



Disorder Detection Of Tomato Plant Using IOT And Ensemble Techniques

Contents

- **Introduction**
 - **Types of biotic disorder**
 - **Abiotic disorder**
 - **Nutritional deficiency disorder**
 - **Application**
 - **Challenges**
- **Literature Survey**
- **Conclusions**
- **References**

1. Introduction

Motivation:

- Uncertain climatic conditions are on rise which has caused agriculture industry to be in dilemma regarding an **overuse of pesticides**.
- *Solanum lycopersicum* commonly known as a tomato plant. The plant belongs to the nightshade family, **Solanaceae**. An article in Indian Express Newspaper quotes one of the farmer's opinion that *"tomato crops requires less labour with high returns, luring farmers to opt for it"*.
- Plant Disorder is defined as *"an abnormal growth and/or dysfunction of a plant. They are the result of some disturbance in the normal life process of the plant"*.
- **Types of disorders**
 1. Biotic
 2. Abiotic
 3. Nutritional deficiency

Types of biotic disorder for *Solanum lycopersicum*

Biotic Disorder:

Biotic plant problems are caused by living organisms, such as fungi, bacteria, viruses, nematodes, insects, mites, and animals. Following are some common tomato plant biotic disorders.

1. Early Blight

This disease is caused by the fungi *Alternaria tomatophila* and *A. solani* and is first observed on the plants as small, brown lesions mostly on the older foliage.

2. Late Blight

Late blight is a potentially devastating disease of tomato and potato, infecting leaves, stems, and fruits of tomato plants.

3. Septoria leaf spot

Septoria leaf spot is caused by a fungus, *Septoria lycopersici*.

4. Bacterial leaf spot

Symptoms begin as small, yellow-green lesions on young leaves which usually appear deformed and twisted.

5. Bacterial wilt

Bacterial wilt is caused by the pathogen *bacterium Ralstonia Solanacearum* and is quite common in the moist sandy soils of the humid coastal south.

Common biotic disorders Contd...

(a)



(b)



(c)



(d)



(e)



Fig Disorders caused due to biotic factors (a) Early blight (b) Late blight (c) Septoria leaf spot (d) Bacterial leaf spot (e) Bacterial wilt

1. Introduction contd...

Abiotic Disorder:

- Unfavorable soil properties
- Fertility imbalances, Moisture extremes, temperature extremes, Chemical toxicity
- Physical injuries, and other problems are examples of abiotic disorders that can reduce plant health and even kill plants
- Plants may grow more slowly or not at all, young leaves may not fully expand, or foliage may not appear as colorful relative to healthy foliage.



1. Introduction contd...

Nutritional Deficiency Disorder

- **Nitrogen (N):** Due to N deficiency, older leaves gradually change from green to paler green. As the deficiency progresses these older leaves become uniformly yellow (chlorotic). Under extreme deficiency, leaves approach a yellowish white color.
- **Phosphorus (P):** Leaves to have a blue/green tint.
- **Potassium (K):** Lack of potassium tends to make older leaves 'scorch', eventually turning brownish and rolling up inwards and downwards.
- **Magnesium (Mg):** Due to magnesium deficiency, there happens a discoloring of the leaves between the veins.
- **Calcium (Ca):** A sign of leaves curling inward and lacking in color shows a deficiency of calcium.
- **Other nutrients** – Other nutrients required in small quantity are Zinc, Copper, Manganese, Iron, Sulphur and Boron.

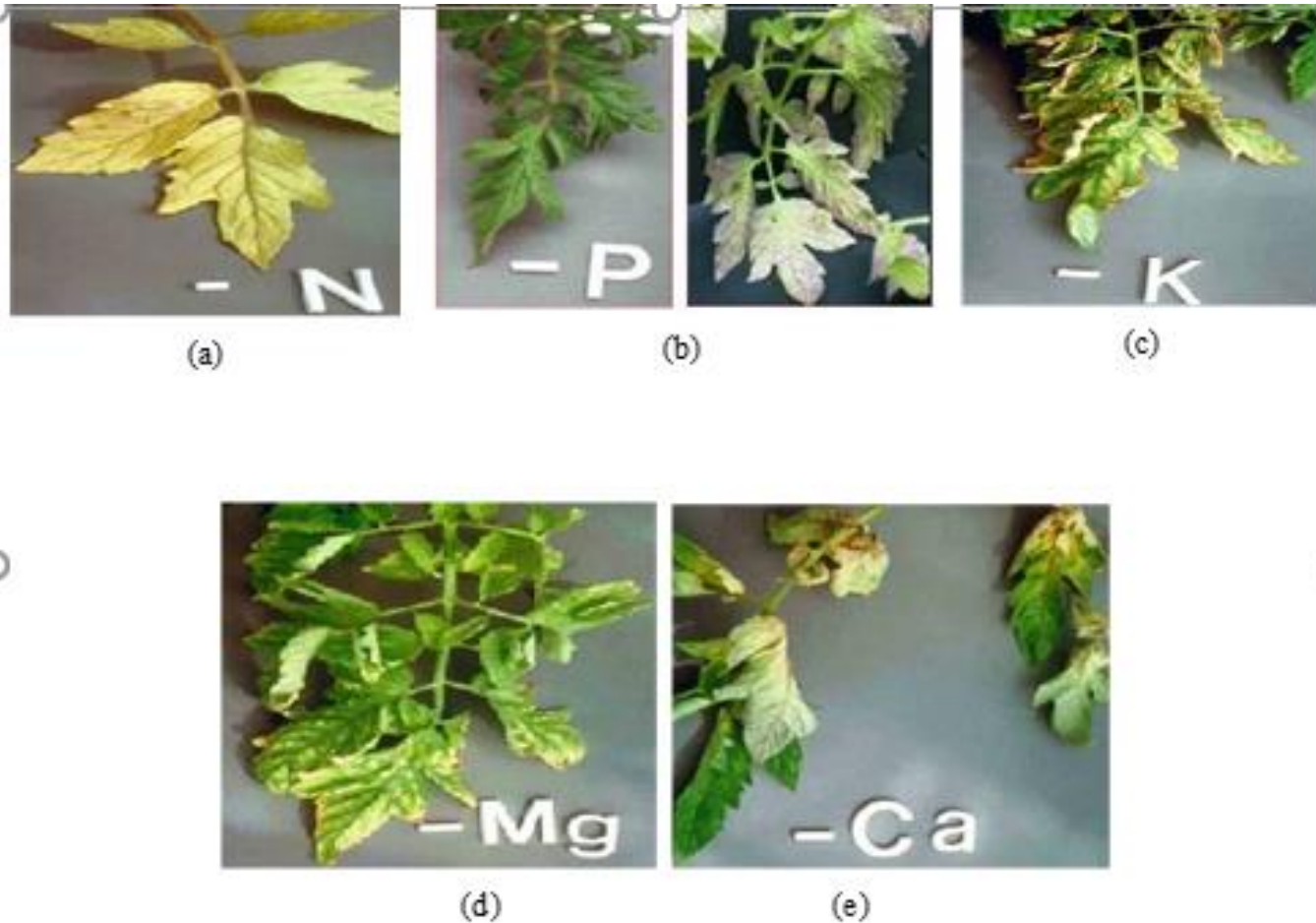


Fig. Nutritional deficiency on plant leaves (a) Nitrogen (b) Phosphorus (c) Potassium (d) Magnesium and (e) Calcium

2. Literature Survey

2.1 Methods in disorder detection

1. Traditional Methods

- Serological assay-based methods
- Nucleic acid-based methods
- Volatile compound-based methods

2. Innovative Methods

- Remote Sensing(RS)
- Image Processing based Methods

2. Literature Survey Contd...

2.2 Feature extraction related literature Survey

Feature Extraction:

It is a transformation of input data into a set of features. Features are distinctive properties of input patterns that help in differentiating between the categories of input patterns.

Following are some of the feature extraction techniques used in the past:

- Gray level Co-occurrence Matrix(GLCM)
- Color Feature
- Gabor Wavelets
- Convolution Neural Network(CNN)
- Deep Learning

3. Methods for Feature Extraction

- The proposed system considers features:

1. Sensor's data
2. Leaf image

It aims at mapping the semantic relationship between the image and the sensor's data (Humidity, Temperature, Moisture).

Features are divided into two categories;

1. Sensor's Based Feature Extraction
2. Deep Learning Based Feature Extraction.

4. Proposed System



Fig .Proposed System

Following are the steps to be follow

Pre-processing

- In this step, the images are prepared through Image Enhancement, Noise Removing, and Resizing.

Feature Extraction

- The proposed system will be extracting features from the sensor's data and from the leaf image.

Ensemble Classification

- The proposed system will be using multiple deep neural nets and sensor data. This will help create a voting system or called an ensemble technique to predict considering multiple outputs from multiple models. Ensemble techniques take multiple classifiers as input and predict based on multiple models.

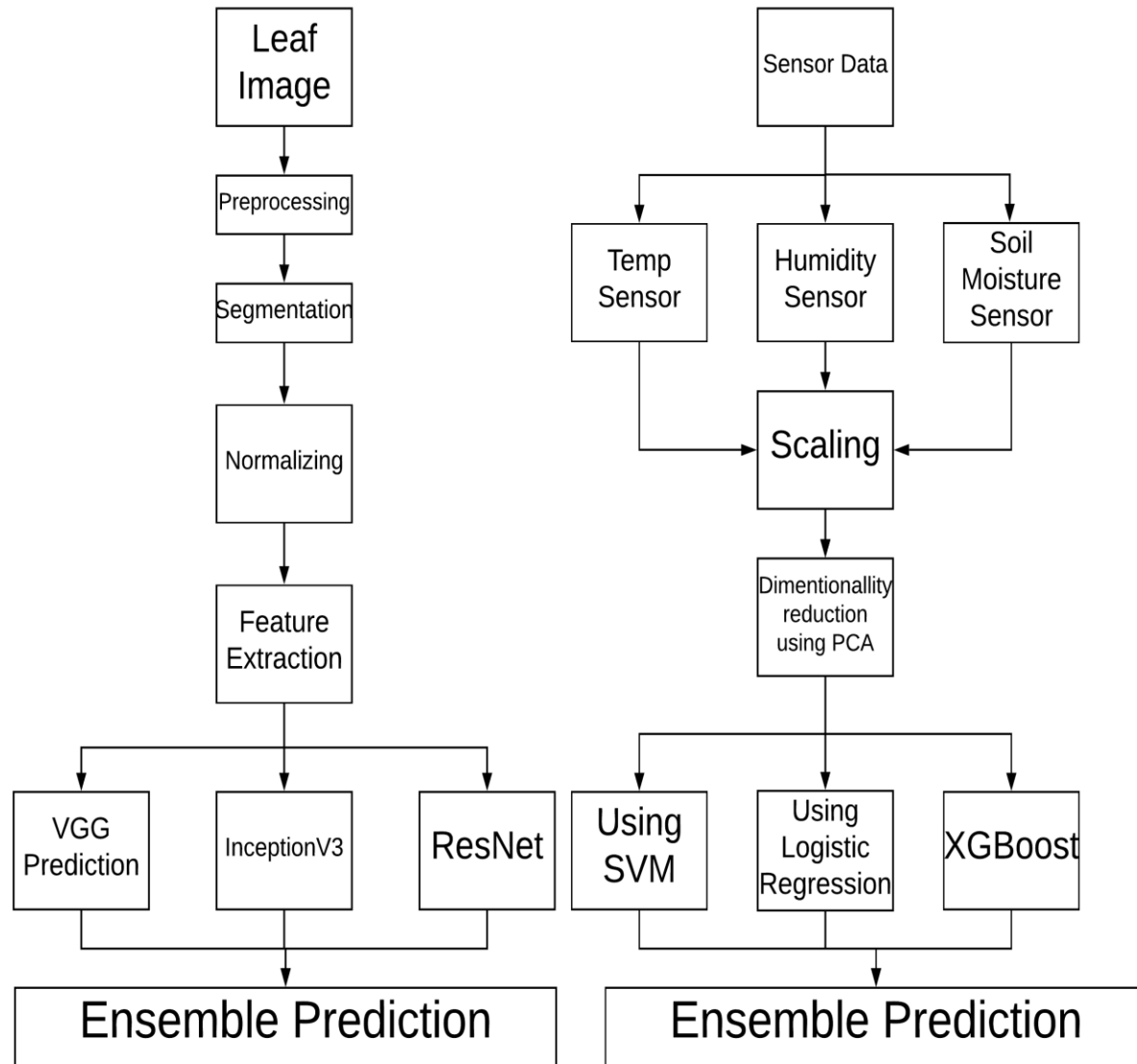


Fig Proposed System

3. Conclusions

- All the past work in disorder detection process directed towards the use of leaf images or sensor-based data.
- This research has given significance to a process where leaf images are combined with sensory input to aid in reliable and efficient detection process.

