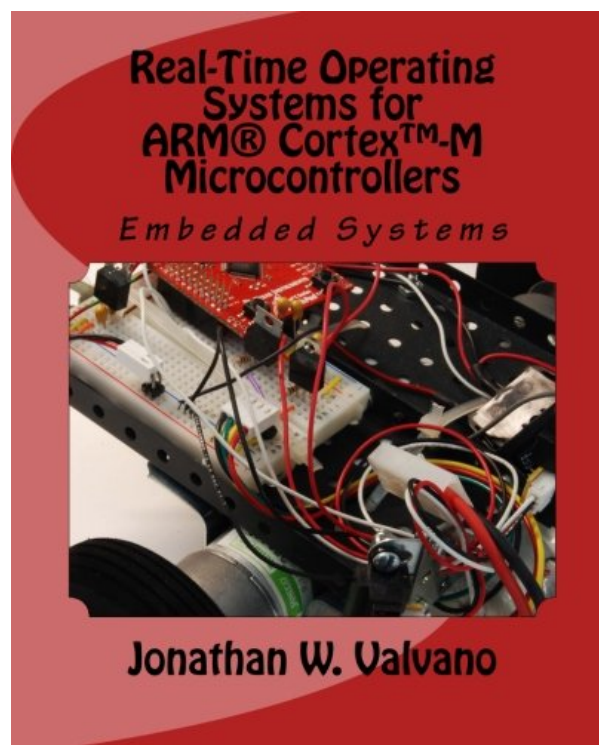# EMBEDDED SYSTEMS: REAL-TIME OPERATING SYSTEMS FOR ARM CORTEX M MICROCONTROLLERS BY JONATHAN VALVANO

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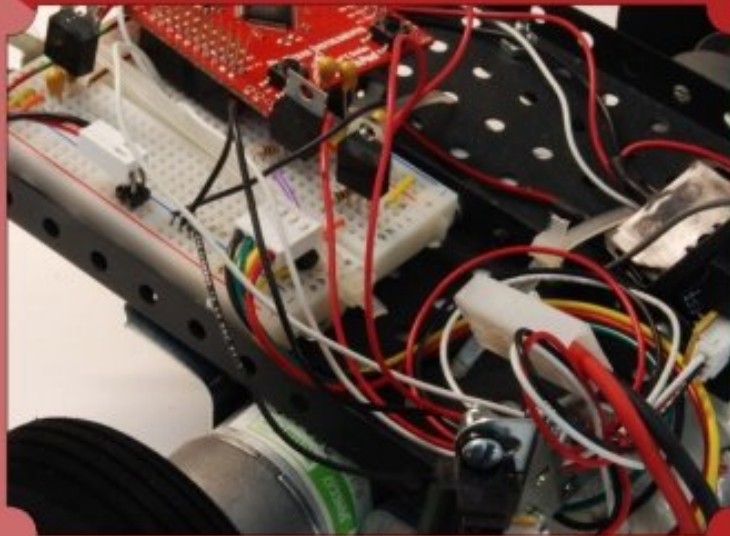
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About the Author
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Embedded systems are a ubiquitous component of our everyday lives. We interact with hundreds of tiny computers every day that are embedded into our houses, our cars, our toys, and our work. As our world has become more complex, so have the capabilities of the microcontrollers embedded into our devices. The ARM® Cortex™-M family represents the new class of microcontroller much more powerful than the devices available ten years ago. The purpose of this book is to present the design methodology to train young engineers to understand the basic building blocks that comprise devices like a cell phone, an MP3 player, a pacemaker, antilock brakes, and an engine controller. This book, now in its third edition (September 2014), is the third in a series of three books that teach the fundamentals of embedded systems as applied to ARM® Cortex™-M microcontrollers. This third volume is primarily written for senior undergraduate or first-year graduate electrical and computer engineering students. It could also be used for professionals wishing to design or deploy a real-time operating system onto an ARM platform. The first book Embedded Systems: Introduction to the ARM Cortex-M Microcontroller is an introduction to computers and interfacing focusing on assembly language and C programming. The second book Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontroller focuses on interfacing and the design of embedded systems. This third book is an advanced book focusing on operating systems, high-speed interfacing, control systems, robotics, and the Internet of Things (IoT). Rather than buying and deploying an existing OS, the focus is on fundamental principles, so readers can write their-own OS. An embedded system is a system that performs a specific task and has a computer embedded inside. A system is comprised of components and interfaces connected together for a common purpose. Specific topics include microcontrollers, design, verification, hardware/software synchronization, interfacing devices to the computer, real-time operating systems, data collection and processing, motor control, analog filters, digital filters, and real-time signal processing. This book employs many approaches to learning. It will not include an exhaustive recapitulation of the information in data sheets. First, it begins with basic fundamentals, which allows the reader to solve new problems with new technology. Second, the book presents many detailed design examples. These examples illustrate the process of design. There are multiple structural components that assist learning. Checkpoints, with answers in the back, are short easy to answer questions providing immediate feedback while reading. Simple homework questions provide more detailed learning opportunities. The book includes an index and a glossary so that information can be searched. The most important learning experiences in a class like this are of course the laboratories. Each chapter has suggested lab assignments. More detailed lab descriptions are available on the web. Specifically for Volume 1, look at the lab assignments for EE319K. For Volume 2 refer to the EE445L labs, and for this volume, look at the lab assignments for EE445M/EE380L.6. There is a web site accompanying this book http://users.ece.utexas.edu/~valvano/arm. Posted here are Keil uVision projects for each the example programs in the book. You will also find data sheets and Excel spreadsheets relevant to the material in this book. The book will cover embedded systems for the ARM® Cortex™-M with specific details on the LM3S8962, TM4C123, and TM4C1294. Most of the topics can be run on either of the TM4C123 or TM4C1294 LaunchPads. Ethernet examples can be run on the LM3S8962 or TM4C1294. Although the solutions are specific for the LM3S/TM4C family, it will be possible to use this book for other ARM derivatives.

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11 of 13 people found the following review helpful.
It's a good book. Cons first since I am giving only ...
By M. Melendez
It's a good book.

Cons first since I am giving only three stars (changed it to 4 since the author really makes an incredible effort to produce a ton of material):

1. It is directed towards RTOS. However the RTOS focus is rather lacking.
2. All RTOS concepts are explained theoretically. However, there are almost no real complete examples developed.
3. The websites (s) supporting the book also don't contain a lot of RTOS support.

Recommendation on a new version:
Ditch many of the chapters on the ARM concepts. They are all important, but they are already covered in great length in the first two books. I don't see the need to re explain NVIC, UART, USB, GPIO to the great length it is detailed. This is actually pretty good data with many developed projects, and it would be fine to have this if the RTOS focus was more, say at least 3 more chapters detailing an example with tasks, semaphores, you would have to pick a particular RTOS but I think that would be ok, they are all a bit similar. Since RTOS is not fully developed then all the "other" good data seemed to pad the book.

Pros:

There is a ton of data on everything about the cortex M MCU. I mean a ton of data and fully developed

projects for all. You name it, and there is a fully developed project with detailed explanations....

This is a great book with some excellent interfacing ideas...
By Mario Ghecea
I just wish that there was more meat to the applications instead of just being simple examples...I assume that the author just leaves this to the end user! I think the concepts are great, for example using linked lists to pass in sequential state. The use of FIFOs in communications, but I feel that there is more to be desired in this modern age where good examples seem to be lacking...It is possible they fall under the rankings of IP and that is something a lot of authors seem to stay clear of...

Not a Real-Time OS Book
By Michael
The author is NOT a software Engineer, he is an EE. (Personal prejudiced, I have not found many EEs that are good at software engineering.) As a result there are plenty of circuit examples, and probably many are useful, but the RTOS information is shallow and incomplete. If the author is going to presume to write about Real-Time Operating Systems, in todays world, he should include some mention of multi-core chips and processor to processor communication. There should be more information about Memory Barrier instructions, and how to use them, than about Maxim chips. More about effectively using the interrupt controller (NVIC) than about digital signal processing. The author stays preliminarily with TI/Luminary Micro ARM products. Not bad, but a limited set. None of these things are bad, in and of themselves, but they are secondary to the title topic - Real-Time Operating Systems for ARM Cortex-M Microcontrollers.

The book is also self-published, presumably to reduce its cost. I don't see it. I have also found that it has numerous typographical errors throughout. This is the second edition, I hope that the author gets a good proofreader before publishing the third edition.

The book may be a fair introduction for the high school student or freshman in college, but it is certainly not sufficient for a true course in Real-Time Operating Systems at any level.

Buy if for reference, if some of the examples are useful. Do not buy it to learn Real-Time Operating Systems.

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