

**VIRTUAL UNIVERSITY OF PAKISTAN, LAHORE**  
**(DEPARTMENT OF COMPUTER SCIENCE)**

**Synopsis for Master of Science in Computer Science (MSCS)**

**I. Name of Student:** X Y Z

**II. VUID:** MS0-0400---

**III. Title of Synopsis: Application of Agent Oriented Requirement Engineering to  
Bilateral (Human-Agent) Negotiation**

**IV. Thesis Research**

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**Duration:** 6 Months Approximately

**V. Supervisory Committee:**

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## **ABSTRACT**

Software development success is based on understanding stakeholder needs and translates those needs into requirements. Requirement engineering is the process of discovering the purpose for which a system is intended. The success of any software product depends on how strongly the requirements are captured. Many daily activities require negotiations, often bilaterally. In such a kind of negotiation, two agents negotiate with each other to reach a consensus. In negotiation, different stakeholders are involved, and they might have contradictory requirements and different priorities. One of the reasons of failures of software is the conflict between stakeholders and developers. Different requirement engineering approaches are in practice but the Agent Oriented Requirement Engineering (AORE) focuses on objects and goals. The AORE models the requirements in terms of tasks and goals. As a result requirements are modeled as autonomous interactive components. Requirement engineering is mainly concerned with the identification of goals. These goals are then transformed into services and constraints. Then finally the responsibilities for the resulting requirements are assigned to agents such as human beings or software.

Electronic negotiation system exists but if there is a hybrid negotiation (human and computer) then this negotiation process becomes more complicated. The main obstacle in such a kind of negotiation is incomplete information as the behavior of human is diverse by nature. Humans do make mistakes as they are influenced by the social and cultural issues. This research is intended to apply an agent oriented requirement methodology to the human agent bilateral negotiation to capture a complete set of requirements. This will help to design model to carry out such a kind of negotiation where a person can assign a machine to negotiate on his/her behalf with another party that is a human. This research will focus about the authorities and responsibilities of the agents who will act the same role as human.

### **Need of the Project**

Requirement Engineering is an area of emergent importance. It focuses on identifying “what” a system is supposed to do rather than “how” which the other subsequent software engineering stages elaborate. In the later phases of development software suffers from

problems of being model and justification of decision that were made in earlier phase. Most of the existing requirement techniques focus on later phase of requirement engineering. An agent oriented requirement engineering technique may be adapted for early phase requirement engineering. The concept of agent encompasses both the human and the non human agent in requirement engineering. The AORE helps to understand the complex relationships and exposes the strengths and weaknesses of existing process. The methodology explains the motives so it is possible to argue that why one alternative was chosen over the other.

The  $i^*$  framework is used to support early phase of requirement engineering. This framework is developed for modeling and reasoning about organizational environments and their information system. This model describes the dependency relationship among various actors and their interests and concerns. Another framework, Requirement Engineering Framework (REF) which is extension of  $i^*$  is used to elicit the requirements by non technical stakeholders. Requirements are evaluated from two perspectives, one is the user's perspective and other is the developer's perspective. User story cards approach is used to evaluate requirements in these perspectives. User oriented view of requirements is presented using user story cards and then these Story cards are mapped to agents cards which presents developer's perspective. All these frameworks are used to capture the requirements in the earlier phase but they are limited to some extent. This research is intended to evaluate and apply the agent oriented requirement engineering framework to bilateral negotiation to understand the requirements better. In a bilateral negotiation, the major concern is to develop a consensus based on the offers made by another agent. A novel idea will be used in this context that enables an agent to participate in bilateral negotiation and cooperate in the decision-making process.

### **Review of Literature**

Lin *et al.* (2006) discussed the role of automated agent in bilateral negotiation. A bilateral negotiation is concerned in which two agents negotiate to reach a consensus over conflicting issues. They developed a simulation environment that can be customized so that utility functions and scenarios, expressed as multi issue attributes, with or without the effect of time, can be used without additional modifications to the configuration of the interface of

the simulation or automated agent. They developed a simulation to test negotiation scenario between England and Zimbabwe to reach an agreement. They conducted three sets of experiments to test the automated agent against a bounded rational agent, against an agent who followed a Bayesian equilibrium strategy and against itself. Their results showed that their agent was indeed able to negotiate successfully with human being and reaching an effective agreement.

Yu (1997a) reviewed concepts of agents in several RE frameworks. He stated that the modeling of functional requirements in terms of collection of agents is supported by Albert (Albert II) language. These agents interact in order to provide services necessary for organization. Albert II language expressed functional requirements in terms of set of formal statements. In order to define the set of admissible behavior the agents may experience, they grouped these statements around agents. Yu (1997b) further proposed two models; Strategic Dependency (SD) and Strategic Rationale (SR). They used SD model to describe dependency relationship among various actors. A SD model consisted of set of nodes represented actors and set of dependencies to describe relationship among them. An SR model allowed visualizing the intentional elements into the boundary of an actor in order to refine the SD model with reasoning capabilities. Ayala *et al.* (2005) did a comparative study of different versions of  $i^*$  that are Goal oriented Requirement Language (GRL) and language of TROPOS methods. They further proposed a conceptual model that can be used as a reference framework for these variants. Singh *et al.* (2008) reviewed various agent oriented requirement engineering frameworks like  $i^*$ , REF, ConGolog and F3 framework and proposed various parameters for their evaluation. Their reviews and evaluation showed that functional and non functional requirements can be modeled, analyzed, verified and documented.

Luiz and Yu (2002) presented a methodology that used strategic actor concept as central organizing concept. Their proposed methodology addressed the early stage of requirement elicitation and analysis. The methodology adopted is to first understand the domain. To understand the domain they systematically collected and analyzed the vocabulary used by stakeholders. They further stated that during the early stages of development an understanding of the problem is required to be established. This understanding may be established by analyzing organizational structure, process and

social relationships. The existing process's alternatives were exposed and see how these alternatives can help to overcome problem and improve existing process.

Bresciani and Donzelli (2003) extended the  $i^*$  framework and proposed an agent based framework Requirement Engineering Framework (REF) designed around the adoption of notion of graph have a simple but effective representation. REF allowed non technical stakeholders to elicit requirements, in cooperation with requirement engineers. REF breaks down the activity into intellectually manageable components and also adopts different approaches in combination. REF is explicitly designed to support the analysts. It helped them in reasoning about socio-technical system, and transforming high-level organizational needs into requirements of the system to be developed, while redesigning the organizational structure itself. They further stated that REF could be improved with respect to the support they provide to the analysts in order to deal with complex, and design related issues of system/organization, such as shared and conflicting stakeholders needs.

Gaur *et al.* (2010a; 2010b) proposed a framework which provides the potential for rapid development of increasingly more versions of prioritized and validated requirement. The methodology is divided into set of framework activities of requirement engineering but all are accomplished in the direction of Agent Oriented System. In the proposed model the requirements were recorded on User Story Card (USCs) which represented the user oriented view of requirements. USCs were mapped to Agents Cards (ACs) which is developer oriented view of requirement. The stakeholders have conflicting requirements; Multi Person Decision Model consisting of fuzzy  $\alpha$ -Cut and total ordering to acquire best possible agreement among stakeholder so that system developed using this integrated set of requirements can eventually lead to a system that satisfies all the stakeholders in the system.

Ahmad (2008) introduced spiral model with supporting element in requirement in the requirement elicitation and analysis process. They stated that negotiation is necessary in requirement elicitation. Oshrat *et al.* (2009) discussed the role of automated agent in negotiation. They presented that negotiation between automated agent and people is much efficient and automated agent perform much better than another state of the art

agent. Lin *et al.* (2006) outlined the design of an automated agent for bilateral negotiation. They discussed how the agent with incomplete information develops a consensus with decision making power.

### **Materials and Methods**

The proposed research is intended to apply an agent oriented requirement methodology to the human agent bilateral negotiation to capture a complete set of requirements. The captured requirements would be applied on a scenario. The main focus in this research would be to elaborate how agent oriented requirement engineering helps to achieve goals. The intention is to see how the ongoing requirements are negotiated and how two agents (human and software agent) interact with each other. An Approach will be presented to apply REF for removal of conflicts among the stakeholders and further clarify the misunderstandings between users and developers with USCs (User Story Cards). By using these frameworks, the agent is allowed to participate in decision making process based on the offers made by another agent.

### **Literature Cited**

- [1] Ahmad, S. 2008. Negotiation in the Requirements Elicitation and Analysis Process. 19<sup>th</sup> Australian Conf. on Software Engineering, ASWEC '08. (Australia) pp. 683-689.
- [2] Ayala, C. P., C. Cares, J. P. Carvallo, G. Grau, M. Haya, G. Salazar, X. Franch, E. Mayol and C. Quer. 2005. A Comparative Analysis of *i\** - Based Agent Oriented Modeling Languages. Proc. of 17th Int. Conf. on Software Engineering and Knowledge Engineering, SEKE'05. (North Blackburn, Australia). pp. 43-50
- [3] Bresciani, P. and P. Donzelli, 2003. A Practical Agent-Based Requirement Engineering Framework, ER – (Workshops) Lecture Notes in Computer Science (LNCS) 2003. Springer-Verlag, (Berlin, Heidelberg). pp. 217-228. ISBN: 3-540-20257-9

- [4] Yu, Eric S. K. 1997a. Why Agent Oriented Requirements Engineering. Proc. of 3<sup>rd</sup> Int. Workshop on Requirement Engineering, REFSQ'97. (Barcelona, Catalonia) pp. 15-22
- [5] Yu, Eric S. K. 1997b. Towards Modeling and Reasoning Support for Early Phase Requirement Engineering. Proc. of 3<sup>rd</sup> Int. Symposium on Requirement Engineering, RE'97. (Washington D.C., USA). pp. 226-235
- [6] Gaur, V., A. Soni, and P. Bedi., 2010a. An Agent Oriented Approach to Requirements Engineering. IEEE 2<sup>nd</sup> Int. Advance Computing Conf., IACC '10. (Patiala, India). pp.449-454
- [7] Gaur, V., A. Soni, and P. Bedi, 2010b. An Application of Multi-Person Decision-Making Model for Negotiation and Prioritizing Requirements in Agent Oriented Paradigm. IEEE Int. Conf. on Data Storage and Data Engineering, DSDE '10. (Banglore, India). pp. 164-168
- [8] Lin, R., S. Kraus, J. Wilkenfeld and J. Barry, 2006, An Automated Agent for Bilateral Negotiation with Bounded Rational Agents with Incomplete Information. Proc. of 17<sup>th</sup> European conf. on Artificial Intelligence, ECAI 2006. (Riva del Garda, Italy). pp. 270-274
- [9] Luiz, M.C. and E. Yu, 2002. Requirement Engineering for Large Scale Multi Agent System. 1<sup>st</sup> Int. Workshop on Software Engineering for Large Scale multi-agent System, SELMAS'02. (Orlando, Florida, USA).pp. 39-56
- [10] Oshrat, Y., R. Lin and S. Kraus, 2009. Facing the Challenge of Human-Agent Negotiations via Effective General opponent Modeling. AAMAS'09 Proc. of 8<sup>th</sup> Int. Conf. on Autonomous Agents and Multiagent Systems - Vol (1). International Foundation for Autonomous Agents and Multiagent Systems (Richland, SC). pp. 377-384. ISBN: 978-0-9817381-6-1

[11] Singh, Y., A. Gosain, M. Kumar, 2008, Evaluation of Agent Oriented Requirement Engineering Frameworks. Int. Conf. on Computer Science and Software Engineering, CSSE 2008. (Wuhan, China). pp. 33-38