Compost Monitoring AI Dataset Documentation

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I. Introduction

The ECO-AI project addresses the challenge of inefficient waste collection and its impact on sustainable agriculture in urban areas, focusing on Huye District, Rwanda. Current waste management often results in unsystematic collection, leading to overflowing bins, pollution, and lost opportunities for organic waste reuse. ECO-AI introduces an AI-based system that predicts

waste generation, optimizes collection routes, and supports organic manure production, contributing to sustainable agriculture.

Relevance to Sustainable Agriculture

ECO-AI supports sustainability by:

Reducing pollution caused by uncollected waste.

Converting organic waste into high-quality manure.

Creating a circular economy model for urban organic waste.

Aligned UN Sustainable Development Goals (SDGs)

SDG 2: Zero Hunger

SDG 11: Sustainable Cities and Communities

SDG 13: Climate Action

Project Overview

The Compost Monitoring AI Dataset project aims to develop a comprehensive dataset that facilitates the optimization of composting processes through advanced data analytics and machine learning. This initiative addresses the challenges posed by organic waste in urban areas, promoting sustainable agricultural practices.

Purpose

The primary objectives of this project are to:

- Predict compost quality and decomposition rates.
- Optimize composting conditions.
- Provide real-time monitoring for effective compost management.
- Support decision-making for farmers and waste management authorities.

Dataset Components

Input Features

- **Organic Material Type**: Types of waste materials (e.g., food scraps, yard waste).
- **Initial Composition**: Carbon-to-nitrogen ratio, moisture content, and particle size.
- **Environmental Conditions**: Temperature, humidity, and aeration levels.
- **Microbial Activity**: Measurements of microbial populations (e.g., bacteria, fungi).

Output Labels

- **Decomposition Rate**: Time taken for materials to break down.
- **Nutrient Levels**: Changes in nitrogen, phosphorus, and potassium levels over time.
- **Compost Quality**: pH levels, temperature profiles, and maturity indicators.

Data Collection Methods

- **Sensors**: Utilizing temperature and moisture sensors for real-time data gathering.
- **Mobile Apps**: Input from users (farmers, waste workers) via mobile applications.
- **Manual Sampling**: Periodic sampling and analysis of compost for laboratory testing.

Data Format and Storage

- **CSV Files**: Structured data storage for easy access and manipulation.
- **Time-Series Data**: Capturing changes over time for predictive modeling.
- **Database Management**: Utilizing databases like PostgreSQL for efficient data handling.

Installation Instructions

To use this dataset, please ensure you have the following installed:

- **Python 3.x**

Data Example

Collected Compost Monitoring Data from Huye, Rwanda

Sample ID	Organic Material Type	Carbon-to-Nitrogen Ratio	Moisture Content (%)	Temperature (°C)	Decomposition Rate (Days)	Nitrogen Level (g/kg)	Compost Quality (pH)
1	Food Scraps	25:01:00	60	35	14	2.5	6.8
2	Yard Waste	30:01:00	50	30	21	1.8	7
3	Mixed Organic Waste	28:01:00	55	32	18	2	6.5
4	Plant Residues	35:01:00	45	28	25	1.5	7.2
5	Animal Manure	20:01	65	40	10	3	6.9

Data Processing

- Convert categorical variables into numerical formats if needed.

Modeling Guidelines

Consider using the following algorithms for analysis:

- **Linear Regression** for predicting nutrient levels.
- **Decision Trees** for classification of compost quality.
- **Random Forest** for improved prediction accuracy.

Challenges and Limitations

Some challenges and limitations include:

- Variability in organic waste composition can affect results.
- Sensor accuracy may influence real-time data collection.
- Environmental factors can introduce noise into the data.

Future Work

Future enhancements may include:

- Expanding the dataset to include more diverse organic materials.
- Developing a user-friendly application for real-time monitoring.
- Integrating machine learning models for automated recommendations.

Usage

This dataset can be utilized for:

- Training machine learning models for compost quality prediction.
- Conducting research on composting processes and optimization techniques.
- Developing applications for real-time compost monitoring.

Contributors

- NIYIGENA Omer (Rwandan)
- Cynthia Anguza (Kenyan)

License

Contact Information

Niyigena omer , omerniyigena5@gmail.com, +250782369715

Cynthia Anguza, +254 794 629179

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