Chapter 5.6
Social Coordination with Architecture for Ubiquitous Agents: CONSORTS

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ABSTRACT

We propose a social coordination mechanism that is realized with CONSORTS, a new kind of multi-agent architecture for ubiquitous agents. By social coordination, we mean mass users' decision making in their daily lives, such as the mutual concession of spatial-temporal resources achieved by automatic negotiation of software agents, rather than by verbal and explicit communication directly done by human users. The prerequisite infrastructure for such an electronic negotiation mechanism is a multi-agent architecture for ubiquitous agents that are grounded in the physical world, by which software agents can trace users' moving history, understand their intentions and preferences, and negotiate each other, all while protecting users' privacy through temporal identifiers. The functionality of social coordination is realized in the agent architecture, where three kinds of agents work cooperatively, i.e., a personal agent that serves as proxy of the user; a social coordinator working as a service agent; and a spatio-temporal reasoner. We also summarize some basic mechanisms of social coordination functionality, including stochastic distribution and market mechanisms.

INTRODUCTION

Social coordination is observed in many scenes in our daily lives. People give way to each other when they happen to pass in a corridor or on the road even if they have not met before. And, when purchasing a train or plane ticket, people often give up their position in line to a really hurrying person. In this chapter, we handle the problem of how such social coordination can be realized as an information service by cooperative software agents that are embedded in social infrastructure.

Based on the rapid development of information technology, we can expect that highly-distributed information processors and sensors will be linked by a network. And, in the near future, they will be grounded to the physical world and embedded in social infrastructure, e.g., rooms, buildings, streets, and roads. In such environments, called ubiquitous or pervasive computing environments, one of the keys to providing several kinds of services for people and society is software agent technology.

The purpose of this research is to show a way to realize a social coordination mechanism in daily life through cooperating agents. By social coordination, we mean automatic negotiation by software agents working as a proxy for users, as opposed to the explicit and verbal communication done directly by human users. We have to pay attention to the difference between social coordination and collaboration. Collaboration means highly-organized activity by human users in order to achieve goals that have not been solved, which usually takes long time to obtain a solution. In contrast, social coordination requires real-time responses, e.g., we have to react rapidly to give a traffic lane to others. On the other hand, the best solution cannot be necessarily acquired through social coordination. Even if the best solution is not obtained, if we can reduce just one percent of the traffic in a city or in a country, it will bring much benefit to the economy and environment.

Reflecting the nature of the problem, social coordination requires different approaches from the ones developed for collaboration, e.g., CSCW (Computer-Supported Cooperative Work), Collaborative Multiagent (Grosz & Kraus, 1996), conventional web-based meeting site, and so on.

EXAMPLE: MASS USER SUPPORT IN THEME PARK

One of the examples of social coordination is mass user navigation in a theme park (see Kurumatani, 2002; Kurumatani, 2003). At present, services such as information providing and reservations for attractions are made possible through conventional web-based agent technology. Our intention is to provide more sophisticated services by using the user's situation. One such service is mass user navigation (Figure 1). People tend to make reservations for a popular attraction regardless of the crowd in front of it, and they might ignore less-crowded despite a fair amount of interest. By coordinating users' intentions and preferences, there is a possibility of controlling resource coordination, such as congestion, while keeping users' satisfied. In other words, mass user navigation means coordinating resources to exchange users' intentions and preferences in order to keep them happy.

In the following sections, we explain the underlying architecture, called CONSORTS, for ubiquitous agents, and we give the formalization of the mass user navigation. The architecture CONSORTS is designed to provide mass user support, in addition to conventional personal support services, in a ubiquitous computing environment.

CONSORTS: ARCHITECTURE FOR UBIQUITOUS AGENTS

CONSORTS (an architecture for COgNitive reSOurce management with physically-gRounding agenTS) is a new kind of architecture for ubiquitous agents. It is designed to realize mass user support in addition to conventional personal assistance. The key concepts in CONSORTS are "semantic grounding" and "cognitive resources." By using sensory information brought through a ubiquitous environment, agents have grounding to the physical world and they are conscious of physical resources (especially spatio-temporal resources) in a cognitive way, i.e., they can recognize, reorganize, and operate raw physical resources as cognitive resources. Services realized in CONSORTS include (1) extension of conventional personal services using information about the physical world, such as position; and (2) mass user support that provides information and social coordination for mass users beyond personal support.

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