A REQUIREMENT MODELLING FRAMEWORK FOR REAL-TIME MULTI-AGENT SYSTEMS

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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PUBLICATIONS BASED ON WORK PERFORMED IN THIS THESIS

1. Ashamalla, A., G. Beydoun and G. Low (2011). Towards agent-oriented approach to a call management system. Information Systems Development, Springer New York: 345-356.
2. Ashamalla, A., G. Beydoun, G. Low and J. Yan (2012). "Towards Modelling Real Time Constraints." ICSOFT 2012 7th International Conference on Software Paradigm Trends. SciTePress Digital Library: 158-164.
3. Ashamalla, A., G. Beydoun and N. Paramesh (2014). "Real-Time Task Attributes and Temporal Constraints.". AMCIS 2014 American Conference on Information Systems. Savannah, Georgia, August 2014.
4. Ashamalla, A., G. Beydoun and G. Low (2017). Model driven approach for real-time requirements analysis of multi-Agent systems. Computer Languages, Systems and Structures Journal (COMLAN), Elsevier. [To appear]

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Real-time constraints are a subset of abstract temporal constraints, which are a class of constraints that are often placed on real world tasks during a problem-solving activity. Violating temporal constraints can produce consequences of unknown severity. Real-time constraints research is extremely useful in environments that require a high degree of availability and reliability, which are the main characteristics of real-time multi-agent systems (RTMAS). Domains currently using RTMAS include, but are not limited to, rescue systems, scheduling applications, electricity, infrastructure systems, flight control systems, marine systems, automotive systems.

This thesis synthesises a framework to support RTMAS requirements analysis to enhance system design identifying real-time and fault tolerance requirements in the early phase of the software development life cycle. The framework consists of a sufficient set of constraints and an associated process to identify and apply the modelling units. The analysts identify the applicable modelling units during the system analysis phase of the sought RTMAS. A design science approach was applied to construct the framework systematically. The framework was validated incrementally as it was constructed using a call centre case study, a meeting scheduling application and an iPhone scheduling application. These case studies have illustrated that the early identification of the real-time constraints and their even distribution among different agent, significantly reduce the chance of an agent failing. These also enhance the system stability and redundancy by providing an extra level of fault tolerance at the agent and task level, as well as at the overall system level.