Case Study - Smart Composting Using AI for Organic Waste Management

Problem Statement: In today's rapidly urbanizing world, the amount of organic waste generated is increasing significantly. Improper disposal of organic waste leads to environmental degradation, greenhouse gas emissions, and overburdened landfills. Manual composting is often inconsistent, time-consuming, and inaccessible for many. This creates a need for an intelligent, automated system that can guide and optimize composting processes for households and communities. Our project leverages artificial intelligence to predict compost quality and guide users in managing organic waste effectively.

Real-Life Example: In urban residential communities, most households discard vegetable peels, food leftovers, and garden waste without proper segregation or composting. One such community in Bangalore piloted our AI-based Smart Composting App. The system enabled residents to input the type and quantity of waste daily. Using our trained ML model, it predicted compost quality, offered guidance, and tracked composting progress. As a result, the community reduced wet waste sent to landfills by **40%**, generated high-quality compost for gardening, and raised awareness around sustainable waste disposal.

Dataset: We used a curated dataset comprising organic waste categories (green/brown), moisture levels, temperature, and historical compost quality records. The model was trained to predict final compost quality based on these inputs. Data was synthetically expanded to include realistic household waste patterns.

Questions:

1. **What features in the dataset are most important for predicting compost quality?**
   - Moisture level, type of waste (green or brown), temperature, composting duration, and pH level (if available) were among the most significant features.
2. **Develop a machine learning model to predict compost quality.**
   - We used a classification-based model (Random Forest Classifier) to predict compost quality into three categories: Good, Moderate, and Poor. The model was trained and validated using cross-validation techniques.
3. **How would you improve the model's accuracy?**
   - Model accuracy can be improved with more real-world data, better sensors to collect live compost metrics (temperature, pH), and implementing ensemble methods like boosting.
4. **What actions should be taken if poor-quality compost is predicted?**
   - The app would suggest corrective actions such as adding more brown material (dry leaves, paper), adjusting moisture, or increasing aeration by turning the compost pile.
5. **How can smart composting contribute to sustainability and reduce waste?**
   - It promotes decentralized waste management, reduces landfill pressure, lowers methane emissions, and creates nutrient-rich compost that replaces chemical fertilizers—contributing to a circular, eco-friendly economy.