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ADVANCED HYDROPONIC SYSTEM WITH MORBIFIC LEAF DETECTION

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ABSTRACT

Agriculture is the largest livelihood provider in India. It significantly contributes to the Gross Domestic Product (GDP), current agricultural advancement is being challenged like never before with sustainable food production and security. In India, dependence on technically independent agricultural productivity contribute majors to underdevelopment and poverty. The major challenge conventional farming practice need to overcome is the unpredictable climate change. Conventional soil dependent farming practice make farmers vulnerable to various manifestations of climate changes. It is necessary that modern farmers need to be technically equipped with precise management and monitoring of the cultivation with access to the scientific data about the field environment. This enables to execute intelligent and informed decisions in time. These can be achieved by alternate new and latest technology of farming such as hydroponics. This paper aims to design a fully automatic hydroponic system, with twenty four hours red LED lighting technology .This increases the photosynthetic rate of plants and there by increases productivity of plants . The system is integrated with leaf disease monitoring. The plant growth using the proposed system is compared with ordinary plant growth and it is found to be better. Growth rate is monitored with the help of IOT.

KEYWORDS: Hydroponic farming, leaf disease monitoring.

1. INTRODUCTION

India is a highly agriculture dependent country, thus the socioeconomic development of the country depends on agriculture. There arise the necessary need of a new and emerging technology which can improve continuously the productivity, profitability, quality of our major farming systems. Hydroponics is soil-less cultural method, which is an innovation for developing plants in alternate arrangement which provides all supplement for ideal plant growth without a medium like soil or rock. Cultivation is in water compartments or in low cost substrates, here we use water. A limitless scope of vegetables can be cultivated through this system. In this paper, a fully automatic hydroponic farming system [1] with leaf disease monitoring is proposed.The system provides automation of water supply, nutrients supply, water level control and 24 hour light supply. It was proved in studies that red light increases the productivity ofplants, thus supply of red light in 24 hours increase the productivity. The system monitors the leaf healthconditions and gives indications if affected by image processing techniques.

2. MATERIALS AND METHODS

The proposed system with the help of sensors monitors the conditions of the plant and incase of adverse conditions, makes the conditions favorable for plant growth. Plant leaf disease is detected by image processing technique. Each and every information regarding the system is informed touser via Bluetooth module and the disease detected is informed to the user via GSM module. The proposed system comprise of two units.

(A)Hydroponic unit:
An IOT based system for hydroponic farming is proposed in this paper. The proposed system automatically maintains the condition for healthy growth of plants withthe use of sensors, pumps, sprayer and cooling fan.The

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temperature and humidity of the system is monitored by DHT11 sensor and if not favorable, is maintained by the cooling fan and water sprayer respectively. The water and nutrient level is monitored by water level sensor and electrochemical sensor and is controlled favorably. Manually controlled draining system is also installed in the system. The lighting provided to the system is continuous red light which increases the productivity of thee plant. In case of failure of lighting, is indicated to the user. And the growth rate is monitored with help of IOT [2].

(B) Disease detection unit:
The image processing algorithm used for leaf disease detection is k-means clustering. Images of leaves are captured by raspberry pi cam and are processed inthe raspberry pi module. The message is passed to the user via GSM module in case of disease detected.

Hardware details

- Arduino: Arduino Uno Atmega 328 microcontroller used is the heart of system which collects sensor output data; process it and controlling functionality of system with 6 analog input pins and 14 digital input pins with TX, RX included. .
- DHT11: It is a basic, ultra low-cost digital temperature and humidity sensor. A capacitive humidity sensor and a thermistor to measure the surrounding air, and gives a digital signal output.
- LDR: Light dependent resistor used here to sense light intensity of the system and gives out respective data to Arduino.
- Electrochemical sensor: It is used to monitor whether sufficient nutrients are supplied to the plant
- Water level sensor: It consists of series of parallel wires exposed traces measured droplets/water volume in order to determine the water level.
- Fan for cooling: When the temperature of the system goes above required level sense by temperature sensor then Fan turns on for cooling under control of Arduino.12V DC fan is used.
- Pump for water and nutrients supply: When water/nutrient solution level in pipe goes below required level and also when nutrient solution goes below or above required range then motor on to supply water and nutrients to plants under control of Arduino.12V DC operated pump used here for waterand nutrients supply. 12V operated relay is used for isolation and switching.
- LED strip: 12V operated red LED strip used.
- Alarm and Indicators: Used to indicate unusual conditions of farm by indication using messaging to phone and buzzer.
- Raspberry PI : The image captured by the camera is sent to the Raspberry PI.the image is processed using the Open CV library and is detected by the raspberry pi.
- Camera:It is used to capture images of crops. It is directly connected to raspberry pi 3 model B.
- HC-05 module: It is a Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.
- GSM:It is used to send the SMS to the owner of the system,whether the system is disease affected or not.
- NodeMCU: It is a single board microcontroller and is a open source IOT platform and includes ESP-12 WiFi module. This enables arduino to connect with internet via the WiFi module, to upload the data to Thinkspeak platform , thus accessible to the user from anywhere.

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Block diagrams

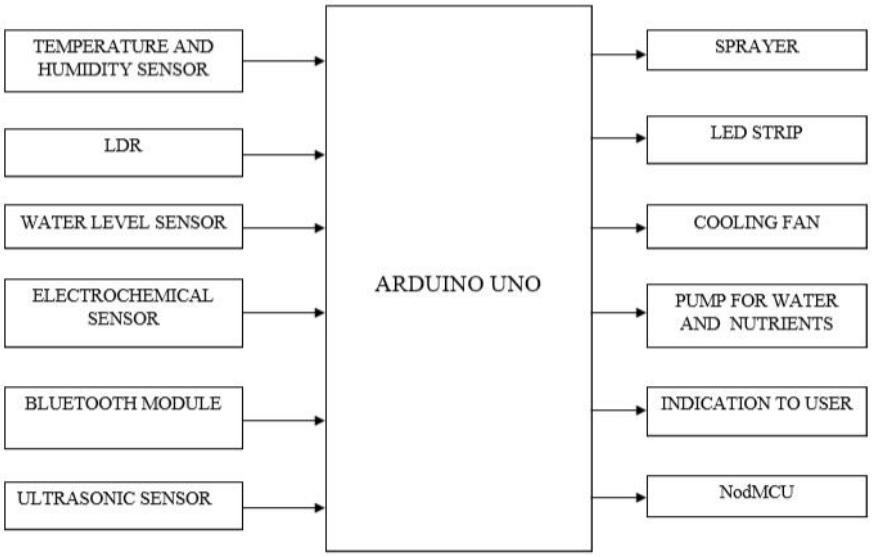

Figure 2.1. Block diagram for hydroponics system

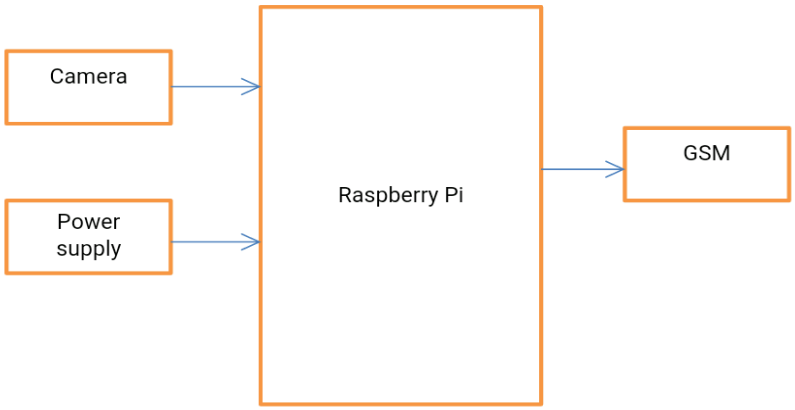

Figure 2.2 Block diagram for leaf disease detection

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Flowcharts

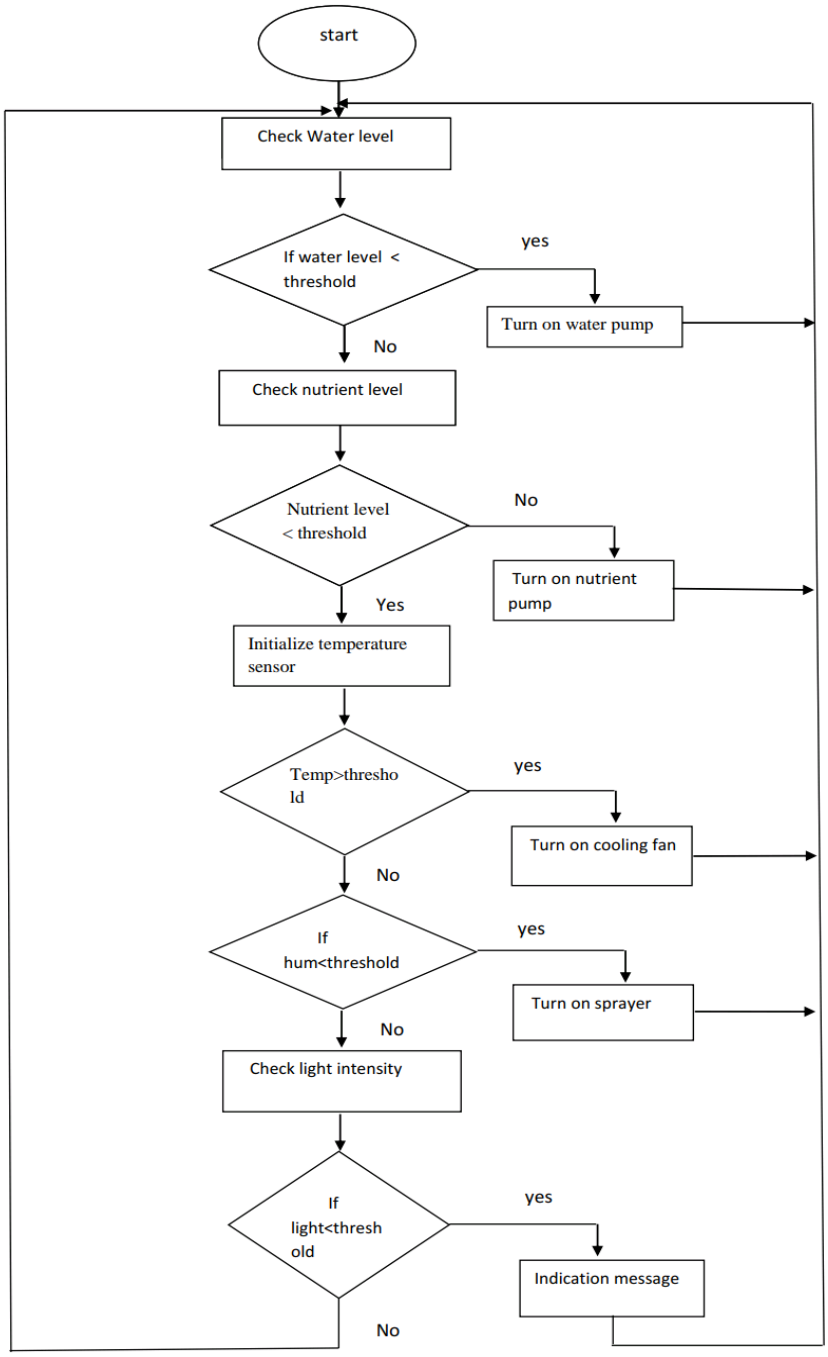

Figure 2.3 Flowchart for hydroponic system

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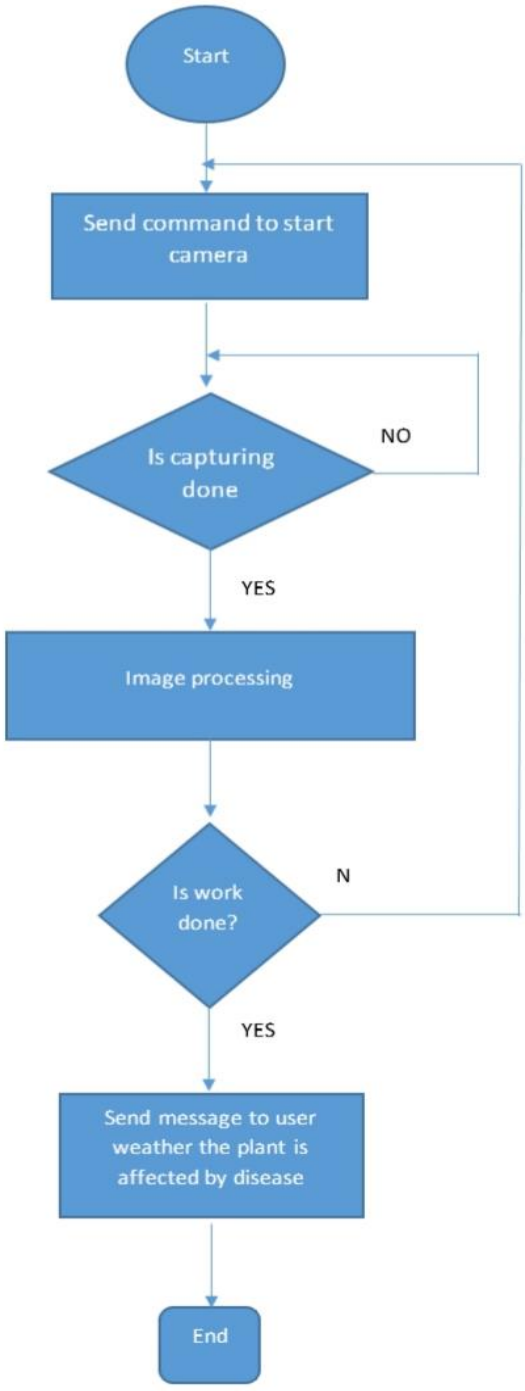

Figure 2.4 Flow chart for leaf disease detection

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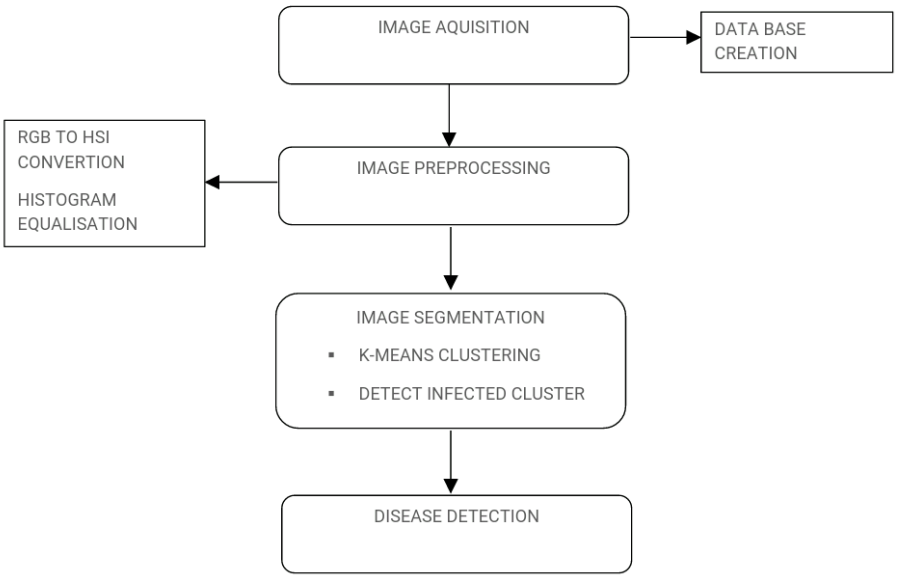
Steps for disease detection



A. Image acquisition
The diseased leaf image is acquired using the camera interfaced to the Raspberry Pi hardware the image is acquired from a certain uniform distance with sufficient lighting.

B. Image pre-processing
Image acquired using the digital camera is pre-processed using noise removal by median filter, color transformation and histogram equalization. The color transformation step converts the RGB image to HSI image and the hue part of the image is considered for the analysis
Masking green pixels:Most of the green colored pixels refer to the healthy leaf and it does not add any value to the disease identification techniques, So the green pixels of the leaf are removed by a certain maskingtechnique.

C. Segmentation
K-means clustering is used to classify the image patches based onattributes/features into K number of group. K is positive integer number. The process of grouping is done by minimizing the sum of squares of distances between data and the corresponding cluster centroid.K denotes the number of coloured leaf patches which results in a perfect separation of infected leaf part leaving out the non infected image pixels in the other clusters. After performing these steps raspberry pi indicates the presence of disease in that plant [5].

3. RESULTS AND DISCUSSION

The plant grown by the proposed system has high growth rate and productivity than a conventional plant.The proposed system uses water instead of soil for farming. Since the proposed system is fully automatic the time to be spent to take care of the plant is reduced. The system facilitates indoor cultivation ie, it makes cultivation possible in modern busy life and without soiland in locations with poor soil conditions. The disease detection module helps the farmer to take necessary steps for cure and prevention. The proposed system can be developed for large scale production.

4. CONCLUSION

The proposed system does automation in hydroponics which have many advantages for the healthy growth of plants. It leads to increase yield of farm with proper amount of nutrientlight ,water and in healthy temperature conditions. This is done in using Arduino based automation of water and nutrient solution with proper management of temperature. A continuous red LED lighting technology increases the photosynthetic rate of

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plants and there by increases the productivity of crops. The growth rate is monitored using IOT technology. The system also provides fully automatic leaf disease monitoring detection and alerting .It is suitable and beneficial, and can be used anywhere irrespective of the climate and yields high production with precise plant management. In this way the proposed system shows many advantages over manual hydroponics system.

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