Information Systems Department
Faculty of Computer and Information Sciences
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Replication for Distributed Databases in Real-Time Systems

DISSERATION

Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Information Systems

To

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Dissertation Title

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Abstract

Distributed Real-Time Database Systems (DRRDBs) demand consistency and timeliness to guarantees the correctness of their performed tasks. There are two approaches to maintain consistency between the actual state of t-he real-time object and its images as reflected by all its replicas distributed over multiple nodes. These two approaches for replication are either *optimistic or pessimistic*, on which all the current existing replication models are based on. These models are trading off consistency for performance, raising the most important issue affecting the design of DRTDBs.

In this dissertation, a replication model *DoMORE* for Distributed Real-Time Database is presented. *DoMORE* is based on a hybrid employing of the two approaches of replication, implying an extension for both the theory and the implementation of them. The model is based also, on increasing the chance of having the updated data items locally without the need to get it remotely from other sites, thus maintain timing constrains for the real-time transactions.

A replication control algorithm is further presented. This algorithm maintains an independent consistency degree for each data object that is dynamically calculated according to some predefined factors. The *DoMORE* model, through the proposed algorithm achieves both availability and consistency for the replicated data as much as possible. It guarantees that all the transactions will read an updated valid data items and maintain both *Temporal Consistency* and *Mutual Global Consistency*.

A general framework to design a replicated real-time database for small to medium scale systems is also presented. A detailed simulation study shows that the proposed model can greatly improves the system performance compared to the systems either without replication or with full replication.

Finally, an investigation of how *DoMORE* model could be implemented as a replication model in a main-memory RDBMS (example: Oracle TimesTen) is also presented.

Keywords: *Distributed Database, Real-time databases, Simulation, Replication, and Replica control algorithm*