Project Report

Project Title:- Smart Agriculture Garden: AI-Driven Sustainable and Protected Farming System

Abstract :-

The Smart Agriculture Garden project presents an AI-powered, computer vision-based system designed to support sustainable farming. It integrates plant disease detection, soil health analysis, and smart irrigation, while offering night-time protection against pests. This system aims to assist farmers and agricultural students in adopting modern technology for better yield and eco-friendly practices.

Scope :-

The project addresses the following key agricultural challenges:

- Early detection of plant diseases to minimize crop loss.
- Monitoring soil health to ensure appropriate nutrient balance.
- Automating irrigation based on soil moisture and weather prediction, saving water resources.
- Providing night-time protection against small animals (e.g., rabbits, rats) using AI-assisted sensors.
- Educating agriculture students on AI applications in modern farming.

Dataset :-

- **Source**: Open-access datasets like PlantVillage for disease detection; custom soil and garden condition images collected for this project.
- **Size**: ~50,000 images for plant diseases; ~500 custom images for soil/condition analysis.

- **Type**: RGB images of plant leaves (healthy/diseased), soil textures, and garden conditions.

Methods :-

- **Model Type**: Convolutional Neural Networks (CNN) for image classification.
- **Architecture**: CNN (3 convolutional layers + ReLU + max-pooling + dense layers).
- **Tools & Libraries**: Python, TensorFlow/Keras, OpenCV, NumPy, Matplotlib, Streamlit for web app interface.
- **Other Components**: Ultrasonic sensors for night protection; optional integration with live weather API for smart irrigation.

Output :-

- Disease classification results with labels (e.g., “Tomato — Early Blight”, “Potato — Healthy”).
- Soil condition assessment: “Suitable”, “Needs nutrients”.
- Irrigation recommendations based on soil and weather data.
- Protection system output: Alert when pests detected.
- (Include screenshots of model predictions, app UI, protection system alert)

Evaluation :-

Metric	Result (%)
Accuracy	93%
Precision	91%
Recall	92%
IoU	85%
mAP	88%
SSIM	0.87
PSNR	28.5 dB

MSE	0.03

(These are Example numbers – replace with your actual metrices after testing your final model)

Conclusion :-

The Smart Agriculture Garden system successfully demonstrates how AI can help improve agricultural productivity and sustainability. By leveraging computer vision, the system provides farmers and researchers with an accessible tool to monitor plant health, soil quality, and crop safety.

Future Scope :-

- Integrate drone-based monitoring for large fields.
- Expand dataset with local farm images for better regional accuracy.
- Develop a mobile app for on-field use.
- Include livestock monitoring with GPS.
- Enable multilingual voice assistant support for farmers.

Annexure

The Smart Agriculture Garden model utilized publicly available and custom data sources. The primary dataset for plant disease detection was the PlantVillage

Dataset :-

(Kaggle: https://www.kaggle.com/emmarex/plantdisease), containing ~50,000 labeled leaf images. Soil and garden condition data were simulated for the prototype stage, with plans for integration of real sensor data in future work. The project code was developed using Python 3.x, TensorFlow, Keras, OpenCV, NumPy, and Matplotlib, with planned extension to Streamlit/Flask interfaces. Hardware components (planned for physical prototype) include ultrasonic sensors and a Raspberry Pi. References include: Hughes & Salathé (2015, arXiv:1511.08060), Mohanty et al. (2016, Frontiers in Plant Science), TensorFlow documentation (https://www.tensorflow.org), and Roboflow (https://roboflow.com). The source code and documentation.

Datasets Used

- PlantVillage Dataset

  Source: https://www.kaggle.com/emmarex/plantdisease

  Details: ~50,000 images of plant leaves classified as healthy or diseased across 38 categories.

- Custom Soil and Garden Images (Prototype Stage)

  Source: Collected manually from garden setup and nearby farms for initial tests.

- Sample COCO-format Object Detection Data (for pest detection prototype)

  Source: COCO dataset (common objects in context) for preliminary bounding box experiments.

Libraries, Tools, and Frameworks

- Python 3.x – Programming language
- TensorFlow / Keras – CNN model development
- OpenCV – Image processing
- Matplotlib / NumPy / Pandas – Data handling and visualization
- Streamlit / Flask (optional) – Web app interface prototype
- Roboflow / LabelImg – Annotation tools for custom data

Hardware / Components (Planned or Prototype Stage)

- Ultrasonic sensor — for night protection system
- Raspberry Pi — for future hardware integration
- Basic digital display (planned) — for garden status output

Code Repository

GitHub: https://github.com/han200711/Smart-Agriculture-Garden-AI

References

1. Hughes, D. P., & Salathé, M. (2015).

An open access repository of images on plant health to enable the development of mobile disease diagnostics.

arXiv preprint arXiv:1511.08060.

https://arxiv.org/abs/1511.08060

2. Mohanty, S. P., Hughes, D. P., & Salathé, M. (2016).

Using deep learning for image-based plant disease detection.

Frontiers in Plant Science, 7, 1419.

https://doi.org/10.3389/fpls.2016.01419

3. PlantVillage Dataset on Kaggle

https://www.kaggle.com/emmarex/plantdisease

4. TensorFlow Documentation

https://www.tensorflow.org

5. Roboflow Documentation

https://roboflow.com

Thus, are the Annexure and Reference of the Project.