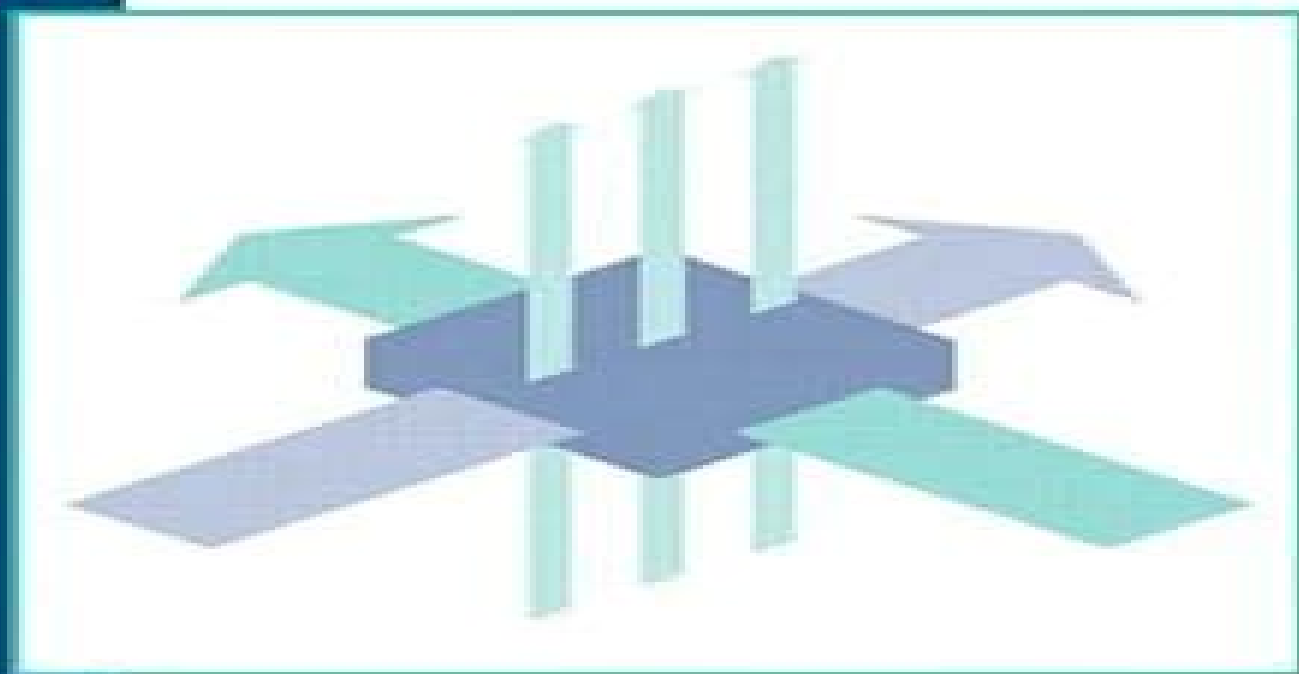


# Embedded Systems

Design and Applications  
with the 68HC12 and HCS12

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Steven F. Barrett  
Daniel J. Pack

# Embedded Systems Design And Applications With The 68hc12 And Hcs12

**Steven F. Barrett, Daniel J. Pack**



## **Embedded Systems Design And Applications With The 68hc12 And Hcs12:**

**Embedded Systems Design and Applications with the 68HC12 and HCS12** Steven Frank Barrett, Daniel J. Pack, 2005 For a second microprocessor course for students enrolled in Electrical Computer Engineering Microcontroller courses Designed for a senior or graduate level embedded systems design course Embedded Systems Design and Applications with the 68HC12 introduces readers to unique issues associated with designing testing integrating and implementing microcontroller microprocessor based embedded systems Embedded Systems Design with the Texas Instruments MSP432 32-bit Processor Dung Dang, Daniel J. Pack, Steven F. Barrett, 2022-06-01 This book provides a thorough introduction to the Texas Instruments MSP432™ microcontroller The MSP432 is a 32 bit processor with the ARM Cortex M4F architecture 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 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 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 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 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 directly configure the device's registers to Driver Library which provides a standardized set of application program interfaces APIs that enable software developers to quickly manipulate various peripherals available on the device Even higher abstraction layers are also available such as the extremely user friendly Energia platform that enables even beginners to quickly prototype an application on MSP432 The MSP432 LaunchPad is supported by a host of technical data application notes training modules and software examples All are encapsulated inside one handy package called MSPWare available as both a stand alone download package as well as on the TI Cloud development site dev.ti.com The features of the MSP432 may be extended with a full line of BoosterPack plug in 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 MSP432 line of microcontrollers programming techniques and interface concepts are provided along with considerable tutorial information with many illustrated 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 microcontrollers or mechatronics but may also be used as a reference for capstone design projects Practicing engineers already familiar with another microcontroller who 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 rapid prototyping system **Embedded Systems Design with the Atmel AVR Microcontroller** Steven F. Barrett, 2010 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 published book titled Atmel AVR Microcontroller Primer Programming and Interfacing Some of the content from this earlier text is retained for completeness This book will emphasize advanced programming and interfacing skills We focus on system level design consisting of several interacting microcontroller subsystems The 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 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 microcontroller can be easily translated to every other microcontroller in the AVR line In succeeding chapters we cover the main subsystems aboard the microcontroller providing a short theory section followed by a description of the related microcontroller subsystem with accompanying software for the subsystem We then provide advanced 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 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 output devices The book concludes with several detailed system level design examples employing the Atmel AVR microcontroller

*Embedded System Design with the Atmel AVR Microcontroller I* Steven Barrett, 2022-05-31 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 published book titled Atmel AVR Microcontroller Primer Programming and Interfacing Some of the content from this earlier text is retained for completeness This book will emphasize advanced programming and interfacing skills We focus on system level design consisting of several interacting microcontroller subsystems The 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 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 microcontroller can be easily translated to every other microcontroller in the AVR line In succeeding chapters we cover the main subsystems aboard the microcontroller providing a short theory section followed by a description of the related microcontroller subsystem with accompanying software for the subsystem We then provide advanced 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 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 output devices The book concludes with several detailed system level design examples employing the Atmel AVR microcontroller

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*Embedded System Design* Peter Marwedel, 2010-11-16 Until the late 1980s information processing was associated

with large mainframe computers and huge tape drives During the 1990s this trend shifted toward information processing with personal computers or PCs The trend toward miniaturization continues and in the future the majority of information processing systems will be small mobile computers many of which will be embedded into larger products and interfaced to the physical environment Hence these kinds of systems are called embedded systems Embedded systems together with their physical environment are called cyber physical systems Examples include systems such as transportation and fabrication equipment It is expected that the total market volume of embedded systems will be significantly larger than that of traditional information processing systems such as PCs and mainframes Embedded systems share a number of common characteristics For example they must be dependable efficient meet real time constraints and require customized user interfaces instead of generic keyboard and mouse interfaces Therefore it makes sense to consider common principles of embedded system design Embedded System Design starts with an introduction into the area and a survey of specification models and languages for embedded and cyber physical systems It provides a brief overview of hardware devices used for such systems and presents the essentials of system software for embedded systems like real time operating systems The book also discusses evaluation and validation techniques for embedded systems Furthermore the book presents an overview of techniques for mapping applications to execution platforms Due to the importance of resource efficiency the book also contains a selected set of optimization techniques for embedded systems including special compilation techniques The book closes with a brief survey on testing Embedded System Design can be used as a text book for courses on embedded systems and as a source which provides pointers to relevant material in the area for PhD students and teachers It assumes a basic knowledge of information processing hardware and software Courseware related to this book is available at <http://ls12-www.cs.tu-dortmund.de/marwedel>

**Embedded System Design with the Atmel AVR Microcontroller** Steven

Barrett, 2009-12-08 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 published book titled Atmel AVR Microcontroller Primer Programming and Interfacing Some of the content from this earlier text is retained for completeness This book will emphasize advanced programming and interfacing skills We focus on system level design consisting of several interacting microcontroller subsystems The 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 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 microcontroller can be easily translated to every other microcontroller in the AVR line In succeeding chapters we cover the main subsystems aboard the microcontroller providing a short theory section followed by a description of the related microcontroller subsystem with accompanying software for the subsystem We then provide advanced 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 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 output devices The book concludes with several detailed system level design examples employing the Atmel AVR microcontroller Table of Contents Embedded Systems Design Atmel AVR Architecture Overview Serial Communication Subsystem Analog to Digital Conversion ADC Interrupt Subsystem Timing Subsystem Atmel AVR Operating Parameters and Interfacing System Level Design Microcontroller Programming and Interfacing with Texas Instruments MSP430FR2433 and MSP430FR5994 Steven F. Barrett, Daniel J. Pack, 2022-06-01 This book provides a thorough introduction to the Texas Instruments MSP430™ microcontroller The MSP430 is a 16 bit reduced instruction set RISC processor that features ultra low power consumption and integrated digital and analog hardware Variants of the MSP430 microcontroller have been in production since 1993 This provides for a host of MSP430 products including evaluation boards compilers software examples and documentation A thorough introduction to the MSP430 line of microcontrollers programming techniques and interface concepts are provided along with considerable tutorial information with many illustrated 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 microcontrollers or mechatronics but may also be used as a reference for capstone design projects Also practicing engineers already familiar with another microcontroller who require a quick tutorial on the microcontroller will find this book very useful This second edition introduces the MSP EXP430FR5994 and the MSP430 EXP430FR2433 LaunchPads Both LaunchPads are equipped with a variety of peripherals and Ferroelectric Random Access Memory FRAM FRAM is a nonvolatile low power memory with functionality similar to flash memory *Embedded Systems Design with the Texas Instruments MSP432 32-bit Processor* Dung Dang, Daniel J. Pack, Steven F. Barrett, 2016-10-26 This book provides a thorough introduction to the Texas Instruments MPS432™ microcontroller The MPS432 is a 32 bit processor with the ARM Cortex M4F architecture 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 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 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 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 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 directly configure the device s registers to Driver Library which provides a standardized set of application program interfaces APIs that enable software developers to quickly manipulate various peripherals available on the device Even higher abstraction layers are also available such as the extremely user friendly Energia platform that enables even beginners to quickly prototype an application on

MSP432 The MSP432 LaunchPad is supported by a host of technical data application notes training modules and software examples All are encapsulated inside one handy package called MSPWare available as both a stand alone download package as well as on the TI Cloud development site dev ti com The features of the MSP432 may be extended with a full line of BoosterPack plug in 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 of microcontrollers programming techniques and interface concepts are provided along with considerable tutorial information with many illustrated 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 microcontrollers or mechatronics but may also be used as a reference for capstone design projects Practicing engineers already familiar with another microcontroller who 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 rapid prototyping system

**Microcontroller Programming and Interfacing TI MSP 430 PART II** Steven F. Barrett, Daniel J. Pack, 2022-11-10 This book provides a thorough introduction to the Texas Instruments MSP430 microcontroller The MSP430 is a 16 bit reduced instruction set RISC processor that features ultra low power consumption and integrated digital and analog hardware Variants of the MSP430 microcontroller have been in production since 1993 This provides for a host of MSP430 products including evaluation boards compilers and documentation A thorough introduction to the MSP430 line of microcontrollers programming techniques and interface concepts are provided along with considerable tutorial information with many illustrated 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 microcontrollers or mechatronics but may also be used as a reference for capstone design projects Also practicing engineers already familiar with another microcontroller who require a quick tutorial on the microcontroller will find this book very useful

**Microcontroller Programming and Interfacing Texas Instruments MSP430** Steven F. Barrett, Daniel J. Pack, 2011-05-01 This book provides a thorough introduction to the Texas Instruments MSP430 microcontroller The MSP430 is a 16 bit reduced instruction set RISC processor that features ultra low power consumption and integrated digital and analog hardware Variants of the MSP430 microcontroller have been in production since 1993 This provides for a host of MSP430 products including evaluation boards compilers and documentation A thorough introduction to the MSP430 line of microcontrollers programming techniques and interface concepts are provided along with considerable tutorial information with many illustrated 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 microcontrollers or mechatronics but may also be used as a reference for capstone design projects Also practicing engineers already familiar with another microcontroller who require a quick tutorial on the microcontroller will find this book very useful

*Microcontroller Programming and Interfacing with Texas*

*Instruments MSP430FR2433 and MSP430FR5994 - Part I* Steven F. Barrett, Daniel J. Pack, 2019-08-27 This book provides a thorough introduction to the Texas Instruments MSP430™ microcontroller The MSP430 is a 16 bit reduced instruction set RISC processor that features ultra low power consumption and integrated digital and analog hardware Variants of the MSP430 microcontroller have been in production since 1993 This provides for a host of MSP430 products including evaluation boards compilers software examples and documentation A thorough introduction to the MSP430 line of microcontrollers programming techniques and interface concepts are provided along with considerable tutorial information with many illustrated 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 microcontrollers or mechatronics but may also be used as a reference for capstone design projects Also practicing engineers already familiar with another microcontroller who require a quick tutorial on the microcontroller will find this book very useful This second edition introduces the MSP EXP430FR5994 and the MSP430 EXP430FR2433 LaunchPads Both LaunchPads are equipped with a variety of peripherals and Ferroelectric Random Access Memory FRAM FRAM is a nonvolatile low power memory with functionality similar to flash memory

**Microcontroller Programming and Interfacing TI MSP430** Steven Barrett, Daniel Pack, 2011-03-02 This book provides a thorough introduction to the Texas Instruments MSP430 microcontroller The MSP430 is a 16 bit reduced instruction set RISC processor that features ultra low power consumption and integrated digital and analog hardware Variants of the MSP430 microcontroller have been in production since 1993 This provides for a host of MSP430 products including evaluation boards compilers and documentation A thorough introduction to the MSP430 line of microcontrollers programming techniques and interface concepts are provided along with considerable tutorial information with many illustrated 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 microcontrollers or mechatronics but may also be used as a reference for capstone design projects Also practicing engineers already familiar with another microcontroller who require a quick tutorial on the microcontroller will find this book very useful [Embedded System Design with the Atmel AVR](#)

[Microcontroller II](#) Steven Barrett, 2022-05-31 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 published book titled Atmel AVR Microcontroller Primer Programming and Interfacing Some of the content from this earlier text is retained for completeness This book will emphasize advanced programming and interfacing skills We focus on system level design consisting of several interacting microcontroller subsystems The 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 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 microcontroller can be easily translated to every other microcontroller in the AVR line In



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Arduino Microcontroller Processing for Everyone! Part I Steven Barrett, 2022-11-10 This book is about the Arduino microcontroller and the Arduino concept The visionary Arduino team of Massimo Banzi David Cuartielles Tom Igoe Gianluca Martino and David Mellis launched a new innovation in microcontroller hardware in 2005 the concept of open source hardware Their approach was to openly share details of microcontroller based hardware design platforms to stimulate the sharing of ideas and promote innovation This concept has been popular in the software world for many years This book is intended for a wide variety of audiences including students of the fine arts middle and senior high school students engineering design students and practicing scientists and engineers To meet this wide audience the book has been divided into sections to satisfy the need of each reader The book contains many software and hardware examples to assist the reader in developing a wide variety of systems For the examples the Arduino Duemilanove and the Atmel ATmega328 is employed as the target processor Table of Contents Getting Started Programming Embedded Systems Design Serial Communication Subsystem Analog to Digital Conversion ADC Interrupt Subsystem Timing Subsystem Atmel AVR Operating Parameters and Interfacing

**Arduino Microcontroller Processing for Everyone!** Steven Barrett, 2022-11-10 This book is about the Arduino microcontroller and the Arduino concept The visionary Arduino team of Massimo Banzi David Cuartielles Tom Igoe Gianluca Martino and David Mellis launched a new innovation in microcontroller hardware in 2005 the concept of open source hardware Their approach was to openly share details of microcontroller based hardware design platforms to stimulate the sharing of ideas and promote innovation This concept has been popular in the software world for many years This book is intended for a wide variety of audiences including students of the fine arts middle and senior high school students engineering design students and practicing scientists and engineers To meet this wide audience the book has been divided into sections to satisfy the need of each reader The book contains many software and hardware examples to assist the reader in developing a wide variety of systems For the examples the Arduino UNO R3 and the Atmel ATmega328 is employed as the target processor The second edition has been updated with the latest on the Arduino UNO R3 processor changes to the Arduino Development Environment and several extended examples Table of Contents Getting Started Programming

Embedded Systems Design Serial Communication Subsystem Analog to Digital Conversion ADC Interrupt Subsystem Timing Subsystem Atmel AVR Operating Parameters and Interfacing      **Microchip AVR® Microcontroller Primer** Steven F. Barrett, Daniel J. Pack, 2019-09-19 This textbook provides practicing scientists and engineers a primer on the Microchip AVR microcontroller The revised title of this book reflects the 2016 Microchip Technology acquisition of Atmel Corporation In this third edition we highlight the popular ATmega164 microcontroller and other pin for pin controllers in the family with a complement of flash memory up to 128 KB The third edition also provides an update on Atmel Studio programming with a USB pod the gcc compiler the ImageCraft JumpStart C for AVR compiler the Two Wire Interface TWI and multiple examples at both the subsystem and system level Our approach is to provide readers with the fundamental skills to quickly set up and operate with this internationally popular microcontroller We cover the main subsystems aboard the ATmega164 providing a short theory section followed by a description of the related microcontroller subsystem with accompanying hardware and software to operate the subsystem In all examples we use the C programming language We include a detailed chapter describing how to interface the microcontroller to a wide variety of input and output devices and conclude with several system level examples including a special effects light emitting diode cube autonomous robots a multi function weather station and a motor speed control system      **Bad to the Bone** Steven F. Barrett, Jason Kridner, 2022-11-10 This comprehensive book provides detailed materials for both novice and experienced programmers using all BeagleBone variants which host a powerful 32 bit super scalar TI Sitara ARM Cortex A8 processor Authored by Steven F Barrett and Jason Kridner a seasoned ECE educator along with the founder of Beagleboard org respectively the work may be used in a wide variety of projects from science fair projects to university courses and senior design projects to first prototypes of very complex systems Beginners may access the power of the Bone through the user friendly Bonescript examples Seasoned users may take full advantage of the Bone s power using the underlying Linux based operating system a host of feature extension boards Capes and a wide variety of Linux community open source libraries The book contains background theory on system operation coupled with many well documented illustrative examples Examples for novice users are centered on motivational fun robot projects while advanced projects follow the theme of assistive technology and image processing applications

**Atmel AVR Microcontroller Primer** Steven F. Barrett, Daniel J. Pack, 2012-06-01 This textbook provides practicing scientists and engineers a primer on the Atmel AVR microcontroller In this second edition we highlight the popular ATmega164 microcontroller and other pin for pin controllers in the family with a complement of flash memory up to 128 kbytes The second edition also adds a chapter on embedded system design fundamentals and provides extended examples on two different autonomous robots Our approach is to provide the fundamental skills to quickly get up and operating with this internationally popular microcontroller We cover the main subsystems aboard the ATmega164 providing a short theory section followed by a description of the related microcontroller subsystem with accompanying hardware and software to

exercise the subsystem In all examples we use the C programming language We include a detailed chapter describing how to interface the microcontroller to a wide variety of input and output devices and conclude with several system level examples

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[Microcontroller Processing for Everyone! Third Edition](#) Steven F. Barrett, 2022-05-31 This book is about the Arduino microcontroller and the Arduino concept The visionary Arduino team of Massimo Banzi David Cuartielles Tom Igoe Gianluca Martino and David Mellis launched a new innovation in microcontroller hardware in 2005 the concept of open source hardware Their approach was to openly share details of microcontroller based hardware design platforms to stimulate the sharing of ideas and promote innovation This concept has been popular in the software world for many years This book is intended for a wide variety of audiences including students of the fine arts middle and senior high school students engineering design students and practicing scientists and engineers To meet this wide audience the book has been divided into sections to satisfy the need of each reader The book contains many software and hardware examples to assist the reader in developing a wide variety of systems The book covers two different Arduino products the Arduino UNO R3 equipped with the Atmel ATmega328 and the Arduino Mega 2560 equipped with the Atmel ATmega2560 The third edition has been updated with the latest on these two processing boards changes to the Arduino Development Environment and multiple extended examples

*Bad to the Bone* Steven Barrett, Jason Kridner, 2022-06-01 BeagleBone Black is a low cost open hardware computer uniquely suited to interact with sensors and actuators directly and over the Web Introduced in April 2013 by BeagleBoard.org a community of developers first established in early 2008 BeagleBone Black is used frequently to build vision enabled robots home automation systems artistic lighting systems and countless other do it yourself and professional projects BeagleBone variants include the original BeagleBone and the newer BeagleBone Black both hosting a powerful 32 bit super scalar ARM Cortex A8 processor capable of running numerous mobile and desktop capable operating systems typically variants of Linux including Debian Android and Ubuntu Yet BeagleBone is small enough to fit in a small mint tin box The Bone may be used in a wide variety of projects from middle school science fair projects to senior design projects to first prototypes of very complex systems Novice users may access the power of the Bone through the user friendly BoneScript software experienced through a Web browser in most major operating systems including Microsoft Windows Apple Mac OS X or the Linux operating systems Seasoned users may take full advantage of the Bone's power using the underlying Linux based operating system a host of feature extension boards Capes and a wide variety of Linux community open source libraries This book provides an introduction to this powerful computer and has been designed for a wide variety of users including the first time novice through the seasoned embedded system design professional The book contains background theory on system operation coupled with many well documented illustrative examples Examples for novice users are centered

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