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IoT based Leaf Disease Detection and Fertilizer Recommendation

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Abstract - *Internet of Things (IoT) is an emerging technology that is making our world smarter. Internet of Things is modular approach to integrate sensors into everyday objects, and interconnecting them over the internet through specific protocols for exchange of information and communication. This paper introduces the concept of internet of things (IOT) and discusses the role of IOT in agricultural disease and insect pest control and gives thought regarding estimation of diverse climatic parameters of plant. The sensors integrated helps in detecting the moisture and humidity in soil and atmosphere. These factors helps in identifying the climatic conditions where the plant grows and the diseases that can be attacked for the plant. In this work we develop a user-friendly IOT architecture to provide on-field disease detection and spraying of recommended pesticides.*

***Key Words*: IOT in agriculture, IOT architecture system, disease detection, agriculture, Fertilizer recommendation,**

I. INTRODUCTION

Agriculture is the important source of every country. The production of agriculture will play an important role in the development of the country. The farmers face lot of problems in the crops due to the diseases. Major problems in the agriculture include water problem, climatic change, pests and diseases in the plants. Due to pests and diseases along the crop losses up to 37% every year. Earlier method for disease prediction and spraying fertilizers requires lot of labour and it is a time and energy consuming process. Manual spraying of pesticides is detrimental to health and work performance. In this work we develop an IOT based user friendly system to detect leaf diseases and to spray recommended fertilizers. When it comes to designing a system for automating these operations one has to decompose its idea into two considerations which are agriculture environment in which robot/system is going to work and precision requirement in the task over traditional methods. Based on this for spraying process, considerations which are taken into account in terms of environment are: robot must be able to move in straightway properly on bumpy roads of farm field, identify the diseased leaves and spray chemical depending on the disease, sensors to be selected for the system must be chosen by considering farming environmental effects on their working. Apart from these things other requirements are including sensors to the robot which will help in detecting moisture content.

When considering the physical aspects of the vehicle or robotic system, farmer's present condition in particular area plays a major role in designing these aspects. Considering facts of farming industry of India, system to be developed must have advantage over traditional methods and tractors in terms of cost, speed, accuracy in operation for which it is designed, fuel consumption and physical energy required by human for it. By targeting these issues and considerations properly the end product will be real help for farmers.

II. Architecture of the system

Software: The real time images of various Lemon leaf diseases are acquired using camera and stored in the database. Then various image-processing methods are applied to the acquired images to get useful features that are important for next analysis process. Features like contrast, correlation, Energy, Skewness, Entropy etc, are calculated for the image and stored in the database. The image comparison is done by some optimization techniques with the stored data. The block diagram is shown in the Fig-1

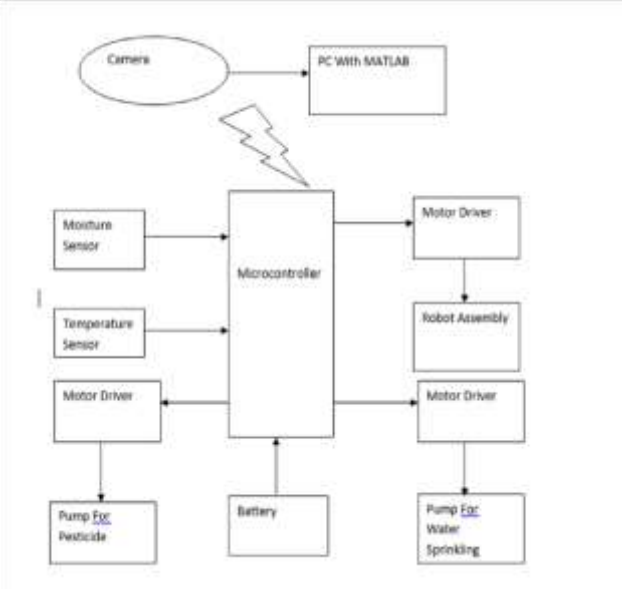


Fig 1: Block diagram of Image Processing

Hardware: Hardware system is integrated with ARM 7 Microcontroller and multiple sensors. Sensor like moisture is connected to microcontroller it is used to detect the moisture content of the soil where crop grows. By detecting the moisture content in the soil, if the moisture content is low compared to the required moisture content then the

water pump attached to the system will sprinkle water. System is connected to the software through Matlab code. When the classification algorithms detect any disease in the leaf it will suggest the pesticides, Once the pesticides are suggested the pesticide pump attached to the system sprays the pesticides.

Fig 2 Robot assembling

ARM7 Microcontroller: ARM7 is one of the widely used microcontroller family in embedded system application. This section is humble effort for explaining basic features of ARM-7.ARM is a family of instruction set architectures for computer processors based on a reduced instruction set computing (RISC) architecture developed by British company ARM Holdings. A RISC-based computer design approach means ARM processors require significantly fewer transistors than typical processors in average computers. This approach reduces costs, heat and power use. These are desirable traits for light, portable, battery-powered devices including smart phones, laptops, tablet and notepad computers, and other embedded systems.

Two Channel Relay Module:

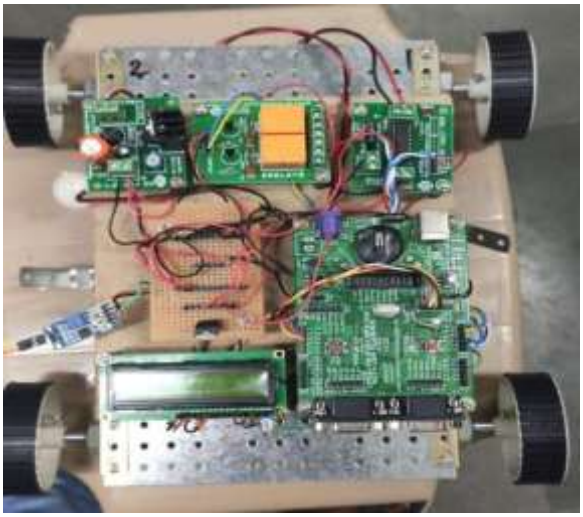
A relay is defined as an electrically operated switch; their main use is controlling circuits by a low-power signal or when several circuits must be controlled by one signal. The first relay was used in long distance telegraph circuits as amplifiers, basically they repeated the signal they received from one circuit, and transmitted it into a different one, they were also used in computers to perform logical operations

Soil Moisture Sensor:

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

DC Voltage Regulator: Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line

Final System:



III. Proposed Methodology

The proposal deals with IoT based system using Image processing techniques. Once the hardware setup finish the task, the software part will be done by the image processing techniques. First the images are acquired using Web camera and processed by SVM algorithm and stored in the database. The image acquired from the camera and from the database will be preprocessed. Next the conversion of RGB to gray scale image will be done, as gray scale image gives perfect accuracy to defect detection, then image resizing, followed by image enhancement and edge detection. Then many analytics technique are carried out to classify the images according to the particular problem at hand. Finally using some optimization techniques image disease is compared with preprocessed images and type of disease and the fertilizers recommended will be displayed on the user interface. The robot assembly is built on pairs of wheels and it is integrated with the hardware parts.

Arm7 Microcontroller which controls hardware, Battery which supplies power for microcontroller and other parts, Sensors, Motor driver is connected to a pump which is used for sprinkling of water and pesticides. Once the disease is detected by the software, it will suggest the fertilizers and it will send results to LCD display and the pump will sprinkle the fertilizers on the diseased leaves

IV. Implementation

First we do the necessary images processing task which includes, convert the RGB image to grayscale, and apply edge detection to identify diseased contours. By matching this with an existing database, application provides immediate results on potentially diseased crops. The compared images will analyze the data, process and transmitted to a centralized database, apart from the localized processing. The database stores a progression of images both spatially and temporally variant for further processing. If the leaf image is diseased then the image is stored in the database for further usage

A. Disease Classification: The diseases can be classified as several types. Some diseases are Citrus Canker, Anthracnose, Cercospora, Alternaria alternata, Aphids etc., for experimental purpose we have taken the samples of Citrus Canker diseases affected Lemon crops from the database and image capture crop. Total of 2 samples taken for consideration work which includes database image and acquired image. It is differentiated as Leaf 1&2.

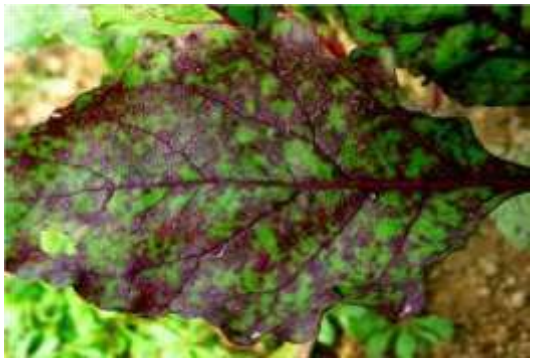


Fig 3: Leaf 1(Anthracnose)

Fig 4: Leaf 2(Diseased leaf acquired from Camera)

B. Data Acquisition:

RGB images of the leaves are acquired from camera and stored in a jpg or png format. These images are then converted to gray scale image since it gives perfect accuracy. Then the gray scale images are resized and enhance the contrast to detect the disease of the image accurately.

Fig 5: Gray Scale image

C. Edge Detection:

Most of the shape information of an image is enclosed in edges. So, the gray scale of each image is extracted using edge detection algorithm.

D. Image optimization and comparison:

Once the image is converted to gray scale, some of the features like Energy, Kurtosis, Skewness, Entropy etc., are acquired. Resizing is done and it is compared with the preprocessed images. And the result is given based on the category it falls in the preprocessed images. Once the disease is detected it will display on the user interface with the recommended fertilizers.

E. User Interface:

User interface will have options like forward, backward, Seeding, Sprinkling etc., These are used to control the robot assembly. Robot will function based on the option we choose on the user interface.

V. CONCLUSION

The rapid development of IOT has an important influence on realizing intensive agriculture, high yield and high quality, and it will provide solid foundation for the development of agriculture information technologies. In this paper the main

VI. Future work

The work has been done for Lemon plant alone; in future the work can be implemented in all crops by the same process and surely it will get the good results. While considering other crops check the symptoms of the diseases alone.

VII. References

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