SNS COLLEGE OF ENGINEERING

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE NAME: 19OE116 - PRODUCT DESIGN AND DEVELOPMENT

III YEAR / VI SEMESTER

Unit 2 - Concept Generation and Selection

Topic 2 – Structured Approaches

Structured Approaches in Concept Generation and Selection:

A structured approach ensures that concept generation and selection are systematic, objective and effective.

The following methodologies help in organizing ideas, evaluating them, and selecting the best solution.

1. Structured Approaches for Concept Generation:

a) Brainstorming:

- A team-based technique that encourages free-thinking and idea sharing.
- Can be structured (with predefined rules) or unstructured (free flow of ideas).
- Example: Generating new sensor-based irrigation techniques for smart farming.

b) Morphological Analysis:

- Breaks down a problem into its key components and explores all possible combinations.

- Uses a morphological matrix to structure solutions.

- Example: Developing an automated greenhouse control system by combining different sensors, power sources, and control algorithms.

c) SCAMPER Technique:

A creative method that modifies existing solutions using seven strategies:

Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Reverse.

Example: Adapting existing IoT-based monitoring systems for pest control in agriculture.

d) TRIZ (Theory of Inventive Problem Solving):

- A problem-solving framework based on patterns of innovation.
- Uses principles such as contradiction resolution and ideality to generate solutions.
- Example: Resolving the trade-off between high water usage and optimal crop growth in irrigation systems.

e) Functional Decomposition:

- Breaks the system into smaller subsystems or functions.
- Helps in understanding different aspects and generating ideas for each function.
- Example: Dividing a precision farming system into sensing, processing, and control functions.

2. Structured Approaches for Concept Selection:

a) Concept Screening (Pugh Matrix):

- A relative comparison method where concepts are evaluated against a baseline (reference concept).

- Each idea is rated as better (+), worse (-), or same (0) compared to the baseline.

- Example: Comparing different embedded controllers for a precision farming system.

b) Weighted Decision Matrix:

- Assigns numerical scores based on predefined criteria (cost, efficiency, feasibility, scalability, etc.)

- Each criterion is weighted based on importance, and concepts are scored accordingly.

- Example: Selecting the best wireless communication protocol (LoRa, Wi-Fi, Zigbee) for farm data transmission.

c) Analytical Hierarchy Process (AHP)

- Breaks decision-making into a hierarchy of criteria and sub-criteria.

- Uses pairwise comparisons and mathematical ranking to find the best alternative.

- Example: Choosing the most suitable embedded platform (Arduino, Raspberry Pi, ESP32) for an agricultural automation system.

d) Kano Model:

- Classifies concepts based on customer satisfaction and necessity.

- Helps prioritize features based on user expectations.

- Example: Selecting features for an IoT-based soil monitoring system.

e) Cost-Benefit Analysis:

- Evaluates concepts based on expected benefits versus costs.
- Ensures the chosen concept provides maximum value with minimal investment.
- Example: Assessing the ROI of deploying autonomous robots for weed control in large farms.

Conclusion:

Using structured approaches in concept generation and selection ensures innovation, feasibility, and efficiency in design.

Combining different methodologies enhances decision-making and leads to optimal solutions.

Thank You...