



Embedded and Mobile Systems

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Presentation Outline

01

**What is are embedded
and mobile systems?**

02

**History to Present of
Embedded Systems**

03

**History to Present of
Mobile Systems**

04

What the future holds





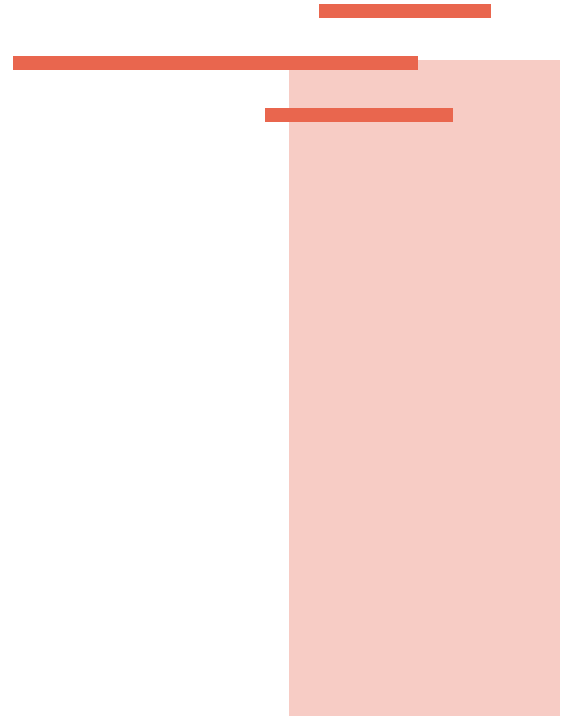
**What are the
characteristics of an
embedded system?**





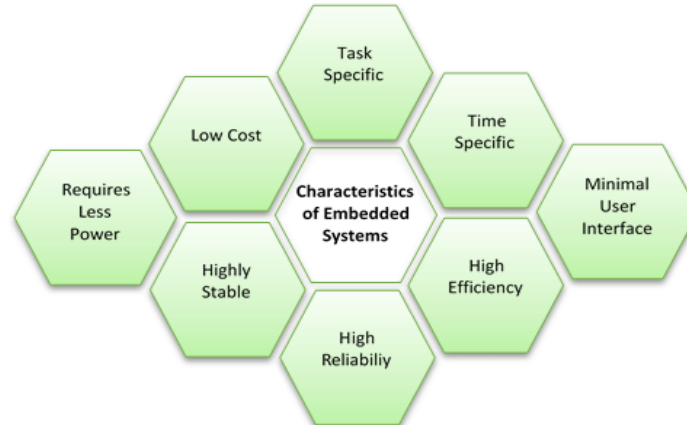
01

**Embedded
and Mobile
Systems**



Embedded Systems Characteristics

- Designed for one specific task and tightly constrained
- Microprocessor or microcontroller based
- Limited memory, low cost, low power consumption
 - No secondary memory in computer
- ROM boot
- Portable – same embedded software in various environments
- Connected to peripherals to connect input and output devices



Microcontroller vs Microprocessor

Microcontroller

A single Integrated Circuit

- Cost less
- Perform one dedicated function
- Code is uploaded and executed
- Much slower speeds (200 MHz)
- Low power consumption
- Just right amount of speed and power for job

Microprocessor

Electrical component used by a computer to do its work. CPU on a single integrated circuit.

- Cost more
- More complex
- Perform a variety of tasks
- Faster speeds (4 GHz)
- High power consumption

Structure of an Embedded System

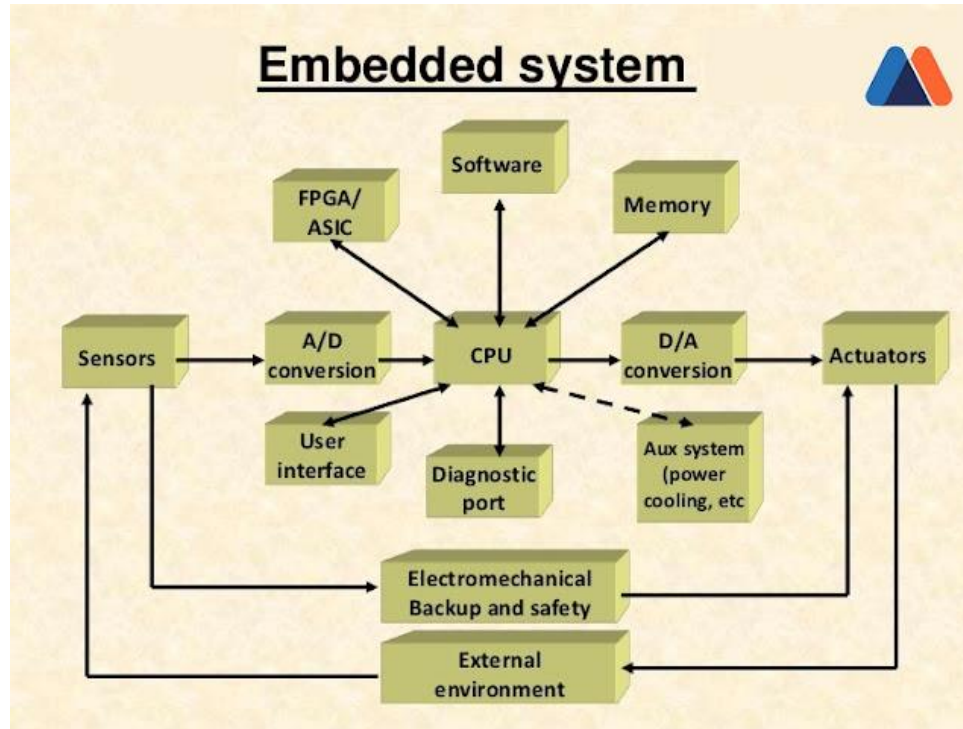


Image from [Swathi Prabhala](#)

Types of Embedded Systems

- **Small Scale**
 - Single 8 or 16-bit microcontroller
 - Battery
 - To develop: Editor, assembler, IDE ,ad cross assembler
- **Medium Scale**
 - 16 or 32-bit microcontrollers
 - Offer both hardware and software complexities
 - To develop: C, C++, or Java and source code engineering tool
- **Sophisticated**
 - Lots of hardware and software complexities
 - May need: IPS (Screen), ASIPs (Application Specific Instruction Set Processor), PLAs (Programmable logic arrays), configuration processor, or scalable processors
 - To develop: Need hardware and software co-design and components which needs to combine in the final system.

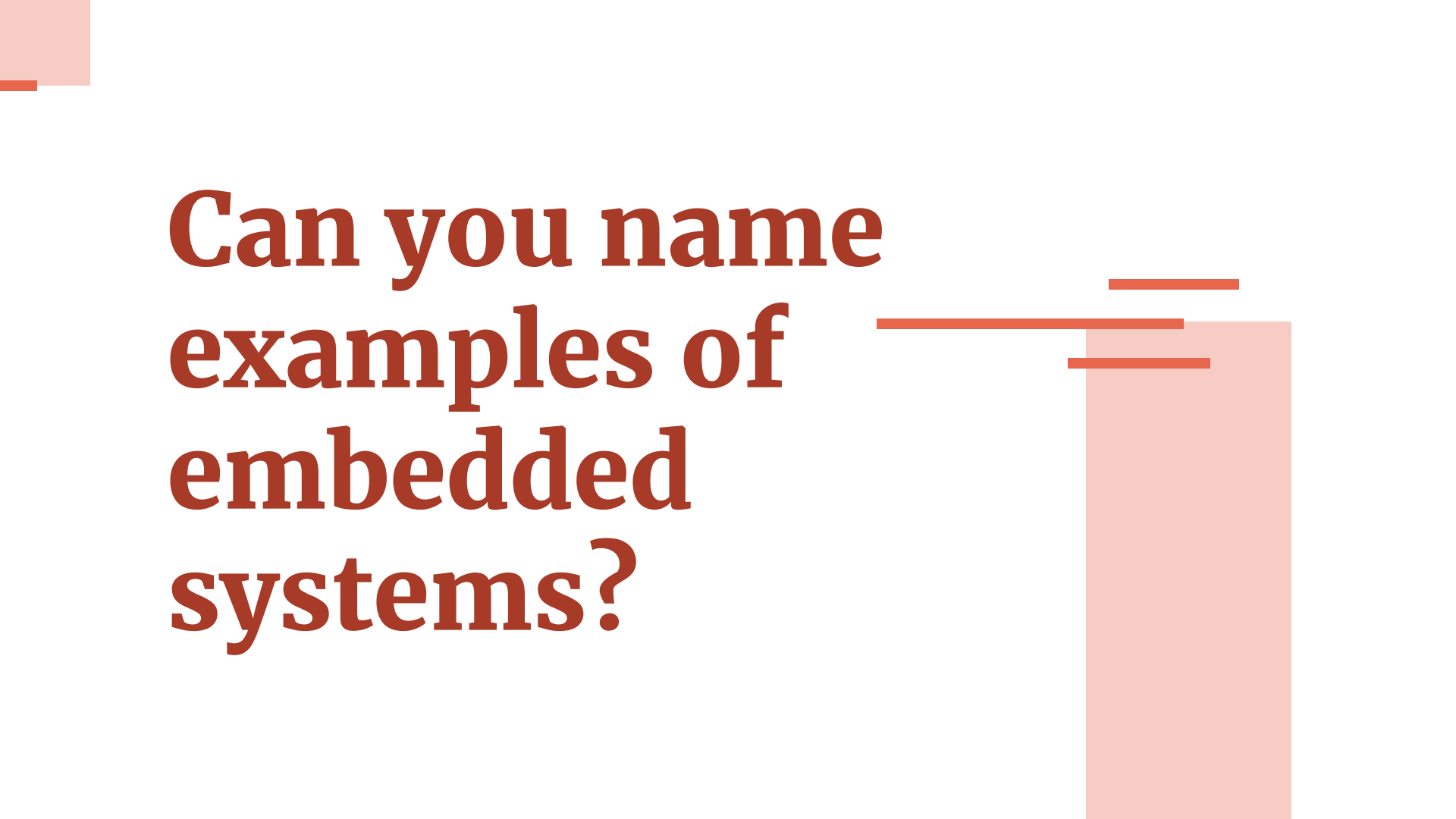
Advantages & Disadvantages

Advantages

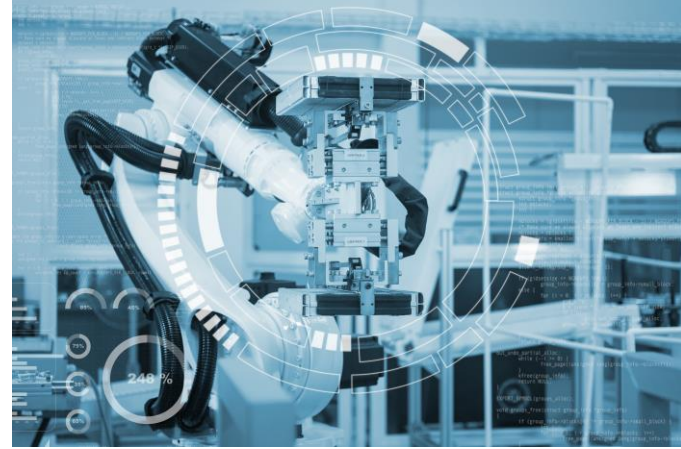
- Less likely to error
- Small in size
- Fast operation
- Low power consumption
- Highly reliable
- Useful in mass production
- Simplified hardware
- Relatively low cost

Disadvantages

- High development effort
- Long time to market
- Limited to a very specific task
- Limited memory resources
- Doesn't offer technological improvement
- Difficult to backup embedded files

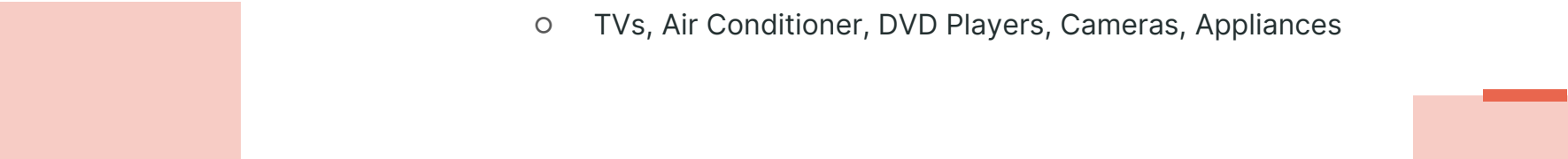


**Can you name
examples of
embedded
systems?**





Applications of Embedded Systems

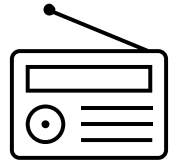
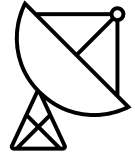
- **Robot Science**
 - Drones, Ground and Underwater Vehicles, Industrial
 - **Medical**
 - Infusion pumps, cardiac monitor, dialysis machine
 - **Automotive**
 - Engine control, ignition, braking
 - **Automobile**
 - Fuel injection, air bags, door locks, lighting system
 - **Networks**
 - Router, Hubs, Gateways
 - **Home Devices**
 - TVs, Air Conditioner, DVD Players, Cameras, Appliances
- 

What are Mobile Computing Devices?

- Transmit Data without a physical link – portable
- Smaller in size than normal computers
- Batteries
- Applications (Although mobile web browsing is getting better)
- 3 Major Elements
 - Mobile Communication
 - Mobile Hardware
 - Mobile Software

Mobile Communication

- Bluetooth
- Cellular Communication
- Wireless WAN, PAN, LAN, MAN
- RFID (Radio Frequency Identification)
- Satellite Communication
- AM/FM Radio



Mobile Hardware

- Batteries – Usually rechargeable
- Body made of metal or plastic
- RAM
- CPU
- Storage – Hard Drive or Solid-State Drive
- Motherboard
- Peripherals

It's basically a computer, but smaller and not as powerful.

Mobile Software

- Operating Systems (More than one specific task this time)
- **Laptop**
 - Windows
 - Linux
 - macOS
- **Smartphone**
 - Android
 - iOS



iOS



<https://logodix.com/ios>



02

History to Present of Embedded Systems



The Start of Embedded

- **1960**- Charles Stark Draper develops integrated circuit for Apollo Guidance Computer at MIT
- **1965**- Autotronics (Boeing now) develops D-17B computer used in the Minuteman missile guidance system
- **1968**- First embedded system for a vehicle
- --During this period integrated circuit prices dropped and usage surges--
- **1971**- Texas Instruments develops first microcontroller
- **1974**- TMS1000 Series becomes commercially available.
 - 4-bit processor, ROM, RAM, \$2 apiece (\$11.41 now)

The Start of Embedded Cont.

- **1978**- National Engineering Manufacturers Association releases standard for programmable microcontrollers
- **1987**- Wind River releases first embedded OS VxWorks
- **1996**- Microsoft releases Windows CE for embedded systems
- **Late 1990s**- First embedded Linux system appears
 - Linux is used in almost embedded devices today
- **2013**- Embedded system market valued at \$8.64 billion

Present Day Embedded

- Embedded systems can be simple, but they are becoming complex
 - drones, automated vehicles, smart homes, wearables, 3D printers, etc.
- Part of our daily lives
 - Credit card readers, traffic lights, thermostats, appliances, etc.
- Vehicles
 - Oxygen sensors, air pressure sensors, air temp, engine temp, ABS, air bags, key-less entry, etc.
- Healthcare
 - CT Scanners, MRI, Sonography for Ultrasounds, pulse oximeters, etc.
- **2020-** Global market for embedded systems reaches \$207.3 billion



03

History to Present of Mobile Systems



The Start of Mobile Systems

- **1970s**- Alan Kay, famous for Xerox PARC, envisions portable computers
- **1981**- Osborne Computer Corp releases first consumer laptop The Osborne 1
 - 5-inch screen, 52 chars per line, \$1,795 (\$5,552 now)
- **1982**- Epson starts selling the HX-20 with a 120 x 32 resolution LCD screen to with rechargeable batteries
- **1983**- The Kyocera Kyotronic with a large 8 line 40-character-wide screen that runs on AA batteries. Also, the Commodore SX-64 becomes first portable color screen releases.
- **1984**- Gavilan SC sports first touchscreen developed and first to be marketed as a “laptop”
- **Mid 1980's**- Color STN and DSTN screens make color screens mainstream

The Start of Mobile Systems Cont.

- **1989**- Apple Macintosh portable is one of the first to feature active matrix 640x400 screen that eradicated the blurring. Apple's first contribution to mobile. GridPad is released, thought of as first tablet.
- **1990**- Intel announces 20MHz 386SL processor for mobile computing
 - Power management features and sleep mode
- **1992**- Windows 3.1.1 released and becomes the standard for laptops
- **1993**- The PDA (personal digital assistant) is introduced in US by Apple
 - First attempt to recognize handwriting and use basic AI in a small digital device
- **1994**- IBM's Thinkpad 755 introduces the CD-ROM drive
- **1996**- U.S. Robotics introduces PalmPilot 1000 for \$299 (\$536 now)
- **1997**- Toshiba makes the Libretto at the size of a VHS tape. Unusable keyboard, but was a full-blown notebook with hard drive and Windows 95

Present Day Mobile Systems

- Most popular:
 - Smart phones (By a long shot)
 - Laptops
 - Wearables (Watches, glasses, bracelets)
 - Handheld Gaming Devices (PS Vita, Switch, DS)
 - Tablets/E-readers



<https://www.cs.odu.edu/~tkennedy/cs300/development/Public/M01-HistoryOfMobileComputing/image5.jpeg>



04

What the future holds



Future of Embedded

- Let's just say the future is bright...
- Autonomous Vehicles
- Constant breakthroughs in robotics
- Smart healthcare systems
 - Providing remote medication
 - Remote patient monitoring
 - Internal-body examinations
- Smart homes
- Smart Agriculture
 - Maximize output while minimizing input by predicting climatic conditions and determining soil conditions



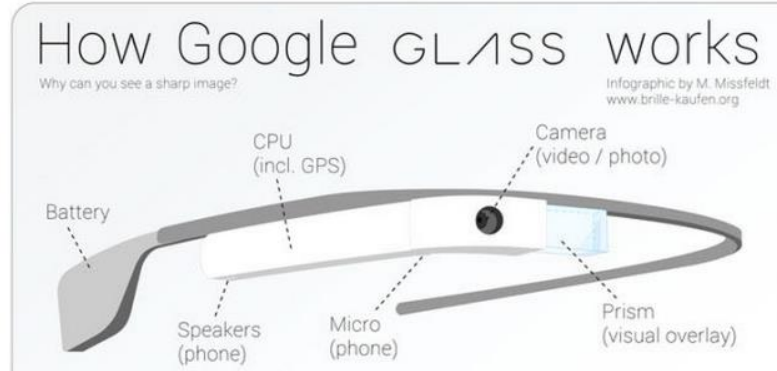
<https://www.safewise.com/ap/uploads/smart-home-1.jpg>

Future of Mobile Systems

- Is it Zucc's "metaverse"?
- Mixed Reality
 - **Virtual Reality**
 - Completely immersed in digital experience
 - **Immersive devices:** Samsung HMD Odyssey+, Oculus Quest
 - **Augmented Reality**
 - Overlays graphics, holograms, or other displays in the physical world
 - **Holographic devices:** Microsoft HoloLens, Google Glass
 - Mixed reality transitions between augmented and virtual
 - Place digital object, hologram, in the physical world as if it were physically present
 - Be present both personally and digitally in physical world in the form of an avatar and collaborate with others at different points in time

Future of Mobile Systems

- Augmented Reality



<https://images.spot.im/v1/production/j1fq82rxlhwon1i7vbr2>

- Virtual Reality



<https://cdn.mos.cms.futurecdn.net/7E6eFTMMLcT8ZUa2tgKh6e.png>

Conclusion

- **What are they?**
 - Embedded Systems- used for specific task
 - Mobile System- portable computer for various tasks
- **History**
 - Embedded Systems- created in 1960s for space and military work
 - Mobile Systems- first created in the 1980s, but had issues
- **Present Day**
 - Embedded Systems- part of everyday lives in appliances, cars, appliances
 - Mobile Systems- extremely popular and with most of us 24/7
- **Future**
 - Embedded Systems- advanced robotics, automated cars, healthcare, agriculture
 - Mobile Systems- allow us to enter Zucc's world and interact virtually



Thank you!

Questions?

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