Project Design Phase
Solution Architecture

Date	15 February 2025
Team ID	LTVIP2025TMID45617
Project Name	**CleanTech: Transforming Waste Management with Transfer Learning**
Maximum Marks	4 Marks

Solution Architecture:

Solution Architecture Overview

Solution architecture serves as the bridge between the real-world waste management problem and the AI-based technical solution. It outlines how the project is structured technically, ensuring that all components work together efficiently to meet business and user needs.

Goals of the Solution Architecture

- Identify the best AI/ML solution (transfer learning) to improve waste classification.
- Clearly define components such as the user interface, backend model, and database.
- Break down development phases including training, testing, deployment, and user access.
- Provide technical specifications and data flow for building and managing the solution.

Solution Architecture Description

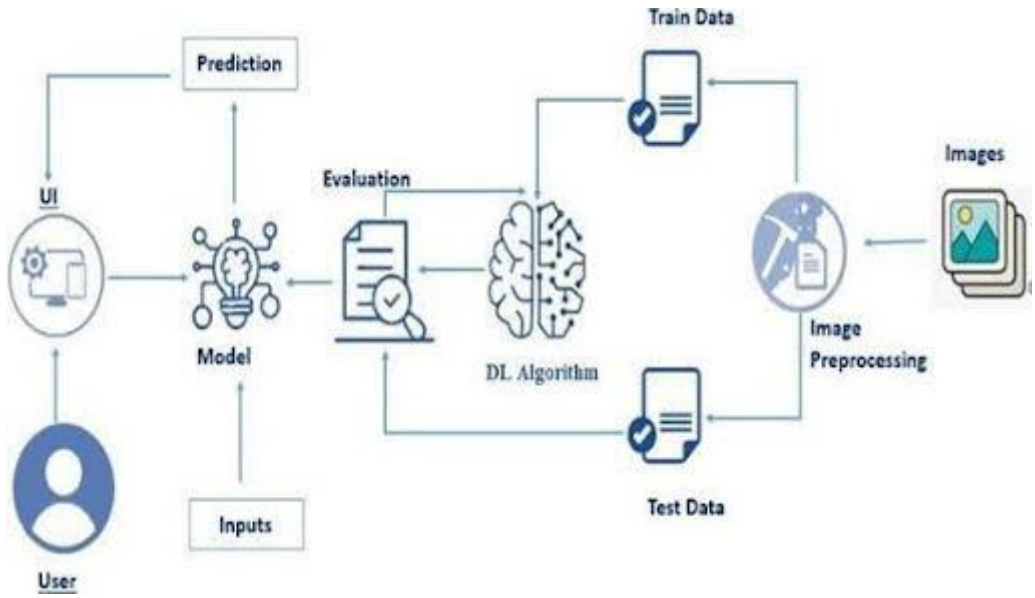
Key Components:

1. **Frontend (Web Interface)**
    - Built using HTML/CSS/JavaScript or Streamlit (if using Python).
    - Allows users to upload images and view classification results.
2. **Backend (Model Server)**
    - Flask or FastAPI-based API server.
    - Hosts the waste classification model using a pre-trained CNN (e.g., VGG16, ResNet).
    - Accepts uploaded images and returns the predicted waste class.
3. **Model (Transfer Learning)**

- Transfer learning applied using a pre-trained model (like VGG16 or MobileNet).
- Fine-tuned on a custom dataset with three classes: biodegradable, recyclable, and trash.
- High accuracy due to smaller training time and better generalization.

4. **Database (Optional)**
    - Stores image logs, predictions, and metadata.
    - Can be implemented with SQLite or Firebase.
5. **Visualization Dashboard**
    - Displays class-wise counts, accuracy, confusion matrix, etc.
    - Tools: Power BI, Tableau, or Matplotlib/Seaborn for basic reporting.
6. **Deployment**
    - Hosted on a cloud platform (e.g., Heroku, AWS EC2, or Google Cloud).
    - API endpoints integrated into the frontend for real-time classification.

Solution Architecture Diagram



Development Phases

Phase	Description
Phase 1: Data Setup	Collect and label image dataset.
Phase 2: Model Building	Implement transfer learning, train and validate the model.
Phase 3: API & UI	Build API for prediction and frontend interface.

Phase	Description
Phase 4: Deployment	Host application and dashboard on a cloud platform.
Phase 5: Testing & Reporting	UAT, dashboard creation, and performance reporting.