# EMBEDDED SYSTEMS

## Class Test – 01

**(Oxygen)**

# Design Process Explained

## What is Design Process?

❑ A **"Design Process"** is a process followed for designing an Embedded System.

- Abstraction, Modeling, Hardware and Software Architecture, Extra functional Properties, System Related Family Designs.
- Modules.
- Mapping.

# Abstraction

❖ Each problem component first abstracted.

⇨ **For example**, Display picture and text as an abstract class.

❖ Robotic system problem abstraction in terms of control of motors in different degrees of freedoms.

❖ Application software abstracted as concurrently running multiple threads and interrupt service threads.

# Modeling

- Procedure Oriented.
- Objected Oriented.
- Sequential processes.
- Concurrent processes.
- State machine.

## Design of Hardware and Software architecture

- Assumed to consists multiple layers.
- Each architectural layer be well understood before a design.

## Design for Extra functional Properties

- Extra functionalities required in the system being developed be well understood from the design.

## System Related Family designs

- Families of related systems developed earlier taken into consideration during designing.

## Modular Design

- **"Modular Design"** refers to decomposition of software into modules that are to be implemented.
- Modules should be such that they can be composed **(coupled or integrated)** later.
- Effective Modular design should ensure effective

  (i) function independence.

  (ii) cohesion.

  (iii) coupling.

## Modules

- Be clearly understood and maintain continuity.
- Appropriate protection strategies are necessary for each module.
- A module is not permitted to change or modify another module functionality.
- For example, protection from a device driver modifying the configuration of another device.

## Mapping

- Mapping into various representations done considering the software requirements.
- **For example,** data flow in the same path during the program flow can be mapped together as a single entity.

## Transform and transaction mapping

- **For example,** an image is input data to a system; it can have a different number of pixels and colors of each pixel.
- The system has to store or process each pixel and color.
- Transform mapping of image is done by appropriate compression and storage algorithms.
- Transaction mapping is done to define the sequence of the images.

## Testing, Verification and Validation

- **Testing** – to find errors and to validate that the implemented software is as per the specifications and requirements to get reliable product.
- **Verification** – refers to an activity to ensure that specific functions are correctly implemented.
- **Validation** – refers to an activity to ensure that the system that has been created is as per requirements agreed upon at the analysis phase, and to ensure its quality.

## Abstraction of Design Process Steps

- A design process bottom-to-top design if it builds starting from the components.
- A design process top-to-down design if it first starts with abstraction of the process and then after abstraction the details are created.
  - ⇨ Top-to-down design approach is most favoured approach.

# Software Design Cycle

❖ Activities for Software Design during Software-Development Process.

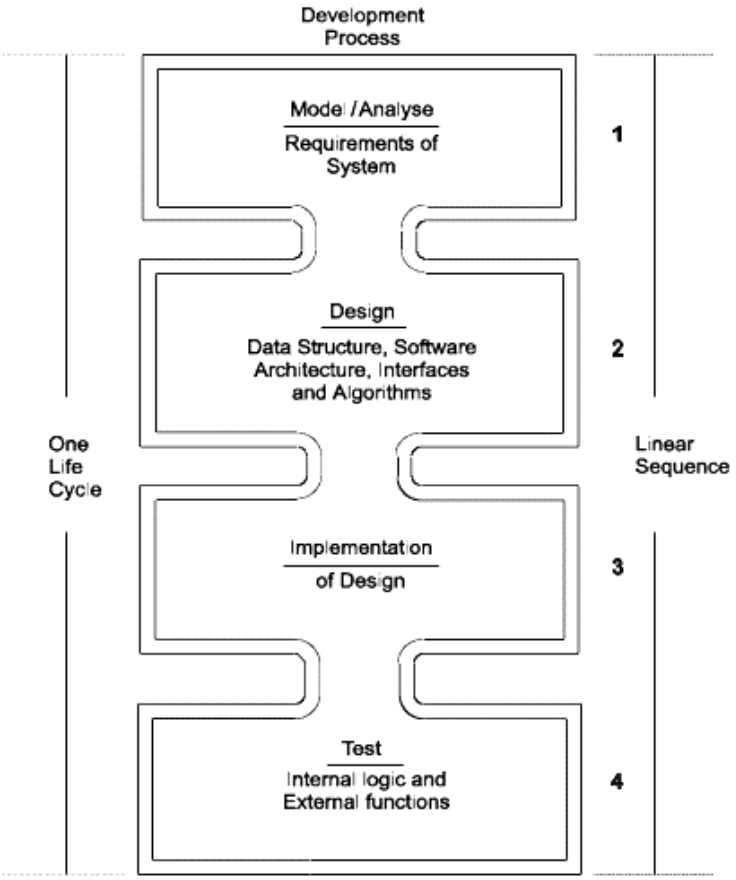


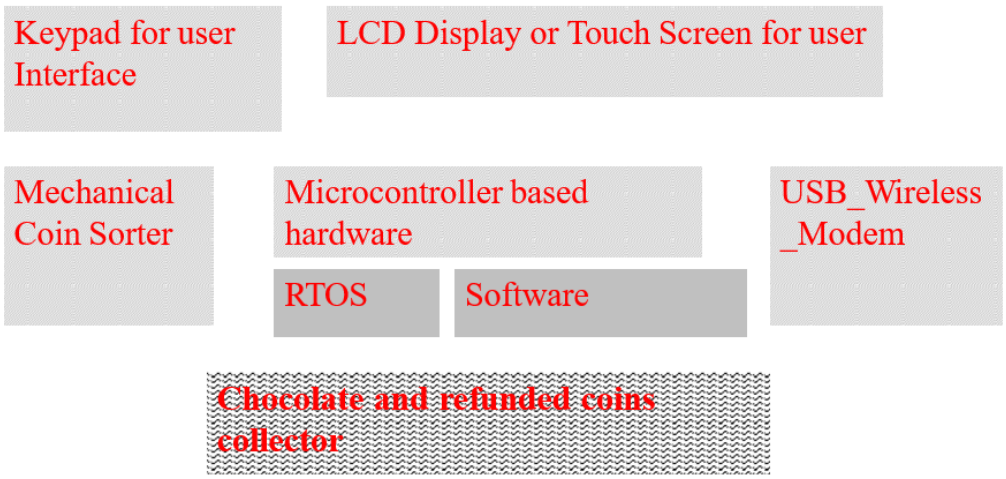

**Figure:** Software Design Cycle

*END OF LECTURE - 1*

## Design Process Examples

- We will learn two examples in this section.
  1. Automatic Chocolate Vending Machine (ACVM).
  2. Smart Card.

## Diagrammatic representation of ACVM




## Automatic Chocolate Vending Machine (ACVM)

- Coin insertion slot.
- Keypad on the top of the machine.
- LCD display unit on the top of the machine. It displays menus, text entered into the ACVM and pictograms, welcome, thank and other messages.
- Graphic interactions with the machine.
- Displays time and date.
- Delivery slot so that child can collect the chocolate and coins, if refunded.
- Internet connection port so that owner can know status of the ACVM sales from remote.

## ACVM Hardware units

- Microcontroller or ASIP (Application Specific Instruction Set Processor).
- RAM for storing temporary variables and stack.
- ROM for application codes and RTOS codes for scheduling the tasks.
- Flash memory for storing user preferences, contact data, user address, user date of birth, user identification code, answers of FAQs.

## ACVM Hardware units (Contd.)

- Timer and Interrupt controller.
- A TCP/IP port (Internet broadband connection) to the ACVM for remote control and for getting ACVM status reports by owner.
- ACVM specific hardware.
- Power supply.

## ACVM Software components

- ✓ Keypad input read
- ✓ Display
- ✓ Read coins
- ✓ Deliver chocolate
- ✓ TCP/IP stack processing
- ✓ TCP/IP stack communication.

# Smart Card

- **Smart card**– a plastic card in ISO standard dimensions, 85.60 mm x 53.98 x 0.80 mm.
- Embedded system on a card.
- SoC (System-On-Chip).

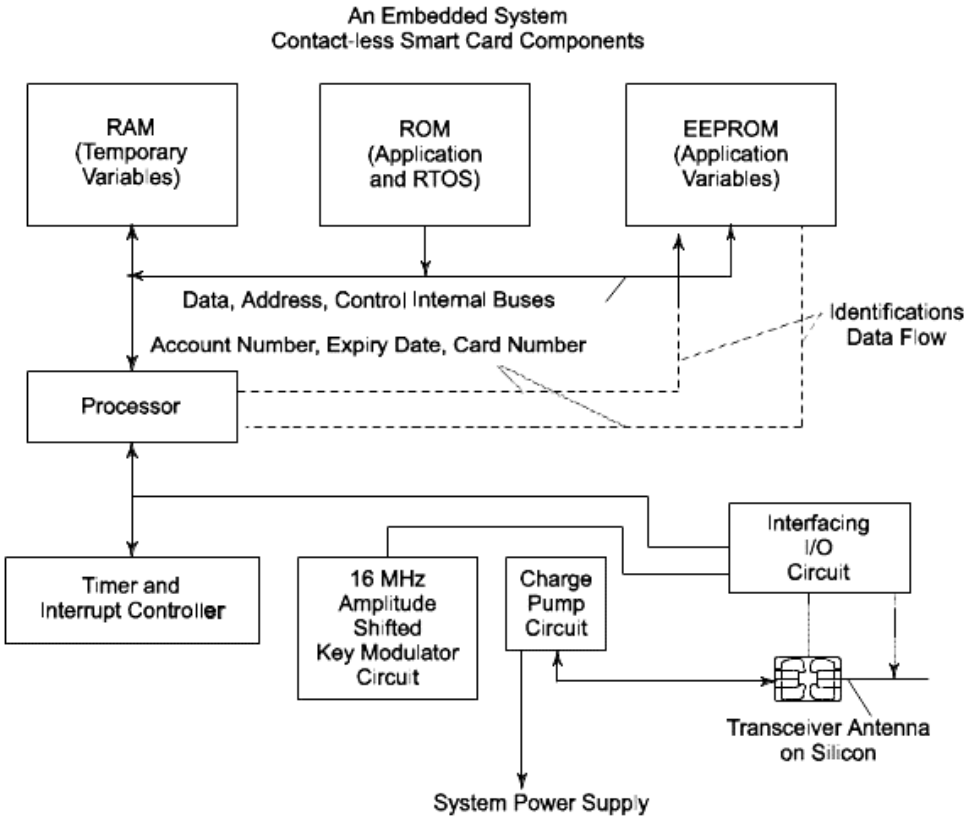



**Figure:** Embedded hardware components in a contact less smart

*THE END*