Es. Assignment 1

Q1. State & Explain hardware architechture of an embedded system.

Ans.

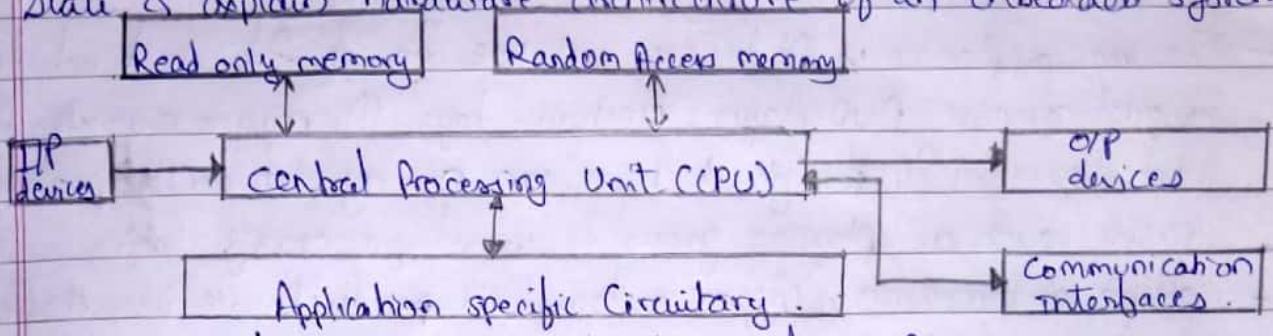

fig. Hardware Architechture of an ES.

i) CPU :- A central processing Unit can be any of following; microcontroller, microprocessor or Digital Signal processor (DSP)
- Microcontroller on chip itself, there will be many other components like memory, serial communication interface, DAC, ADC, etc
- Microprocessors are more powerful but you need to use many external components
- DSPs is used for applications in which signal processing is involved such as audio video proc.

ii) Memory :- Memory is categorised as RAM & ROM.
- Contents of Random Access memory (RAM) will be erased if power is off.
- Read only memory retains the contents even if the power is switched off.

iii) Input device :- ES have very limited capability of handling I/P devices.
- Many ES will have small keypad which allows you to press one key for specific command. Keypad may be used to input only digits.
- Many ES used in process control do not have i/p device for user interaction & take inputs from sensors, transducers, etc.

iv) Output devices :- O/p devices in ES also have limited capability.
- Some ES have LEDs to indicate some signals, health status, etc.
- A small LCD can be used for displaying some important parameters.

v) Communication interface :- ES may need to interact with other ES or they may have to transmit data to a desktop.
- ES are provided with one or few communication interfaces such as RS232, RS422, RS485, USB, Ethernet, etc.

CO2 Illustrate applications of embedded systems

- Consumer appliances :- At home we use no. of ES which include digital camera, DVD player, electronic toys, Microwave oven, etc. Palmtops are powerful ES through which we can carry out general purpose tasks such as playing games & word processing.
- Office automation :- Office automation products we use that consists of ES are copying machine, fax machine, printer, scanner, etc.
- Industrial automation :- The ES for industrial use are designed to carry out specific task such as monitoring temperature, pressure, humidity voltage, current, & then take appropriate action based on monitored levels to control other devices or to send information to centralised monitoring.
- Medical electronics :- In medical equipment many things have ES like ECGs, EEGs, blood pressure measuring devices, X-ray scanners, etc.
- Computer Networking :- Computer networking products such as bridges, routers, ISDN, Asynchronous Transfer Mode are embedded systems which implement necessary data communication protocols.
- Telecommunications :- In this fied ES can be categorised as subscriber terminals & network equipment. Subscriber terminals such as key telephones, terminal adapters, web cameras are ES. The new equipment includes multiplexers, satellite modems, etc.
- Wireless technologies :- Mobile phones, Personal digital assistants, palmtops can now be used to access multimedia services over internet.
- Instrumentation :- The measuring equipments we use in labs to measure parameters such as weight, temperature, pressure, voltage, current, etc are all ES.
- Security :- Security devices at homes, offices, airports, etc for authentication & verification are ES. Biometric systems & face recognition systems are now extensively used for authentication.

Qs. Determine & explain categories of embedded system.

- ES are categorised as
  i) Stand-alone ES
  ii) Real-time systems.
  iii) Network information appliances
  iv) Mobile devices.

i) Stand alone ES :- They work in stand-alone mode.
- They take i/ps, process them & produce desired o/p.
- I/p can be electronic signals ~~to arrive~~ from transducers or commands from human being such as pressing button.
- O/p can be LED or LCD display for displaying of information to the users. ES used in process control, automobiles, consumer electronic items fall in category
- Ex. are TV, Microwave oven, CD player, AC, etc.

ii) Real time systems :- ES in which some specific work has to be done in specific period of time is called as real time systems. The systems which have strict deadlines are called hard real time systems & in ES where deadlines are imposed but not following them once in a while will not lead to a catastrophe is called soft real time systems. Ex DVD player.

iii) Network Information appliances :- ES that are provided with network interfaces & accessed by n/ws such as LAN or internet.
- ES are connected to a n/w like a n/w running TCP/IP protocol suite, such as the Internet or ~~Intranet~~ a company's Intranet.
- Ex. Web camera connected to internet.

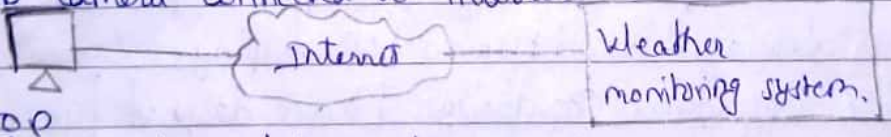

fig. Networked information Appliance.

iv) Mobile devices :- Mobile devices such as mobile phones, PDAs, smart phones etc are special category of ES. Though PDAs do many general purpose tasks, they need to be designed just like conventional ES. The limitations of mobile devices are memory constraints, lack of good interfaces such as full fledged keyboard & display etc are found in ES hence mobile devices are considered as ES.

Q1 Describe specialities of Embedded system.

- i) Reliability: Reliability is a paramount importance in ES. They should continue to work for thousands of hours without break under extreme environmental conditions like very high/low temperatures, humidity, etc. they should withstand bump & vibrations.
- ii) Performance: Many ES have time constraints. The system must meet such deadlines. If deadlines are missed, disaster may happen.
- iii) Power Consumption: Most ES operate through battery & to reduce drain and avoid recharging frequently, power consumption of ES must be low. It may be achieved by reducing hardware components and using Programmable logic devices (PLDs) & Field Programmable Gateways (FPGAs).
- iv) Cost: Cost should be minimal for ES used in consumer electronics or office automation. Hardware Engg. debate on component selection to reduce even 0.1$
- v) Size: Size should be minimum for ES. To reduce size & weight Hardware Engg have to design their boards by reducing component count to maximum possible extent.
- vi) Limited User interface: ES do not have sophisticated interfaces for input/output. They take electrical signals as i/p & produce same as o/p. In some ES, input is through small fun" keypad or set of buttons & o/p is displayed on LEDs or LCD displays.
- vii) Software Upgradation Capability: ES are designed for very specific task so once s/w is transferred in h/w, the s/w will run throughout life but in some cases it may be necessary to upgrade s/w. Nowadays s/w upgradation is done by downloading the s/w onto es throug a n/w connection.

Q5. Describe recent trends in ES.

- i) Processor power: Powerful 8-bit, 16-bit, 32-bit, 64-bit micro controllers & microprocessors are available. Clock speed & memory addressing capability of processors is also increasing.
- ii) Memory: Cost of memory chips is reducing day by day. So the ES can be made functionally rich by incorporating additional features such as networking protocols & even graphical user interfaces.
- iii) Operating systems: Main advantage of embedding an OS is that s/w development will be very fast & maintaining code is very easy. If real-time performance is required, a real-time OS can be used.
- iv) Communication interfaces & Networking capability: With availability of low cost chips ES can be provided networking capability through communication interfaces like Ethernet, 802.11 wireless LAN, infrared. Due to enhanced memory capacities of ES, TCP/IP protocol stack & HTTP server s/w can also be ported on system & such systems can be accessed from anywhere on earth.
- v) Programming languages: ~~Development tools such as MATLAB & Simulink~~ Development of ES was done mostly in assembly languages. However, due to availability of cross-compilers, most of development is now done in high level languages like C, C++, Java, Python.
- vii) Development tools: Development tools such as MATLAB & simulink can be used to model an ES as well as to generate code substantially reducing development time. Availability of no. of tools for ~~deployment~~ development debugging & testing as well as for modelling the ES is resulting way for fast development of robust & reliable systems.
- viii) Programmable Hardware: Programmable logic devices (PLDs) & field Programmable Gate Arrays (FPGAs) pave the way for reducing the components on an ES, leading to small, low cost systems.