robot. We show task-interaction integration in settings such as a restaurant and show how our architecture technically applies to these settings.

In chapter 6, we go over various experiments using our system to understand its effect and evaluate our system from both a technical and social perspective, including appropriate and in- appropriate behavior in task postponing, how people interact with robots to use its task skills, training a robot's initial interaction behavior, and examples where the system is beneficial in a real setting such as a guiding robot.

In chapter 7, we summarize our achievements and provide future directions.

In summary, we have proposed a task execution system with an interpersonal situation scenting capability, which handles the different interaction situations during task execution, achieves the barebone robotic skills requested in our society, and allows the robot to self-supervise interaction behaviors at an initiating stage of an interaction. From experiments inside and outside the lab, we have evaluated our concept, the technical approach, and the potential effects of a task execution robot with social capabilities including non-verbal initiating behaviors.