Design Requirement

EECE401 Seniro Design I

Dr. Charles Kim

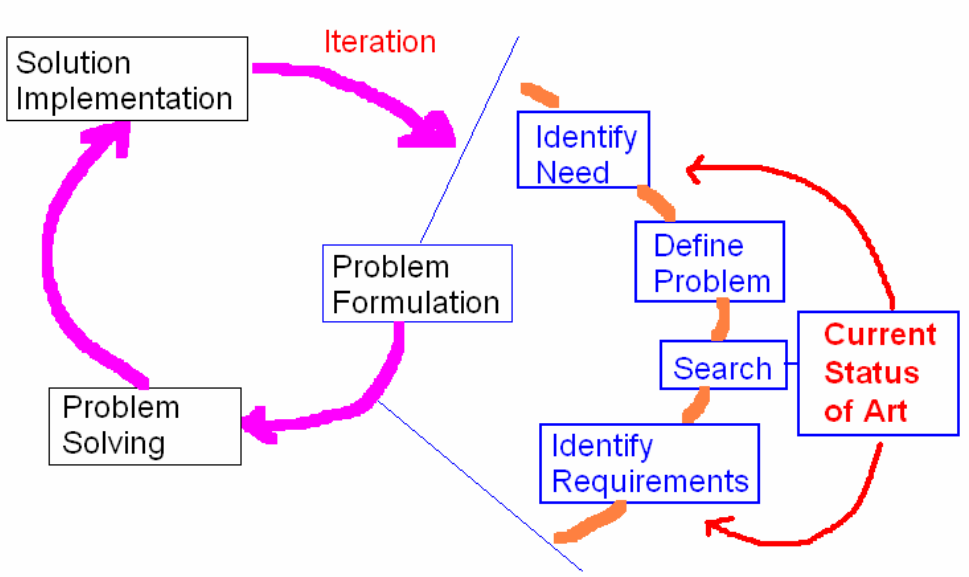
Dept of Electrical and Computer Engineering
Howard Univesity
Washington, DC

The Next Step with Project Topic

- Clear understanding of the PROBLEM of the project
- Establish REQUIREMENTS for problem
- Three primary activities
  - Working with customers/users to get information
    - Interviews, Concept Maps, Observation
  - Discussing the problem with each other
    - Clarification within a group
  - Researching Information
    - Libraries and online sites
      - Be careful:
        - » Accuracy and Authority
        - » Objectivity
        - » Currency
    - Existing products
      - Benchmarking
    - Experts
      - Consulting Experts
      - Advisors

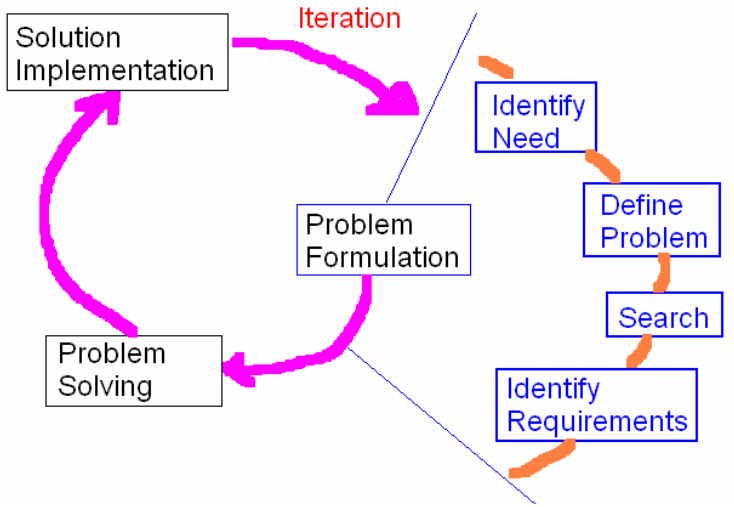
Current Status of Art

- Study and understanding of the field knowledge around the project topic
- The current status of the field related to the project topic
- Main issues specific to the project topic



Requirement Identification

- Step 1:
  - Clear, unambiguous description of the problem
- Step 2
  - Establishment of clear set of Design Requirements
- What is “Design Requirements”
  - Technical Guide
  - Specifications



Design Requirements

- The process of reducing the size of design space.
- The guideline which guides all the way to the end.
- **Two Components of Design Requirements**
  - Constraints
  - Criteria
- **Constraints**
  - What a design solution must and must not do.
  - Key question: “Does the design meet the constraints?”
  - Boundary of design space
    - Physical, social, ethical, corporate, or personal
  - Examples
    - Page Turner
    - Wireless guitar amplification system
- **Criteria**
  - Differentiation tool between designs that pass the constraints
  - What “should” and “should not” the design do?
  - Key Question: “**How well** does the design meet the criteria?”
  - Example:10% gas mileage improvement from the stock vehicle

Good Design Requirements

- Design Requirements should:
  - Be as quantitative, measurable, and precise as possible
  - Describe the Need, not the solution
  - Be Comprehensive
  - Be presented in an easy to understand

Requirements – Be Measurable

- If you cannot test whether a “requirement” is met, then it is not a requirement
- Testable → Measurable → Quantitative
- Example:
  - 2-liter soda container
    - Bad: “must be safe”
    - Good:
  - Wireless Guitar Amplification System
    - Bad: “lower power consumption”
    - Good:
    - Bad: “Sound quality should not be changed”
    - Good:
  - PV connection to Power Grid
    - Bad: “saving electricity bill”
    - Good:

Requirements – Need is described

- Should not limit the range of solutions unnecessarily
- 2-liter soda container
  - Good: “container”
  - Bad: “bottle”
- Page Turner
  - Bad: “Must be Bluetooth enabled”
  - Good:
- Wireless Guitar Amplification System
  - Bad: “Use Bluetooth technology”
  - Good:
  - Bad: “must have wheels to move around”
  - Good:
- Hybrid Vehicle
  - Bad: “Gasoline engine is minimally used”
  - Good:

Requirements – Be Comprehensive

- How to be comprehensive?
  - Include a team in the formulation of requirement
  - Keep the customers (or stakeholders) in the loop
  - Checklist
    - Spur Ideas
    - Identify gaps

Sample requirement items (1)

- **Aesthetics**: “70% of target guitarists indicate that the appearance of the system will encourage purchasing it”
- **Cost**: “Each container must cost less than $0.10 to manufacture given a production of 2 million per year”
- **Dimensions**: “It must fit within 10”x6”15”
- **Easy of use**: “must not require more than 1 minute to set up the system”
- **Energy Use**: “The maximum power demand must be less than 20W and lasts at least 2 hours with standard audio system emergency power source”
- **Environment**: “The system should stand more than 4 hours in temperatures ranging from 40F to 130F.
- **Ergonomics**: “The system must be able to be lifted up with less than 10 pound force”
- **Interface with other systems**: “all connectors must fit on audio industry terminals”
- **Lifespan:** “The soda container must last for 2 years when filled with pressurized soda at 85F”

Sample requirement items (2)

- **Maintenance**: “Required annual maintenance should be minimized and must not exceed 10 minutes per 1 person”
- **Manufacturability**: “Must be able to produce 1000 systems per day”
- **Noise Level:** “The noise level of the system should be less than 60dB at 2 feet from front of the device when operating”
- **Patents:** “Must not infringe on the following patents: (1), (2), etc”
- **Performance:** “Car must reach 110 mph”
- **Recycling**: “Container must be made of at least 33% post-consumer materials and must be 100% recyclable”
- **Reliability:** “Less than 0.01% of the system should fail”
- **Safety:** “The system should not get in fire when dropped from 3 feet while in operation”
- **Standards:** “The EMC standards and FCC part 15 in particular must be approved”
- **Weight:** “The system must be less than 1 pound”

Sample Design Requirement (Descriptive Format)

- Sample (Page Turner)
  - We intend to design a page-turner for the disabled that will turn the pages of a hardback or paper-back book (no 3-ring binders) as large as 8.5x11 inches and as small as 4x6 inches, up to 2 inches thick, not weighing more than about 6 lb, back and forth, but one single page at a time. The selling price of the final product will be about $500. We will produce a prototype within 6 months.
- What's missing?
  - We will follow all standards and regulators for the product which includes, but not limited to, Section 508, Subpart B 1194.24 of Rehabilitation Act.
  - Timeline and Schedule?

Sample Design Requirement (Tabular Format)

- 1. Lane Departure Warning System
  - XLS File 1
- 2. Distribution Fault Locator
  - XLS File 2
- 3. Automatic Map Follower
  - XLS File 3

Summary of “Problem Formulation”

- The most important first step in design process
- Is focused on identifying the requirements of a design project
- Involves activities of
  - gathering information about needs
  - Formulating Design Requirements: Constraints and Criteria
- Will be used throughout the design process as Guideline for
  - Concept development and exploration
  - Basis for testing

First Assignment

- For the given project topic
  - Identify the overall customer needs using the gathered information→ Problem Definition
  - Search and investigate the current status of art → Current Status of Art
  - Identify the design requirements → Design Requirement
  - Electronic Submission by Tuesday, 21OCT09, 11:59 PM.
    - A Word file must include
      - Project Title
      - Team Members
      - Problem Definition (Description)
      - Current Status of Art (Description)
      - Design Requirement (Description AND Table)