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SMART IRRIGATION SYSTEM: PLANT DISEASES IDENTIFICATION USING IP

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ABSTRACT—. In agriculture research of automatic plant disease detection is essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect symptoms of disease as soon as they appear on plant leaves, stem. The term disease is usually used only for destruction of live plants. This paper provides methods used to study of leaf disease detection using image processing. The methods studies are for increasing throughput and reduction subjectiveness arising from human experts in detecting the plant disease..

INDEX TERMS— Automation, cellular networks, Internet, irrigation, measurement, image processing, traits, water resources, wireless sensor networks (WSNs).

I. Introduction

AGRICULTURE uses 85% of available freshwater resources worldwide, and this percentage will continue to be dominant in water consumption because of population growth and increased food demand. There is an urgent need to create strategies based on science and technology for sustainable use of water, including technical, agronomic, managerial, and institutional improvements.[2]

In traditional system, there is one set of pump, water resource like well, pond, damn, river etc., one drip system and manual starter. In this case, as per the demand, farmer starts the pump manually. Then drip system get started also there is no provision to identify the plant diseases. It is done by using observing only visual symptoms of disease same like in sprinkler system, the irrigation is done by farmer.

In traditional system, the sprinkler are used to irrigate the field, but by using this irrigation system, the field is not properly irrigated. Because the water which will be sprinkled is not properly absorbed by field. In this method the percentage of water, pesticides, fertilizer required is more. So it is not actually good method by considering the low water resources. There are lots of limitations in our traditional system viz,

1. Water is not properly given to field. In some case it deliver in large amount and in some cases in low amount.
2.
3. Fertilizers given to plants are not well proportioned or well efficient.
4. Lack of proper understanding of the need to grow crops sustainably will push farmers into a vicious circle – of debts, heavy use of fertilizers, water mismanagement, low productivity and thus more debts for the next cycle
5. Sustainability in agriculture is of utmost importance as many problems faced by farmers are related to this.
6. There is no single provision to identify the plant diseases in traditional method. And it is very difficult to identify disease by farmer.

Ultimately, the consumption of water, fertilizers should be low and plant diseases identification is our ultimate aim. So I proposed one system for removing the limitations.

The proposed system is basically consist of automated irrigation system which has a wireless information unit (WIU) in a circuit it acts as server and base station both. Wireless information unit acts as a base station of my project [2].

In WIU, consist one GSM module, Wi-Fi, DSP and microcontroller. Base station requires two inputs from camera to measure the growth of plant and identifying the diseases and another is from three tanks viz water, pesticides and fertilizers.

Plant diseases recognition is done with the help of camera. From picture WIU will decide the growth and diseases of plants with the help of image processing in the raspberry pi module. Also the growth of plant is decided with the help of camera [1] [5].

Automated irrigation system is a wireless sensors network. All irrigation system is working on the inputs from sensors. The main functions of a wireless sensor network are sensing; processing; and communication. The sensing circuitry consumes less power than the processor. But the power consumption of the radio communication is much more than that of the processor. It is required in the sensor networks to co-ordinate the sensor networks' access to the shared medium [2]. In base station our third input is from the sensors to measures the levels of 3 tanks as per requirements by the soil and plants.

II. DISEASE RECOGNITION

A. Using Visual Identification

In visual identification where images and/or short descriptions are used to uniquely identify diseases when possible and suggest refining the visual identification process in cases of ambiguous identification. It has been designed in a way that allows easy definition of additional diseases by uploading the correct images and defining the identification rules and diseases. In this way the system may aid growers on identifying various diseases when using the system remotely while the system is developed and maintained centrally. This approach may ease the process of manual visual diseases identification until machine vision technology is mature enough to perform this task automatically.

Most plant diseases around 85 percent are caused by fungal or fungal-like organisms. However, other serious diseases of food and feed crops are caused by viral and bacterial organisms. Certain nematodes also cause plant disease. Some plant diseases are classified as "abiotic," or diseases that are non-infectious and include damage from air pollution, nutritional deficiencies or toxicities, and grow under less than optimal conditions. For now, we'll look at diseases caused by the three main pathogenic microbes: fungus, bacteria and virus. If plant disease is suspected, careful attention to plant appearance can give a good clue regarding the type of pathogen involved.

B. Using - Image Processing

Using image-processing for disease detection has become popular in medicine, because it is a rapid and reliable way to assess a patient's condition. This practice is particularly useful when the distance between practitioner and patient prevent direct consultations. The advantage in using a 'computerized process' is the high level of accuracy in the diagnosis and prognosis, as well as the significant reduction of costs in comparison to the traditional method of face-to-face diagnosis.

In agriculture, numerous image-processing based computerized tools have been developed to help farmers to monitor the proper growth of their crops. Special attention has been put towards the latest stages of growth, that is, when the crop is near harvesting. For example, at the time of harvesting, some computer tools are used to discriminate between plants and other objects present in the field. In the case of machines that uproot weeds, they have to discriminate between plants and weeds, whilst in the case of machines that harvest; they have to differentiate one crop from the other [1] [5] [7] [8].

The algorithm starts by converting the RGB image into the H, I3a and I3b colour transformations. The I3a and I3b transformations were developed from a modification of the original I1I2I3 colour transformation, to meet the requirements of the plant disease dataset. The transformed image is then segmented by analyzing the intensity distribution. Once the image was segmented, the extracted region was post-processed to remove those pixels that were not considered part of the target region.

To test the accuracy of the proposed algorithm, manually segmented image were compared with those segmented automatically. This procedure was accomplished by analyzing the neighborhood of each pixel and the gradient of change between them.

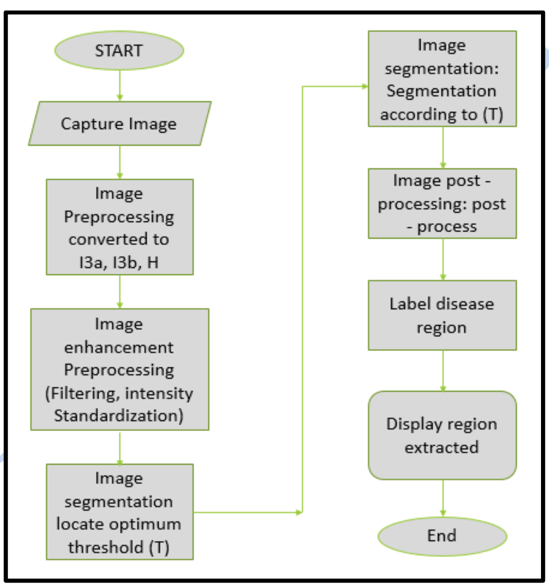

Figure 1 - Image processing-based algorithm to automatically identify plant disease visual symptoms.

Stages of Algorithm

This study reports on an algorithm for the detection of visual symptoms of disease by the analysis of coloured images. The algorithm was divided into four stages:

(1) Image pre-processing: to specify a suitable colour transformation that best highlighted the diseased regions shown in the picture;
(2) Image enhancement: to develop a filter that could highlight those regions considered targets (possible diseased regions);
(3) Image segmentation: to identify regions in the image that were likely to qualify as diseased region;
(4) Image post-processing: to remove unwanted background regions.

A flowchart of the complete process is shown in Fig. 3 [1][3][5].

1. Pre-processing

The previous stage looked for a suitable colour transformation capable of coping with the requirements of the plant disease image data set. The objective of pre-processing is to adjust the intensities of the image in order to highlight areas considered as targets (visual symptoms of disease). After this process the image will be ready for segmentation.

2. Image enhancement

The objective of image enhancement is to improve the quality of the image by different means e.g. varying intensities, so that segmentation can be more efficient. Therefore, success in the segmentation process is determined by the accuracy with which diseased regions of the image were correctly selected. To begin the process, images were enhanced by means of applying a Gaussian filter. This filter suppresses high frequencies; its effect is to blur the image, in a similar manner to the mean filter [1].

3. Image Segmentation –

Once the image was both enhanced and normalized, the next procedure was to identify an optimum threshold that could differentiate between background and target object (i.e. the region showing the current symptoms of the disease). Following the investigation of a number of segmentation techniques the 'histogram of intensities'' was selected. This section explains how diseased and background regions were separated. The segmentation procedure was undertaken using a threshold value that was calculated applying segmentation by maximum intensity location in a histogram of frequencies. The idea of this procedure is to accurately interpret the distribution of the data along the histogram, so that the appropriate threshold point can be easily identified.

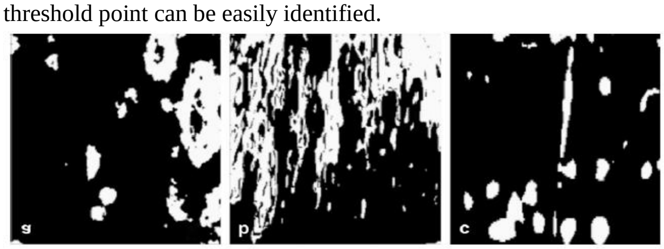

Figure 2 – Results of automatic image segmentation.

4. Image Post - Processing

Apart from the two exceptions mentioned above, the segmentation process produced three matrices corresponding to the I3a, I3b and H channels. Each matrix contained the regions that, according to the analysis undertaken in the previous section, could be disease symptoms. These three matrices were summed and turned into a unique matrix, which represents the set of diseased regions (Fig. 4.6). Since the summed matrix still contains regions of pixels either too small or unconnected, the small regions of pixels were deleted using the morphological binary open function, which removes all connected regions that have fewer than P (six for this experiment) pixels. Another procedure filled holes using region filling. These two methods are part of the mathematical morphology operations. Fig. 4.6(a) and (b) presents the resulting images after the segmentation and post-processing procedures. The most relevant regions in terms of area having been selected, labelling is applied then to classify each region. Fig. 4.6(b) shows the extracted image with a number of potentially diseased regions. To demonstrate the success of the process, the original region was placed under the final segmented regions.

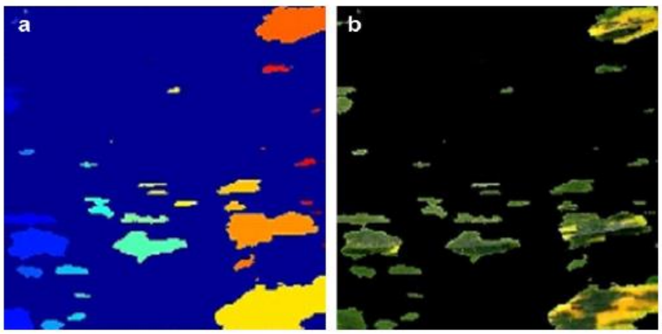

Figure 3 - Image post-processing. (a) Diseased regions; (b) final image with original intensities.

III. Smart Irrigation System with Diseases Recognition using IP

The emergence and development of plant diseases and pest outbreaks has become more common nowadays, as factors such as climate and environmental conditions are more unsettled than ever. The rate of spread of disease depends on current crop conditions and susceptibility to infection. When plants become diseased, they can display a range of symptoms such as coloured spots, or streaks that can occur on the leaves, stems, and seeds of the plant. These visual symptoms continuously change their colour, shape and size as the disease progresses.

We proposed the system for three reasons

1. Identifying growth of plan
2. Pre-diseases planning
3. Post diseases recovery

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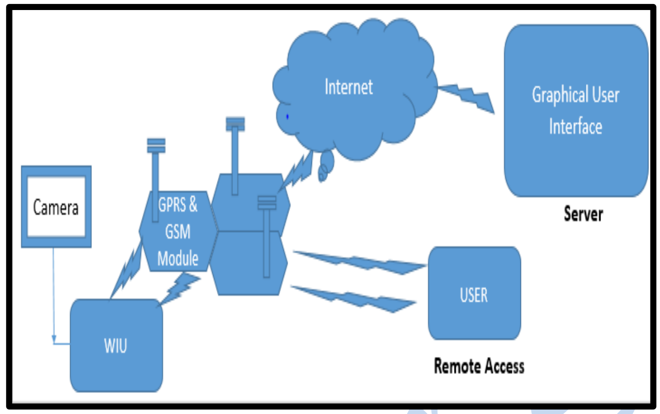

Figure 4 – Block diagram for Smart Irrigation system using Image Processing

3.1Wireless Information Unit

Wireless Sensor Unit is a basic part of the system. Wireless information unit is a device which contains one GSM & GPRS integrated module, raspberry pi module. WIU is basically is a medium between camera and GUI for communication with the help of GPRS module. In WIU, GPRS is specially used for the communication between WIU and graphical user interface. And GSM module is used for the communication with a user or farmer.

Develop a system to identify the growth of plant, identifying the post diseases of plants and planning for pre diseases will not occurred on the plants to save the plant disease free and healthy. To identifying growth and diseases from camera with the help of image processing, required a best algorithm to process the image from camera and gives the decision to the base station (WIU), saving the time to process and suggest best fertilizers and pesticides to the farmer via SMS.

The system framework (Figure 6.1) consisting of wireless information unit, ideal database for comparing the images with ideal images of diseases, graphical user interface or cell phone, server , communication medium GPRS, WI-FI for wireless communication and camera which capture images of plants and send to the BS or Server

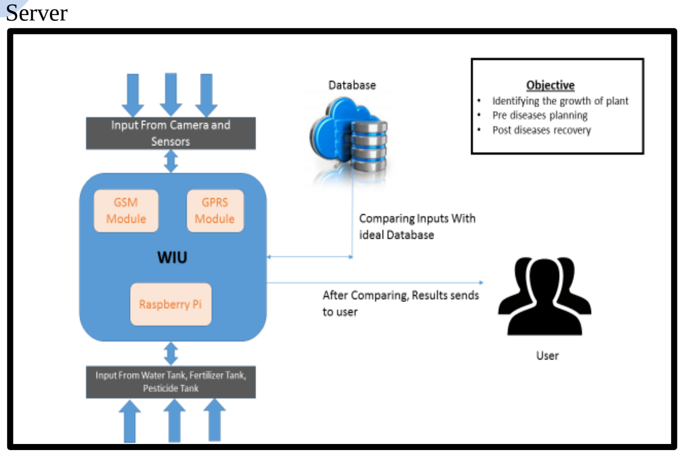

Figure 5 – Wireless Information Unit

Communication between WIU and ideal database is done by GPRS module. Also user is connected wirelessly with the help of GSM module via Internet or cellular service provider.

Diseases identification is done precisely and accurately with the help of digital image processing by comparing the image taken from camera to ideal images of diseases so that diseases should be detected clearly and using user will be notify by SMS and send the 3 best fertilizers name or 3 best pesticides name which is good for the plants and health for plant.

The diseases recognition is done with high accuracy and makes the plant environment healthy and good. One of the most important benefits of the product is that a single farmer can manage more than one field. This makes the product truly unique in its kind [1] [2] [8]. The soil moisture and temperature data from each WSU are received, identified, recorded, and analyzed in the WIU. The WIU consists of a master microcontroller an XBee radio modem, a GPRS module.

The functionality of the WIU is based on the microcontroller, which is programmed to perform diverse tasks. The first task of the program is to download from a web server the date and time through the GPRS module. The WIU is ready to transmit via XBee the date and time for each WSU once powered. Then, the microcontroller receives the information package transmitted by each WSU that conform the WSN [2].

Master Microcontroller is decide the one mode of operation among three mode of operation. The three modes are

1. Automatic Mode
2. Semi-automatic Mode
3. Manual Mode

In the Automatic Mode, the operation is done automatically without any human effort. In this case the mode of selection of water, fertilizers, pesticides is controlled by programmer and the flow of water is decided as per the plant requirement as per the reading taken from sensors. In the Semi-automatic mode, only selection mode of water is automatic and other two parameter is manual, it will be decided by farmer or user. The ultimate use of this mode is to continent for farmer to adjust the dosages of fertilizer and pesticides. In the third mode i.e. manual mode the total control will give to farmer to adjust all parameter by their own convenience. These mode are acted as per the selection of modes by farmer [1].

3.2 GPRS Module

The wireless telemetry unit, model was used to establish communication between the controller and supervisory system. This model has the ability to automatically manage the GPRS connection and perform the compatibility of this technology to the protocol transparently (without protocol conversion) with the supervisory system used [2].

The GPRS Modem is a cellular modem. This GPRS modem includes an embedded transmission control protocol/Internet protocol stack to bring Internet connectivity, a UFL antenna connector and subscriber identity module (SIM) socket. In addition, it establishes the communication with the URL of the web server to upload and download data. If the received signal strength is poor, then all data are stored into the solid-state memory of the WIU and the system try to establish the connection each hour.

The irrigation system can be adjusted to a variety of specific crop needs and requires minimum maintenance. The modular configuration of the automated irrigation system allows it to be scaled up for larger greenhouses or open fields. In addition, other applications such as temperature monitoring in compost production can be easily implemented. The Internet controlled duplex communication system provides a powerful decision making device concept for adaptation to several cultivation scenarios. Furthermore, the Internet link allows the supervision through mobile telecommunication devices, such as a smartphone. Besides the monetary savings in water use, the importance of the preservation of this natural resource justify the use of this kind of irrigation systems.

IV. Conclusion

The smart irrigation system using image processing will be feasible and cost effective for optimizing water resources, fertilizers and pesticides for agricultural production. This irrigation system allows cultivation in places with water scarcity thereby improving sustainability.

The automated irrigation system developed proves that the use for recognizing plant diseases from the leaf of plant using image processing and also use of water can be diminished for a given amount of fresh biomass production. We will try to use of solar power in this irrigation system is pertinent and significantly important for organic crops and other agricultural products that are geographically isolated, where the investment in electric power supply would be expensive.

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