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Plants health monitoring and prediction for precision horticulture

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Abstract

The hydroponic farming industry is growing rapidly, and it can solve major world food crisis problems. Health monitoring and diseases identification of the plant is very important for agriculture. Monitoring of health and disease on plant plays an important role in successful cultivation of crops in the farm. Identification of the plant diseases is the key to preventing the losses in the yield and quantity of the agricultural product. It is very difficult to monitor the plant diseases manually. Some diseases spread so rapidly they can affect an entire plant and crop. Early detection of a diseases can prevent an entire crop from harm and attention a farmer would need to place on their system. The proposed system is capable of detecting the disease at the earlier stage as soon as it occurs on the leaf, hence saving the loss and reducing the dependency on the expert to a certain extent is possible. The aim of this study is to design, implement and evaluate an image processing-based software solution for automatic detection and classification of plant leaf diseases. This technology helps the farmer to identify what type of diseases that the plant is being affected. The image has been processed in MATLAB and the status of the leaf has been identified with the help of neural network classification. Then the environment circumstances such as temperature, humidity and moisture has been monitored. After the image has been processed in the software it sends SMS to the user by using Global System for Mobile Communication (GSM). The SMS contains leaf status, particular solution and environmental conditions.

Keywords: Image processing; Disease detection; Data comparison; Ajus big data analysis; Local language translation.

1. Introduction

Hydroponic plants need nutrient solution for growing. The plants can't get sufficient nutrition which will have impact on growth of that plants. Automatic water controlling system to avoid the water sacristy problems.

The process of plant growth is a very important study for the mechanism of crop formation and getting more yield. Decease detection in plants plays an important role in agricultural field. Plant treatment requires observation on plant growth. The study of the plant diseases means study of visually observable pattern seen on the plant. Detection and recognition of leaves diseases are likely to give better performance and can provide clues to treat the diseases in its early stages. Early detection of diseases could yield more and reduce the loss. Farmers can take preventive measures. The plant leaf for the detection of disease is considered which shows the disease symptoms. The image processing technique that detects the kind of the disease the leaf is affected with and analyze the different diseases among the leaves.

2. Image Processing

End-to-end hydroponic plant health traceability system is very useful for monitoring the crops. Farmers can use camera and various types of sensors such as temperature, humidity, gas for health monitoring the plants. The software

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application will read the different sensors data, if there is any variation occurs the application automatically send an alert like SMS or alarm to the farmers with solution of the issue. In addition to that send the diseases of the plant.

Yellow and rotten leaves are main types of abnormal leaves in hydroponic plants.

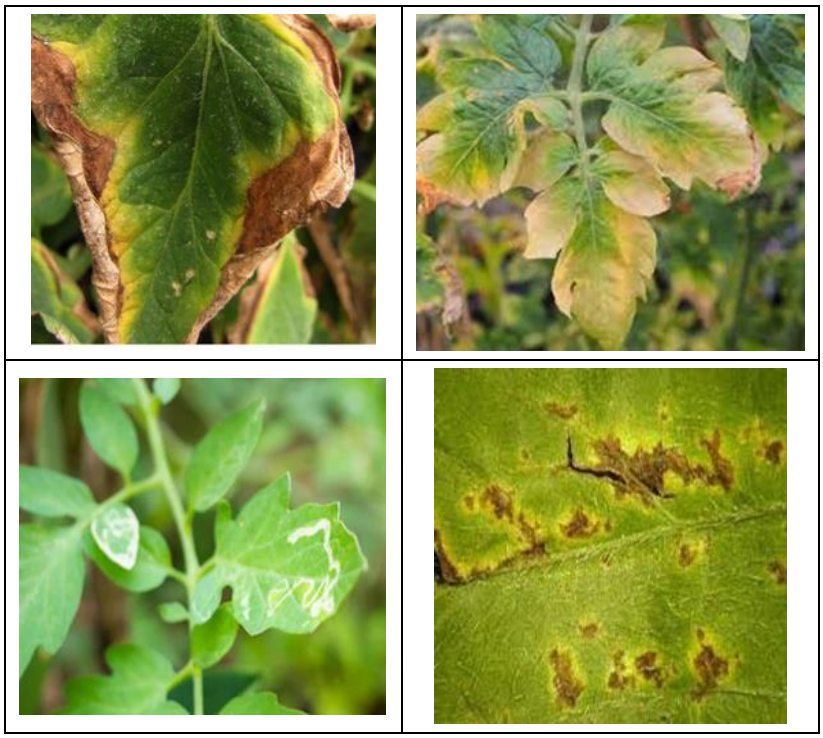

Figure 1 Disease prediction

Image processing technique is a method for converting an image into digital form and carrying out certain operations in order to obtain information on the image. The application of multiple cameras in image processing has increased the accuracy of the results. The accurately detection and classification of the plant disease is very important for the successful cultivation of crop and this can be done using image processing.

The research object used was a tomato plant which was cultivated hydroponically with the NFT (nutrient film technique) method. In the agricultural field loss of yield mainly occurs due to widespread disease. If proper care is not taken then it effects the product quality, quantity or productivity is affected. Image segmentation, which is an important aspect for diseases detection in plant leaf diseases.

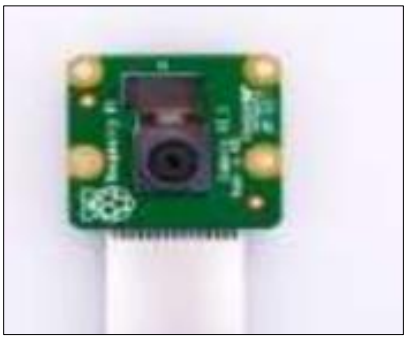

Figure 2 Camera

The images of the plant are captured by a digital camera. All cameras were set to capture objects with a maximum size of 25 cm2 × 25 cm2. After the image processing we will get the meaningful information from images such as finding shapes, identifying colors, or measuring object properties etc. Texture analysis is the characterization of regions in an image by their texture content. After the Image segmentation process, we will get an image into parts or regions. This

division into parts is often based on the characteristics of the pixels in the image. The Camera Module can be used to take high-definition video, as well as stills photographs.

3. Research Tools and Methodology

The tools used in this research were Matlab 2018a Software, Postgresql database server, Cameras, Laptop, Water, Lights, Air Pump and Net Pots. The ingredients used in this research was tomatoes seeds and mix nutrition.

The research method is designing software systems for monitoring plant growth. Then proceed with the manufacture of hydroponic installations along with devices for capturing digital images.

An image processing technique is applied to monitor the health of hydroponic plant leaf. The status of plant and environment details such as temperature, humidity etc are intimated to farmers via SMS alert and Email alert. In the proposed work the images of Tomato plant leaves are considered for the purpose of experiments.

Feature extraction is a process in which the image can be analyzed by using different parameters such as size, colors, etc.

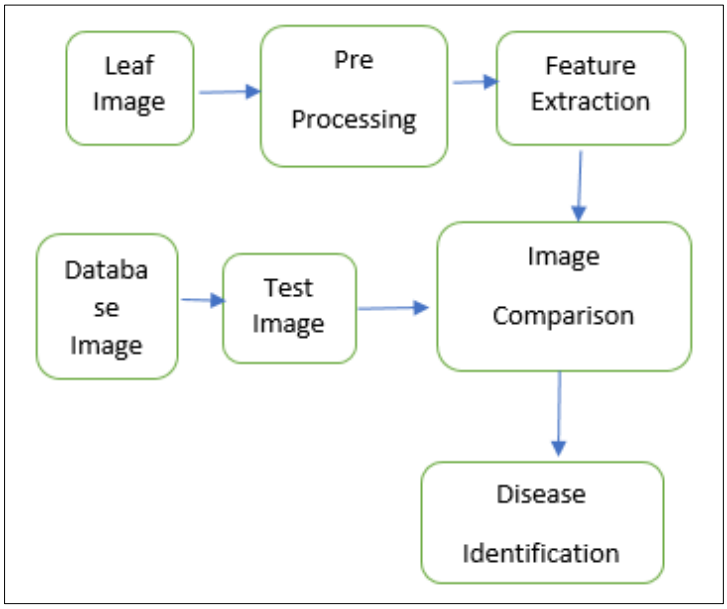

Figure 3 Proposed Model

The farmers can monitor the sensor data and plant leaf disease status using an Android-based mobile application, which is connected over IoT environment. In this manner, the farmer can continuously track the status of his field using the mobile app.

The database consists of previously infected images, which is used for identifying the plants diseases. Once we use multiple plants, we need to identify the plants details from the previously stored database. Hence, we can use the following source code for finding the previously stored data. It's a Ajus big data analysis source code. After running the source code, the output result time will take only milli seconds for big data analysis. This source code can use terabyte data analysis. Postgress database is used for this purpose. We can compare the two databases for getting the mother tongue/ local language report.

3.1. Big Data Analysis

The **Ajus big data** analysis comparison source code is as follows.

- Function: matchd(text)
- DROP FUNCTION matchd(text);

CREATE OR REPLACE FUNCTION matchd(s text)

- RETURNS text AS

$BODY$DECLARE

- Ajus text;
- nm1 text;
- nm2 text;
- nm text;
- pos integer;
- len integer;
- --t integer;

BEGIN

- en := length(s);
- pos := 1;
- <<ablock>>
- BEGIN
- LOOP

Ajus:= substring(s from pos for 3);

IF substring(Ajus from 1 for 1) != ' ' AND substring(Ajus from 2 for 1) != ' ' AND substring(Ajus from 3 for 1) != ' ' AND substring(Ajus from 1 for 1) != '.' AND substring(Ajus from 2 for 1) != '.' AND substring(Ajus from 3 for 1) != '.' THEN

- pos := pos-1;
- EXIT ablock;
- pos := pos+1;
- END IF;
- pos :=pos + 1;
- EXIT WHEN pos > len;
- END LOOP;
- END;
- nm1 := substring(s from (pos+1));
- nm2 := (substring(nm1 from 1 for position(' ' in concat(nm1, ' '))-1));
- nm := (substring(nm2 from 1 for position('.' in concat(nm2, '.'))-1));
- return dmetaphone_alt(nm);

END;$BODY$

LANGUAGE plpgsql VOLATILE

- COST 100;

ALTER FUNCTION matchd(text)

OWNER TO postgres;

- Function: matchs(text)
- DROP FUNCTION matchs(text);

CREATE OR REPLACE FUNCTION matchs(s text)

- RETURNS text AS

$BODY$DECLARE

- Ajus text;
- nm1 text;
- nm2 text;
- nm text;
- pos integer;
- len integer;
- --t integer;

BEGIN

- len := length(s);
- pos := 1;
- <<ablock>>
- BEGIN
- LOOP

Ajus := substring(s from pos for 3);

IF substring(Ajus from 1 for 1) != ' ' AND substring(Ajus from 2 for 1) != ' ' AND substring(Ajus from 3 for 1) != ' ' AND substring(Ajus from 1 for 1) != '.' AND substring(Ajus from 2 for 1) != '.' AND substring(Ajus from 3 for 1) != '.' THEN

- pos := pos-1;
- EXIT ablock;
- pos := pos+1;
- END IF;
- pos :=pos + 1;
- EXIT WHEN pos > len;
- END LOOP;
- END;
- nm1 := substring(s from (pos+1));
- nm2 := (substring(nm1 from 1 for position(' ' in concat(nm1, ' '))-1));
- nm := (substring(nm2 from 1 for position('.' in concat(nm2, '.'))-1));
- return soundex(nm);

END;$BODY$
LANGUAGE plpgsql VOLATILE

- COST 100;

ALTER FUNCTION matchs(text)

- OWNER TO postgres;

Ajus Big Data Analysis Query is as follows.

select ajudta. plant_name “Plant Name “, ajudta.ph,ajudta.desease_name” Desease Name”,ajudta.remedy”Remarks/Suggestion”,ajudta.plant_id“PlantId”,ajudta.leaves_type”Leaves Type”, link_processed.plant_name “ PlantName”,link_processed.ph“PH”,link_processed.leaves_type“LeavesType”,link_processed.leaves_color“LeafColor”,link_processed.humidty “Humidity” from ajudta, link_processed where link_processed .plant_name=ajudta.plant_name and matchs(link_processed.leaves_type) = matchs (ajudta.leaves_type) and matchd(link_processed.desease_name) =matchd(ajudta.desease_name) order by ajudta.plant_id;

We can use the following VB script for translating the English language to their mother tongue/ local language, which is very helpful for farmers. When they received the alert message via SMS, they farmers can easily identifying the remarks/report. “Find and replace multiple characters in Excel sheet “method can used for translating language. we can use VB script for this purpose. The following script is used for translating local language.

3.2. Language Translation – VB Script

```
Sub Multi Find NReplace()

'Update 20140722

Dim Rng As Range

Dim InputRng As Range, ReplaceRng As Range

xTitleId = "AjusBigData"

Set InputRng = Application. Selection

Set InputRng = Application. InputBox ("Original Range ", xTitleId, InputRng. Address, Type:=8)

Set ReplaceRng = Application. InputBox("Replace Range :", xTitleId, Type:=8)

Application. Screen Updating = False

For Each Rng In Replace Rng.Columns (1).Cells

InputRng.Replace what:=Rng.Value, replacement:=Rng.Offset(0, 1).Value

,Look At:=xlPart, _

Search Order: =xlByRows, Match Case:=False, SearchFormat:=False, Replace Format:=False

Next

Application. Screen Updating = True

End Sub
```

4. Result

The output gives the information of the disease of the plant along with the nutrient deficiency details. The SMS format is using the local language. Hence the famers can read it and identify the details very easily. This way the health conditions of the plants are continuously monitored and necessary steps for the prevention of disease are taken.

5. Conclusion

The detection of plant disease is very important for the successful cultivation of the crops, this can be done using image processing. Our aim was to detect the plant's health and send an SMS alert to farmers to take precautions on its disease. Our expected outcome is, to detect a leaf disease and to take precautions by using mix nutrients and light spectrum. This method of disease detection is done periodically and send the report to farmers such that the spreading of disease can be easily controlled.

Compliance with ethical standards

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Disclosure of conflict of interest

Authors have declared that no conflict of interests exists.

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