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Monitoring Plant Growth and Disease in IoT

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Abstract:
Agriculture plays an important role in India. Almost 75% of people depend on agriculture. Nowadays practice of agriculture is been reduced. It is in a destroying stage. Since there is an increase in a number of cities and buildings, level of an agriculture get decreased. Due to some environmental hazards growth of the plants are affected severely. Water, temperature, humidity and nutrient level are some factors which decreases the growth of the plant. When these factors are reduced, plants do not grow efficiently and they produce only low quality crops. Farmers cannot achieve the expected growth. To overcome this problem we have designed and developed a new project by using number of sensors. These sensors measure the values of above mentioned factors which help to rescue the plant from critical condition. Using image processing toolbox presence of diseases in plants are identified and accuracy of diseases are found by segmenting the captured image.

Keywords: Image processing, MATLAB, MPlab, PIC microcontroller

I. INTRODUCTION

Agriculture is the most important part in our life. It plays a major role in human lives. It provides food for both animals and human beings. It plays a vital role in human anthropology. Environmental factors like air, moisture, temperature, humidity, fertilizer, pesticides and level of minerals in the soil determines the growth and production system of agriculture. To avoid the occurrence of diseases is impossible. But the effect of diseases can be reduced. .Virus, bacteria, fungi, algae etc., are some pathogens which affects the growth of the plants. Leaves, root, stems and fruits the parts of the plant which is prone to the affection of diseases. These are the major problems faced by the farmers in the field of an agriculture. Farmers cannot be able to visit the farmand monitor the crops regularly. They can only detect the presence of diseases through their naked eye. But accuracy cannot be achieved. In remote area communication is very less and it takes more time to reach. So that diseases cannot be detected at the early stage. Due to this plants are dead. To overcome these problems we adapt the techniques of digital image processing which includes image acquisition, image preprocessing, segmentation and disease identification. Smart farming can be achieved using Internet Of Things. It helps to monitor the growth of the plants by using the sensors (soil moisture, light, humidity, temperature). The farmers can monitor the condition of field from anywhere. It has high efficiency while compared to traditional methods.

II. LITERATURE REVIEW

Tanmyee.P has proposed the collection of periodic images of crops of large area by proper monitoring and analyzing the obtained image with respect to the place it was taken. The advantage of this method is that it reduces the use of pesticide for large area. It will spray the pesticide only to the infected region. The drawback is that since wireless method is used it takes some time delay to cure the disease.[1] Adhao Asmita Saragangadhar used the concept of Support Vector Machine based regression techniques for the detection for the detection of cotton diseases. Android app is also developed to display disease along with ON/OFF relay. The main advantage of this system is that the app allows movement of system from one place to another. Farmer can check the condition of soil at different places using sensor and used the concept of automatic motor ON/OFF with relay. Cost effectiveness is achieved using raspberrypi. This gives an accuracy of 83.26% for cotton disease detection. Vijaisingh has proposed a method which gives a classification of different diseases and algorithm for image segmentation techniques for automatic detection with less computational efforts better results achieved. The less computational effect shows the efficiency of proposed algorithm in the classification of leaf diseases. Advantage of the system is that diseases are identified at earlier stage. JayrajChopta has proposed a system which can predict diseases of cotton crop using decision tree classifier by considering parameters like temperature, humidity, soil moisture, etc which would help formers by providing good quality production of crops. Prediction occurs the help of decision tree classifier By considering suitable range from the user analyze it with the training data and provides required output. Amogh Jayaraj Rau have developed a IoT based intelligent irrigation system with the analysis of disease detection. Smarter irrigation and reduced consumption of water along with nitrogen deficiency detection which enables the farmers to increase their output with less effort. The further enhancement of this project would be to calculate the amount of fertilizer from the nitrogen deficiency.

III. PROPOSED METHODOLOGY

In this proposed system the main work is to detect the presence of diseases in plants like tomato, brinjal and banana. Plants diseases can be identified and monitored both by hardware and software techniques such as using sensors, image processing tools and internet of things. These are the following parameter which are to be measured and compared in this system:

1. Moisture level in the soil
2. Chlorophyll level in the leaf
3. Conductivity of the soil in the presence of minerals (sodium, potassium, phosphorous)

Segmentation is the method used for improved accuracy of detecting disease using image processing technique. Crop disease detection is also done by using Image Processing techniques. To capture an image of an leaf camera is placed near plant so that image of a leaf from the plant is taken. An image which is captured is sent to the server for the image processing techniques. Using Image processing techniques presence of diseases in a leafis detected and the present condition of a leaf is sent to the IoT webpage which in turn help the farmer to get knowledge about the plants growth through mobile phone application.

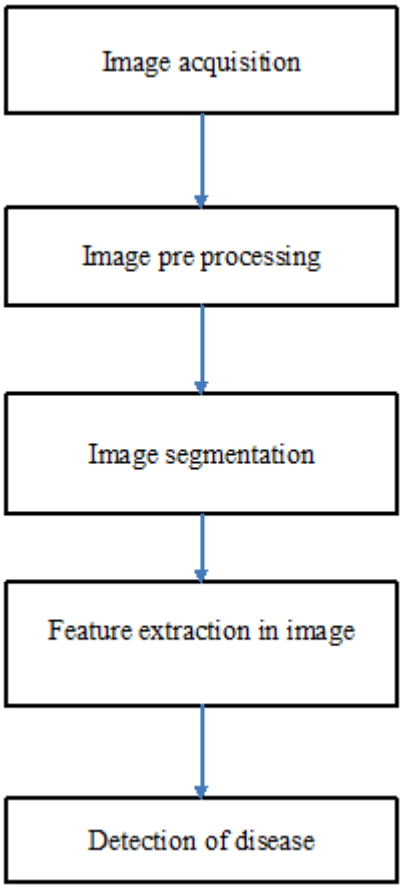
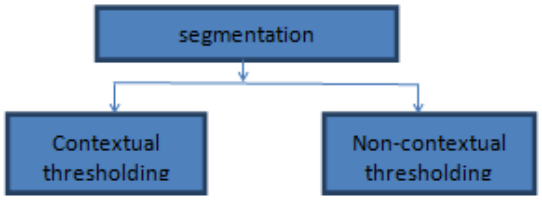


IMAGE ACQUISITION: It is the first and foremost process in image processing. It is defined as the process of capturing an image from the source by the hardware components like digital camera, mobile phones etc.,It is the initial step for the workflow. An energy which comes from the source was converted into voltage. This conversion takes by the combination of power from the source and some kind of energy is being sensed by the sensor material. The analog voltage waveform is digitized to obtain a digital value which can be read easily. Some of the sensors like line sensor, array sensor, single image sensor are used to capture an image from the source.

IMAGE PREPROCESSING: It is the second process which takes place at the lowest abstraction. The main aim of pre processing is to eliminate or remove the unwanted noise in an image. Simultaneously it also enhances the certain features of an image for further image processing techniques. This method depends according to the size of the nearby pixel which helps to calculate the brightness of new pixel. Redundancy in an image is also to be considered. Some distortion in sources may be due to an uneven illumination of light to an object. This means an uneven sensitivity of light sensors towards source. Brightness of an image is adjusted to decrease the level of degradation. Let us consider the multiplicative error coefficient be e(i,j) which describes the changes of an image from ideal identity to transfer function.g(i,j) be the desired image.f(i,j) be the image containing degradation.

$$f(i,j)=e(i,j)\ g(i,j)$$

IMAGE SEGMENTATION: Segmentation is the third step which plays a major role in the identification of diseases in plants. It is a process of partitions an image into small segments. It also separates the regions in an image containing each pixel having similar features. Segmentation is the initial step from pre processing to get high level image description in terms of its features. The successful satisfaction of an image depends on the reliability of segmentation. There are two types of segmentation process. They are

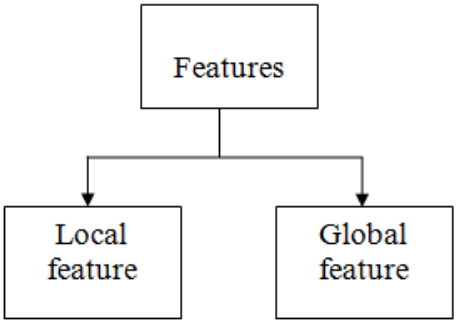


1.Simplethresholding
2.Adaptivethresholding
3.colorthresholding
4.Split and Merge

1.Pixel connectivity
2.Region similarity
3.Region growing

Contextual segmentation exploits the above mentioned relationships between the object based on their color. To express the state of the object coding should be written. Similarly in non contextual segmentation some coding have to be written for the spatial relationships between features in an image and the pixels which grouped together on the basis of global features like color, shape etc.,

FEATURE EXTRACTION IN AN IMAGE:
Feature extraction is the fourth process which plays an important role in the image processing field. These techniques are used to achieve the features in classifying and recognition of an image. Its main aim is to extract the relevant information from the whole image. Feature extraction contains the information which is required to distinguish the number between the classes and provides permission for the necessary operation. Features are divided into two categories. They are local features and global features.



Local features are geometric in nature. Global features are topological and statistical in nature.

DISEASE DETECTION: The final step is the identification of disease take place after segmentation. Based on the color of the leaf, possibilities for the presence of diseases are predicted. If the leaf is full green color, it indicates that the plant has good health. Partial green color indicates that the leaf of the plant is

affected partially. Lack of a green color pigment shows that the leaf is completely affected with some kind of disease.

Healthy leaf (100%chlorophyll)

partially healthy leaf

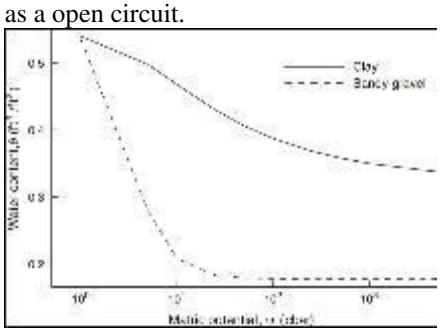
Weak leaf(no chlorophyll)

RESOURCES USED:

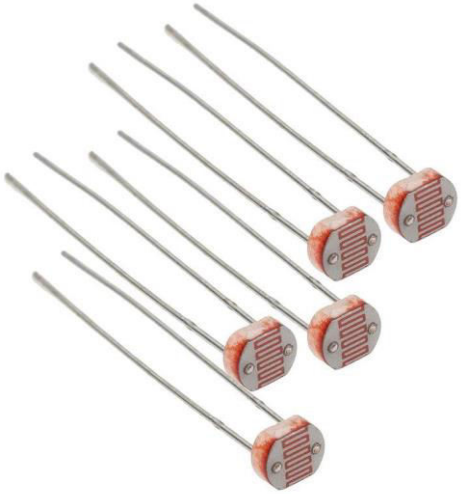
A. PIC Microcontroller is the main resource used in this concept. PIC means Peripheral Interface Microcontroller which is a RISC based architecture. PIC memory architecture follows only the Harvard pattern of a separate memory for a program and data which has separate buses. Program memory of a PIC microcontroller is 4K*14 memory space. It can store 13 bit of instruction set. Data memory of a PIC microcontroller is about 368 bytes. Timers, counters, serial ports, I/O ports and oscillators are some main components of the PIC microcontroller. They are controlled by special function registers. Memory of EEPROM occupies about 256 bytes in a memory space. For timing generation oscillators are used. CCP module operates in 3 modes. They are,

CAPTURE: It is used for the detection of arrival of signal.
COMPARE: It used as an analog comparator which gives an output when the timer reaches a specified reference value.
PWM mode: Pulse width modulation is done with 10 bit resolution.

B. Soil moisture sensor:Soil Moisture sensor is used to measure the water content in soil. This sensor also gives the analog and the digital output. Based upon the principle of a open circuit soil sensor work. When a soil is wet current passes from one terminal to another terminal. It gives the value of moisture in the soil. When soil is dry current the current will not pass through the circuit and it shows low value of voltage. When the soil is wet it gives high voltage value and it will act as a open circuit.



C. Chlorophyllmeter: Chlorophyll is measured by many ways. One of the simplest method is by using light dependent resistor(ldr) or photoresistor. LDRis a light controlled variable resistor. If the intensity of an incident light increases, resistance of the photoresistor decreases. Time lag occurs between incidence of light and subsequent changes in resistance usually 10ms.



LDR sensor

D. wi-fi module:ESP8266 is a wi-fi enabled system On a chip module. It is introduced for IoT applications which has the capabilities of 2.4 GHz wi-fi, 16 GPIO, I2C serial communication protocol,10 bit ADC.

ESP01 has 8 pins(2 GPIO PINS) and a PCB antenna trace. Antenna is for receiving the signals from the transmitter. E.Motor and relay:A relay is an electrically operated component. It is used as a switch. It is used to control a circuit by separating low power signal from high power signal. Several circuits are needs to be controlled by a single signal. A dc motor used in this project is a submersible water pump motor with an operating voltage of 2.5-6 volts. Precaution must be taken that the motor is fully submerged inside the water or outside the water. Because running the motor in dry condition may cause severe damage to the motor by heating.

F.LCD display:A liquid crystal display is a flat panel display. It uses light modulating property of liquid crystals. It contains several layers. Some of them are two polarized panel filters and electrodes. It is based on the principle of blocking light rather than emitting it. It consumes only less power and is of low cost with the high contrast.

IV.RESULT AND ANALYSIS:

Different parameters are related to plant growth such as soil moisture level and its conductivity, chlorophyll content of a leaf and some related factors which were sensed through the sensors are given as the input to the PIC microcontroller. Dc motor is interfaced with PIC for the automatic irrigation purpose. When the level of soil moisture is low or less than average, consider that as a dry condition of soil which makes the motor to irrigate the soil automatically. When the soil moisture is high, motor automaticaaly gets off. Its ON/OFF state along with the parameters determined from sensor is updated to IoT webpage. Then the condition of leaf obtained from the color pigment, based segmentation in digital image processing is also updatedin an IoT. Mobile application has also been developed . Which in turn helps the farmers to know about the state of crop even from remote areas. This reduces the effort of the personnel engaged in agricultural field activities. This system can detects only the condition of the plant whether it is affected with disease or not and do not imply exactly what kind of disease has affected the crop. The following is the graphical representation of mineral level from conductivity of soil, moisture level and the level of chlorophyll.

V.CONCLUSION

Monitoring the plant growth is not that much easy. Hence by using this system plants growth can be monitored. By measuring moisture level of the soil and chlorophyll pigment of a leaf from plant along with the color based segmentation of a leaf and automatic irrigation of water to the field is explained in this paper. Threshold values has been setup for moisture content of the soil when the soil moisture is low ,buzzer gives an alarm and led indicator glows when values from sensor goes below certain predefined reference value helping uneducated person. Chlorophyll content of the leaf is measured by using LDR sensor. With this current setup farming becomes smarter simultaneously reducing the efforts of farmer.

VI.FUTURE WORK

From the current system the future development would be in the direction of finding the possible diseases which can occur in the plants with their symptoms, causes and control of diseases for every individual plant are found. With certain locality by analyzing the high quality digital image from surveillance camera or digital camera will be monitor the entire field. Providing better solution to diseases by calculating the amount of fertilizers required for the plants to grow is given by knowing the mineral content in the soil would be a further enhancement. Giving all the above mentioned data in form of a database is the future extension of this project

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