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AI based pest detection and alert system for farmers using IOT

Dr. K. Prasanthi Jasmine, P. Lohitha, K. Manasa, T. Raja Rajeswari

Department of Electronics and Communication Engineering, Andhra Loyola Institute of Engineering and Technology, Vijayawada, India.

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KEYWORDS

Image Processing, Raspberry Pi, Python.

ABSTRACT

Agriculture plays an important role in economy and it is the backbone of the economic system for developing countries. India is one of the key players in agricultural precinct worldwide. Although there are many sophisticated technologies in the field of agriculture, still there is no proper technology to control the problems related to pests. Disinclination to pesticides for controlling agricultural pests is a worldwide problem. To overcome this particular problem, an AI based pest detection model is designed. The purpose of this model is to further illustrate, through classification using an artificial neural network, the effectiveness of acoustic approaches in pest detection. Numerous types of research have demonstrated the viability of acoustic technologies for insect detection and monitoring using different sound parameterization and classification methods. IR sensors and sound sensor are employed to identify the presence of insects. Deep learning technique is used to analyze and categorize the audio signal with the help of AI model to detect the type of pest. This model not only aims on detecting the pest but also alerting the farmers by notifying through their mobile phones with the help of Wi-Fi module and IoT.

1. INTRODUCTION

Agriculture is a crucial part of our country's economy. Almost 70% of rural homes depend on agriculture and it also contributes about 17% to the total GDP. Agriculture provides employment to around 60% of the population. Therefore, correct detection of crop diseases is needed to strengthen the area of agriculture and economy of our nation. Farmers have a wide variety of crops to choose from for their farms. In any case, the cultivation of crops for maximum profit and standard manufacturing is often scientific. With the support of technical expertise, this might be developed. The monitoring of continuously recurring crops needs ultimate authority, particularly for disease control, which can have a major impact on components of production in order to earn a profit. The image procedure is the most effective method

for obtaining a compensated position in agricultural application tasks. Images of plants can be used to detect sickness. Aid for agricultural development can help to offset this effect. Because the majority of the basic symptoms are tiny, human vision limits the disease's detection. This approach is tedious and time consuming. A style system that mechanically recognizes, classifies, and quantitatively diagnoses illnesses is required.

1.2 CLASSIFICATION OF CROP DISEASES

Crop or plant diseases are mainly classified into three types. They are as follows 1. Bacterial diseases 2. Leaf mold diseases 3. Early/Late Blight In detailed explained of classified diseases are as shown as follows 1.2.1 BACTERIAL DISEASES Bacteria that cause plant diseases are spread in many ways—they can be splashed about by rain or carried by the wind, birds or insects. People can unwittingly spread bacterial diseases by, for instance, pruning infected orchard trees during the rainy season. Water facilitates the entrance of bacteria carried on pruning tools into the pruning cuts. Propagation with bacteria-infected plant material is a major way of pathogenic bacteria are moved over great distances. No matter how the bacterial pathogens are disseminated, they require a wound or natural opening, such as stomata, to get inside a plant host. Once inside they then kill host cells, by the means described above, so that they can grow. Between hosts they may grow harmlessly on plant surfaces and then can overwinter or survive unfavorable environmental periods or the absence of a susceptible host by either going dormant in infected tissue, infested soil or water, or in an insect vector.

1.2.2LEAF MOLD DISEASE

Virus particles are extremely small and can be seen only with an electron microscope. Most plant viruses are either rod-shaped or isometric (polyhedral). TMV, potato virus Y (PVY), and cucumber mosaic virus (CMV) are examples of a short rigid rod-shaped, a long flexuous rod- shaped, and an isometric virus, respectively. Viruses consist of an inner core of nucleic acid (either ribonucleic acid [RNA] or deoxyribonucleic acid [DNA]) surrounded by an outer sheath or coat of protein (referred to as the capsid). The capsid is further enclosed by a membrane in most human and animal viruses that helps the virus pass through the cell membrane in these types of cells. Since the cell membrane in plants is surrounded by a rigid cell wall, plant viruses require a wound for their initial entrance into a plant cell. Wounds in plants can occur naturally, such as in the branching of lateral roots. They may also be the result of agronomic or horticultural practices, or other mechanical means; fungal, nematode, or parasitic plant infections; or by insects. In some cases, the organism creating the wound can also carry and transmit the virus.

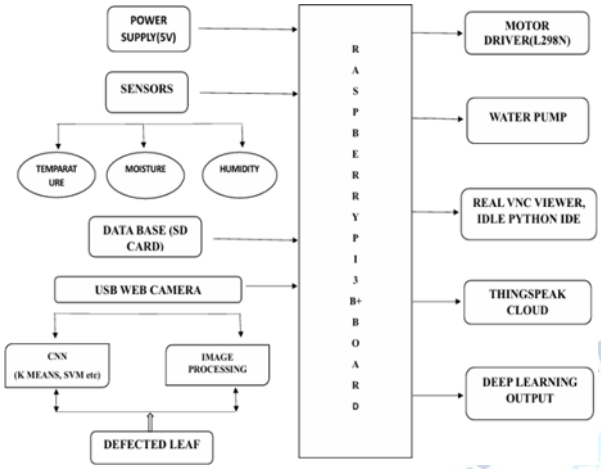
1.2.3LATE / EARLY BLIGHT

Late blight, also called potato blight, disease of potato and tomato plants that is caused by the water mold Phytophthora infestans. The disease occurs in humid regions with temperatures ranging between 4 and 29 °C (40 and 80 °F). Hot dry weather checks its spread. Potato or tomato plants that are infected may rot within two weeks. The Great Famine in Ireland in the mid-19th century was caused by late blight of the potato plant. Late blight destroyed more than half of the tomato crop in the eastern United States in 1946, leading to the establishment of a blight- forecasting service in 1947. A number of such forecasting services are maintained at universities and governmental organizations across the world. Late blight of potato is identified by blackish/brown lesions on leaves and stems that may be small at first and appear water- soaked or have chlorotic borders but expand rapidly and the entire leaf becomes become necrotic. In humid conditions, P. Infestans produces sporangia and sporangiophores on the surface of infected tissue and the resulting white sporulation can be seen at the margins of lesions on abaxial (lower) surfaces of leaves. As many lesions accumulate, the entire plant can be destroyed in a matter of days after the first lesions are observed if the appropriate fungicide applications are not used.

PROPOSED METHODOLOGY

Plants are susceptible to several disorders and attacks caused by diseases. There are several reasons that can be characterizable to the effects on the plants, disorders due to the environmental conditions, such as temperature, humidity, nutritional excess or losses, light and the most common diseases that include bacterial, virus, and fungal diseases. Those diseases along with the plants may shows different physical characteristics on the leaves, such as a change in shapes, colors etc. Due to similar patterns, those above changes are difficult to be

distinguished, which makes their recognition a challenge, and an earlier detection and treatment can avoid several losses in the whole plant. In this paper, we are discussed to use recent detectors such as Faster Region-Based Convolutional Neural Network (Faster R-CNN), Region-based Fully Convolutional Networks (R FCN) and Single Shot Multi box Detector to detection and classification of plant leaf diseases that affect in various plants



block diagram

POWER SUPPLY

5V power supplies (or 5VDC power supplies) are one of the most common power supplies in use today. Linear regulated 5VDC power supplies regulate the output using a dissipative regulating circuit. They are extremely stable, have very low ripple, and have no switching frequencies to produce EMI.

DC MOTORS

The raspberry pi model is programmed such that if the either soil moisture or temperature parameters cross a predefined threshold level, the irrigation system is automated, i.e. the relay connected to the raspberry pi will turn ON or OFF the motor. A DC motor is an electrical machine that converts electrical energy into mechanical energy.

THING SPEAK CLOUD

Thing Speak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to Thing Speak from your devices, create instant visualization of live data, and send alerts. Thing Speak provides instant visualizations of data posted by your devices to Thing Speak.

SD CARD

A Secure Digital (SD) card is a tiny flash memory card designed for high- capacity memory and various portable devices, such as car navigation systems, cellular phones, e- books, PDAs, smartphones, digital cameras, music players, digital video camcorders and personal computers. Secure Digital, officially abbreviated as SD, is a proprietary non- volatile flash memory card format developed by the SD Association (SDA) for use in portable devices.

RASPBERRY PI

Raspberry Pi is a small single board computer. By connecting peripherals like Keyboard, mouse, display to the Raspberry Pi, it will act as a mini personal computer. Raspberry Pi is popularly used for real time Image/Video Processing, IoT based applications and Robotics applications. The Raspberry Pi 3 Model B is the latest version of the $35 Raspberry Pi computer. The Pi isn't like your typical machine, in its cheapest form it doesn't have a case, and is simply a credit-card sized electronic board -- of the type you might find inside a PC or laptop but much smaller

USB CAM

A USB webcam is a camera that connects to a computer, usually through plugging it in to a USB port on the machine. The video is fed to the computer where a software application lets you view the pictures and also transfer them to the Internet. A USB webcam is a camera that connects to a computer, usually through plugging it in to a USB port on the machine. The video is fed to the computer where a software application lets you view the pictures and also transfer them to the Internet.

HARDWARE SPECIFICATIONS

DC MOTOR

A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homopolar motor (which is uncommon), and the ball bearing motor, which is (so far) a novelty. By far the most common DC motor types are the brushed and brushless types, which use internal and external

commutation respectively to create an oscillating AC current from the DC source so they are not purely DC machines in a strict sense.

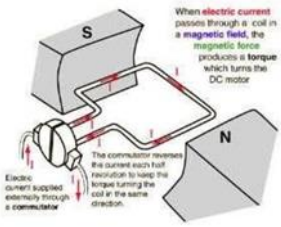


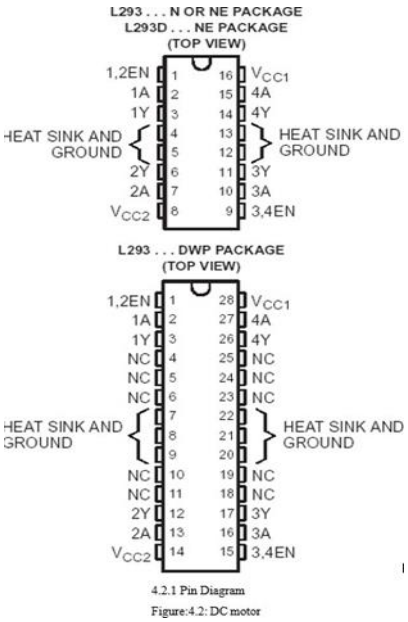
Figure:4.1: DC motor

L293, L293D (QUADRUPLE HALF H-DRIVERS)

The L293 and L293D are quadruple high- current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high- current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source.

Features

- Featuring Unit rode L293 and L293D
- Products Now From Texas Instruments
- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Thermal Shutdown
- High-Noise-Immunity Inputs
- Functionally Similar to SGS L293 and
- SGS L293D
- Output Current 1 A Per Channel
- (600 mA for L293D)
- Peak Output Current 2 A Per Channel
- (1.2 A for L293D)
- Output Clamp Diodes for Inductive
- Transient Suppression (L293D)



4.2.1 Pin Diagram

Figure:4.2: DC motor

SUBMERSABLE WATER PUMP

pump that works on 3-6V DC. It is extremely

simple and easy to use. Just immerse the pump in water, connect a suitable pipe to the outlet and power the motor with 3-6V to start pumping water. Great for building science projects, fire-extinguishers, firef ighting robots, fountains, waterfalls, plant watering systems etc.

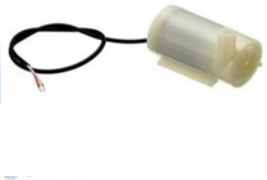


figure: water pump

This motor is small, compact and light. It can be controlled from a micro controller/Arduino using our DC Motor Drivers or one of our Relay Boards. You may use our 5V SMPS Power Supply Adapter to run this pump. You may also use our 6V Solar Panel to run the pump with appropriate a 6V voltage regulator.

Raspberry Pi

RASPBERRY PI is a microprocessor board, based on the Broadcom BCM2837, is a 64-bit ARMv7 Quad Core Processor. It has 40 general purpose input/output pins, USB ports, LAN port (Ethernet port), a Micro SD card slot, a DSI display port, a micro-USB power input, a composite video and audio output jack, a CSI camera port, and a HDMI video output. It contains everything

needed to support the microprocessor. Connect it to a computer in which Raspbian OS is installed and power it with an adapter. Raspberry Pi 3 model B differs from all preceding boards in that it does not have an on-board WIFI, Bluetooth and USB boot capabilities. The Pi 3 is roughly 50% faster than all preceding boards. "Raspberry" is a reference to a fruit naming tradition in the old days of microcomputers. A lot of computer companies were named after fruit. "Pi" is because we are going to produce a computer that could only really run Python. So, the 'Pi' is for Python.

Table: Description of Raspberry Pi 3 Model B Data

S. No	Description	Property
1	Operating Voltage	5V
2	Input Voltage	230V
3	Current	2.5A
4	Micro Processor oa	dcom 64 bit ARM V7
5	General purpose I/O Pins	40
6	Processor Speed	1.2 GHz
7	Storage	Micro SD card
8	RAM	1 GB SDRAM@400 MHz
9	Bluetooth	4.1
10	USB ports	4
11	Ethernet port	10/100 Mbps
12	Operating system	Raspbian
13	WIFI (Inbuilt)	802.11 Wireless LAN
14	Length	85.60 mm
15	Width	56.5 mm
16	Weight	45 g

Ethernet port

We use Raspberry Pi as a gaming console, media server, or stand-alone computer, WIFI is a great way to get internet access. But if you connect to your Pi with SSH or a remote desktop application a lot, Wi-Fi is actually one of the slowest and least reliable ways to do it. A direct ethernet connection is much faster and a lot more stable. By connecting to your Pi directly from your laptop or desktop with an ethernet cable we are bypassing your local network, and we aren't sharing bandwidth with other computers on your network. It also allows us to connect to our Pi when you're outside of your home network. If we are experiencing slow connectivity and network time outs with our current set up, we need to try this! All we need to set it up is an ethernet cable and a way to access the Raspberry Pi command prompt.

Fig: Ethernet port

PIN DIAGRAM OF RASPBERRY PI 3 MODEL B BOARD

Raspberry Pi 3 Model B board will have different blocks. There will be a Broadcom system on a chip (SoC) microprocessor with an integrated ARM- compatible Central Processing Unit (CPU) as the core of the project, on-chip Graphics Processing Unit, USB port to connect the USB cable between the PC & the board, a micro-USB pin to connect an adapter.

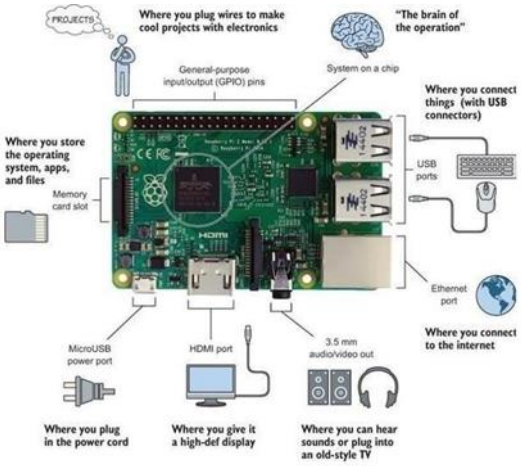


Figure :4.9: Raspberry Pi 3 Model B pin Description

Fig 7. feed stock preparation

Figure:4.10: GPIO Pin Description of Raspberry PI 3 Model B Board

	Raspberry Pi 3 Model B	Raspberry Pi Zero	Raspberry Pi 2 Model B	Raspberry Pi Model B+
Introduction Date	2/29/2016	11/25/2015	2/2/2015	7/14/2014
SoC	BCM2837	BCM2835	BCM2836	BCM2835
CPU	Quad Cortex A53 @ 1.2GHz	ARM11 @ 1GHz	Quad Cortex A7 @ 900MHz	ARM11 @ 700MHz
Instruction set	ARMv8-A	ARMv6	ARMv7-A	ARMv6
GPU	400MHz VideoCore IV	250MHz VideoCore IV	250MHz VideoCore IV	250MHz VideoCore IV
RAM	1GB SDRAM	512 MB SDRAM	1GB SDRAM	512MB SDRAM
Storage	micro-SD	micro-SD	micro-SD	micro-SD
Ethernet	10/100	none	10/100	10/100
Wireless	802.11n / Bluetooth 4.0	none	none	none
Video Output	HDMI / Composite	HDMI / Composite	HDMI / Composite	HDMI / Composite
Audio Output	HDMI / Headphone	HDMI	HDMI / Headphone	HDMI / Headphone
GPIO	40	40	40	40
Price	$35	$5	$35	$35

Raspberry Pi Specifications

RESULTS

Step 1

Web camera which is connected to camera serial interface port of Raspberry pi It continuously monitors the crop field.

Step 2

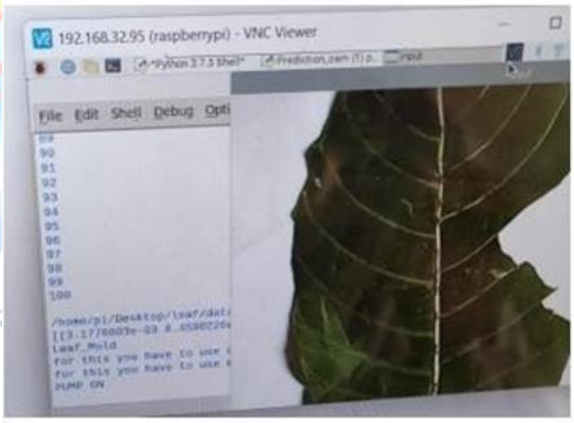
As soon as web camera detects the disease, the information i.e. disease name and required pesticide name are sent to farmer's device.

Step 3

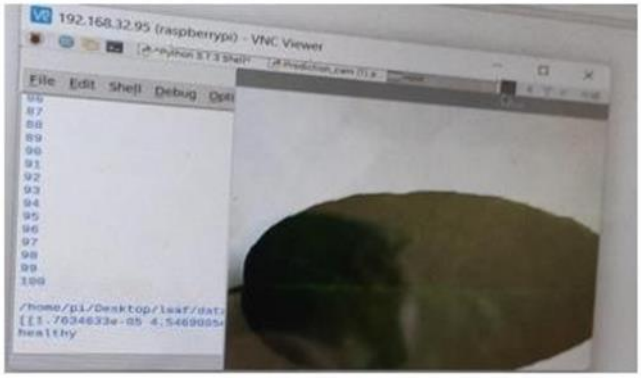
After detecting the disease, it displays the disease name and required pesticide and it automatically sprays pesticides to the crops.

Late Blight

early blight



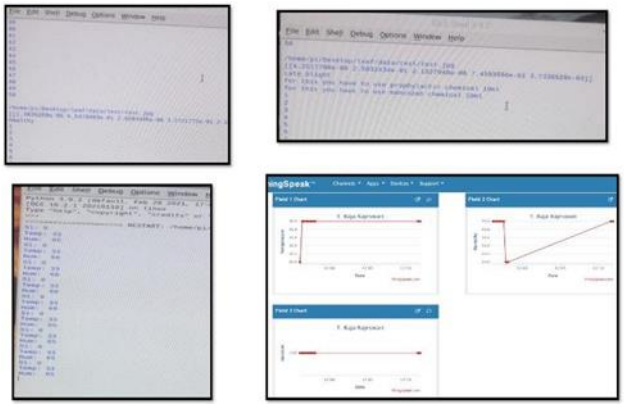
leaf mold



Healthy

Step 4

We can identify temperature, moisture, humidity by thing speak app by using software and also VNC viewer windows.



Software results

SUMMARY AND CONCLUSIONS

Basically, there are three main types of Leaf disease, they are Bacterial, Fungal and Viral. It is important in plant disease detection to have the accuracy in the plant disease detection but at the same time the process should be of high speed. Work can be extended by the use of quad copter for the capturing of images of leaves of the different plants in the farm at field level. This system can be connected to the server for further processing. The objective of this work is the detection, classification of leaf diseases and all information about the disease is sent to the farmer's mobile phone through the internet. To increase the speed and accuracy of detection as well as classification of leaf diseases we using Raspberry pi 3 model B module. One more important benefit of this system is that it gives the name of the pesticide required to use in order to prevent the disease from spreading. It providing name of pesticide as per the disease, to save labor price by eliminating need of labor for regular observation of plants to check whether it is affected by any disease or not. This system will largely contribute in growth in the yield of the farms.

In this paper, an AI based pest detection system is designed for controlling agricultural pests. This model uses the effectiveness of acoustic approach in pest detection and uses AI for pest classification. This system also alerts the farmers when pests are detected by sending the message to their mobile phones with the help of Wi-Fi module. This system also has the facility of automatic spraying of pesticide. With the use of this system, farmers can remotely access the pesticide application device, eliminating the need for them to physically visit the field. This pest detection system is very important to society. Farmers can use this system to keep an eye on their fields at any time, and remote control is possible. By detecting and destroying the pests at an early stage, both agricultural productivity and the nation's gross domestic product can be significantly increased.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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