http://ansinet.com/itj

ITJ

ISSN 1812-5638

# INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 5 (6): 1117-1121, 2006
ISSN 1812-5638


# A Multi-agents System Approach for Designing Complex Systems

[1]Faiza Saheb and [2]Mohamed Batouche
[1]Department of Computer Science, Laboratory LRI, University Badji Mokhtar,
BP1223000 - Annaba, Algeria
[2]Department of Computer Science, Laboratory LIRE, University Mentouri,
25000-Constantine, Algeria

**Abstract:** The production of software is a scientific and economic problem, particularly the design of complex systems witch require evolving methods and approaches. In this study we propose designing developed in the framework of the Multi-Agents Systems (MAS). At present researches are developed in area of multi-agent systems. They are used in various domains, where they present interesting alternative with classical approaches. We interest to systems whose organization is complex and are adaptive in their environment. System can endowed with life and was able to be initiative, adaptive and emergent in their environment. We propose present with software complex phenomenon to use reactive multi-agent systems within organization represented with three levels. Interface level and internal level and control level who permit to evaluate and given to the organization modification.

**Key words:** Design, multi-agents system, reactive agents, emergence, control

## INTRODUCTION

The design of complex system is considered a crucial step in software development.

Thus the complexity and growing evolution of new software applications make techniques approaches and tools of designing less performance. Most of systems hose used old approaches of design are designed with a manner to conserve only the final results of different designs.

The richness informational connected to the best use for designer in the process of designing is completely omitted. The systems not saved the way traced by the designer between choose effected and/or to take decisions. More then some complex system used knowledge with heterogeneous and granularity whose necessitate approaches manipulate different disciplines (Baquiast, 2002; Bousquet and Gautier, 1999).

Some methodologies were proposed to guide the designers in the tasks for analyses and design (Mbala *et al*., 2003; Pavard and Salenbier, 2003; Picard *et al*., 2002). To satisfy this we are oriented to artificial intelligence and artificial life. Also the model advocated to designing complex system is a model which use the reactive multi-agent systems inspired from distributed artificial intelligence who are for object to release systems organizations whose able to solve problems through reasoning and artificial live with search to understand and to model smart systems (with live) witch will be to survive, to emerge, to adapt and to reproduce within hostile environment (Ennaji, 2000; Ferber, 1995; Guerrin *et al*., 1998; Gutknecht and Ferber, 1998; Lenay, 1994; Ramat and Preux, 2001).

**This method permit:** To develop applications with growing complexity witch exceed widely human comprehension.

To experiment sociological and psychological reflexions about theory models concerned the inter-personnel relations.

Present research in the domain of multi-agent systems, known a high development. They are applied in various domains when they present an interest alternative for classical approaches (Lenay, 1994; Mbala and Reffay, 2005; Mbala *et al*., 2003; Cardon, 2001). In complex organization, the agents were creed to employ methods permitted for system to equip with multiple functions (Gutknecht and Ferber, 1998) . The agent try had to reach them objective, which is fixed for them to change by using their knowledge capacities among their links with their acquaintances network to produce a better organization. They communicate messages between us according to a language that are equipped. They released their pro-actions, to activate the totally of agents organization.

**Corresponding Author:** Faiza Saheb, Department of Computer Science, Laboratory LRI, University Badji Mokhtar, BP1223000 - Annaba, Algeria

The system must have behavior permeating variability, a transformation of components and their relationship. This design permits the system to be in action in its environment with emergence of internal state adapted for current situation.

Although design facilitate the maintenance and decrease the cost of change given for the system, this in particularity means that a design must be easy for comprehension and the effect of change must be localized. It is possible to achieve these objectives when design gives for the system a high cohesion and lower coupling for systemic approaches (Saheb and Sahnoun, 2004a, b). For the case of MAS the design will be perfect when agents of organization will be coherent on the one hand witch means that they cooperate in effective manner and those agents can have almost few knowledge towards them to cooperate better as the same in the alive on the other hand the agents can have lower coupling when they cure characterized with autonomy and by their capacity to realize complex tasks, learning to do and adapted to change able circumstances within agents are included.

## SUPPLY OF MAS

**The MAS offer proprieties such as:**

- Efficacy of processing: the agents work in parallel and communicate with asynchronous way.
- The robustness and the surety of the functionality: the out of functionality of some agents hasn't appreciably modifying the global behavior of the system.
- The flexibility and the processing on a large scale: we can increase the number of agent for processing systems that are more and more complex without perturbing the work of existing agents.
- Its present a low cost of functionality: the sharing out of processing between a number of unites reduce the cost level. Its present an interesting cost of development and reuse: it is simple to develop by specialist agent independently each other for reuse.

## DEFINITION OF AGENT

The agent is a real or abstract entity who is capable to act on him self or his environment, he dispose of partial representation of its environment and in multi-agent universe can communicate with authors' agents and the behavior witch is the consequence of his observations, from his knowledge and from his interactions with the authors' agents.

**Characteristics of agent:**

- The agent is autonomous: He is a program that perceives informations from his environment and can act with the latter. He pursue goals/or realize tasks so that his behavior correspond to objectives defined by his designer.
- The agent is intelligent: He can adopt different strategies to optimize some sizes that characterize objectives of the designer.
- The agent is in interaction: The multiple forms that the agent meet can lead him to consider permanently current processing that this is to find expression in his adaptation for change of his entourage, which can modify his behavior in the all of abstraction levels.
- His interactions open the possibility to act with coordinate way for all available abstraction levels.

## ADOPTED APPROACH

We particularly interested for systems whose organization is complex and they adapted to their environment. Systems keep up with living paradigm and they are able to have initiative and adaptive of original behaviors. We advocate that agents in these systems will be reactive (Fig. 1), so as to be constructing easy and generated by automatically reproduction. These agents must have to possess structural limit knowledge but revisable, their goal will be modifiable according to knowledge, manipulated in the communications.

The reactive agents have been supervised by mechanisms of motivation to push them to carry out task, as satisfaction of goal defined by designer.

Also we can make to reply uniquely for environment stimulus their behaviour is integrally keep in their local state of world witch are throwing into.

The unpolished structure of reactive agents imposed for them more rigid behaviour. For this reason reactive agent aren't very powerful because they used only there average. Individually they are very lower, but their strength is obtained from their capacity to side in-group, it means to construct groups able to adapt for their environment.

Thus, it is not in the level individual those reactive agents are interesting, but in the level of population and the capacity of adaptation and evocation with emerge interaction between these members.

The reactive agents are found in the masses, but by their member and the tendency witch produce, they can meet complex tasks.

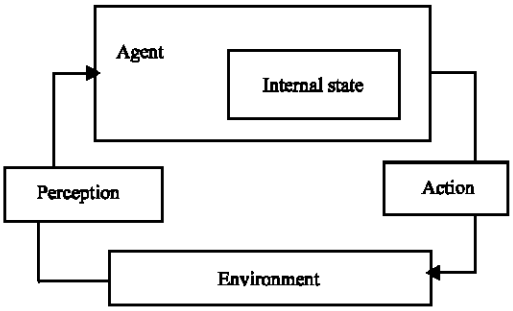


Fig. 1: Reactive agent model

The reactive agents haven't a description of their environment so they are not able to foresee what can happen. For these reason it is necessary to anticipate planning actions to accomplish (Ferber, 1995; Dutech, 2003).

## ARCHITECTURE AND BEHAVIOUR

The general problematic in software engineering for complex systems can emphasize in modeling complex systems can be particularly considered:

- The easiness of design.
- The efficiency of implementation.
- The validity of a model.

The design of complex multi-agent systems distinguish from design of other type of classical systems in particular distributed systems with at last two dimensions:

- The importance of interactions between agents whose are effect on the architecture of the agents.
- The role of environment as inscription place to permit to divide result of activities of each agent and as set of constraint of dynamic system.

Also architecture and behaviour of system agents determine the design architecture. Indeed for designing multi-agent system some steps are suggested (Pierre and Muller, 2002):

- The description of global behavior or precisely the global structure that multi-agent system can release (macro level).
- Projection of this structure on interaction structure in micro level to determinate agent's identity and interaction dynamic.

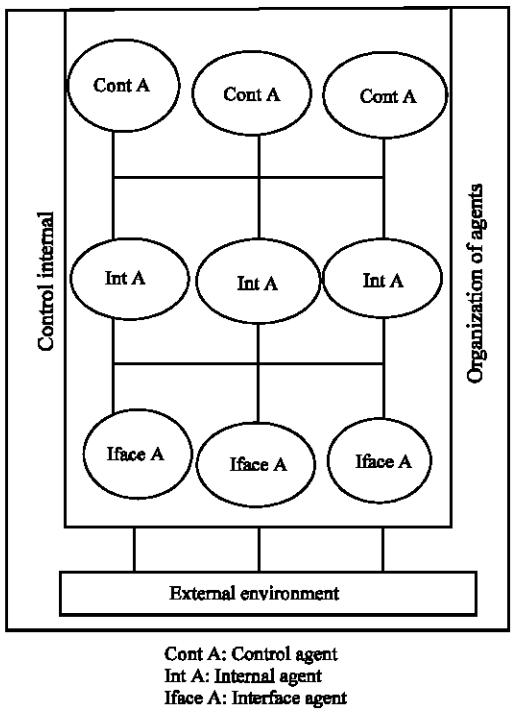


Fig. 2: Architecture of the system

- Specification of behavior of individual agent's produce observed interactions.

Sure of work considered that model of agent architecture can be simplified on two distinct behaviors.

Internal functioning concerned several of agent characteristics; it is a reactive behavior, the planing on learning.

External behavior (interface): represent communication aspect and cooperation, or the perception of its environment and the action within (Yoo and Pierre, 2001; Cardon, 2001; Ferber, 1995).

We propose in this part the architecture of agent organization viewed as a system of collective agents witch has social characteristics of aggregation, of grouping and of restructuring. Our system is constituted of three levels (Fig. 2):

- Interface level composed of communicates agents with external environment with given extraction of information coming from outside in entry and managing actions to make on the environment.
- Internal level composed of development agents taken information from interface level and communicates to them to make tasks or to solve a problem.

- Control level to supervise the work of internal agents and evaluated the functionality of internal agents to insure a good functionality of system, so that evaluated and adapted better for changeover given from environment.

The levels must be interactive in global organization with communication between agents, permitting cooperation and emergence of significant groups. For modeling agents it is need to define their architecture (functions and interactions).

Thus if we like to show the behaviour of agent the designer can be produced by interaction between system and its environment. We propose to decompose the global behavior that we want to realize in sub behavior in order to facilitate implementation (Chaib-Draa, 2002).

The structure of complex system architecture will be represented by software components.

Then the system will be composed with adaptive, evolving components whose emerge that represent functions of MAS. Each component can be composed on one or several of tasks (Meurise and Briot, 2001).

## COMMUNICATION MODEL

To qualified agent of intelligent, it is essential to prove their capacity to communicate in individual or collective main. We represented interactions between agents by protocol of communication to express (information or a conversation) by using language of communication (Fougers, 2003; Mathier and Routier, 2003; Picard *et al*., 2002). The languages of communication between agents identified different level to constitute a conversation.

## CONTROL MODEL

The two fundamental problems in manipulation of complex system of agent are the representation and to master the behavior of agent's organization considered as set.

These two problems are linked to central problem that is a control. For our architecture we advocate a level constructed by supervisor agents that insure the control of organization in the one hand from the point of view of cooperation and other hand from the point of coherence.

The control agents will be doted of metrics to measure a degree for example of cooperation and coherence to permit for used control process.

## CONCLUSIONS

The complexity of MAS required methodologies of designing. This can specified the agents, their interactions and organization behaviour. The agents will be represented by adaptive and evolving components. The interactions are represented by communicate languages. Control agents that permit evaluation of global organization design will insure the control.

## REFERENCES

Baquiast, J.P., 2002. The intelligent automates robotic, artificial live, virtual reality, information, reflexion, discussion'. www .admirontes. asso.fr/ larevue/ 2002/ bricabra. htm.

Bousquet, F. and D. Gautier, 1999. Comparison of two approaches to modeling dynamics SPATIALE and ACTEUR ', Cybergeo 199, N°89.

Cardon, A., 2001. Studing design and control for behavior off strong organization of agents. www. admiroutes. asso.fr /larevue/2001/22/Robot.pdf.

Chaib-Draa, B., 2002. Caual Maps: Theory, Implementation and practical applications in multi-agents environments. IEEE Trans. Knowl. Data Eng., 14: 1201-1217. csdl. computer.org/comp/trans/tk/ 2002/06/k1438.pdf

Dutech, A., O. Buffet and F. Charpillet, 2003. Learning by Reinforcing for Designing Reactive Multi-agents Systems. Multi-Agents, JFSMA'03, Hanmamet, Tunis, Buffet, O., A. Dutech and F. Charpillet, docinsa. insa-lyon.fr/these/ 2004/ zenmir/ 19_bibliographie. pdf -, pp: 219-231.

Ennaji, M., 2000. Modeling agents for software architecture command for vehicle' ,www. irisa. fr /manifestations / 2000/ jjcr/ Papiers/ ennaji.pdf -.

Ferber, J., 1995. The multi-agents system to collective intelligence', Inter- Edn., Paris, pp: 521.

Fougers, A.J. Cognitive architecture of communicate agents in complex of systems of information. www.lifl.fr/mfi03/liste.html.

Guerrin, F., R. Coudier, S. Calderon, J.M. Paillatt.1998. Design of multi-agents model for manager elevate in rural locality'. Actes des JFIASSMA 98, Pont les moussons, Hermès.

Gutknecht, O. and J. Ferber, 1998. The organizational meta - model for analyze, design and execution of multi - agentsystems'.www.madkit. org/papers/jfiadsma 98_ogjf.pdf.

Lenay, C., 1994. Emergent organization in populations: biology, ethnology, artificial system. Intellectica, 19: 9-17.

Mathieu, P. and J.C. Routier, 2005. Yann Seg,'RIO: Role, Interaction and Organization. www. lifl.fr /mfi03 /actes/mfi03-a03.pdf.

Mbala, A., C. Reffay and T. Chanier, 2001. SIGFAD: multi -agent systems to support computer science users by human learning. lifc. univ-fcomte.fr/RECHERCHE/P7/ pub/EIAH03/mbala_eiah03.pdf .

Mbala, A. and C. Reffay, 2005. Supporting distributed collaborative learning with usage analysis based systems. In Procs of the Intl. Workshop 'Usage Analysis in Learning Systems', in Conjuction with the AIED'2005 Intl. Conf. on Artificial Intelligence and Education, Amsterdam, Netherlands, pp: 111-112.

Meurise, T. and J.P. Briot, 2001. An approach based on Components for designing agents. Tech. Comp. Sci., 20: 583-602.

Pavard, B. and P. Salenbier, 2003. From cognitive engineering to the theory of complex systems away of analysis and modeling of central activity on design. GRIC-IRIT (UMR5505 CNRS), SEELF.

Picard, G., D. Capera, M.P. Gleizes and P. Glize, 2002. A simple application of ADELFE focusing on analysis and design, the mechanical synthesis problem: http: //www.irit.fr/SMAC.

Pierre, J. and Müller, 2002. From autonomous systems to multi-agents systems: Interaction, emergence and complex system.

Ramat, E. and P. Preux, 2001. A multi-agents and object for modeling and simulation of complex systems. www.utt.fr/mosim01/pdf/ARTICLE-070.pdf.

Saheb, F. and Z. Sahnoun, 2004. Intelligent assistance based on knowledge for software design. Proceedings of 8th conference MCSEAI'04, Sousse, Tunisia, pp: 113-124.

Saheb, F. and Z. Sahnoun, 2004. Intelligent assistance for software design. Proceedings of Conference MAJESTIC'04, Poster_14_1_4_saheb, Calais, France.

Yoo, M.J. and J.P. Briot, 2001. Componential approach for modeling mobile cooperate agent. ftp. lip6. fr/ lip6 /reports /2001/lip6.2001.013.pdf