A Study On Plant Disease Detection Using IoT

Ashwin KS[1], Sebastian Cyriac[2]

[1]U.G.Scholar,S6 BCA A BATCH
DEPARTMENT OF COMPUTER SCIENCE
SANTHIGIRI COLLEGE OF COMPUTER SCIENCES VAZHITHALA, IDUKKI, KERALA
ashwinks9747@gmail.com

[2]ASST. PROFESSOR ,DEPARTMENT OF COMPUTER SCIENCE
SANTHIGIRI COLLEGE OF COMPUTER SCIENCES VAZHITHALA, IDUKKI, KERALA
sebastiancyriac@santhigiricollege.com

Abstract: *In this paper an automatic system has been developed to see whether or not the plant is healthy or unhealthy. The conventional growth of the plants, yield and quality of agricultural merchandise is seriously tormented by disease. This paper tries to develop an automatic system that detects the presence of illness within the plant.An automatic illness detection system is developed victimisation sensors like temperature, humidness and color supported variation in plant leaf health condition. The values supported temperature, humidness and color parameters are accustomed establish presence of disease.*

Keywords: Internet of things,sensor,Disease,iot,sensor module,hyperspectral imaging.

1. Introduction

Internet of things (iot) is system of interconnected device which includes mechanical, electronic and electrical components which is used for gathering information from various places or about various object with the help of sensors. There are different types of sensors are available for different purposes some of them are temperature sensor, pressure sensor ,light sensors ,micro cameras ,Thermal cameras etc.

In the field of Agriculture the farmers are facing so many difficulties for planting and cultivating food crops. A farmer should capable of monitoring all the crops at all time but it is not practically possible to monitor all the days so some of the plants and food crops are destroyed due to lack of minerals and water contents, and sun lights. Avoiding these problems plants are facing a serious issue which will destroy all the plants due to the attacks of fungal, viral, bacterial, and also by small insets these problems will cause preventing the plants growth and yielding. in this paper we will solve this issue by continues monitoring the plants and paddy fields and identifying the plant disease whether it is caused by fungal, viral or any other.

Agriculture plays a major role in human life. Almost 60% of the population is involved directly or indirectly in some agriculture activity.But today, farmers have quit agriculture and shifted to different sectors because of less adoption of automation and different reasons like increase within the demand of agricultural laborers. So, Farmers currently rely upon adoption of psychological feature solutions with technological advancements to amass the advantages. Hyperspectral Imaging and Internet of Things jointly produces new dimensions in the field of smart precision farming. This proposed methodology aims to create an approach for plant leaf disease detection. this approach combines IoT and hyperspectral imaging which together process and extract data with accuracy.

2. ROLE OF IOT IN AGRICULTURE

Agriculture has changed more than merely a way to feed ever growing populations. Plants became a very important supply of energy, and to measure a elementary piece within the puzzle to resolve the matter of world warming. There are many dangerous diseases that have an effect on different plants which have the potential to cause important economical, social and ecological losses. In this context, diagnosing diseases in an accurate and timely way is of the utmost importance[1].the use of internet of things(iot) provides platform for all sensors to be connected to each other and can transfer various information.

The internet of things (IoT)aims to control both the mechanical and non mechanical electronic devices with the help of wireless networks we can manage our IoT devices it is at the tip of our finger all the needs can be done using a smart phone[2] .it give more flexibility than using wired network . we can store the data in the cloud or we store it in the external storage devices such as pen drive ,hard disk, memory cards etc. the sensor is the main essential part of the IoT ,the sensor collect the information concurrently and it sends to the sensor hub . the all information are transferred to the server .the server can process the data from the sensor module. The sensors may be in the form of camera, infrared LED, motion sensors etc. the processed data is then transferred to the cloud network storage .the cloud network can be accessed by using the internet from remote and distant locations through our smartphones, computers, tablets etc. .[3]these are the controllers used .the data from the cloud can be taken using our router ,the data from the cloud is taken in the form of Ethernet. some of the wireless communication protocols that dealing with the internet are Wi-Fi ,z-wave and ZigBee.

3. Sensors

A sensor is a electronic device which is used to capture or detect the objects or which are in motion. A sensor can detect

the concurrent changes that happens to an object or any living thing . sensors are available for different purposes .according to the requirement. Biosensor,Image sensor,Monitoring sensor etc are some of the common sensors.

In biomedicine and biotechnology, sensors which detect analytes thanks to a biological component, such as cells, protein, nucleic acid or biomimetic polymers,are called biosensors and image sensors are used in digital imaging and digital cameras,and monitoring sensors are used for housemonitoring, office and agriculture monitoring, traffic monitoring.In the agricultural area we are using image sensors and monitoring sensors.[4]

3.1 Temperature and moisture sensor

The temperature Sensors used in the system to find the amount of heat energy or coldness that is generated by an object or system, allowing us to "sense" or detect any physical change and to that temperature used to produce either an analogue or digital output.and moister sensor measuring moisture content in soils and substrates.

Fig 3.1 SM150T

3.2 hyperspectral camera sensor

Fig 3.2.1 hyperspectral camera

Hyper spectral Camera sensor is a sensor which is used to capture the image of the object or a remote place.hyperspectral imaging is an effective remote sensing technique which captures pictures in different dimension or wavelength each pixel of the object can be taken in a high definition clarity .in the normal camera it shoots in the colors red,green and blue which the visible light in the spectrum.but in the hyperspectral camera it have various colors in different wavelength and it can capture as well as the visible light and non-visible light .This is preferable for many applications because the spatial dimension can provide extra information on shape,gradient, or texture of the target.So, image processing systems are used on remote sensing platforms for assessing landscape of vegetation as well as in plant phenotyping systems for higher throughput analysis of the individual plants .There are many different types of hyperspectral cameras available FX10 and FX17,and Micro-Hyper spectral etc.A typical hyperspectral imaging system contains a light source, objective lenses, an imaging spectro graph, and an area detector. The light that illuminates or excites the targetlight which the source generates . The common lights used by such systems are halogen lamps but for cheaper and more powerful light sources has increased,light emitting diode (LED) technology, lasers and changable sources have also been incorporated The objective lenses focus the incoming light onto the area detector. As the light travels through the objective lenses, the imaging spectro graph disperses the broadband light into separate, discrete wavelengths. After the light has traveled through the dispersion device, it reaches an area detector, which measures the intensity of the light by converting it into electrical signals..Hyperspectral imaging systems typically use one of four acquisition methods: point scanning line scanning, wave-length scanning or snapshot (nonscanning).[5]
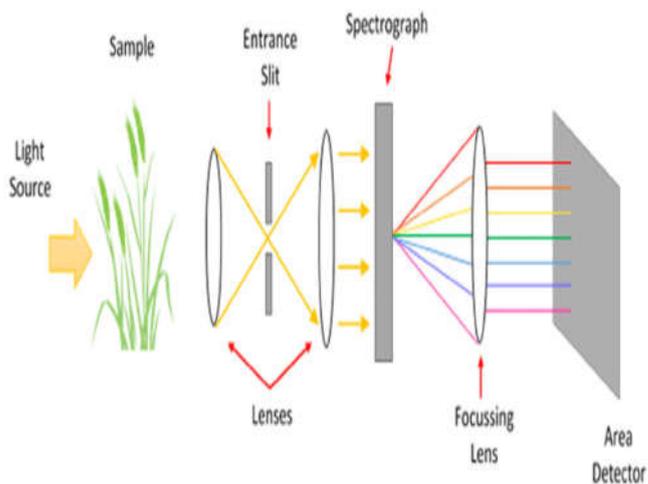

Fig 3.2.2 spectral imaging

3.3 Motion sensor

A motion detector is associate device that utilizes a sensing element to detect close motion. Such a tool is commonly integrated as a element of a system that mechanically performs a task or alerts a user of motion in a part. They type a significant part of security, automatic lighting management, home management, energy potency, and different helpful systems. Active ultrasonic sensors emit ultrasonic sound waves that reflect off objects and bounce back to the original

emission point.some other motion sensor use microwave and electro magnetic wave.

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Fig 3.3 Motion sensor

3.4 *Weather sensors*

These sensors can   measure wind speed, wind direction, outdoor and indoor temperatures, outdoor and indoor humidity, barometric pressure, rainfall, and UV or solar radiation.these sensors can collect most accurate weathers of our location and this data can be shared to other devices .

Fig 3.4 Weather sensor

3.5 *Sensor module*

Fig 3.5 Sensor module

A sensor module is a combinatonary circuitry of different sensors like Temperature, pressure,motion etc.

4. Plants Disease Detection and solution for paddy fields

For the detection of Disease presence in agriculture we have to monitor the field thoroughly.the disease detection is simple rather than the solution .the diseases that can be of fungal,viral and also due to insects .the disease caused by insets can be easily determined but diseases due to fungal and viral cannot be identified easily

At first we need a cloud based database which stores the details of some plants and trees,details such as plants required minerals,amount of moisture,soil conditions,temperature,and various hyperspectral images in different climate conditions and the database also contains the mesophyll information of the plant from hyperspectral imaging and also it contains the various common fungal,viral diseases that are causing to each plant based on the living condition .the weeds can also cause destruction to the plant so the database also includes the hyperspectral images of different insects and the database also stores the various solutions for each disease.
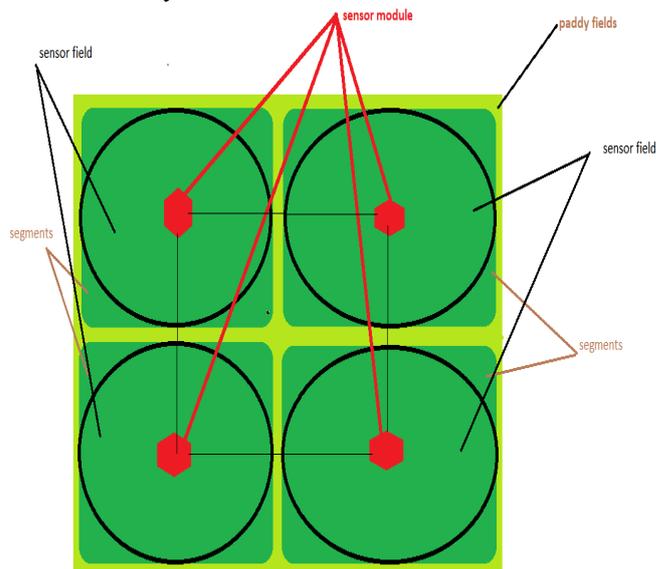
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4.1 *Attacks by insects*

Fig 4.1.1 division of paddy field

In the case of a paddy field it may be a big square shaped place so the entire paddy field can be further subdivided ,in the above figure 4.1 we can see the entire paddy field is divided into a four these can be known as the sectors or segments in the each segment we are placing a sensor module,the sensor module consist of different types of sensors such as temperature,moisture,motion,weather,and a high definition camera sensors these all together molded into and electronic circuit which is called the sensor module. By these different sensors we can detect the amount of water,minerals,soil

type,motion of the different insects and the camera can capture the images of plants and we can monitor the timely weather forecasting.by this module we can track almost every activities in the paddy field,if there are four segments then their have four sensor modules. All the sensor module is capable of sending and receiving various information with the help of internet.

The motions and attacks by the insects are monitored all the times and the module captures pictures in different dimensions and it evaluates the climate conditions soil conditions with accurate positioning and the data is sent to a computer for computation and the processed data is sent to the cloud and cross match the data with the existing data ,and if the data is same it will provide data about the insect,solution measures to an external computer from the cloud platform

Fig 4.1.2 various pests in paddy

4.2 *Fungal and Viral disease*

Most of the times the fungal and viral disease will cause to spreading of the infection, the spread depth of the infection can be detected and we can see the fungal and viral disease by spotting accurately by hyperspectral imaging.for our eye can seen only the colors red,green and blue so the images capture through our eyes and normal camera only have rgb colored and its composition images .in hyperspectral imaging camera we can use both the rgb color spectrum and other spectrum .the hyperspectral camera will take a multidimensional pictures in different wavelength.normally a camera will capture an image with rgb colour and their only have 3 bands with large wavelength band .we can only see the colors in between 400-700nm..and a little of infrared.the hyperspectral images can have colors based on the wavelength and also it have the colors rgb.in this it has band with a small wavelength band and each band will hold the information of each pixel of the image .for a single leaf hyperspectral imaging takes 100 pixels with a spatial resolution which can give more dense information .the wavelength can capture the changes to the plant pigments such as chlorophyll,carotenoids which

provides color such as orange,yellow,bright red etc.These camera can take pictures of mesophyll cell structure with 700-1300nm wavelength and also it can deeply take pictures of water content in the plant with an extended wavelength of 1300-2500nm . of by absorbing the different wavelength if the variation in the color causes the fungal infection.plant pigments plays major role in plants growth it is called photosynthesis which means the plants absorb the light and moisture which causes the growth of plants. the color abnormality will affect its growth .whenever the plant cell show a white light instead of other colors which means that plant is affected by fungal/viral .with accurate weather and position of the disease which means the disease is affected to which all pixels and are recorded properly and these information sends to the computer. and the system cross match the image with cloud data and the analysis of the disease with the sensor modules can be done and solution is sent to system from cloud. In order to find viral disease the information taken by the hyperspectral camera sends to all the sensor module and as an acknowledgment the sensor modules sent information about that does the disease is spread in its sensor field.and thus the system assumes that it is a viral disease and corresponding solutions to the disease is taken from the cloud by the system and solution and monitored report are further stored in cloud for future analysis .these information can be taken by the user at any time from anywhere.
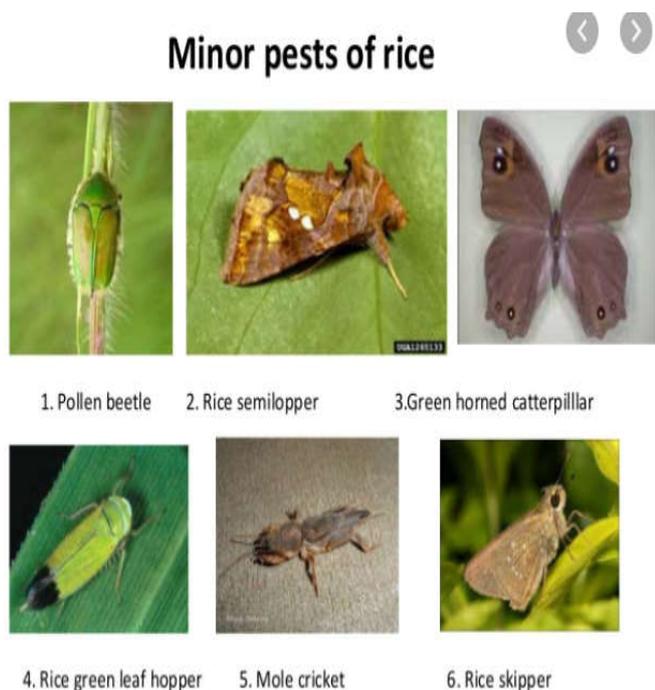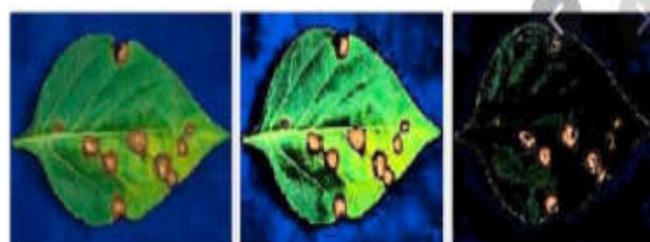

Fig 4.2 fungal/viral disease

5. Implementation

5.1 *Drone based hyperspectral imaging*

In this a standard drone is made with a large battery and it is enclosed with hyperspectral camera and a wi-fi enabled module which can connect to other iot devices and share there data to cloud and other systems they can be used for closely watching the field every time thus the close watching enables to capture high accurate hyperspectral images. By using this

drone it scans the field in line by line like interlaced scanning method used in remote sensing.

Fig 5.1 hyperspectral imaging by drone

5.2 Robotic hyperspectral imaging

In this method we use robotic mechanical devices to collect information from the field ,it is composed of different sensors it can detect different presence of water,mineral, light etc. The robotic arm enables a function to collect samples from the field.

Fig 5.2 Robotic hyperspectral imaging

6. Advantages and disadvantages

6.1 Advantages

- **Early Detection**: The early detection of the plant disease and nutrients loss can be find and can provide cure mechanisms.
- **High quality multi-dimensional pictures**: high quality pictures can be taken, 100 pixels can be taken from a small leaf
- **Shareable**:The Information can be shared to various iot devices.
- **Continuous Plant Monitor**: plant monitored in all times with high accuracy.
- **Weather forecasting**:High accuracy weather forecast enables to monitor the climate changes.
- **Identification**:Identifying different insets and creatures
- **Detecting motions**:by different sensor it is possible to track all actions performed by different insets.
- **Detection of minerals** :The sensors can detect the minerals in the soil.

- **Wavelength based Technology** :by the hyper spectral imaging the images are taken based on wavelength.
- **Cloud based system**:All the collected data from the field is stored in the cloud.

6.2 Disadvantages

- **Complex :**wavelength based Technology and its processing is very complex to understand.
- **High costly :**For buying the sensor modules and hyperspectral camera we have to spend a lot of money the cost increases by its connectivity range and also we need to purchase cloud storage.
- **Security issues :** we know that iot devices always connected to internet so their is a chance of risk to our internet devices if any hacker break into the connected Wi-Fi the attacker can manipulate the function of the iot device.if we need better security then we have to spend money for buying firewall .
- **E -waste :**E-waste are always threat to the environment

7. Conclusion

Agriculture is one amongst the indispensable sectors in our country. Iot will enables the farmer to monitor their agri-Lands in an efficient manner.in the modern world all the things are automated ,these enables human to collect as much of data by the continuous monitoring .so in this paper we can monitor the plants diseases and major attacks by the insects and provide solution the Disease .

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Author Profile

Ashwin ks received the BCA degree in Computer Sciences from Santhigiri college of computer sciences, Vazhithala in 2021.

Sebastian Cyriac received the MCA professional degree in computer science .Currently working as assistant professor in

Santhigiri college , vazhithala.