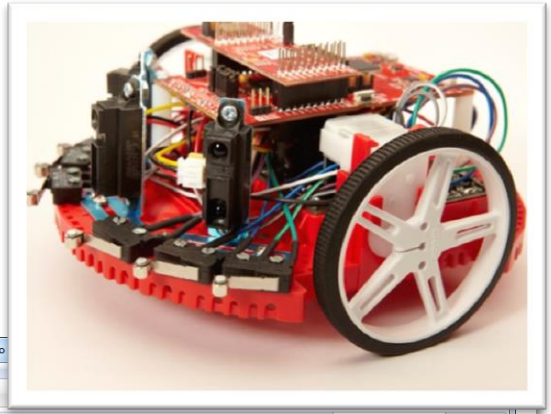
Module 1

Lecture: Running Code on the LaunchPad using CCS

Running Code on the LaunchPad using CCS

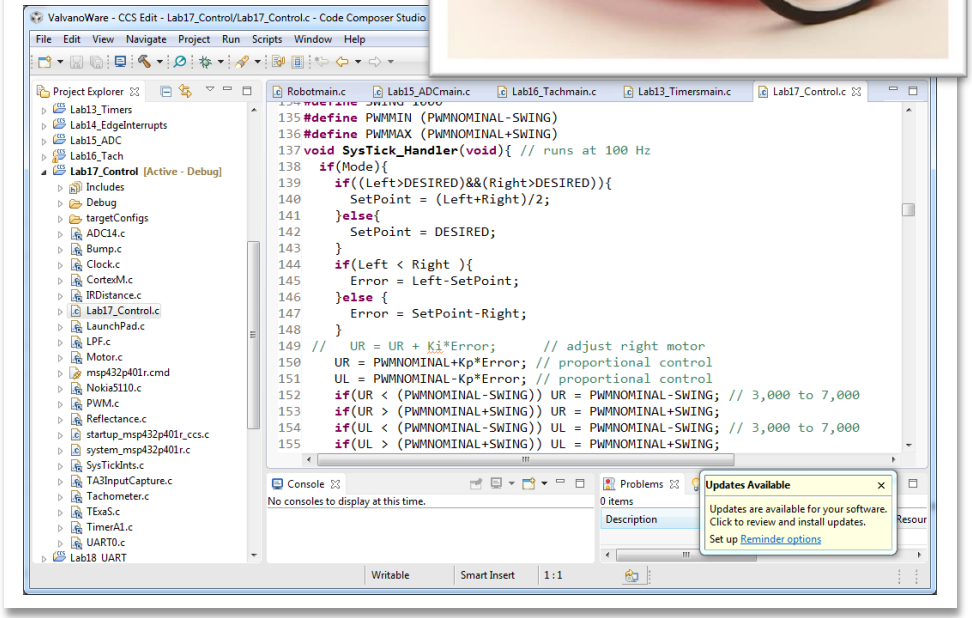


You will learn in this module

- Introduction to Embedded Systems

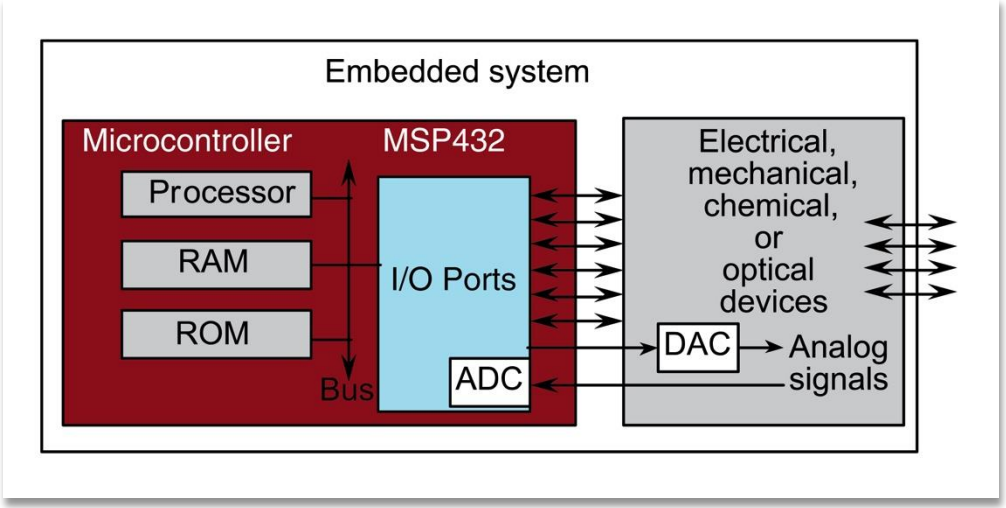
- Code Composer Studio
  - Software installation
  - Compile-link-download-debug

- TI Robotics Systems Learning Kit
  - Software installation
  - Documentation
  - Resources



What is an Embedded System?

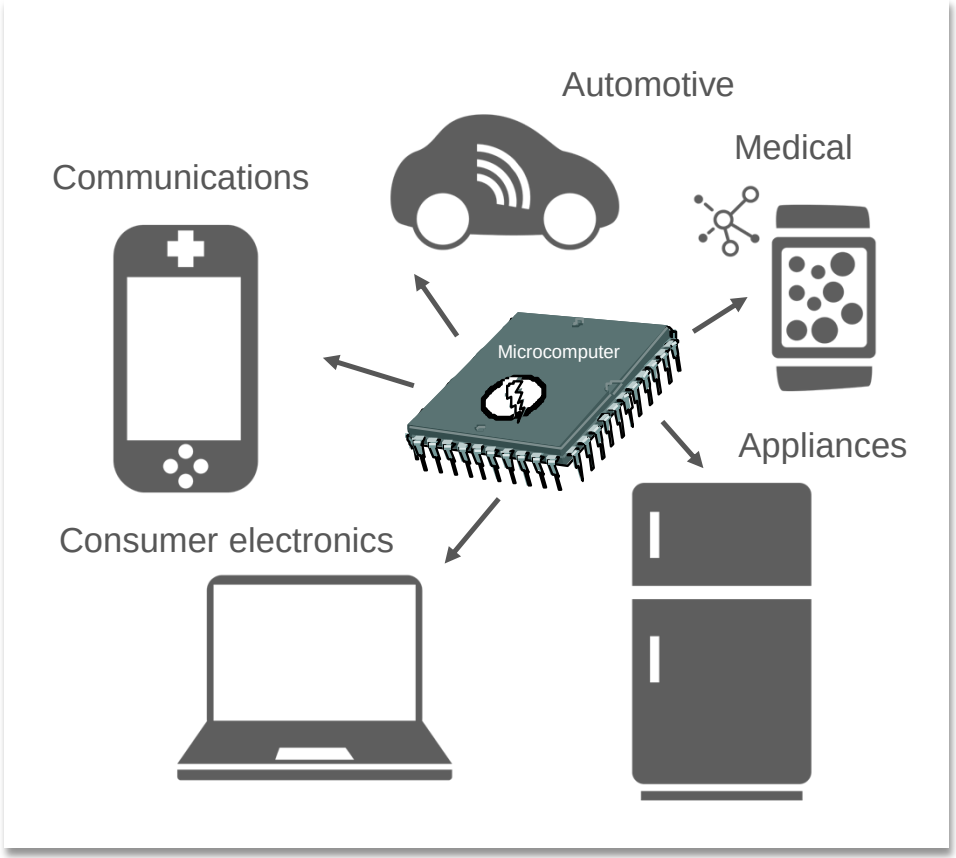
- Includes a microcomputer like the MSP432
- Configured to perform a specific dedicated application
- Software programmed into ROM
- Software that is not accessible to the user of the device
- Software that solves only a limited range of problems
- Its microcomputer embedded or hidden inside



Embedded System Applications

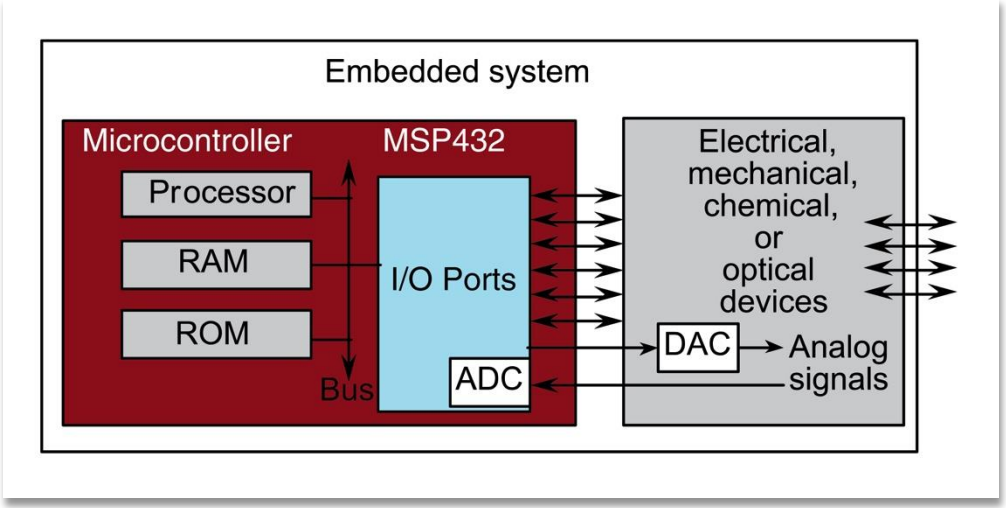
- Communications
- Automotive, ~20/car
- Military
- Medical
- Consumer, ~150/home
- Machine control

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

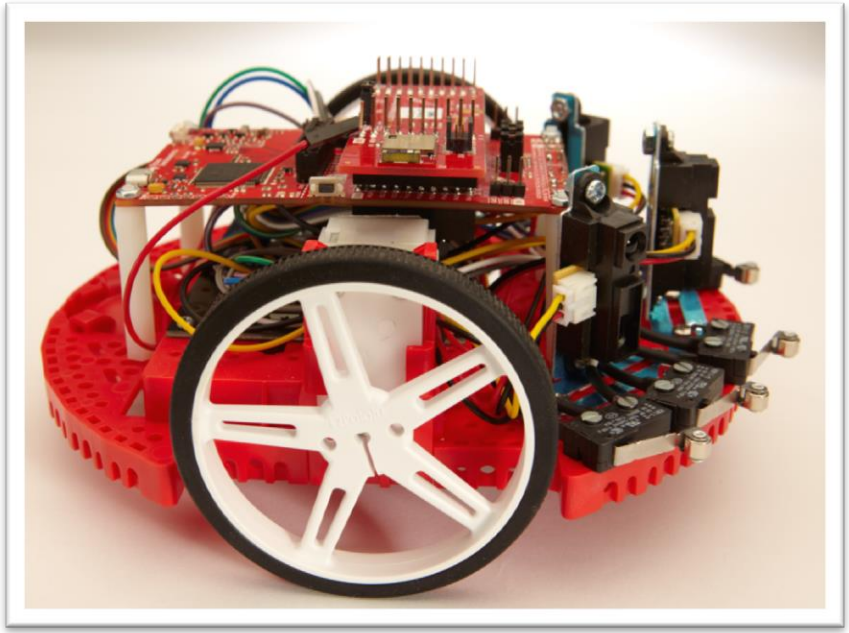
Embedded System

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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