

TI-RSLK

Texas Instruments Robotics System Learning Kit



TEXAS INSTRUMENTS



Module 1

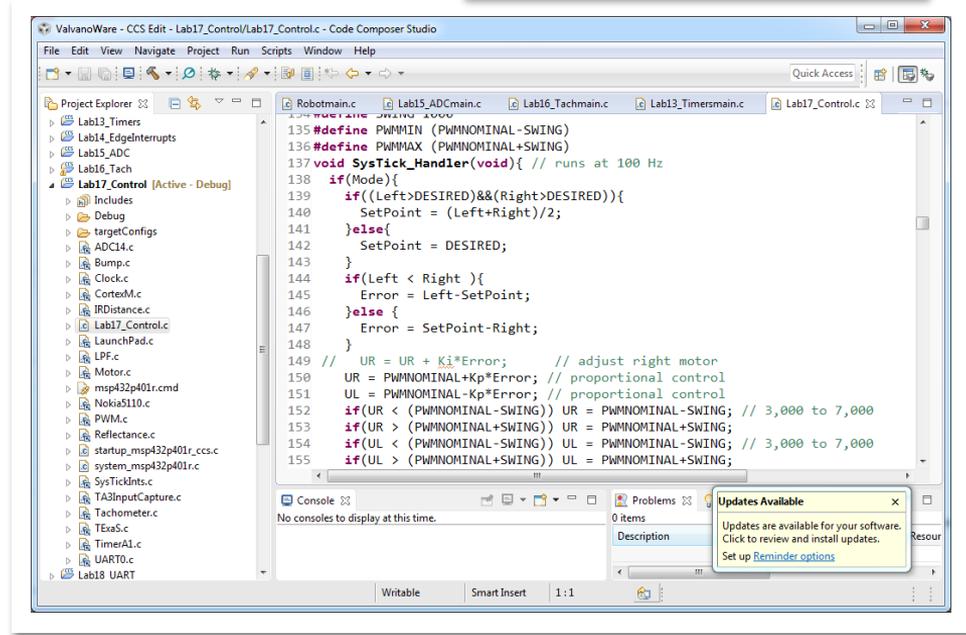
Lecture: Running Code on the LaunchPad using CCS



Running Code on the LaunchPad using CCS

You will learn in this module

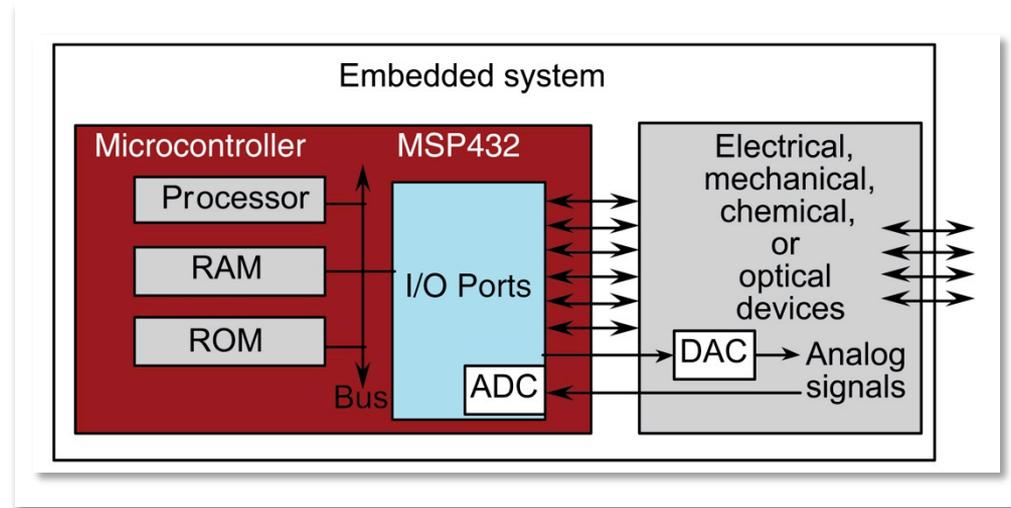
- Introduction to Embedded Systems
- Code Composer Studio
 - Software installation
 - Compile-link-download-debug
- TI Robotics Systems Learning Kit
 - Software installation
 - Documentation
 - Resources





What is an Embedded System?

- Includes a microcomputer like the MSP432
- Configured to perform a specific dedicated application
- Software programmed into ROM
- Software that is not accessible to the user of the device
- Software that solves only a limited range of problems
- Its microcomputer embedded or hidden inside

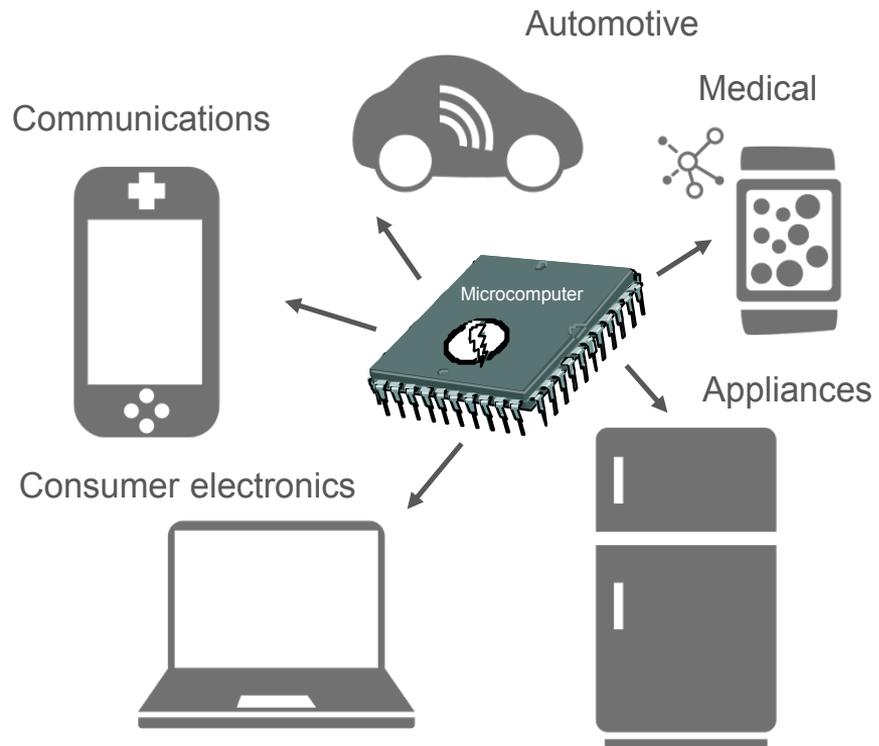




Embedded System Applications

- Communications
- Automotive, ~20/car
- Military
- Medical
- Consumer, ~150/home
- Machine control

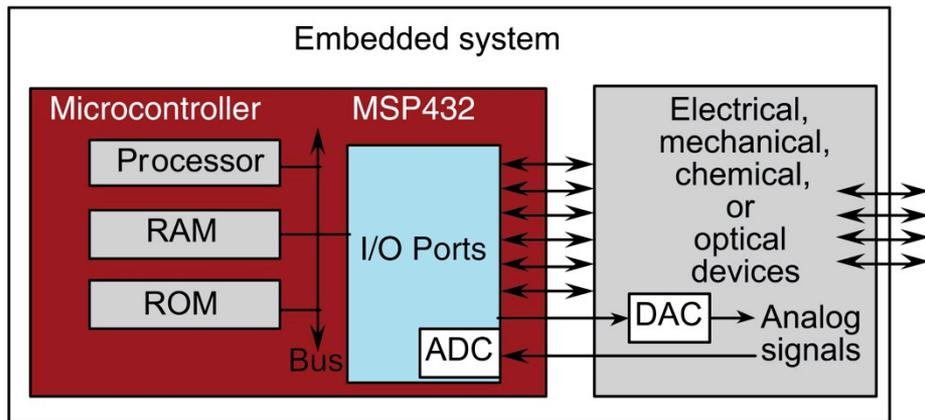
You probably use ~300/day





Embedded System Characteristics

- Reacts and interacts with physical environment continuously
 - Accepts inputs
 - Performs calculations
 - Generates outputs
- Upper bound on the time required to perform input/calculation/output
- System includes:
 - Subsystems
 - Interfaces between subsystems





Big Ideas of Embedded Systems

- HW/SW Architecture
 - Non processor centric view of architecture
 - Microcontroller, FPGA, analog circuits

- Bowels of the “operating system”
 - Specifically, the lower half of the OS
 - Concurrency, parallelism, synchronization

- Real world design
 - Performance vs. cost tradeoffs, constraints

- Analyzability
 - Prove your drive-by-wire system functions correctly

- Application-level techniques
 - Power Aware Programming



Categories of Embedded Systems

- General Computing
 - Applications similar to desktop computing, but embedded
 - Video games, set top boxes, wearable computers, automatic tellers
- Control Systems
 - Closed loop feedback control of real time system
 - Vehicle engines, chemical processes, nuclear power, flight control
- Signal Processing
 - Computations involving large data stream
 - Radar, Sonar, video compression
- Communication & Networking
 - Switching and information transmission
 - Telephone system, Internet

IoT with SimpleLink:

- Wi-Fi
- Bluetooth low energy
- Sub-1 GHz



Embedded System Constraints

- Small Size, Low Weight
 - Handheld electronics
 - Transportation applications weight costs money

- Low Power
 - Battery power for 8h to 10y (laptops often last only 2 hours)
 - Limited cooling may limit power even if AC power available

- Harsh environment
 - Heat, vibration, shock
 - Power fluctuations, RF interference, lightning
 - Water, corrosion, physical abuse

- Safety critical operation
 - Must function correctly
 - Must not function incorrectly

- Extreme cost sensitivity
 - \$.05 adds up over 1,000,000 units



Real-Time Systems

- Hard real time
 - Missing a timing constraint is unacceptable,
 - Safety-critical systems
- Firm real time
 - Value of a task past its timing constraint is zero but not harmful
 - Audio/video streaming
- Soft real time
 - Value of a task diminishes the later it completes
 - Email, web servers



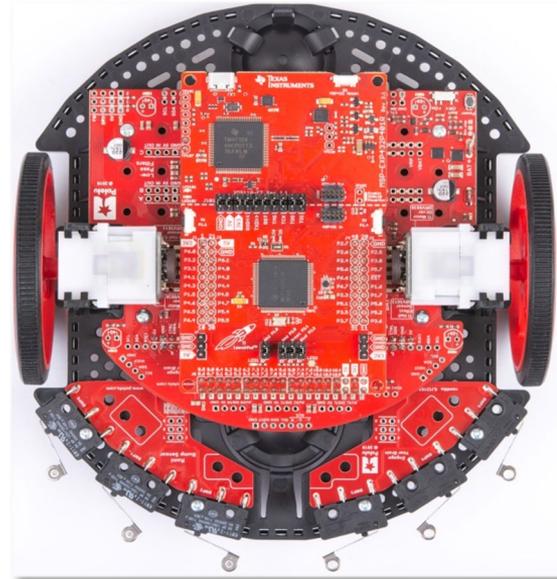
Embedded System

Summary

- Embedded Systems
 - Reactive
 - Real-time
 - Constraints
 - Ubiquitous
- Systems
 - Mixed analog/digital/software
 - Subsystems
 - Interfaces
 - Verification

Real-time

- Hard
- Firm
- Soft



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