THE SPECIFICATION, ANALYSIS, AND EXECUTION OF REQUIREMENTS AND DESIGNS FOR REAL-TIME SYSTEMS

FINAL PROGRESS REPORT

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The goal was to further develop a methodology, language, and tools, based on state-machines, for describing, analyzing, and executing requirements and designs for concurrent and distributed real-time systems.

Using our communicating real-time state machine (CRSM) notation, we showed how specifications-in-the-large could be obtained with simple mechanisms for composing CRSMs into subsystems and larger systems, and how assertion checking can be employed to monitor systems changes. Events and data messages that are communicated among distributed components are often time-stamped as a way to handle timing constraints, ordering, and causality; the idea of time-stamped event histories, i.e., sequences of time-stamped events ordered by time, was developed as a new real-time programming object and supported by an implementation extension of our CRSM simulator. Our current work is focused on real-time communication models that fit naturally into a state-machine framework and that can be applied to the many and diverse forms of distributed communication that exist.

Real-time systems, state machines, specification methods
A. STATEMENT OF THE PROBLEM STUDIED

The general problem and purpose was to develop methods for specifying and analyzing real-time systems. In particular, the goal was to further develop a methodology, language, and tools, based on state-machines, for describing, analyzing, and executing requirements and designs for concurrent and distributed real-time systems. Emphasis was on the handling of time, scalability, and real-time communications.

B. SUMMARY OF THE MOST IMPORTANT RESULTS

Using our communicating real-time state machine (CRSM) notation\(^1\), we showed how specifications-in-the-large could be obtained with simple mechanisms for composing CRSMs into subsystems and larger systems, and how assertion checking can be employed to monitor systems changes\(^2\). Events and data messages that are communicated among distributed components are often time-stamped as a way to handle timing constraints, ordering, and causality; the idea of time-stamped event histories, i.e., sequences of time-stamped events ordered by time, was developed as a new real-time programming object and supported by an implementation extension of our CRSM simulator\(^4\). Finally, our current work is focused on real-time communication models that fit naturally into a state-machine framework and that can be applied to the many and diverse forms of distributed communication that exist.

In addition to the publications listed in Part C, the research was also disseminated via several invited talks. The PI gave an invited presentation at the First International Workshop on Real-Time Computer Systems and Applications in Seoul, Korea, in December, 1994 on the topic “Specifying large real-time systems with communicating real-time state machines.” He also gave one of the keynotes at the Twenty-third IFAC/IFIP Workshop on Real-Time Programming, Shantou, China, in June, 1998. Finally, at the July 1998 ARO Workshop on Software Design Automation for Reactive Systems, Shaw delivered an invited talk on “Some software challenges in large monitoring and control systems.”

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C. LIST OF ALL PUBLICATIONS AND TECHNICAL REPORTS


D. LIST OF ALL PARTICIPATING SCIENTIFIC PERSONNEL SHOWING ANY ADVANCED DEGREES EARNED BY THEM WHILE EMPLOYED ON THE PROJECT

- Liliana Alfaro, Graduate Student Research Assistant (M.S., 1998)
- Sean Sandys, Graduate Student Research Assistant (current Ph.D. student)
- Alan Shaw, Professor (Principal Investigator)