

Digital System & Embedded System

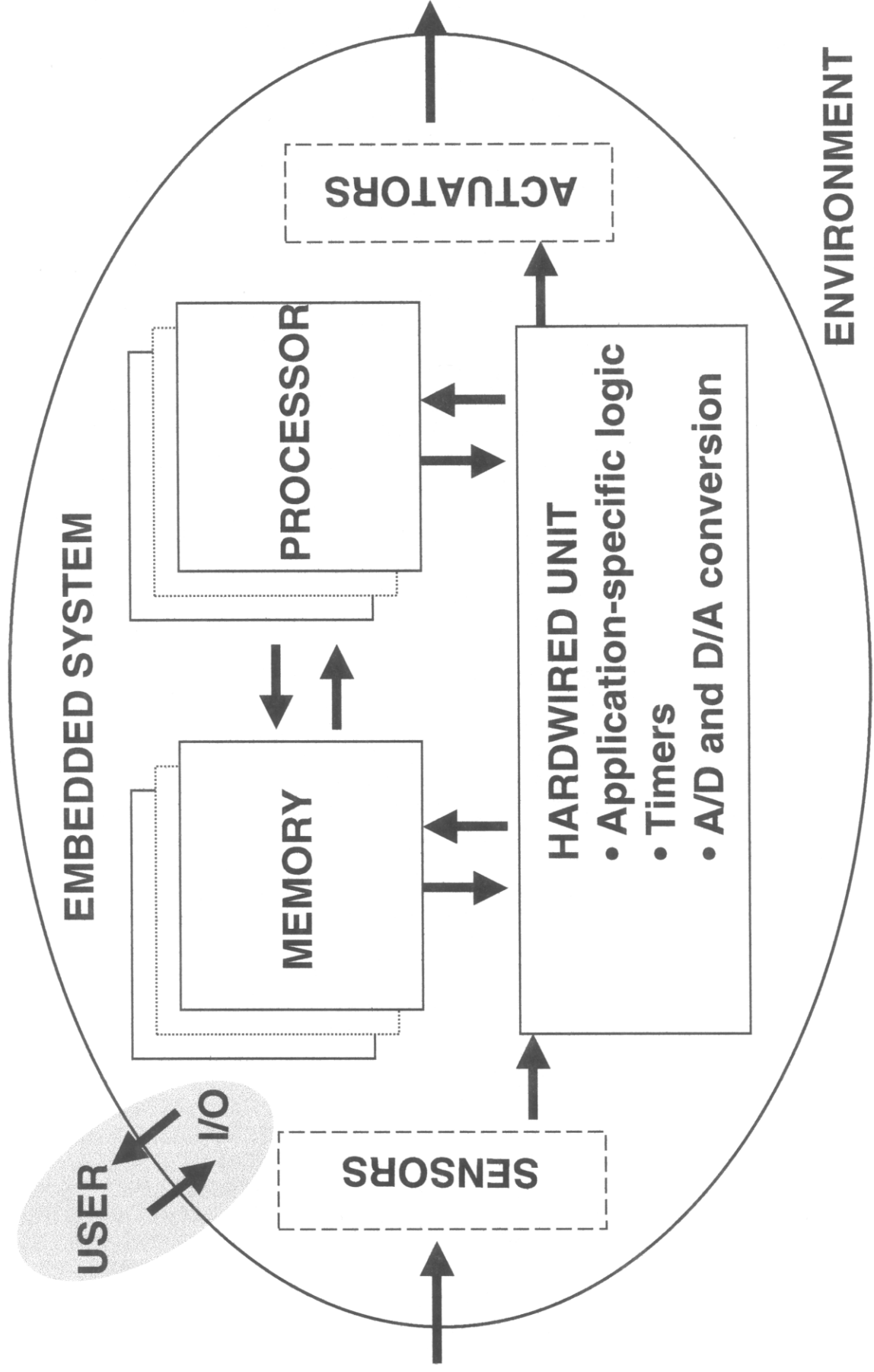
- Digital System: may provide service
 - as a self-contained unit (e.g., desktop PC)
 - as part of a larger system (e.g., digital control system for manufacturing plant)
- Embedded System:
 - part of a larger unit
 - provides dedicated service to that unit

G. De Micheli and R. Gupta, "Hardware/Software Co-Design," *Proc. IEEE*, 85(3), March 1997, pp. 349-365

Examples of Embedded Systems

- PC having dedicated software programs and appropriate interfaces to a manufacturing assembly line
- Microprocessor dedicated to a control function in a computer, e.g., keyboard/mouse input control

Parts of an Embedded System



Parts

- Actuators - mechanical components (e.g., valve)
- Sensors - input data (e.g., accelerometer for airbag control)
- Data conversion, storage, processing
- Decision-making
- Range of implementation options
- Single-chip implementation: system on a chip

Features of Embedded Systems

1. Application Domains



2. Degree of Programmability

A) Instruction Set Architecture programming

(e.g., machine code, assemble, higher level language)

- microprocessors
- microcontrollers
- programmable digital signal processors (DSPs)

B) Hardware Level programming

- FPGA: field-programmable gate array
(gate-level interconnects are configured after IC fabricated)
- ASIC: application-specific integrated circuit
(programming set at time of manufacture)
(Gives higher performance and lower power requirements)

Some Application Domains

- CONSUMER PRODUCTS

- Appliances, Games, A/V, Intelligent home devices

- TRANSPORTATION

- Autos, Trains, Ships, Aircrafts

- PLANT CONTROL

- Manufacturing, Chemical, Power Generation

- NETWORKS

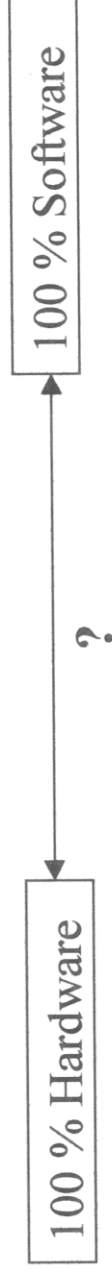
- Telecommunication, Defense

- Local
 - e.g., appliance
- Locally distributed
 - e.g., aircraft control over a LAN
- Geographically distributed
 - e.g., telephone network

Features of Embedded Systems

3. Hardware/Software Partitioning

How is the system functionality partitioned between application-specific Hardware and software executed on one or more processors.



Example: Hand-held RS232 terminal (next page).

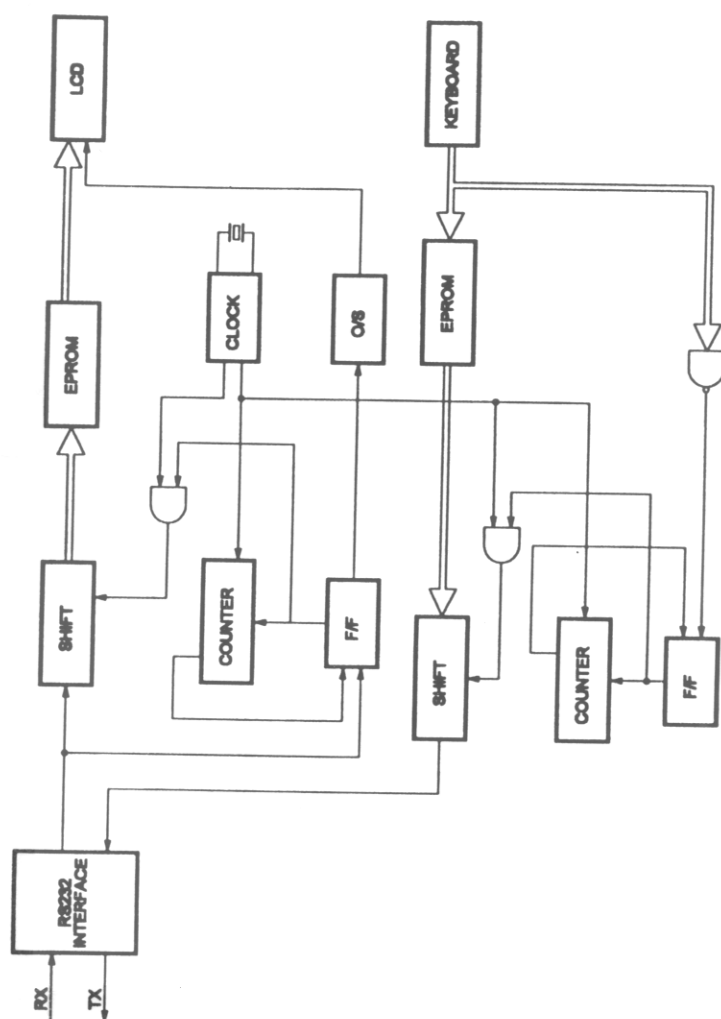


Figure 1-2. Block diagram for a discrete logic hand-held RS232 Terminal.
Parts for device cost approximately \$20.14.

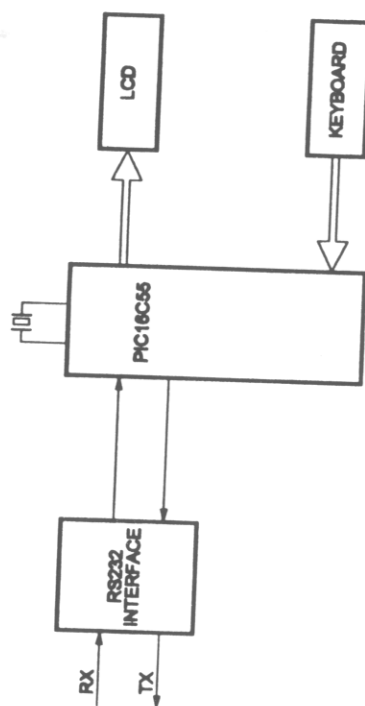


Figure 1-3. The same RS232 Terminal as in Figure 1-2, but utilizing a microcontroller. Total cost is around \$11.59.