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Implementation of IoT with Image processing in plant growth monitoring system

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Abstract

An automated system for monitoring the growth of plant can be done with appropriate taxonomies. Such kind of information can be useful for formers, botanists, industrialists, food engineers and physicians. This work combines Image Processing and IoT to monitor the plant and to collect the environmental factors such as humidity and temperature. In image processing, a recognition system capable of identifying plants by using the images of their leaves has been developed and with the help of the images use of pesticides can be controlled. The system runs pre-processing and feature extraction techniques on the image before a pattern matcher compares the information from this image with the ones in the database in order to get potential matches. The different features that are extracted and compared are the color, texture and shape of the leaf. Based on the pattern recognition a leaf can be identified as healthy or deceased. Here we combine IoT and Image processing. In addition, our system is simple to use, fast and highly scalable.

Keywords: Internet of Things (IoT), Image Processing, MATLAB.

INTRODUCTION

India is an agriculture based country. Two-third of population relies upon agriculture directly or indirectly. It is not merely a source of livelihood but a way of life. It is the main source of food, fodder and fuel. It is the basic foundation of economic development. It provides highest contribution to national income. In addition to this, agriculture also provides employment opportunities to very large percentage of population. The climate conditions of our country is isotropic, still we are not been able to utilize agriculture resources. The reason behind this is the lack of rains and scarcity of water. Another cause may be unplanned use of water due to which a remarkable amount of water goes in vain.

At the present era, the farmers have been using various pesticides for crop at regular intervals. Presence of pests and disease affect the rate of crop cultivation. It reduces crop yield in a significant amount and as a result there will be an increase in poverty, food insecurity and mortality rate. The current system relies on visual observation which is a time consuming process. This problem can be completely resolved if we use automatic control of using pesticides in which the pesticides will be used based on the growth of the crop. With the advancement in image processing technology, it is feasible to create an automated mechanism for the detection of pests.

The Internet of Things is the network of physical objects-devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity-that enables these objects to collect and exchange data. The Internet of Things has been defined in Recommendation ITU-T Y.2060 (06/2012) as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. Building a loT application requires the right selection and combination of sensors, networks and communication modules. The above setup is then collaborated with concepts of image processing, cloud computing, etc. Research conducted in September 20 14 on early loT adopters, suggests that the majority of the companies that have adopted loT are already seeing some measurable benefits. Respondents said that they have deployed or plan to use loT in many areas, including asset tracking, security, fleet management, field force management, energy data management, and condition-based monitoring. loT has wide applications in the fields of transportation, lifestyle, building, agriculture, factory, health care and many more. It is often described as a network of networks. Due to this, it can perform various tasks efficiently and accurately.

Image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics of parameters related to the image. It usually refers to digital image. Digital image processing makes use of various computer algorithms to perform image processing on

digital images. It is widely used for classification (identifies to which class does a newly found observation belong), pattern recognition (recognize known and discover unknown patterns), feature extraction (initial information which is used to make further derivations), multi-scale signal analysis (signal processing) and projection (three dimensional object is converted into a planar surface).

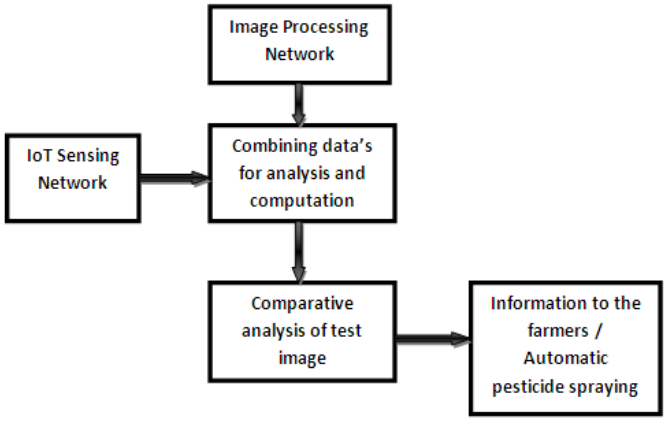


Figure 1: Process flow diagram

As discussed earlier, IoT and Image processing are combined together in agricultural field in order to increase product yield and to reduce the crop failure. We focused on plant failure due to environmental factors through IoT technology. IoT system includes sensors, Arduino and a camera that regularly captures the plant. The color, texture, shape and area of the leaf are the parameters also considered in this work. After examine the conditions of the plants we go for image processing. The initial test is done by using MATLAB software. In addition to the environmental factors, the plant with a diseased leaf can also be identified using Image processing. Based on the output and constraints the pesticides will be sprayed for the crop/plant where the disease is identified. If there is any change that corresponds to the deterioration in the plants growth, the farmer is immediately informed. Early diagnosis will thus help in taking the necessary actions to increase the produce and reduce failure of crops.

PROPOSED ALGORITHM

The main idea is to combine the concepts of Image processing techniques and Internet of things to get the required results. The factors to be considered are temperature and humidity that leads to delicate the changes in the health of the plant. The Changes that a plant undergoes are captured by the camera and analyzed with the MA TLAB software. The process of capturing image and the required environmental factors are done with the IoT network. A storage device can be used to store all the required data's for the analysis.

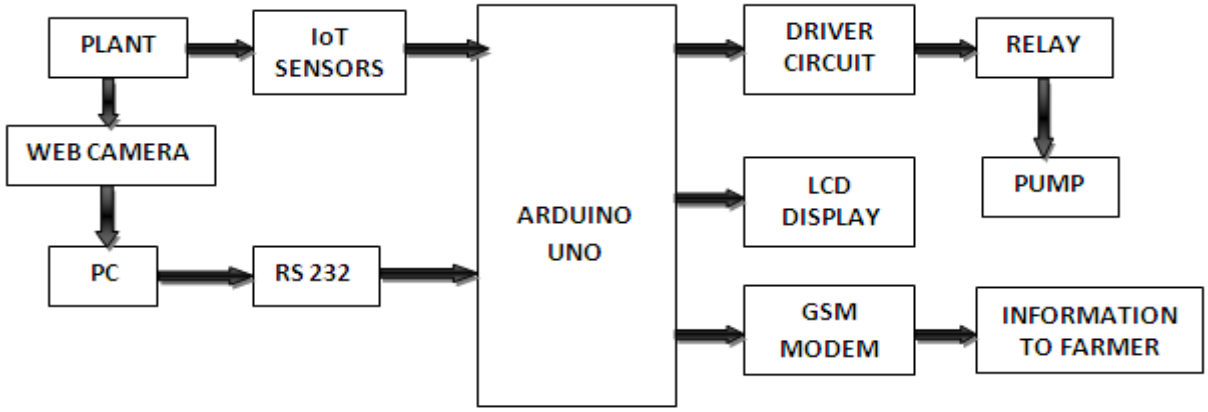
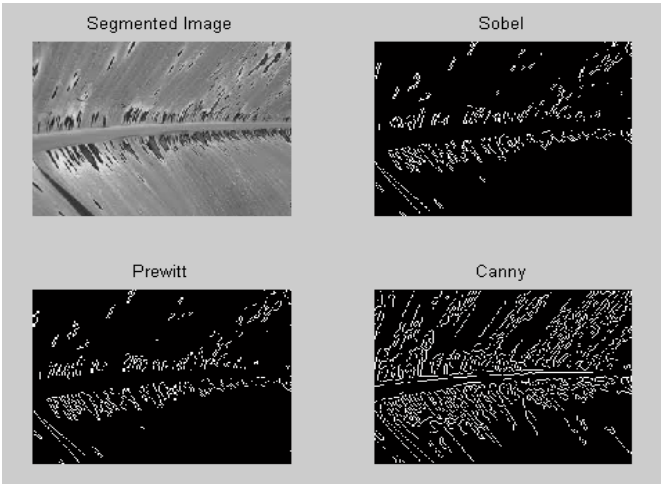


Figure 2: Block Diagram of the proposed system

In Image processing section, initially the image is captured from the camera and further the image is processed using k means clustering for segmenting the image. The processed image is then edge detected using three different edge detection techniques. The edge detection techniques used are sobel, prewitt and canny algorithm. The diseased sample banana leaf has been taken for the edge detection analysis.

Amongst the three edges detection methods used, canny edge detection algorithm gives the better and reliable detection. Owing to its optimality to meet with the three criteria for edge detection and the simplicity of process for implementation, it became one of the most popular algorithms for edge detection method.



RESULTS

A. Banana original and gray image

The original image taken for analysis and its converted gray image is given below.

Figure 2: Original image with gray scale image

B. Banana anthracose

The diseased image of banana anthracose is taken for analysis,it is converted gray scale image and canny is shown below.

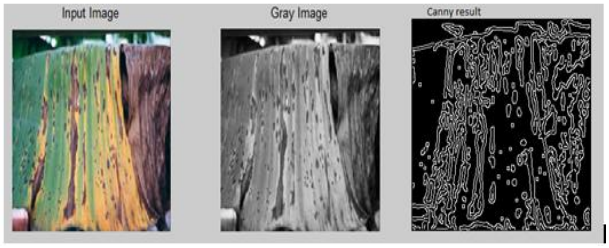


Figure 3: Diseased image of banana leaf

C. Banana spot high

The diseased image of banana spot high is taken for analysis and it is converted gray scale image and canny is shown below

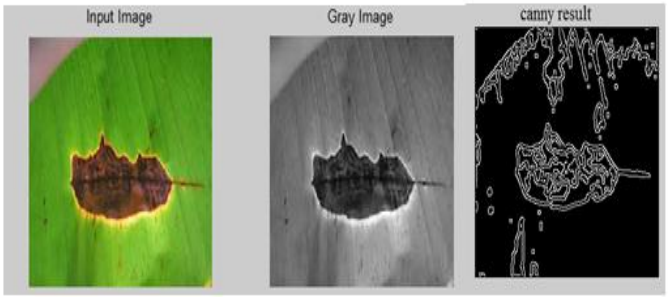


Figure 4: Banana leaf with spot high disease

D. Paddy original and gray

The original image taken for analysis and its converted gray image is given below

Figure 5: Original image of Paddy leaf

E. Paddy brown spot

The diseased image of paddy brown spot is taken for analysis, it is converted gray scale image and canny is shown below

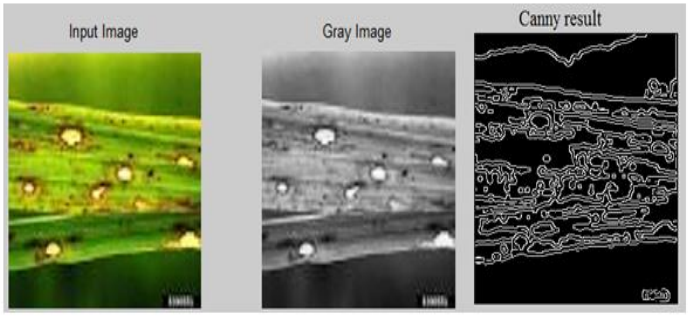


Figure 6: Paddy identified with a narrow brown spot disease

F. IoT Section

In this work, the growth of banana tree and paddy are taken for analysis. Environmental factors like temperature and humidity plays a major role for the growth of a plant. Temperature and humidity sensors are used for the measurement and are connected with the IoT network. The optimal temperature range for banana tree is about 25°C to 30°Cand Paddy is 20°C to 27°C. The data's collected from Temperature and Humidity sensors are given to Arduino UNO kit from which the information is communicated to the farmers.

Step 1: Initialize the sensor to send data at 9600 baud rate

Step 2: Start reading humidity and temperature values from the assigned analog pin

Step 3: Print to in /\C and Humidity in % on the serial monitor

Step 4: Continue to read data at a delay of 2000ms

Step 5: De-initialize the sensor and terminate

By using IoT, the whole process is automated and data's are collected using sensors. The growth of plant depends on the environmental factors. The disease free plant with the required amount of humidity and temperature shows the health of the plant. These can be achieved using IoT network and Image processing technique.

CONCLUSION

The work prevails over an automated pesticides control mechanism which reduces human intervention in the crop cultivation. It prevents the adverse effects of over usage of pesticides which leads to reduction in crop cultivation. This model can be successfully applied to achieve

great results with most types of crops. In this project, the goal is implementation of controlled irrigation techniques using same principles. It is achieved with prominent results by acquiring the images of agriculture land. The image is then filtered by applying mean filter algorithm to remove noise created by various lighting conditions. The filtered image is then segmented and processed by image processing technology to extract the information. In the future, other image processing techniques may be used to enable the detection and extraction more efficient and accurate. It can be seen that how Internet of Things and Image Processing can be combined and implanted in the field of agriculture to get satisfactory results. Some level of automation is achieved in terms of capturing images in regular intervals. Also the status of the environment is regularly checked and updated. This gives rise to the possibility of constant monitoring of the fields and the environmental factors. The loT sensing network so established can easily be mounted on a rover to monitor and collect data of the field on a regular basis. This will immensely help the farmers as they cannot be on their field 24/7. The information collected can be communicated to the farmers. The rovers can have the specific amount of pesticides, fertilizers on board.

No conflict of interest: Nil

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