Gömülü ve Gerçek Zamanlı Sistemler

Yrd. Doç. Dr. Mustafa Engin
mustafa.engin@ege.edu.tr
mustafa.engin8@gmail.com
Ege Meslek Yüksekokulu 114 nolu oda, Tel:3112548
Elektronik Teknolojisi Programı sayısal Elektronik ve Mikroişlemciler Laboratuvarı

Dersin Amacı

- İleri düzeydeki gömülü sistemlerin tasarımı ve kullanımını içeren projelerin yürütülmesine yönelik temel bilginin edinilmesidir.
- Ders Kitabı:
- High-Performance Embedded Computing: Architectures, Algorithms, and Applications Morgan-Kauffman Publishers, 2007, Wayne Wolf
- Fundamentals of Embedded Software, "Daniel W. Lewis", Prentice Hall, 2004.
- Embedded Systems: Real-Time Interfacing to Arm Cortex-M Microcontrollers, Jonathan W. Valvano 2012

CHAPTER 1

INTRODUCTION

What is an Embedded System?

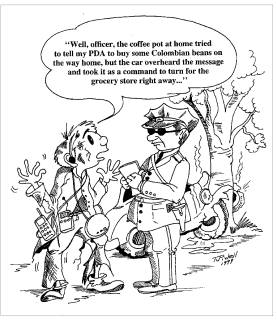
- Electronic devices that incorporate a computer (usually a microprocessor) within their implementation.
- A computer is used in such devices primarily as a means to simplify the system design and to provide flexibility.
- Often the user of the device is not even aware that a computer is present.

Embedded Rules!

- Embedded processors account for 100% of worldwide microprocessor production!
- Embedded:desktop = 100:1
- 1999: #embedded processors in the home estimated at 40-50.

Design Goal: Reliability

- Mission Critical
- Life-Threatening (hayatı tehdit eden)
- 24/7/365
- Can't reboot!



Design Goal: Performance

- Multitasking and Scheduling
- Optimized I/O ➔ Assembly Language
- Limits, Inaccuracies of Fixed Precision

Design Goal: Cost

- Consumer Market: Minimize Manufacturing Cost.
- Fast Time to Market Required
- No chance for future modification.

What is a Real-Time System?

- Real-time systems process events.
- Events occurring on external inputs cause other events to occur as outputs.
- Minimizing response time is usually a primary objective, or otherwise the entire system may fail to operate properly.

Hard/Soft Real-Time Systems

- Soft Real-Time System
  - Compute output response as fast as possible, but no specific deadlines that must be met.
- Hard Real-Time System
  - Output response must be computed by specified deadline or system fails.

Multi-Tasking and Concurrency

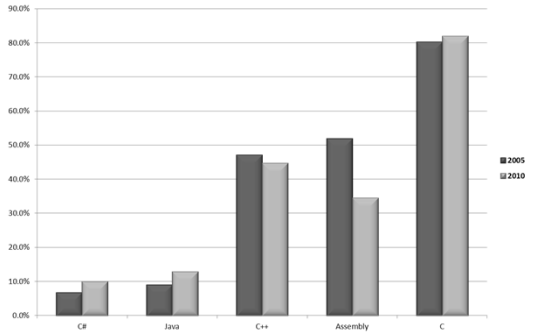
- Most real-time systems are also embedded systems w/several inputs and outputs and multiple events occurring independently.
- Separating tasks simplifies programming, but requires somehow switching back and forth among the different threads of computation (*multi-tasking*).
- *Concurrency* is the appearance of simultaneous execution of multiple tasks.

Three Concurrent Tasks Within a Programmable Thermostat

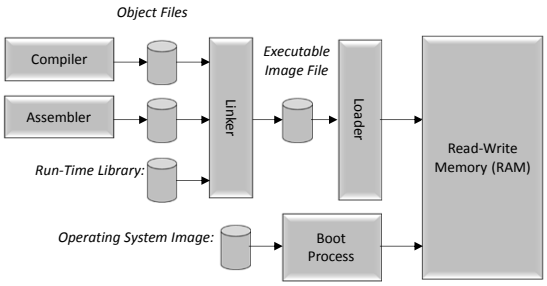
/* Monitor Temperature */	**/* Monitor Time of Day */**	**/* Monitor Keypad */**

do forever {
measure temp ;
if (temp < setting)
start furnace ;
else if (temp >
setting + delta)
stop furnace ;
}
	do forever {
	measure time ;
	if (6:00am)
	setting = 72^{o}F ;
	else if (11:00pm)
	setting = 60^{o}F ;
	}
		do forever {
		check keypad ;
		if (raise temp)
		setting++ ;
		else if (lower temp)
		setting-- ;
		}

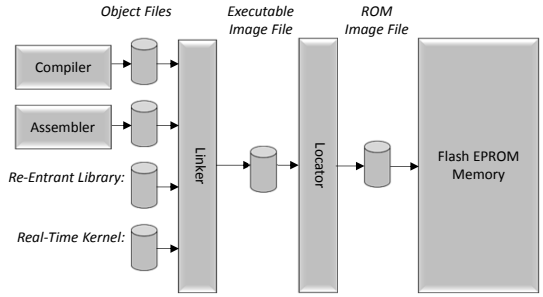
Programming Language Use in Embedded Designs



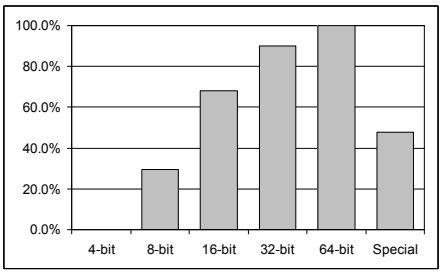
Desktop Application Development



Embedded Application Development



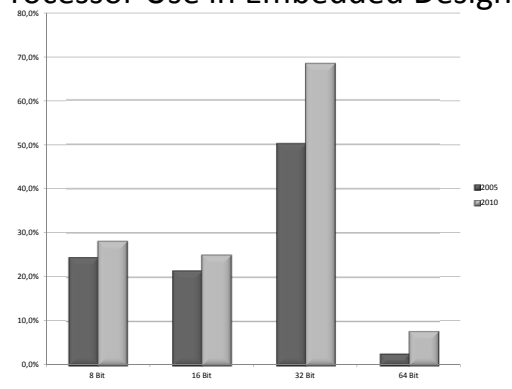
Use of Real-Time Kernels in New Embedded Designs.



Examples of Embedded Real-Time Software.

Property	*FAX Machine*	*CD Player*
Microprocessor:	16-bit	8-bit
Number of Threads:	6	9
Read-Write Memory (RAM):	2048 Bytes	512 Bytes
Total RAM Actually Used:	1346 Bytes (66%)	384 Bytes (75%)
Amount Used by Kernel:	250 Bytes (19%)	146 Bytes (38%)
Read-Only Memory (ROM):	32.0 KB	32.0 KB
Total ROM Actually Used:	28.8 KB (90%)	17.8 KB (56%)
Amount Used by Kernel:	2.5 KB (8.7%)	2.3 KB (13%)

Processor Use in Embedded Designs



ARM Powered Products

Product: Hunter Programmable Digital Thermostat.

Microprocessor: 4-bit

The tiny ATMEL 8-bit picoPower AVR processor in Vitality's GlowCap™ helps people remember to take their medication on time. It can sense when the bottle is opened, transmit that information wirelessly to a Vitality server, flash its LED, and play a ring-tone.

The Vendo Vue40 vending machine uses a 16-bit Hitachi H8/3007 processor.

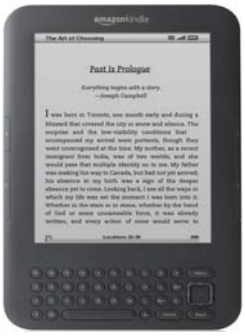
The Sonicare DiamondClean toothbrush uses an 8-bit PIC microprocessor.

Product: Miele dishwashers.

Microprocessor: 8-bit Motorola 68HC05.

NASA's 2003 Mars Exploration Rover used an BAE Systems RAD6000 32-bit RISC cpu and Wind River Systems' VxWorks embedded real-time operating system

The Seagate Barracuda XT disk drive incorporates two ARM Cortex-R4 processors – one to control the servos, and another to handle the command and data flow.



The Amazon Kindle 2 uses a 32-bit ARM processor.

Product: Sony Aibo ERS-110 Robotic Dog.

Microprocessor: 64-bit MIPS RISC.