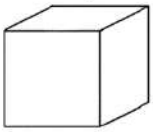
MODULE 3: DESIGN COMMUNICATION

COMMUNICATING DESIGNS GRAPHICALLY

There are different modes of graphical designs to communicate our design to various stakeholders.

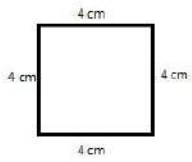
[1] **Sketching:** Sketching is a powerful tool in design because it enables us to convey our design ideas to others quickly and concisely. There are several types of sketches like Orthographic sketches, Axonometric sketches, Oblique sketches and Perspective sketches.

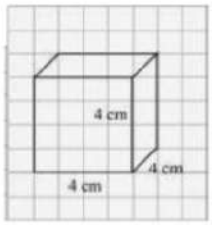


[2] **2D drawings/ 3D drawings:** They are the more formal representations of sketches. It includes proportion control and annotations.

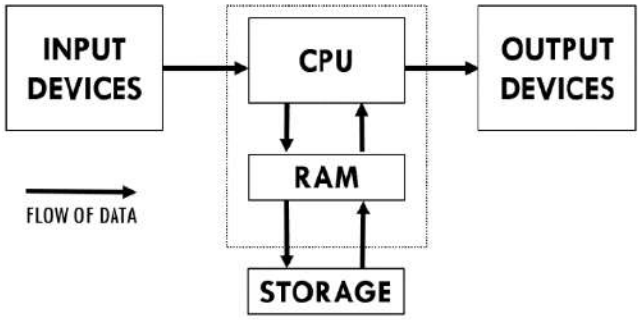
Annotations: They are clear and easily understandable notes provided on sketches for conveying the meaning behind the sketched ideas.

Proportions: It is extremely useful to show the relative sizes of parts, components, or features in a sketch. That's why it is generally a good idea to sketch designs on graph paper, because it is easier to control those relative sizes using the graph paper's grid pattern.

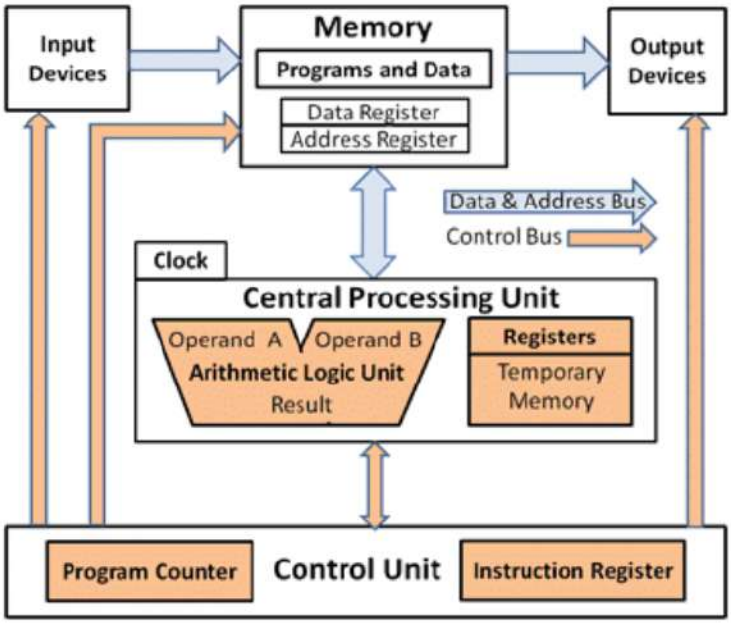




[3] **Block diagrams / Layout drawings:** It represents the various components in the system and their interrelationships. That is, it shows how the various components are connected together. Figure below shows the block diagram of digital computer.



[4] **Detailed drawing /Architecture diagram:** Architecture diagram of a system comprises of various components/elements of that system, interrelationship between them and the externally visible properties of those elements. These drawings must show tolerances, and they must also specify materials and any special processing requirements. Figure below shows the architecture diagram of Digital computer.



[5] **Assembly drawings / Component diagrams:** Assembly drawings show how the individual parts or components of a device fit together. An exploded view is commonly used to show such "fit" relationships. Assembly diagram of digital computer is shown below.

[6] **Animations:** Animation within engineering becomes a clear way to study simulation of a whole system within its intended environment. This provides context for complicated issues, allowing engineering teams to find flaws or help explain complicated issues. Animation tools are used for developing animations. Example: Blender, Maya, Solidworks etc. are used for creating animations.

COMMUNICATING DESIGNS

- REPORTING is an essential part of a design project: We have not completed our project if we have not communicated our work and findings to our client and to other stakeholders the client may designate.
- Final design results can be communicated in several ways, including oral presentations, final reports (that may include design drawings and/or fabrication specifications), and prototypes and models.

COMMUNICATING DESIGNS ORALLY

The elements of an oral presentation are listed below:

- A **title slide** that identifies the client(s), the project, and the design team or organization responsible for the work being presented. This slide should include company logos.
- A **roadmap** for the presentation that shows the audience the direction that the presentation will take. This can take the form of an outline, a flowchart, a big picture slide, and so on.
- A **problem statement**, which includes highlights of the revised problem statement that the team produced after research and consultation with the client.
- **Background** material on the problem, including relevant prior work and other materials developed through team research. References should be included but may be placed in a slide at the end of the presentation.
- The **key objectives** of the client and users should be mentioned.
- The **key constraints** that the design must meet.
- **Functions** that the design must perform, focusing on basic functions, and means for achieving those functions.
- **Design alternatives**, particularly those that were considered at the evaluation stage, including diagrams and descriptions of each.
- **Highlights of the evaluation procedure and outcomes**, including key metrics or objectives that bear heavily on the outcome.
- The **selected design**, explaining why this design was chosen.
- **Features of the design**, highlighting aspects that make it superior to other alternatives and any novel or unique features.
- **Proof-of-concept testing**, especially for an audience of technical professionals for whom this is likely to be of great interest.
- **A demonstration of the prototype**, assuming that a prototype was developed and that it can be shown. Video or still photos may also be appropriate here.
- **Conclusion(s),** including the identification of any future work that remains to be done, or suggested improvements to the design.

ORAL PRESENTATION – CASE STUDY OF AUTOMATIC COFFEE MUG

Automatic Hot Coffee Mug

Project developed by
Johan Jacob Pratheesh
Ashish Mathew Varghese

Project Head: Dr. Pramod Mathew Jacob

PRAMOD'S ACADEMY
Learn to Apply Knowledge

OUTLINE

- Introduction
- Problem Statement
- Background
- Objectives
- Constraints
- Functions/Functional Requirements
- Design Alternatives
- Selected Design / Proposed Design
- Features of Design
- Testing
- Demonstration /Prototype/ Results
- Conclusions

PROBLEM STATEMENT

- To develop a portable coffee mug which will automatically heat the coffee inside it.

BACKGROUND

- Existing coffee mug designs varies in its shape and the build material.
- Build materials can be
  - Glass 
  - Clay/Ceramics 
  - Paper 
  - Steel / Copper  
  - Plastic 
  - Wood etc. 

OBJECTIVES

- To design a coffee mug which will check the temperature of coffee inside it.
- To develop a coffee mug which will automatically heat up the coffee if the temperature of coffee is less than a threshold temperature.
- To design a electric powered coffee mug to keep the coffee hot.

CONSTRAINTS

- Coffee mug should be portable.
- Coffee mug should be durable.
- It should be environmental friendly.

FUNCTIONAL REQUIREMENTS

Functional Requirement (FR)

FR1: To sense the temperature of the coffee inside the mug
FR2: To automatically heat up the coffee if the coffee is cold (Based on threshold value)
FR3: To heat the coffee manually.

DESIGN ALTERNATIVES



SELECTED DESIGN & ITS FEATURES

- Portable
- Has lid so that coffee can be transported from one place to another.
- Made up of steel inner chamber.
- Environmental friendly.
- Powered by USB

DEMONSTRATION & TESTING

- The individual components like hot plate, sensors etc. are unit tested.
- After integration, the product was tested for its functionality.
- The product is tested by keeping hot coffee for a period of one hour.
- The threshold temperature is set as 60 degree Celsius.
- When the sensor value was less than 60, the coffee mug was automatically turned on heated up the coffee.
- The product is checked by manually turn on the switch and found working.

CONCLUSIONS

- An automatic hot coffee mug was modelled and developed.
- The coffee mug has two operating modes: Automatic and manual mode.
- In automatic mode, if the temperature of coffee is less than the threshold, it will automatically turn on the mug and heat up the coffee.
- In manual mode, user can heat the coffee whenever required.
- The coffee mug designed was portable and is made of environmental friendly materials.

COMMUNICATING DESIGNS -WRITING

- The usual purpose of a final or project report is to communicate with the client in terms that ensure the client's thoughtful acceptance of a team's design choices.
- The client's interests demand a clear presentation of the design problem, requirement analysis, design alternatives and decisions taken.
- The results should be summarized in clear and understandable language. Highly detailed or technical materials are often placed in appendices at the end of the report, in order to support clarity.
- The final report writing is a structured process similar to design process.

STRUCTURED PROCESS IN REPORT WRITING

- ❑ Determine the purpose and audience of the technical report.
- ❑ Construct a rough outline of the overall structure of the report.
- ❑ Review that outline within the team and with the team's managers or, in case of an academic project, with the faculty advisor.
- ❑ Construct a topic sentence outline (TSO) and review it within the team. (Example: Entries in Table of Contents)
- ❑ Distribute individual writing assignments and assemble, write, and edit an initial draft.
- ❑ Solicit reviews of the initial draft from managers and advisors.
- ❑ Revise and rewrite the initial draft to respond to the reviews.
- ❑ Prepare the final version of the report and present it to the client.

OUTLINE OF FINAL REPORT

- Abstract
- Table of Contents / Executive summary
- Introduction and overview
- Problem statement and problem definition or framing, including relevant prior work or research.
- Design alternatives considered.
- Evaluation of design alternatives and basis for design selection.
- Results of the alternatives analysis and design selection.
- Supporting materials, often set out in appendices, including.
- Drawings and details.
- Fabrication specifications.
- Supporting calculations or modelling results; and other materials that the client may require.

MATHEMATICAL MODELLING IN DESIGN

- Often when engineers analyse a system to be controlled or optimized, they use a mathematical model. In analysis, engineers can build a descriptive model of the system as a hypothesis of how the system could work, or try to estimate how an unforeseeable event could affect the system. Similarly, in control of a system, engineers can try out different control approaches in simulations.
- A mathematical model usually describes a system by a set of variables and a set of equations that establish relationships between the variables. Variables may be of many types; real or integer numbers, Boolean values or strings, for example.
- The variables represent some properties of the system, for example, the measured system outputs often in the form of signals, timing data, counters, and event occurrence. The actual model is the set of functions that describe the relations between the different variables.
- For example: The required resistance value 'R' in a circuit can be derived during the mathematical relationship between Voltage 'V' and current 'I'.

$$R = V/I$$

- Another simple activity is predicting the position of a vehicle from its initial position, direction and speed of travel, using the equation that distance travelled is the product of time and speed.
- In computer science, mathematical models may be used to simulate computer networks.
- In mechanics, mathematical models may be used to analyse the movement of a rocket model.
- The advantages of mathematical modelling are:
    i. Models exactly represent the real problem situations.
    ii. Models help managers to take decisions faster and more accurately.
    iii. They typically offer convenience and cost advantages over other means of obtaining the required information on reality.
    iv. Large and complex problems can be solved with ease.
    v. Models act as communicators to others by providing information and impact in changing conditions.

PROTOTYPING & PROOFING THE DESIGN

- A prototype in design thinking is "A simulation or sample version of a final product, which is used for testing prior to launch."
- The goal of a prototype is to test products (and product ideas) before spending lots of time and money into creating the final version of the sellable product.
- Prototyping serves to provide specifications for a real, working system rather than a theoretical one. In some design workflow models, creating a prototype (a process sometimes called materialization) is the step between the formalization and the evaluation of an idea.
- One of the best ways to gain insights in a Design Thinking process is to carry out some form of prototyping. This method involves producing an early, inexpensive, and scaled down version of the product in order to reveal any problems with the current design. Prototyping offers designers the opportunity to bring their ideas to life, test the practicability of the current design, and to potentially investigate how a sample of users think and feel about a product.
- Prototyping can be evolutionary prototyping or throwaway prototypes.

EVOLUTIONARY PROTOTYPE

- Evolutionary Prototyping build a robust prototype and constantly improve it.
- These prototypes are built only with well understood requirements instead of acknowledging all the requirements.
- It allows developers to add features or make changes that couldn't be devised during the requirements analysing and designing.
- Developers are helped to develop part by part of the system considering the usability aspects and this type of prototypes are delivered a working system to the end user.

THROWAWAY PROTOTYPE

- Throwaway prototypes are developed from the initial requirements but they are not used for the final product and not an alternative for written specification of the requirements.
- It enables quick prototyping and commit to throwing the prototype away. If the users can get quick feedback on their requirements, they may be able to refine the requirements early in the development of the software. Then changes can be done early in the development life cycle.
- Differences between Evolutionary and Throwaway prototyping

Criteria	Evolutionary Prototype	Throwaway Prototype
Definition	A robust prototype which is continuously refined	Builds in quick time and is later discarded.
Associated with	Refined products, Future concepts, State-of-the-art demonstrations	Early-stage design, Minimum viable product

ADVANTAGES OF PROTOTYPING

- Evaluate technical feasibility
- Enhance product quality
- Effectively present ideas to various stakeholders
- Test the product before building it.
- Can be used to identify the complexities and thereby reduce risks in development.
- Can be used for proper planning.