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Systems

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During the past few years there has been an dramatic upsurge in research and development, implementations of

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new technologies, and deployments of actual solutions and technologies in the diverse application areas of embedded systems. These areas include automotive electronics, industrial automated systems, and building automation and control.

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Comprising 48 chapters and the contributions of 74 leading experts from industry and academia, the Embedded Systems Handbook, Second Edition presents a comprehensive view of embedded systems: their design, verification, networking, and

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applications. The contributors, directly involved in the creation and evolution of the ideas and technologies presented, offer tutorials, research surveys, and technology overviews, exploring new developments,

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deployments, and trends. To accommodate the tremendous growth in the field, the handbook is now divided into two volumes. New in This Edition:

- Processors for embedded systems
- Processor-centric architecture description

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languages

Networked

embedded systems

in the automotive

and industrial

automation fields

Wireless embedded

systems Embedded

Systems Design and

Verification Volume

I of the handbook is

divided into three

sections. It begins

with a brief

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introduction to embedded systems design and verification. The book then provides a comprehensive overview of embedded processors and various aspects of system-on-chip and FPGA, as well as solutions to design challenges. The

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final section
explores power-
aware embedded
computing, design
issues specific to
secure embedded
systems, and web
services for
embedded devices.
Networked
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Volume II focuses
on selected
application areas of

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networked
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embedded systems.

It covers automotive field,
industrial
automation, building
automation, and
wireless sensor
networks. This
volume highlights
implementations in
fast-evolving areas
which have not
received proper

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coverage in other publications.

Reflecting the unique functional requirements of different application areas, the contributors discuss inter-node communication aspects in the context of specific applications of networked

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embedded systems. As electronic technology reaches the point where complex systems can be integrated on a single chip, and higher degrees of performance can be achieved at lower costs, designers must devise new ways to undertake the laborious task

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of coping with the numerous, and non-trivial, problems that arise during the conception of such systems. On the other hand, shorter design cycles (so that electronic products can fit into shrinking market windows) put companies, and consequently

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designers, under pressure in a race to obtain reliable products in the minimum period of time. New methodologies, supported by automation and abstraction, have appeared which have been crucial in making it possible for system

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designers to take over the traditional electronic design process and embedded systems is one of the fields that these methodologies are mainly targeting. The inherent complexity of these systems, with hardware and software

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components that usually execute concurrently, and the very tight cost and performance constraints, make them specially suitable to introduce higher levels of abstraction and automation, so as to allow the designer to better tackle the many

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problems that
appear during their
design. Advanced

Techniques for

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Design and Test is

a comprehensive

book presenting

recent

developments in

methodologies and

tools for the

specification,

synthesis,

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verification, and test of embedded systems, characterized by the use of high-level languages as a road to productivity. Each specific part of the design process, from specification through to test, is looked at with a constant emphasis

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on behavioral
methodologies.

Advanced Austin

Techniques for
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Design and Test is
essential reading
for all researchers
in the design and
test communities as
well as system
designers and CAD
tools developers.

The Industrial

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Information
Technology

Handbook focuses on existing and emerging industrial applications of IT, and on evolving trends that are driven by the needs of companies and by industry-led consortia and organizations.

Emphasizing fast

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growing areas that have major impacts on industrial automation and enterprise integration, the Handbook covers topics such as industrial communication technology, sensors, and embedded systems.

The book is

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organized into two parts. Part 1 presents material covering new and quickly evolving aspects of IT. Part 2 introduces cutting-edge areas of industrial IT. The Handbook presents material in the form of tutorials, surveys, and technology

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overviews,
combining
fundamentals and
advanced issues,
with articles
grouped into
sections for a
cohesive and
comprehensive
presentation. The
text contains 112
contributed reports
by industry experts
from government,

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companies at the
forefront of
development, and
some of the most
renowned academic
and research
institutions
worldwide. Several
of the reports on
recent
developments,
actual deployments,
and trends cover
subject matter

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presented to the
public for the first
time.

Appropriate for use
as a graduate text
or a professional
reference,

Languages for
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Systems is the first
detailed, broad
survey of hardware
and software
description

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languages for embedded system design. Instead of promoting the one language that will solve all design problems (which does not and will not ever exist), this book takes the view that different problems demand different languages, and a designer who

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knows the spectrum
of available

Languages has the
advantage over one
who is trapped
using the wrong
language.

Languages for
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concentrates on
successful, widely-
used design
languages, with a

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secondary emphasis
on those with
significant
theoretical value.

The syntax,
semantics, and
implementation of
each language is
discussed, since
although hardware
synthesis and
software
compilation
technology have

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steadily improved, coding style still matters, and a thorough understanding of how a language is synthesized or compiled is generally necessary to take full advantage of a language. Practicing designers, graduate students, and

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advanced
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undergraduates will
all benefit from this
book. It assumes
familiarity with
some hardware or
software languages,
but takes a
practical,
descriptive view
that avoids
formalism.

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Analysis and
Verification

Third IFIP/ACM

International

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Symposium, IESS

2009, Langenargen,

Germany,

September 14-16,

2009, Proceedings

Ambient

Intelligence: Impact

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Analysis,
Architectures and
Modelling of
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Advanced
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Design and Test
Testing Complex
and Embedded
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*Ubiquitous in
today's consumer-
driven society,*

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*embedded systems
use*

*microprocessors
that are hidden in
our everyday
products and
designed to
perform specific
tasks. Effective use
of these embedded
systems requires
engineers to be
proficient in all
phases of this*

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effort, from planning, design, and analysis to manufacturing and marketing. Taking a systems-level approach, Real-Time Embedded Systems: Optimization, Synthesis, and Networking describes the field from three distinct

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aspects that make up the three major trends in current embedded system design. The first section of the text examines optimization in real-time embedded systems. The authors present scheduling algorithms in multi-core embedded

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systems, instruct

on a robust

measurement

against the

inaccurate

information that

can exist in

embedded

systems, and

discuss potential

problems of

heterogeneous

optimization. The

second section

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focuses on synthesis-level approaches for embedded systems, including a scheduling algorithm for phase change memory and scratch pad memory and a treatment of thermal-aware multiprocessor synthesis

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technology. The final section looks at networking with a focus on task scheduling in both a wireless sensor network and cloud computing. It examines the merging of networking and embedded systems and the resulting evolution of a new

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type of system known as the cyber physical system (CPS). Encouraging readers to discover how the computer interacts with its environment, Real-Time Embedded Systems provides a sound introduction to the design, manufacturing, marketing, and

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*future directions of
this important tool.*

This book

*constitutes the
refereed*

*proceedings of the
5th IFIP TC 10*

International

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Symposium, IESS

2015, held in Foz

do Iguaçu, Brazil, in

November 2015.

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The 18 full revised papers presented were carefully reviewed and selected from 25 submissions. The papers present a broad discussion on the design, analysis and verification of embedded and cyber-physical systems including

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design methodologies, verification, performance analysis, and real-time systems design. They are organized in the following topical sections: cyber-physical systems, system-level design; multi/many-core system

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design; memory system design; and embedded HW/SW design and applications.

Embedded System Design: Modeling, Synthesis and Verification

introduces a model-based approach to system level design. It presents modeling

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techniques for both computation and communication at different levels of abstraction, such as specification, transaction level and cycle-accurate level. It discusses synthesis methods for system level architectures, embedded software and

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hardware components. Using these methods, designers can develop applications with high level models, which are automatically translatable to low level implementations.

This book, furthermore,

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describes simulation-based and formal verification methods that are essential for achieving design confidence. The book concludes with an overview of existing tools along with a design case study outlining the practice of

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embedded system
design.

*Specifically, this
book addresses the
following topics in
detail: . System
modeling at
different
abstraction levels .
Model-based
system design .
Hardware/Software
codesign . Software
and Hardware*

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component

synthesis. System

verification. This

book is for groups

within the

embedded system

community:

students in courses

on embedded

systems,

embedded

application

developers, system

designers and

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*managers, CAD
tool developers,
design automation,
and system
engineering.*

*This volume
originates from the
School on
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Systems held in
Veldhoven, The
Netherlands, in
November 1996 as
the first event*

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organized by the

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Educational Forum.

Besides thoroughly
reviewed and

revised chapters

based on lectures

given during the

school, additional

papers have been

solicited for

inclusion in the

present book in

order to complete

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*coverage of the
relevant topics.*

*The authors address
professionals
involved in the
design and
management of
embedded systems
in industry as well
as researchers and
students interested
in a competent
survey. The book
will convince the*

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reader that many architectural and algorithmic problems in the area of embedded systems have well documented optimal or correct solutions, notably in the fields of real-time computing, distributed computing, and fault-tolerant

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computing.

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Design: Topics,

Techniques and

Trends

Methods, Practical

Techniques, and

Applications

Introduction to

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Real-Time

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*A Cyber-Physical
Systems Approach*

Measuring and

Improving Code

Coverage for

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Microcomputer

Systems: Real Time

Interfacing provides

an in-depth

discussion of the

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design of real-time
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embedded systems
using 9S12

microcontrollers.

This book covers
the hardware

aspects of

interfacing,

advanced software

topics (including

interrupts), and a

systems approach

to typical embedded

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applications. This text stands out from other

microcomputer systems books because of its balanced, in-depth treatment of both hardware and software issues important in real time embedded systems design. It

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features a wealth of detailed case studies that demonstrate basic concepts in the context of actual working examples of systems. It also features a unique simulation software package on the bound-in CD-ROM (called Test Execute

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and Simulate, or
TExaS, for short)
that provides a self-
contained software
environment for
designing, writing,
implementing, and
testing both the
hardware and
software
components of
embedded systems.

Important Notice:

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Many enterprises
regard system-level
testing as the final
piece of the
development effort,
rather than as a tool

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that should be integrated throughout the development process. As a consequence, test teams often execute critical test plans just before product launch, resulting in much of the corrective work being performed in

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a rush and at the
last minute.

Presenting
combinatorial
approaches for
improving test
coverage, Testing
Complex and
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details techniques to
help you streamline
testing and identify
problems before

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they occur—including turbocharged testing using Six Sigma and exploratory testing methods. Rather than present the continuum of testing for particular products or design attributes, the text focuses on boundary conditions.

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Examining systems and software testing, it explains how to use simulation and emulation to complement testing. Details how to manage multiple test hardware and software deliveries Examines the contradictory

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perspectives of testing—including ordered/ random, structured /unstructured, bench/field, and repeatable/non repeatable Covers essential planning activities prior to testing, how to scope the work, and how to reach a

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successful
conclusion Explains
how to determine
when testing is
complete Where
you find
organizations that
are successful at
product
development, you
are likely to find
groups that practice
disciplined,

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strategic, and
thorough testing.

Tapping into the
authors' decades of
experience
managing test
groups in the
automotive industry,
this book provides
the understanding to
help ensure your
organization joins
the likes of these

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groups.

Modeling and
Analysis of Real-
Time and
Embedded Systems
with UML and
MARTE explains
how to apply the
complex MARTE
standard in practical
situations. This
approachable
reference provides a

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handy user guide,
illustrating with
numerous examples
how you can use
MARTE to design
and develop real-
time and embedded
systems and
software. Expert co-
authors Bran Selic
and Sébastien
Gérard lead the
team that drafted

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and maintain the standard and give you the tools you need apply MARTE to overcome the limitations of cyber-physical systems. The functional sophistication required of modern cyber-physical systems has reached a point

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where traditional
code-centric
development

methods are proving
less and less
capable of

delivering a reliable
product in a timely
manner. In Modeling
and Analysis of Real-
Time and

Embedded Systems
with UML and

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MARTE, you will learn how to take advantage of modern model-based engineering methods and corresponding industry standards to overcome these limitations. These methods take full advantage of computer-supported

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automation allowing timely detection of design flaws to reduce engineering risk, leading thereby to better overall product quality and greater productivity. Understand the design rationale behind the MARTE standard needed to take full advantage

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of its many powerful modeling capabilities Best apply the various MARTE features for the most common use cases encountered in the design of real-time and embedded software Learn how MARTE can be used together with

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the SysML language
for the design of
complex cyber-
physical systems
Discover how
MARTE can be
used for different
kinds of computer-
supported
engineering
analyses to predict
key system
characteristics early

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in development
Customize MARTE
for a specific

domain or project

It is well known that
embedded systems
have to be

implemented
efficiently. This
requires that

processors
optimized for certain
application domains

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are used in
embedded systems.

Such an
optimization
requires a careful
exploration of the
design space,
including a detailed
study of
cost/performance
tradeoffs. In order to
avoid time-
consuming

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assembly language programming during design space exploration, compilers are needed. In order to analyze the effect of various software or hardware configurations on the performance, retargetable compilers are

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needed that can generate code for numerous different potential hardware configurations. This book provides a comprehensive and up-to-date overview of the fast developing area of retargetable compilers for embedded systems.

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It describes a large set important tools as well as

applications of retargetable compilers at different levels in the design flow.

Retargetable
Compiler
Technology for
Embedded Systems
is mostly self-

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contained and requires only fundamental knowledge in software and compiler design. It is intended to be a key reference for researchers and designers working on software, compilers, and processor

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optimization for
embedded systems.

Chapter 13.

Designing

Trustworthy

Software Systems

Using the NFR

Approach

Using

Microcontrollers and
the MSP430

Developing Cyber-

Physical Systems

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Real-Time
Interfacing to the
Msp432

Microcontroller
Embedded Systems
Handbook 2-Volume
Set

Design of an
Intelligent
Embedded System
for Condition
Monitoring of an
Industrial Robot

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This textbook provides practicing scientists and engineers an advanced treatment of the Atmel AVR microcontroller. This book is intended as a follow-on to a previously

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published book,
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titled Atmel
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AVR

Microcontroller
Primer:

Programming and
Interfacing.

Some of the
content from
this earlier
text is
retained for
completeness.

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This book will emphasize advanced programming and interfacing skills. We focus on system level design consisting of several interacting microcontroller subsystems. The

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first chapter
discusses the
system design
process. Our
approach is to
provide the
skills to
quickly get up
to speed to
operate the
internationally
popular Atmel
AVR

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microcontroller
line by
developing
systems level
design skills.

We use the
Atmel ATmega164
as a

representative
sample of the
AVR line. The
knowledge you
gain on this

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microcontroller
can be easily
translated to
every other
microcontroller
in the AVR
line. In
succeeding
chapters, we
cover the main
subsystems
aboard the micr
ocontroller,

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providing a
short theory
section
followed by a
description of
the related
microcontroller
subsystem with
accompanying
software for
the subsystem.
We then provide
advanced

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examples
exercising some
of the features
discussed. In
all examples,
we use the C
programming
language. The
code provided
can be readily
adapted to the
wide variety of
compilers

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available for
the Atmel AVR
microcontroller
line. We also
include a
chapter
describing how
to interface
the
microcontroller
to a wide
variety of
input and

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output devices.
The book
concludes with
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detailed system
level design
examples
employing the
Atmel AVR micro
controller.
This Expert
Guide gives you
the techniques

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demonstrating
timeless
implementation
details Proven
and practical
techniques
reflecting the
authors'
expertise built
from years of
experience and
key advice on
tackling

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critical issues
In response to
tremendous
growth and new
technologies in
the
semiconductor
industry, this
volume is
organized into
five, informati
on-rich
sections.

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Digital Design
and Fabrication
surveys the
latest advances
in computer
architecture
and design as
well as the
technologies
used to
manufacture and
test them.
Featuring

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from leading
experts, the
book also
includes a new
section on
memory and
storage in
addition to a
new chapter on
nonvolatile
memory
technologies.

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Developing
advanced
concepts, this
sharply focused
book— Describes
new
technologies
that have
become driving
factors for the
electronic
industry
Includes new

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development
best
illustrates the
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progress
encountered by
the fabrication
and technology
sector Contains

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advances in
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Describes

performance

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measures, which

are the bottom

line from the

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view Discusses

design

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techniques used
to create
modern computer
systems,
including high-
speed computer
arithmetic and
high-frequency
design, timing
and clocking,
and PLL and DLL
design

This book

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provides a thorough introduction to the Texas Instruments MPS432™ microcontroller. The MPS432 is a 32-bit processor with the ARM Cortex M4F architecture

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and a built-in floating point unit. At the core, the MSP432 features a 32-bit ARM Cortex-M4F CPU, a RISC-architecture processing unit that includes a built-in DSP engine and a

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floating point unit. As an extension of the ultra-low-power MSP microcontroller family, the MSP432 features ultra-low power consumption and integrated digital and analog hardware

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peripherals.

The MSP432 is a new member to the MSP family. It provides for a seamless transition to applications requiring 32-bit processing at an operating frequency of up

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to 48 MHz. The processor may be programmed at a variety of levels with different programming languages including the user-friendly Energia rapid prototyping platform, in

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assembly
language, and
in C. A number
of C
programming
options are
also available
to developers,
starting with
register-level
access code
where
developers can

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directly
configure the
device's
registers, to
Driver Library,
which provides
a standardized
set of
application
program
interfaces
(APIs) that
enable software

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developers to quickly manipulate various peripherals available on the device. Even higher abstraction layers are also available, such as the extremely user-

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friendly
Energia
platform, that
enables even
beginners to
quickly
prototype an
application on
MSP432. The
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supported by a
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technical data,
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notes, training
modules, and
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examples. All
are
encapsulated
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handy package
called MSPWare,
available as
both a stand-

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features of the
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extended with a
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modules. The MSP432 is also supported by a variety of third party modular sensors and software compiler companies. In the back, a thorough introduction to the MPS432 line

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of microcontrol
lers,
programming
techniques, and
interface
concepts are
provided along
with
considerable
tutorial
information
with many
illustrated

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examples. Each chapter provides laboratory exercises to apply what has been presented in the chapter. The book is intended for an upper level undergraduate course in micro

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controllers or
mechatronics
but may also be
used as a
reference for
capstone design
projects.
Practicing
engineers
already
familiar with
another microco
ntroller, who

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require a quick tutorial on the microcontroller , will also find this book very useful. Finally, middle school and high school students will find the MSP432 highly approachable via the Energia

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rapid
prototyping
system.

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European
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Forum School on
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Veldhoven, The
Netherlands,
November 25-29,
1996

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Design with the
Atmel AVR

Microcontroller

Unleash the

Power of

Arduino!

Retargetable

Compiler

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Tools and

Applications

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The Industrial

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Technology

Handbook

This book

provides an in-

depth discussion

of the design,

implementation

and testing of

embedded

microcomputer

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systems. The book covers the hardware aspects of interfacing, advanced software topics (including interrupts), and a systems approach to typical

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***embedded
applications.***

This book

***stands out from
other***

***microcomputer
systems books***

because of its

balanced, in-

depth treatment

of both

hardware and

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***software issues
important in
real time
embedded
systems design.
The book
features a
wealth of
detailed case
studies that
demonstrate
basic concepts***

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***in the context of
actual working
examples of
systems. It also
features a
unique
simulation
software
package on the
bound-in CD-
ROM (called
Test Execute***

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***and Simulate, or
TexaS, for short)***

***-- that provides
a self-contained
software
environment for
designing,
writing,
implementing,
and testing both
the hardware
and software***

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***components of
embedded
systems.***

***This book
presents the
technical
program of the
International
Embedded
Systems
Symposium
(IESS) 2009.***

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Timely topics, techniques and trends in embedded system design are covered by the chapters in this volume, including modelling, simulation, verification,

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***test, scheduling,
platforms and
processors.***

***Particular
emphasis is paid
to automotive
systems and
wireless sensor
networks. Sets
of actual case
studies in the
area of***

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***embedded
system design
are also***

***included. Over
recent years,
embedded
systems have
gained an
enormous
amount of
proce- ing power
and***

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***functionality
and now enter
numerous
application
areas, due to the
fact that many
of the formerly
external
components can
now be
integrated into
a single System-***

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on-Chip. This

tendency has

resulted in a

dramatic

reduction in the

size and cost of

embedded

systems. As a

unique

technology, the

design of

embedded

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systems is an essential element of many innovations.

Embedded systems meet their performance goals, including real-time constraints, through a

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***combination of
special-purpose
hardware and
software
components
tailored to the
system
requirements.
Both the
development of
new features
and the reuse of***

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***existing
intellectual
property
components are
essential to
keeping up with
ever more
demanding
customer
requirements.
Furthermore,
design***

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***complexities are
steadily growing
with an***

***increasing
number of
components
that have to
cooperate
properly.***

***Embedded
system***

designers have

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Systems

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***to cope with
multiple goals
and constraints
simul- neously,
including
timing, power,
reliability,
dependability,
maintenance,
packaging and,
last but not
least, price.***

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Hugo de Man

Professor

Katholieke

Universiteit

Leuven Senior

Research Fellow

IMEC The

steady evolution

of hardware,

software and

communications

technology is

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***rapidly
transforming
the PC- and
dot.com world
into the world of
Ambient
Intelligence
(AmI). This next
wave of
information
technology is
fundam- tally***

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***different in that
it makes
distributed
wired and
wireless
computing and
communication
disappear to the
background and
puts users to
the foreground.
AmI adapts to***

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***people instead
of the other way
around. It will
augment our
consciousness,
monitor our
health and
security, guide
us through
traffic etc. In
short, its
ultimate goal is***

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***to improve the
quality of our
life by a quiet,
reliable and
secure***

***interaction with
our social and
material
environment.***

***What makes
AmI engineering
so fascinating is***

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***that its design
starts from
studying person
to world
interactions that
need to be
implemented as
an int- ligent
and autonomous
interplay of
virtually all
necessary***

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***networked
electronic
intelligence on
the globe. This
is a new and
exciting
dimension for
most elect- cal
and software
engineers and
may attract
more creative***

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***talent to
engineering
than pure
technology does.
Development of
the leading
technology for
AmI will only
succeed if the
engineering
research
community is***

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***prepared to join
forces in order
to make Mark
Weiser's dream
of 1991 come
true. This will
not be business
as usual by just
doubling
transistor count
or clock speed
in a***

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microprocessor

or increasing

the bandwidth

of

communication.

An introduction

to the

engineering

principles of

embedded

systems, with a

focus on

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***modeling,
design, and
analysis of cyber-
physical
systems. The
most visible use
of computers
and software is
processing
information for
human
consumption.***

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The vast majority of computers in use, however, are much less visible. They run the engine, brakes, seatbelts, airbag, and audio system in your car. They

*digitally encode
your voice and
construct a
radio signal to
send it from
your cell phone
to a base
station. They
command robots
on a factory
floor, power
generation in a*

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*power plant,
processes in a
chemical plant,
and traffic
lights in a city.*

*These less
visible*

*computers are
called*

embedded

*systems, and the
software they*

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embedded
software. The
principal
challenges in
designing and
analyzing
embedded
systems stem
from their
interaction with
physical***

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processes. This book takes a cyber-physical approach to embedded systems, introducing the engineering concepts underlying embedded systems as a

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***technology and
as a subject of
study. The focus
is on modeling,
design, and
analysis of cyber-
physical
systems, which
integrate
computation,
networking, and
physical***

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processes. The second edition offers two new chapters, several new exercises, and other improvements. The book can be used as a textbook at the advanced

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***undergraduate
or introductory
graduate level***

and as a

professional

reference for

practicing

engineers and

computer

scientists.

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*familiarity with
machine
structures,*

computer

programming,

basic discrete

mathematics

and algorithms,

and signals and

systems.

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Microcomputer
Systems: Real
Time
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***Modeling and
Analysis of Real-
Time and
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Systems with
UML and
MARTE***

This textbook
serves as an
introduction to
the subject of
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systems design,

using

microcontrollers

as core

components. It

develops concepts

from the ground

up, covering the

development of

embedded

systems

technology,

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architectural and
organizational
aspects of

controllers and
systems,

processor models,
and peripheral

devices. Since mic
roprocessor-based
embedded

systems tightly
blend hardware

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and software components in a single application, the book also introduces the subjects of data representation formats, data operations, and programming styles. The practical

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component of the
book is tailored
around the

architecture of a
widely used Texas
Instrument ' s
microcontroller,
the MSP430 and a
companion web
site offers for
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experimenter ' s

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kit and lab
manual, along
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constitutes the
refereed post-
proceedings of
the 12th
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Workshop on
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Systems with
special focus on
realization of
reliable systems
on top of
unreliable
networked
platforms, held in
Laguna Beach, CA

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in September
2005. Coverage
includes model-
based software
development of
network-centric
system-of-
systems,
foundations of
future design and
programming
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intelligent and
robust
middleware.

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book introduces
readers to many
new techniques
for enhancing and
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systems, which

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community so far.
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books that focus
on a single
abstraction level
such circuit level
or system level
alone, the focus of
this book is to deal
with the different
reliability
challenges across

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different levels
starting from the
physical level all
the way to the
system level (cross-
layer approaches).
The book aims at
demonstrating
how new
hardware/software
co-design
solution can be

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proposed to effectively mitigate reliability

degradation such as transistor aging, processor variation, temperature effects, soft errors, etc. Provides readers with latest insights into

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novel, cross-layer
methods and
models with
respect to
dependability of
embedded
systems; Describes
cross-layer
approaches that
can leverage
reliability through
techniques that

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are pro-actively designed with respect to techniques at other layers;
Explains run-time adaptation and concepts/means of self-organization, in order to achieve error resiliency in

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complex, future

many core

systems.

Considered a

standard industry

resource, the

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provided

researchers and

technicians with

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the authoritative
information
needed to launch
a wealth of
diverse
applications,
including those in
automotive
electronics,
industrial
automated
systems, and

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building
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automation and
control. Now a
new resource is
required to report
on current
developments and
provide a
technical
reference for
those looking to
move the field

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accommodate this

growth, the

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Second Edition

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comprehensive

view on this area

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of computer
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engineering with
a currently

appropriate
emphasis on
developments in
networking and
applications.

Those experts
directly involved
in the creation
and evolution of

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the ideas and
technologies
presented offer
tutorials, research
surveys, and
technology
overviews that
explore cutting-
edge
developments and
deployments and
identify potential

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trends. This first self-contained volume of the handbook, Embedded Systems Design and Verification, is divided into three sections. It begins with a brief introduction to embedded

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systems design
and verification. It
then provides a
comprehensive
overview of
embedded
processors and
various aspects of
system-on-chip
and FPGA, as well
as solutions to
design challenges.

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The final section explores power-aware embedded computing, design issues specific to secure embedded systems, and web services for embedded devices. Those interested in

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taking their work
with embedded
systems to the
network level
should complete
their study with
the second
volume: Network
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Engineering for

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Handbook

*This thesis introduces a
successfully designed
and commissioned
intelligent health
monitoring system,
specifically for use on
any industrial robot,
which is able to predict*

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the onset of faults in the joints of the geared transmissions. However the developed embedded wireless condition monitoring system leads itself very well for applications on any power transmission equipment in which the loads and speeds are not constant, and access is restricted. As such this provides significant

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scope for future development. Three significant achievements are presented in this thesis. First, the development of a condition monitoring algorithm based on vibration analysis of an industrial robot for fault detection and diagnosis. The combined use of a statistical control chart with time-domain signal

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*analysis for detecting a
fault via an arm-
mounted wireless
processor system
represents the first stage
of fault detection.*

*Second, the design and
development of a
sophisticated embedded
microprocessor base
station for online
implementation of the
intelligent condition
monitoring algorithm,*

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and third, the implementation of a discrete wavelet transform, using an artificial neural network, with statistical feature extraction for robot fault diagnosis in which the vibration signals are first decomposed into eight levels of wavelet coefficients.

This book, published
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November 2015 as a 1st edition 1st printing, is the second in a series of three books that teach the fundamentals of embedded systems as applied to MSP432 microcontrollers. These books are primarily written for undergraduate electrical and computer engineering students.

They could also be used

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*for professionals
learning the ARM
platform. The first book
Embedded Systems:
Introduction to the
MSP432 is an
introduction to
computers and
interfacing focusing on
assembly language and
C programming. This
second book focuses on
interfacing and the
design of embedded*

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*systems. The third book
Embedded Systems:
Real-Time Operating
Systems for ARM Cortex-
M Microcontrollers is
an advanced book
focusing on operating
systems, high-speed
interfacing, control
systems, and robotics.
An embedded system is
a system that performs a
specific task and has a
computer embedded*

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inside. A system is comprised of components and interfaces connected together for a common purpose. This book presents components, interfaces and methodologies for building systems. Specific topics include the architecture of microcontrollers, design methodology,

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*verification,
hardware/software
synchronization,
interfacing devices to
the computer, timing
diagrams, real-time
systems, data collection
and processing, motor
control, analog filters,
digital filters, real-time
signal processing,
wireless
communication, low-
power design, and the*

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internet of things. In general, the area of embedded systems is an important and growing discipline within electrical and computer engineering. The educational market of embedded systems has been dominated by simple microcontrollers like the PIC, the 9S12, and the 8051. This is because of their market

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share, low cost, and historical dominance.

However, as problems become more complex, so must the systems that solve them. A number of embedded system paradigms must shift in order to accommodate this growth in complexity. First, the number of calculations per second will increase from millions/sec to

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billions/sec. Similarly, the number of lines of software code will also increase from thousands to millions. Thirdly, systems will involve multiple microcontrollers supporting many simultaneous operations. Lastly, the need for system verification will continue to grow as

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*these systems are
deployed into safety
critical applications.*

*These changes are more
than a simple growth in
size and bandwidth.*

*These systems must
employ parallel
programming, high-
speed synchronization,
real-time operating
systems, fault tolerant
design, priority
interrupt handling, and*

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networking.

Consequently, it will be important to provide our students with these types of design experiences.

The purpose of writing these books at this time is to bring engineering education into the 21st century. This book employs many approaches to learning. It will not include an exhaustive

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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

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components that assist learning. Checkpoints, with answers in the back, are short easy to answer questions providing immediate feedback while reading. 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

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the laboratories. Each chapter has suggested lab assignments. More detailed lab descriptions are available on the web. Specifically, look at the lab assignments for EE445L and EE445M. These books will cover embedded systems for ARM Cortex-M microcontrollers with specific details on the MSP432. Although the

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solutions are specific for the MSP432, it will be possible to use these books for other ARM derivatives. Volume 3 can be used for either the TM4C or MSP432 families.

This book constitutes the refereed proceedings of the 4th IFIP TC 10 International Embedded Systems Symposium, IESS 2013, held in

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Paderborn, Germany, in June 2013. The 22 full revised papers presented together with 8 short papers were carefully reviewed and selected from 42 submissions. The papers have been organized in the following topical sections: design methodologies; non-functional aspects of embedded systems;

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*verification;
performance analysis;
real-time systems;
embedded system
applications; and real-
time aspects in
distributed systems. The
book also includes a
special chapter
dedicated to the BMBF
funded ARAMIS project
on Automotive, Railway
and Avionics Multicore
Systems.*

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*Software Engineering
for Embedded Systems:
Methods, Practical
Techniques, and
Applications, Second
Edition provides the
techniques and
technologies in software
engineering to optimally
design and implement
an embedded system.*

*Written by experts with
a solution focus, this
encyclopedic reference*

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gives an indispensable aid on how to tackle the day-to-day problems encountered when using software engineering methods to develop embedded systems. New sections cover peripheral programming, Internet of things, security and cryptography, networking and packet processing, and hands

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on labs. Users will learn about the principles of good architecture for an embedded system, design practices, details on principles, and much more. Provides a roadmap of key problems/issues and references to their solution in the text

*Reviews core methods and how to apply them
Contains examples that*

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*demonstrate timeless
implementation details*

*Users case studies to
show how key ideas can
be implemented, the
rationale for choices
made, and design
guidelines and trade-
offs*

*Reliable Systems on
Unreliable Networked
Platforms*

4th IFIP TC 10

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*Systems Symposium,
IESS 2013, Paderborn,
Germany, June 17-19,
2013, Proceedings*

12th Monterey

*Workshop 2005, Laguna
Beach, CA, USA,
September 22-24, 2005.*

Revised Selected Papers

Timing and Memory

Optimization for

Embedded Systems

Introduction to

Embedded Systems,

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Second Edition

IFIP TC10 Working

Conference: Austin

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(IESS), May 30 - June 1,

2007, Irvine (CA), USA

Trustworthy

systems are

essential for

critical

operations—they

ensure that

reliability,

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usability, interoperability, and security are built into the systems, and that the systems deliver when they are most needed. There are environments where trustworthiness is an essential property in

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*military,
government, and
civil domains.*

*Examples include
missile
deployment
control systems,
the tax
submission
system of the
federal
government, and
nuclear safety
control systems.*

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However, not many methods exist for the systematic engineering of trustworthy software systems. In this chapter we describe the application of the NFR Approach for designing a trustworthy

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software system.

The NFR

Approach, where

NFR stands for

“non-functional
requirement,”

treats

trustworthiness

as a goal to be

achieved during

the process of

software

development. The

NFR Approach

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uses a structure
called the

Softgoal

Interdependency
Graph to capture
the

trustworthiness
definition,

depict

architectural

elements as

softgoals, and

rationalize the

extent of

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*trustworthiness
in the design.*

*Advantages of
this approach
include the
ability to
nurture
consensus among
multiple
definitions of
trustworthiness,
capture design
rationale,
evaluate*

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*qualitatively
the extent of
trustworthiness
achieved, and
maintain
historical
records of
design
decisions. We
apply the NFR
Approach to
design a
trustworthy
Phoenix system,*

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which is a message-oriented middleware system used by the US Air Force.

Welcome to Real-Time Bluetooth Networks - Shape the World. This book, now in its second printing December 2017, offers a format

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*geared towards
hands-on self-
paced learning.*

*The overarching
goal is to give
you the student
an experience
with real-time
operating
systems that is
based on the
design and
development of a
simplified RTOS*

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*that exercises
all the
fundamental
concepts. To
keep the
discourse
grounded in
practice we have
refrained from
going too deep
into any one
topic. We
believe this
will equip the*

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*student with the
knowledge
necessary to
explore more
advanced topics
on their own. In
essence, we will
teach you the
skills of the
trade, but
mastery is the
journey you will
have to
undertake on*

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your own. An operating system (OS) is a layer of software that sits on top of the hardware. It manages the hardware resources so that the applications have the illusion that they own the

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hardware all to themselves. A real-time system is one that not only gets the correct answer but gets the correct answer at the correct time. Design and development of an OS therefore requires both, understanding

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*the underlying
architecture in
terms of the
interface*

*(instruction set
architecture,
ISA) it provides
to the software,
and organizing
the software to
exploit this
interface and
present it to
user*

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*applications.
The decisions
made in
effectively
managing the
underlying
architecture
becomes more
crucial in real-
time systems as
the performance
(specifically
timing) demands
go beyond simple*

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logical correctness. The architecture we will focus on is the ARM ISA, which is a very popular architecture in the embedded device ecosystem where real-time systems proliferate. A quick

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introduction to the ISA will be followed by specifics of TI's offering of this ISA as the Tiva and MSP432 Launchpad microcontroller. To make the development truly compelling we need a target application that

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has real-time constraints and multi-threading needs. To that end you will incrementally build a personal fitness device with Bluetooth connectivity. The Bluetooth connectivity will expose you to the evolving

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domain of Internet-of-things (IoT) where our personal fitness device running a custom RTOS will interact with a smartphone.

This book is a subset of
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Introduction to
ARM Cortex-M Mic

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*Microcontrollers,
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configured for
specific use in
EE319K*

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taught at the
University of
Texas at Austin.
It is first
edition, fourth
printing,*

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December 2017.
The section numbers in this book also specify the corresponding section in the original book. This first book is an introduction to computers and interfacing focusing on

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*assembly
language and C
programming. The
second book*

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Systems: Real-
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focuses on hardw
are/software
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the design of
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*systems. The
third book*

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*Microcontrollers
is an advanced
book focusing on
operating
systems, high-
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interfacing,*

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*control systems,
and robotics.*

*The third volume
could also be
used for
professionals
wishing to
design or deploy
a real-time
operating system
onto an ARM
platform. There
is a web site
accompanying*

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this book <http://users.ece.utexas.edu/~valvano/arm>. Posted here are ARM Keil uVision and Texas Instruments Code Composer Studio projects for each of the example programs in the book.

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*introduction to
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specification
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*presents the
essentials of
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for embedded
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discusses
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and provides an overview of techniques for mapping applications to execution platforms, including multi-core platforms. Embedded systems have to operate under tight constraints and, hence, the book

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also contains a selected set of optimization techniques, including software optimization techniques. The book closes with a brief survey on testing. This third edition has been updated and revised to

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reflect new trends and technologies, such as the importance of cyber-physical systems and the Internet of things, the evolution of single-core processors to multi-core processors, and

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methodology, networks-on-chip, distributed and networked systems, and system verification. It places emphasis on automotive and medical applications and includes case studies and special aspects in embedded system design.

This textbook introduces the concept of embedded systems

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with exercises using
Arduino Uno. It is
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