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Engineering and Applications

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REAL-TIME SYSTEMS

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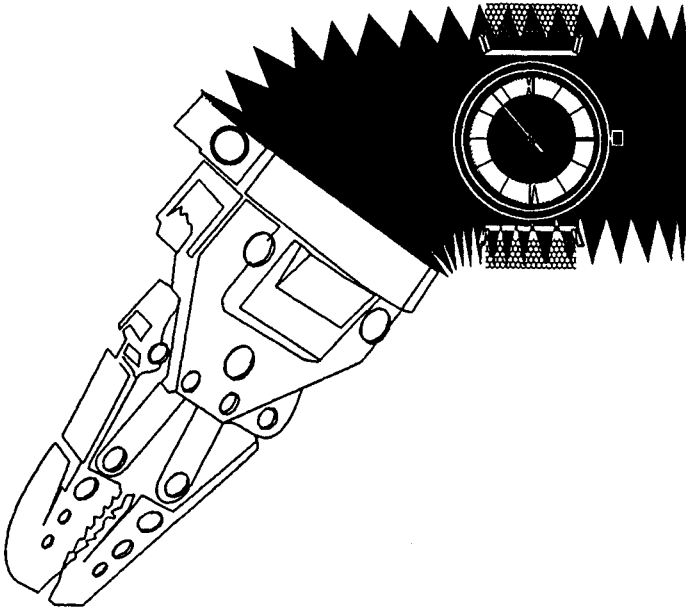
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REAL-TIME SYSTEMS

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FOREWORD

I am very pleased to write a foreword to this book, which is so timely and is authored by so many recognized experts in the evolving new discipline of "real-time computer science".

As a matter of fact, real-time aspects have been considered in the past only marginally - if at all - by the computer science community. This fact can easily be explained from the very definition of real-time systems as *those systems in which the correctness depends not only on the logical results of computations but also on the time at which the results are produced*. A mathematically oriented computer scientist is educated to deal with logics, algebra, etc.; thus, with time-independent computations. It is the engineer who finds himself involved in real-time problems. Therefore, it is not surprising that efforts to cope with real-time problems have been undertaken by application oriented institutions, such as software firms, control engineering departments of universities, etc. And, as well, it is not surprising that application-oriented thinking produced ad hoc results, but not a consistent and sound theory of real-time systems.

It is only recently that computer science institutions are becoming interested in real-time computing, realizing the significance of real-time systems and their increasing practical importance. Some indications of this interest are, for example, the foundation of a committee on real-time systems in the German computer science association (Gesellschaft für Informatik) two years ago, and the introduction of the journal *Real-Time Systems* by Kluwer Academic Publishers in 1989.

The two editors of this book, Dr. Schiebe and Dr. Pferrer, owe the merit of bringing together many well-known experts in the field of real-time systems, and, as well, to cover the most important areas in a consistent way. Starting with the historical background, the book presents theoretical foundations, continues with models and tools, with practical considerations and with examples for applications, and ends with future developments. It is thus a compendium of the actual state-of-the-art of real-time computer science and it certainly will help to teach real-time thinking to future computer scientists.

*R. Lauber
Stuttgart, Germany*

PREFACE

Now that real-time systems have been freed from the former squeeze between hardware limitations and cost-constraints, it becomes feasible to be concerned about a more systematic approach to the whole field of Real-Time Systems Engineering.

Why this book? Although quite a few books on the subject of Real-Time Systems Engineering already exist, they often reflect a very personal view of one author only. This book, in contrast, attempts to cast light on this rapidly developing discipline from diverse angles without harmonizing the different perspectives the authors may have. At the same time, it is organized systematically so that it can be used as a source book and a textbook at the same time. This book, however, is not a problem-solver or a cookbook. Instead, it makes suggestions of different kinds for novel approaches to Real-Time Systems Engineering, keeping in mind that the most dangerous phrase employed by computer people, as Grace Hopper (who retired as rear admiral of the US Navy in 1986 after working successfully more than 40 years on computers) once stated:

"But we've always done it that way".

(viz, writing programs in Assembler, avoiding programming tools, overlooking operating systems developments, denouncing safety as a personal matter...). Hopefully, by presenting innovative concepts in this important field of real-time processing, this book will encourage the reader to reassess his own thinking and to even

"try it also another way".

M. Schiebe
University of Ulm

How this book is organized:

Part 1 presents an overview to the origins of real-time processing.

Part 2 contains material of predominantly theoretical character that will be new, if not somewhat alien, to most readers and thus may trigger some discussions.

Part 3 introduces useful modeling concepts and tools that may have escaped, e.g., the weathered engineer who has concentrated his energy on ploughing through major Assembler programs to be pressed into mini-memories of present and former generations of microcomputers.

Part 4 focuses on the more practical aspects of Real-Time Engineering and is meant to give an overview of the present state-of-the-art, both in hardware and software including related concepts in robotics.

Part 5 gives examples for novel and even controversial real-time applications that illustrate the present state-of-the-art.

Part 6 focuses on future developments, gives suggestions for future research activities and for an educational program.

The book is complemented by a Glossary that tries to define the terminology employed in Real-Time Systems Engineering.

Acknowledgements

This book was conceived during a Workshop on Real-Time Processing organized by the Editors at the University of Ulm, FRG, in 1989. This fact - together with the long-standing experiences in Europe with civil applications in real-time engineering - is responsible for the dominance of contributions by European engineers and computer scientists, a fact which may be new for the readers from overseas.

The Editors would like to thank all authors for their valuable contributions and in particular the consulting editors, Drs. W. A. Halang, A. Knoll, and O. Künzel for their work.

The lay-out and editing (performed on an ATARI ST with Calamus (c)) is always a painstaking effort and has thus required the fullest attention of Mrs. U. Richter to whom we are particularly grateful.

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