Distributed Resource Allocation: Generic Model and Solution Based on Constraint Programming and Multi-Agent System for Machine to Machine Services

Kamal Moummadi, Casablanca University, Morocco
Rachida Abidar, Casablanca University, Morocco
Hicham Medromi, Casablanca University, Morocco

ABSTRACT

The growth of technological capabilities of mobile devices, the evolution of wireless communication technologies, and the maturity of embedded systems contributed to expand the Machine to machine (M2M) concept. M2M refers to data communication between machines without human intervention. The objective of this paper is to present the grand schemes of a model to be used in an agricultural Decision support System. The authors start by explaining and justifying the need for a hybrid system that uses both Multi-Agent System (MAS) and Constraint Programming (CP) paradigms. Then, the authors propose an approach for Constraint Programming and Multi-Agent System mixing based on controller agent concept. The authors present concrete constraints and agents to be used in a distributed architecture based on the proposed approach for M2M services and agricultural decision support. The platform is built in Java using general interfaces of both MAS and Constraint Satisfaction Problem (CSP) platforms and the conception is made by agent UML (AUML).

Keywords: Agent UML (AUML), Constraint Programming (CP), Constraint Satisfaction Problem (CSP), Distributed Architecture, Machine to Machine (M2), Multi-Agent System (MAS)

1. INTRODUCTION

Communication technologies based on the use of networks and mobile wireless technologies allow machines to communicate easily without human intervention.

Since the last decade and with the appearance of mobile equipments as the PDAs (Personal Digital Assistant), the need of remote control, and synchronization, between mobile devices and central servers, became essential. In this article, we propose a generic modal called TCG (total control of greenhouses) based on multi-agent systems in compliance with Constraint Programming paradigms for M2M services and agricultural decision support.

TCG implements a scalable architecture respecting three parts: information systems, networks, and remote equipment. The proposed model is developed in Open source and ensure, the reliability as the core software used

DOI: 10.4018/jmcmc.2012040104
is reliable (Eclipse, Apache, etc.), viability as it is standards-based computing (J2E, etc.); interoperability because of the compatibility with different devices; portability to operate on all operating systems; and finally optimization because it uses controller-Agents for Constraints Solving or CACS for short. CACS is intended to be used for solving Distributed Constraint Satisfaction Problem (DCSP) which is an emerged field from the integration between two paradigms of different nature: Multi-Agent Systems (MAS) that is characterized by the autonomy and the distribution of its entities and the Constraint Satisfaction Problem paradigm (CSP) where all constraints are treated in central manner as a black-box. CACS is based on special kind of agents called controllers. A controller role is to encapsulate and verify some constraints assigned to it. CACS allows grouping constraints to form a subset that will be treated together as a local problem inside the controller. The platform is built in Java using general interfaces of both MAS and CSP platforms.

In the next sections we give a short introduction to the constraint programming and multi-agent system, after that we describe our approach for mixing both paradigms in order to model the problem of water using for M2M services and agricultural decision support, then we give an outline onto M2M concept, and the platform implemented by our EAS (Systems’ Architecture Team), used to communicate and to synchronize data between a central server and mobile devices with ANDROID OS, in order to remote control the greenhouses via a PDA(Personal Digital Assistant). This article ends by conception elaborated by AUML and realization of the platform, and finally conclusions and perspectives.

2. MULTI-AGENT APPROACH

2.1. Introduction

The Agent-Oriented (AO) approach gives the ability to concept flexible systems with complex and sophisticated behavior, by combining highly modular components. These components represent agents having autonomy and interaction characteristics.

What is an agent? The term agent has many definitions. According to Wooldridge (1997) an agent is a software system that is:

- Situated in some environment,
- Capable of autonomous actions in order to meet its objectives.
- Capable of communicating with other agents.

From this definition we can say that an agent is an entity that can act and react in his environment and interact with other agents.

An agent is everything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors (Russell & Norvig, 1995).

Intelligent agents continuously perform three functions: perception of dynamic conditions in the environment; action to affect conditions in the environment; and reasoning to interpret perceptions, solve problems, draw inferences, and determine actions (Wassim, 2004).

2.2. Agent Technology

Agent-based systems are one of the most important areas of research and development to have emerged in information technology in the 1990s. Put at its simplest, an agent is a computer system that is capable of flexible autonomous action in dynamic, unpredictable and typically multi-agent domains. In particular, the characteristics of dynamic and open environments in which, for example, heterogeneous systems must interact, and operate effectively within rapidly changing circumstances and with dramatically increasing quantities of available information, suggest that improvements on traditional computing models and paradigms are required. Thus, the need for some degree of autonomy, to enable components to respond dynamically to changing circumstances while
Reconnaissance Attack on IPv6 to IPv4 Tunneling
[www.igi-global.com/article/reconnaissance-attack-ipv6-ipv4-tunneling/76392?camid=4v1a](www.igi-global.com/article/reconnaissance-attack-ipv6-ipv4-tunneling/76392?camid=4v1a)

Context-Aware Personalization for Mobile Services
Abayomi Moradeyo Otebolaku and Maria Teresa Andrade (2019). *Advanced Methodologies and Technologies in Network Architecture, Mobile Computing, and Data Analytics* (pp. 818-830).
[www.igi-global.com/chapter/context-aware-personalization-for-mobile-services/214663?camid=4v1a](www.igi-global.com/chapter/context-aware-personalization-for-mobile-services/214663?camid=4v1a)