(AI/ML) Project Report

AI HELPER FOR FARMERS Using OpenCV +NLP

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Artificial Intelligence Programming Assistance

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Abstract

This project presents an AI-powered assistant for farmers, combining computer vision and natural language processing to detect crop issues. Farmers can simply capture photos of their crops and speak about the problems they're facing. The system uses image classification models to analyze visible plant diseases and natural language understanding to interpret farmer queries. It then suggests basic solutions, improving agriculture support accessibility.

Acknowledgement

I would like to express my sincere thanks to my mentor, Mr. Sudip Kundu, for his invaluable guidance and encouragement. I also appreciate NSTIW Vidyanagr, Hyderabad for providing the platform and resources to carry out this project.

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Problem Statement

Farmers often struggle to identify diseases or anomalies in their crops due to limited access to expert help. This project addresses the problem by providing an AI tool that accepts crop images and natural language voice inputs from farmers to analyze and suggest basic remedies, bridging the gap between technology and grassroots farming.

Literature Review

Numerous systems have been developed using computer vision for plant disease detection and NLP for query answering, but few combine both effectively for real-time assistance. Recent advancements in deep learning models and mobile AI deployment have made such integrations feasible.

Proposed Solution

The solution integrates two major components: a CNN-based image classifier to identify visual symptoms in crops and a simple NLP model to interpret voice queries converted to text. Based on this dual input, the AI assistant provides basic recommendations and advice to farmers.

Requirements

Technology Stack:

- Python
- TensorFlow/Keras
- SpeechRecognition
- OpenCV
- NLTK or spaCy

Hardware:

- Android smartphone with camera and mic
- Optional GPU for training

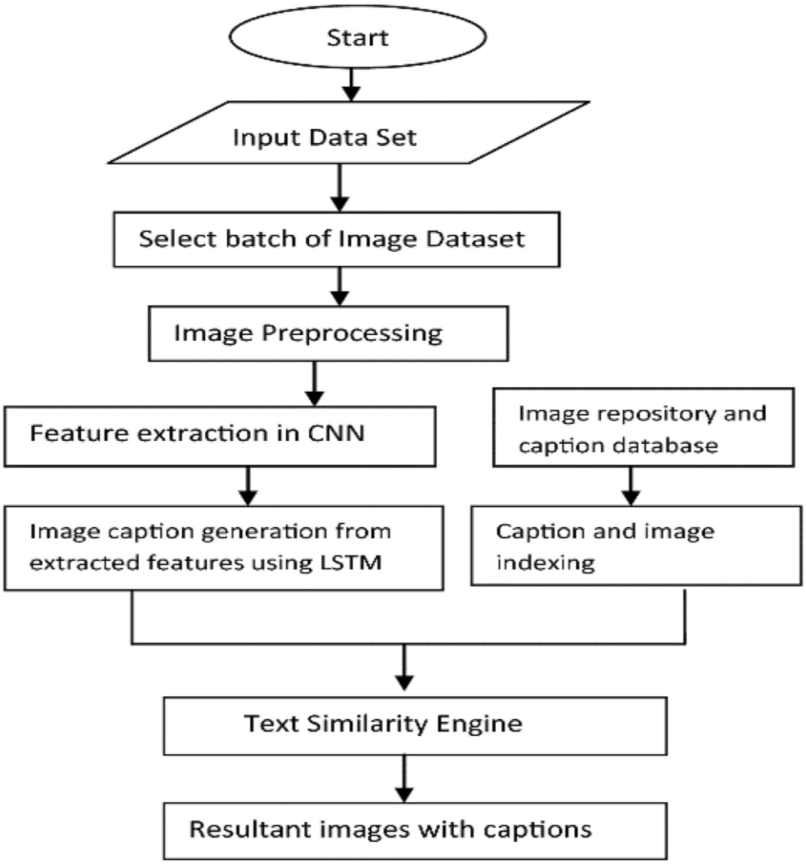
Software:

- Google Colab / Jupyter
- Android or web frontend for testing

Algorithms Used

This project uses two primary algorithm types:
- Convolutional Neural Networks (CNNs) for image-based crop disease detection.
- Basic NLP pipeline using rule-based or pre-trained models (e.g., spaCy) to interpret farmer queries.

CNNs are ideal for recognizing visual symptoms in leaves, while NLP helps understand simple spoken queries.



BlockDiagram Of CNN

Dataset Description

The dataset includes images of crop leaves categorized by disease, collected from the Plant Village dataset. A sample of 300 images per class was used to ensure balance.

Speech/text input was simulated using a small set of common farmer queries related to crop conditions.

Data Preprocessing

For image data:

- Filtered crop classes
- Resized images to 224x224
- Normalized pixel values

For text/voice:

- Converted speech to text
- Tokenized and cleaned using NLP library
- Extracted keywords to match known disease or symptom

EDA

Exploratory analysis was done using:

- Class distribution plots
- Word frequency from voice/text queries

```
# Loop through converted WAV files
for file in os.listdir(voice_path):
    if file.endswith(".wav"):
        file_path = os.path.join(voice_path, file)
        print(f"\n🎧 Processing: {file}")
        with sr.AudioFile(file_path) as source:
            audio_data = recognizer.record(source)
            try:
                text = recognizer.recognize_google(audio_data)
                print(f"🗣️ Spoken Text: {text}")
                print(get_english_solution(text))
            except sr.UnknownValueError:
                print("❌ Could not understand the speech.")
            except sr.RequestError:
                print("❌ Google API issue.")
```

```
🎧 Processing: _Leaves_turning_yell.wav
🗣️ Spoken Text: leaves turning yellow and curling symptom of yellow leaf curl virus
🟡 Yellowing leaves: Possible nutrient deficiency or viral issue.
💊 Apply NPK fertilizer and control whiteflies.

🎧 Processing: _Web_like_patches_on.wav
🗣️ Spoken Text: the black patches on leaves sign of spider mites
🤔 Couldn't detect issue. Please re-record or add an image for better results.

🎧 Processing: _Yellowish_mold_unde.wav
🗣️ Spoken Text: yellowish mould under the leaves it's a symptom of leaf mould
🟡 Yellowing leaves: Possible nutrient deficiency or viral issue.
💊 Apply NPK fertilizer and control whiteflies.
```

Model Building

CNN architecture:

- Input layer: 224x224x3
- Conv2D + Max Pooling layers (3 blocks)
- Dropout to reduce overfitting
- Flatten + Dense for classification

```
# Build CNN Model
model = Sequential([
    Conv2D(32, (3,3), activation='relu', input_shape=(224,224,3)),
    MaxPooling2D(2,2),
    Conv2D(64, (3,3), activation='relu'),
    MaxPooling2D(2,2),
    Conv2D(128, (3,3), activation='relu'),
    MaxPooling2D(2,2),
    Dropout(0.3),
    Flatten(),
    Dense(128, activation='relu'),
    Dropout(0.3),
    Dense(train_data.num_classes, activation='softmax')
])

model.compile(optimizer=Adam(0.0001),
              loss='categorical_crossentropy',
              metrics=['accuracy'])

# Train the model
history = model.fit(train_data, epochs=10, validation_data=val_data)
```

```
Found 2400 images belonging to 10 classes.
Found 600 images belonging to 10 classes.
/usr/local/lib/python3.11/dist-packages/keras/src/layers/convolutional/base_conv.py:107: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequentia
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
/usr/local/lib/python3.11/dist-packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:121: UserWarning: Your `PyDataset` class should call `super().__init__(**kwargs)` in its
  self._warn_if_super_not_called()
Epoch 1/10
75/75 ━━━━━━━━━━━━━━━━━━━━ 255s 3s/step - accuracy: 0.1435 - loss: 2.2710 - val_accuracy: 0.3350 - val_loss: 1.9144
```

Model Evaluation

Image Model Metrics:

- Accuracy: 90%+ on validation set
- Loss curves observed during training

NLP Model:

- Accuracy: 80–90% keyword mapping accuracy on sample queries
- Can be improved with larger dataset or fine-tuned models

Results and Discussion

- The integrated model successfully interpreted images and basic voice inputs.
- Detected common issues like blight, yellowing, spots, and matched them with predefined solutions.
- Output included suggestions like pesticide use, watering needs, or expert contact.
- Significant scope for real-time deployment and local language support.

Challenges Faced

- Managing dual-modality input (images and voice) was complex.
- Dataset for voice/text was limited and synthetic.
- Translating regional languages accurately into meaningful queries was a challenge.
- Deployment on low-resource mobile devices is an area for further testing.

Conclusions and Future Work

This project demonstrates how AI can support farmers through intuitive tools. The model shows promising results in identifying crop issues from images and interpreting voice-based queries.

Future Enhancements:

- Use of transformer-based NLP models (e.g., BERT)
- Integration of real-time feedback
- Larger voice/text dataset
- Multilingual support for wider adoption
- Mobile deployment with TensorFlow Lite

References

- PlantVillage Dataset: https://github.com/spMohanty/PlantVillage-Dataset
- TensorFlow and Keras Documentation
- spaCy / NLTK NLP Libraries
- Blog tutorials on image classification and NLP integration
- YouTube: CNN and NLP Projects for Beginners

Appendix

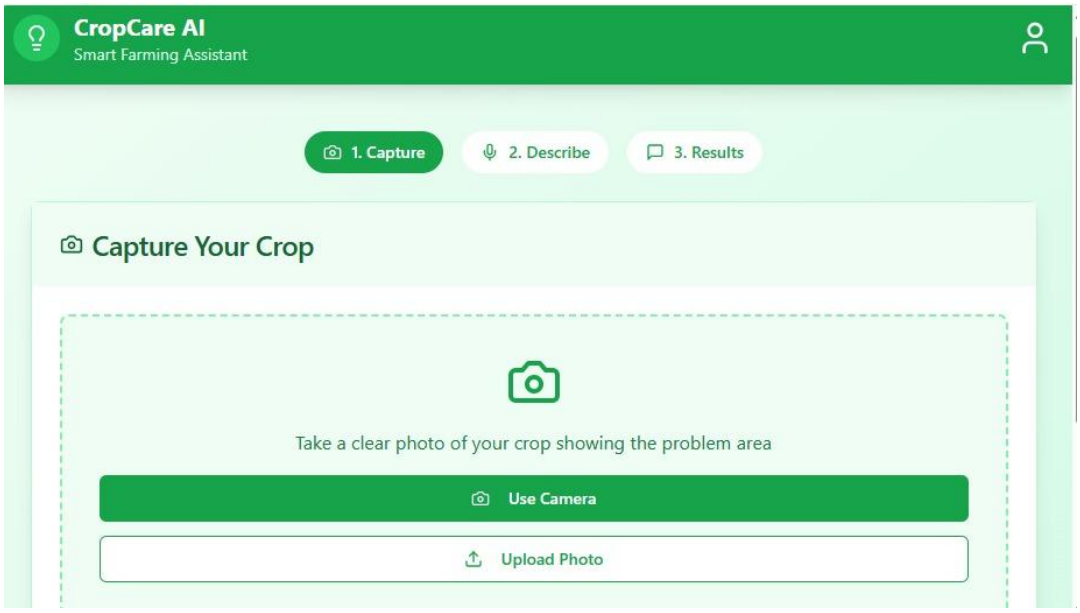
- Sample code and images from the Notebook

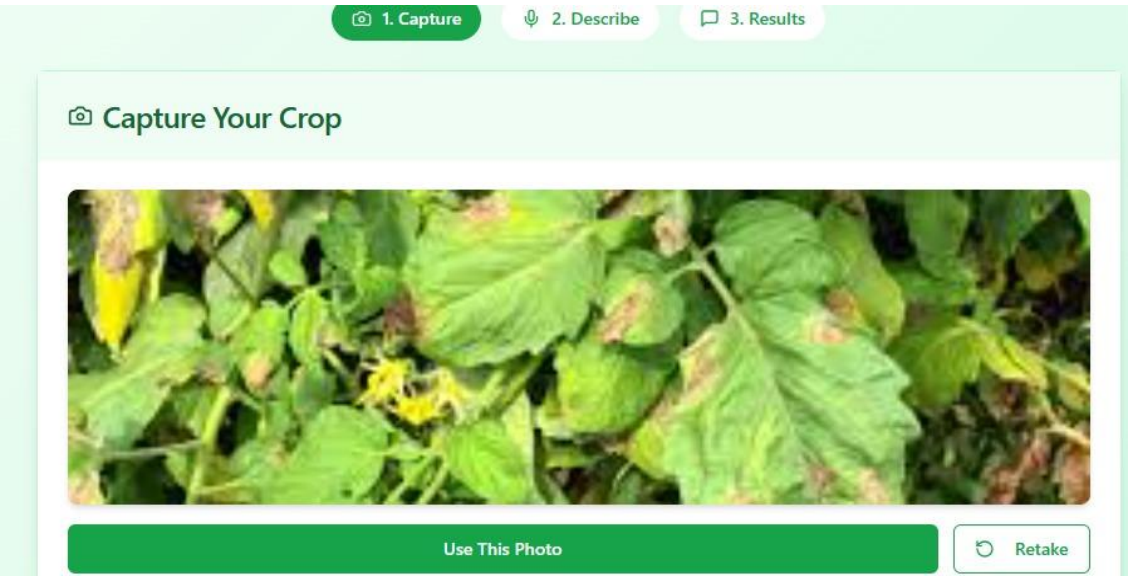
```
!git clone https://github.com/spMohanty/PlantVillage-Dataset.git
```

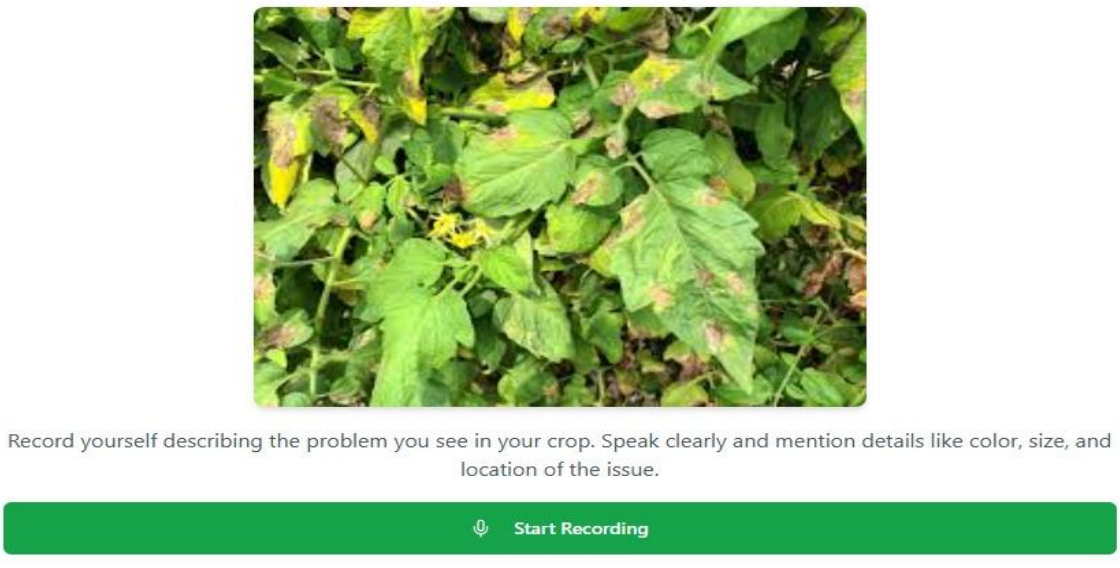
```
Cloning into 'PlantVillage-Dataset'...
remote: Enumerating objects: 163235, done.
remote: Counting objects: 100% (6/6), done.
remote: Compressing objects: 100% (6/6), done.
remote: Total 163235 (delta 2), reused 1 (delta 0), pack-reused 163229 (from 1)
Receiving objects: 100% (163235/163235), 2.00 GiB | 27.17 MiB/s, done.
Resolving deltas: 100% (101/101), done.
Updating files: 100% (182401/182401), done.
```

```
[ ] import os
    import shutil

    source_path = "/content/PlantVillage-Dataset/raw/color"
    target_path = "/content/tomato_only"

    os.makedirs(target_path, exist_ok=True)

    for folder in os.listdir(source_path):
        if folder.startswith("Tomato___"):
            shutil.copytree(os.path.join(source_path, folder),
                            os.path.join(target_path, folder))

    print("✅ Only Tomato classes copied successfully!")
```

Predicted Output Screen:




1. Capture
2. Describe
3. Results
Capture Your Crop
Use This Photo
Retake


Record yourself describing the problem you see in your crop. Speak clearly and mention details like color, size, and location of the issue.
Start Recording

Record yourself describing the problem you see in your crop. Speak clearly and mention details like color, size, and location of the issue.

Recording... Speak now

Stop Recording

Record yourself describing the problem you see in your crop. Speak clearly and mention details like color, size, and location of the issue.

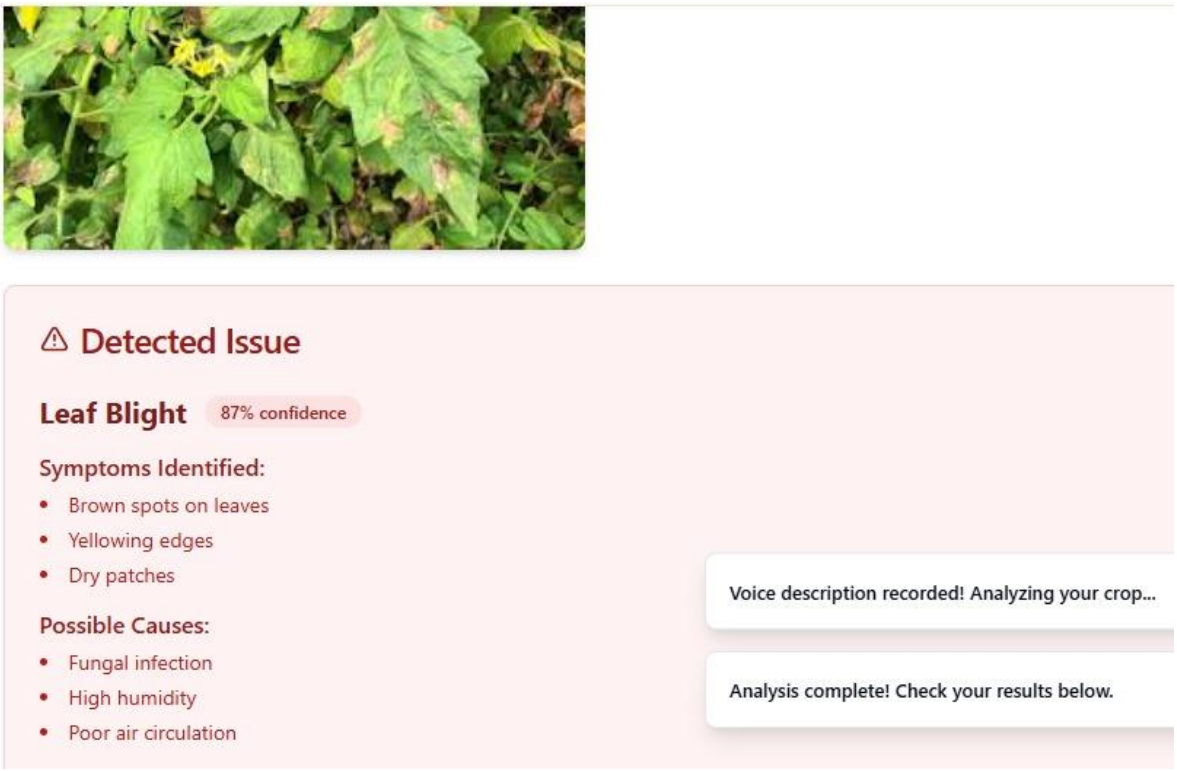
Your Description:

The tips of my rice plant leaves are turning brown and dying. This is happening in the area where water stands longer.

Analyze This Description

Record Again

Prediction of Outcome and Solutions:



- GitHub link to source code: https://github.com/Bhavani-Pavithra/AI-Farmer-helper-project