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Pest Detection and Automatic Pesticide Spraying Using Raspberry pi

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Abstract: *Internet of Things (IoT) devices are exposed to many advanced vulnerabilities and various new inventions India has agriculture as its primary occupation. Economy of the country highly depends on Agricultural productivity. To increase productivity controlling of Pest infestation plays an important role. Many kinds of pests can hurt plants as they grow. According to the Pesticide manufacturers the only solution to control pests is to spray pesticides regularly. Farmers go around the fields and spray pesticides, which can cause adverse effects on their health leading to dreadful diseases such as respiratory disorders, asthma, skin diseases and cancer. Our system proposes an automated approach to identify the pests and spray pesticides. IoT plays an important role in recognizing the pests that lie on the leaves. And the crop is monitored regularly in order to prevent the disease causing pests by spraying the pesticide over the field by using automatic pesticide sprayer. So these preventive measures will help to avoid the diseases and yield is more and the crop obtained is healthy. By this we can reduce manual work, unnecessary of spraying pesticides, eliminate the disease causing pests in the field and have the healthy crop with good quality.*

Key Words: *IoT; Pest detection; Automatic Pesticide sprayer.*

1. INTRODUCTION:

Over the last several decades, customers' lifestyles and needs have gone through tremendous changes. This present new challenges for the farmers whose production has to meet the customers' demands (3). India has agriculture as its primary occupation. According to IBEF (India Brand Equity Foundation), 58% of the people living in rural areas in India are dependent on agriculture (4). Agriculture is mainly defined in terms of crops and there is the vast variety of available crops. While integrating these crops with image processing, it has valuable importance in different application areas (2). Due to the increasing demand in agricultural industry the need to effectively grow a plant and increase its yield is very important. In order to do so, it is important to monitor the plant during its plant growth period (1Some of the effective agricultural image processing areas are according here the division of agricultural image processing is done under the application specification (2). Agricultural image processing is not only limited to single object type, instead it is defined under four major application areas called, crop image processing, plant and leaf processing, fruits and vegetable processing and land and soil processing. . Recently, Internet of Things (IOT) concepts extend Precision Agriculture with smart, distributed, and collaborating sensors and technologies (5). Raspberry pi and in case of any discrepancy send a SMS notification as well as a notification on the application developed for the same to the farmer's smartphone using Wi-Fi/3G/4G. The system has a duplex communication (4). And we use neural networks to detect the plant disease and image processing interfaced with artificial intelligence to detect the pest or insect.

In this a broader view to the pest detection as well as classification model is defined. The work here is defined as a generic frame to identify the object. The types of pests or insects are specified according to the variation in their sizes and texture. After detecting it sprays the respective pesticide So we will have the best production and healthy crop. In this paper we propose pest detection and automatic pesticide sprayer using IoT devices by integrally and systematically providing and managing pest detecting and automatic pesticide spraying. The users can safely use various application services utilizing IoT devices because they are very secure.

2. LITERATURE REVIEW:

- Various researchers have proposed different techniques to identify and detect the pests. Identification of Leaf Disease in Pepper plants is done by Jobin Francis [1] using Soft Computing techniques. this method, disease of the leaf is detected using Image Processing technique. Since it detects after the pests have eaten it and gone, this method is not useful in controlling pests.
- Martin [2] proposed a system for Identification and Counting of Pests using Extended Region Grow Algorithm. In the proposed work, identification and counting of pests to predict the amount of pesticide to be sprayed is done based on the extended region grow algorithm in image processing .This algorithm provides best identification and count of pests but it is slow and takes a lot of time.
- Y.Lanthier[3] has defined a work on the classification and segmentation of SAR images to obtain the land areas under the specification of reformation of soil. This kind of segmentation is performed based on pixel level analysis performed respective to region specification and identification.
- Sanjeev S Sannakki[4] "Diagnosis and Classification of grape leaf disease using neural networks", has defined a neural network based work to identify the disease detection and classification. Author defined the diagnostic approach to identify the disease under the intelligent system. Grape leaf disease segmentation is done using k-means clustering. The diseased portion from segmented images is identified.
- Patil K. A, N. R. Kale[5], " A Model for Smart Agriculture Using IoT", International Conference on Global Trends in Signal Processing, Information Computing and Communication, IEEE 2016. proposes a wise agricultural model in integration with ICT. ICT have always mattered in Agriculture domain. Over period, weather patterns and soil conditions and epidemics of pests and diseases changed, received updated information allows the farmers to cope with and even benefit from these changes. It is really challenging task that needs to provide such knowledge because of highly localized nature of agriculture information specifically distinct conditions. The complete real-time and historical environment information helps to achieve efficient management and utilization of resources. The issue is that the technique can achieve convenient wireless connection within a short-distance.
- Johnny et.al [6] developed a pest identification system using neural network. In this system for object detection uses background subtraction method is used. Then the feature extraction and segmentation performed. To identify the insect Kohonen Self Organizing Maps neural network is used.
- ShaileshMalonde.et.al. (May-2016):They developed a multipurpose pesticide spraying machine based on solar panels .It gives maximum work output with minimum effort. The arrangement of nozzles is adjustable according to the crops and this alone pump can used for multiple crops[7]. This model carries multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time. Constant flow valves can be applied at nozzle to have uniform nozzle pressure.
- Johnny L. Miranda, Bobby D. Gerardo and Bartolome T. Tanguilig III, "Pest Identification using Image Processing Techniques in Detecting Image Pattern through Neural Network", Advances in Computer and Electronics Technology, 2014 [8].In this paper, a detailed and broader view of plant/leaf disease recognition and classification is defined. The paper has explored the agricultural image processing along with the exploration of associated application area and has defined a broader model to perform the effective recognition of image.
  Drawback of this paper is in this we are detecting the leaf which is diseased so that here the plant is already effected by a disease.
- Image Processing for Smart Farming: Detection of Disease and Fruit Grading'**.** Monika Jhuria, Ashwani Kumar, Rushikesh borse -2013 IEEE second international conference on Image Information[9]. In this paper they have detected diseased leaf by change in texture and shape and damaged fruit by change in its area.
- " Design and Development of Multipurpose Pesticides Spraying Machine", "Journal of Advance Engineering and Global Tecnolagy",ISSN:2309-4893, Volume 02,Issue -03,May 2016[10] – In this paper, we presented a holistic IoT-based agricultural monitoring system. The main component of this system is an in-situ WSN that is tailored for the collection of sensor information that is of special interest for Smart Farming. The focus of the sensor network is on the continuous assessment of the LAI that is relevant for a precise monitoring of crop growth processes. Drawback of this project is it just spraying the pesticides and monitoring the crops but not detecting the pests.

3. MATERIALS:

Raspberry pi : It is the main component which is the mother board of the project. It is capable of doing everything you'd expect a desktop computer to do. An SD card inserted into the slot on the board acts as the hard drive for the raspberry pi. It is powered by USB and the video output can be hooked up to a traditional RCA TV set, a modern monitor, or even a TV using the HDMI port, it has 40 pins out of which 28 are GPIO(General purpose Input Output) pins.

Web cam : A webcam is a compact digital camera which works same as conventional digital camera but is designed to interact with the web pages and other internet pages. It captures the real time images through a tiny grid of light detectors, known as charge coupled device (CCD) from the location where it is placed. Here we are using it for video processing while monitoring the field.

Relay : Relay works on the principle of electromagnetic attraction. It acts as a switch i.e., on and off. The main operation of relay comes in places where only a low-power signal can be used to control a circuit. Relays are used to provide time delay functions. They are used to time the delay open and delay close of contacts. They are also used as Protective relays. The relay has 5 pins GND, 5v, common, normally close and normally open.

Submersible Pump : It is a device which has hermetically sealed motor. The motor is close coupled to the body of the water booster pump. It pumps the water to the surface by energy conversion that works in a cycle. The rotary energy is converted into kinetic energy that is further converted into pressure energy. The submersible pump works by pulling the fluid towards itself. During the intake, the rotating impeller pushes the fluid through the diffuser. From there, the fluid goes to the surface.

4. METHODOLOGY:

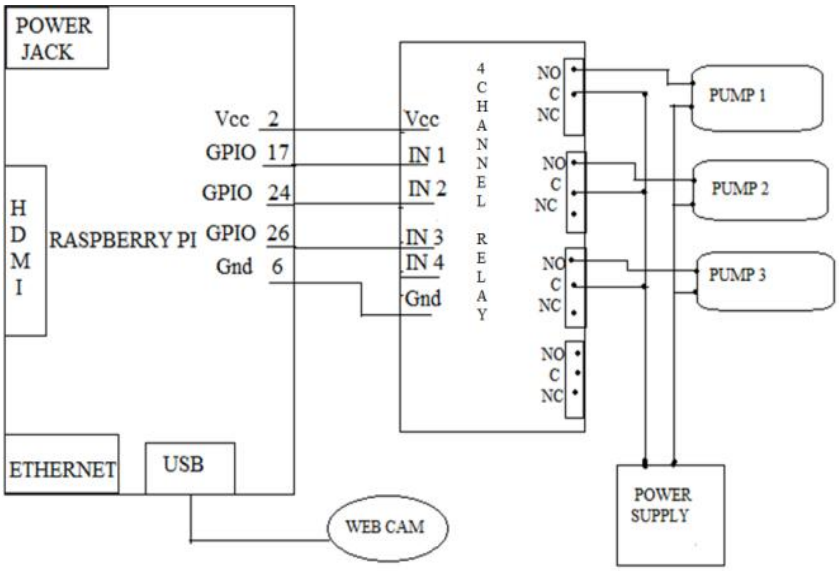


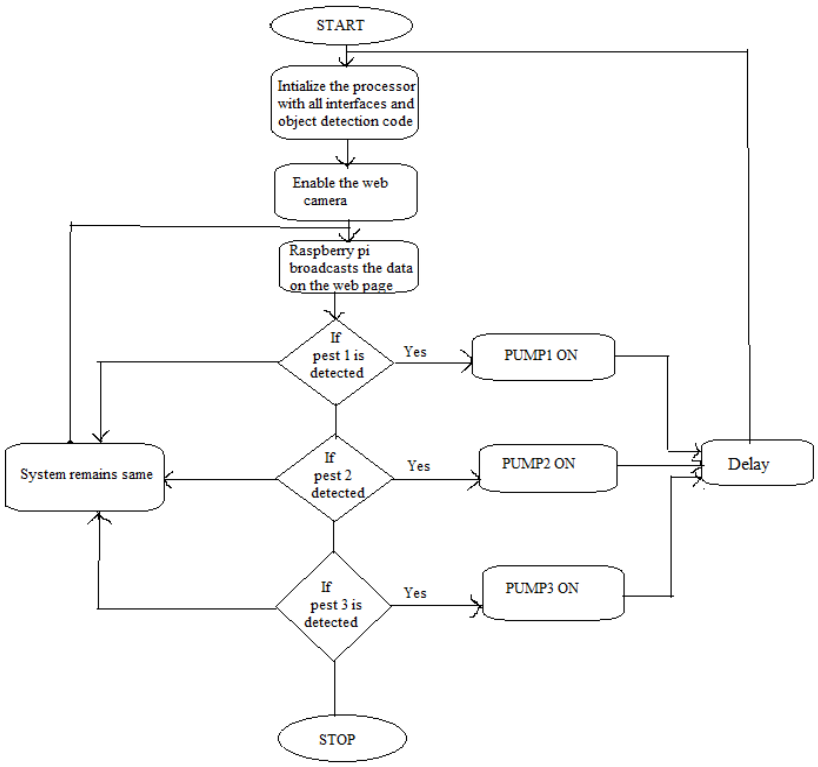
Figure 1. circuit diagram

The above fig shows the circuit connections of the project.

- In this we are providing the power supply of 5v to the raspberry pi.
- Ethernet is connected in order to provide internet access and it helps to display the data on the web page.
- To the USB port we are connecting the web camera to monitor the field. We can observe the monitoring on the desktop whether there is any pest in the field or not.
- We are connecting a 4 channel relay to the raspberry pi by connecting Vcc to Vcc and Gnd to Gnd and GPIO 17 pin to IN1 , GPIO 24 pin to IN2 ,GPIO 26 pin to IN3.
- Each single relay in the channel is connected to a pump (relay normally open to motor positive terminal 3 normally closed terminals are connected to the positive terminal of the external power supply. And negative terminal of each pump is connected to the negative of the power supply.

So when this system is turned on, the web cam starts monitoring the field, here we are using object detection code in order to detect the pests .If any pest is detected in the field the relay which acts as a switch turns on so that the pesticide pump will turn on here we are have programmed the code in such a way that if first pest is detected then the respectable first pump should turn on or if the second pest is detected the second pump should turn on or if the third pest is detected the third pump will turn on and if no pest is detected or any other pest other than the three pests is detected the system remains same.

FLOW CHART OF THE SYSTEM:



Above Fig 2 .shows flow chart of the proposed system.

A flow chart shows the step by step procedure of the system.

- First of all we have to Initialize the processor (raspberry pi)with all interfaces like SD card(first of all the SD card should be formatted and then and insert it) and write the object detection code , Web cam, Relay, Submersible pump.
- Now we have to enable the web camera. So when code is compiled and run the web camera starts surveillance i.e., it monitors the field .We can observe the process by connecting raspberry pi to computer and we can see on the desktop.
- In order to monitor the field through web cam at the backend we have used the detection code so that it conducts monitoring of the field based on the delay provided.
- If any pest is detected which is already programmed then we can see that pest is detected on the web page and when the pest is detected the pump turns on. If no pest is or any other pest which is not known the system is detected then it prints pest not detected.
- If the pest 1 is detected then the respectable pesticide pump 1will turn on If pest 2 is detected the pump 2 will turn on and If pest 3 is detected the pump 3 will turn on.
- So the pesticide is sprayed over the field. By this we can prevent diseases in the early stage.

FLOW CHART FOR VIDEO PROCESSING THROUGH WEB CAM:

- Install Open CV and D libs. Here we are using python language to write the code.
- Open C(*Open source computer vision library*) is a library of programming functions mainly aimed at real time computer vision.
- A digital library, digital repository, or digital collection, is an online database of digital objects that can include text, still images, audio, video, digital documents, or other digital media formats.
- A series of convienient functions to make basic image processing operations such as translation,rotational, resizing, Skeletonization, and displaying Matplotlib images easier with OpenCV and Python.
- Tkinter is a Python binding to the Tk GUI(Graphical user interface)toolkit. It is the standard Python interface to the Tk GUI toolkit, and is Python's de facto standard GUI. Tkinter is included with standard Linux Microsoft Windows and Mac OS X installs of Python.
- Now run the code written for detecting.
- A frame window opens on the desktop, by this we can observe what is happening in the field.

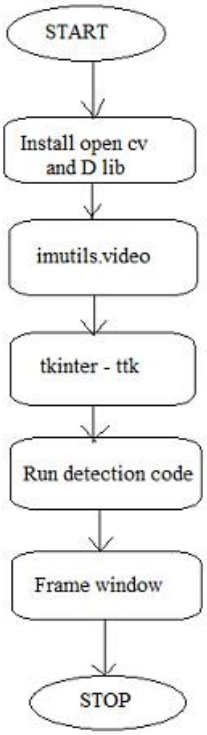


Figure 3. flow chart of video processing through web cam

5. ANALYSIS OF PEST DETECTING AND PESTICIDE SPRAYING

The internet of things is a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers and the ability to transfer data over a network without requiring human-to- human or human-to-computer interaction. In this project we are proposing a new technique using Internet of Things We are detecting the pest in the early stage by monitoring the whole crop we are using the raspberry pi and web camera for accuracy.

Parameter	Pump	Pesticide Sprayer
Pest detected	On	On
Pest not detected	Off	off

Image processing plays an important role here by this we are able to detect the pest in the field and we are connecting motors to the raspberry pi with relay in between. Finally the working of the project is after monitoring the crop if any pest is detected in the field and the respectable pesticide sprayer will turn on. So that we can prevent the field from getting the diseases at early stage and Crop will become more productive and the crop obtained is more healthy.

6. RESULTS and DISCUSSION:

Figure 4. When pest 1 is detected

We can see this in our desktop. So, when it detects the pests it prints pest 1 detected so that the relays turns on and pesticide sprayer will turn on immediately and sprays the pesticide over the field.

PEST	Pump 1	Pump 2	Pump 3
Pest 1	on	Off	Off
Pest 2	off	On	Off
Pest 3	off	Off	On

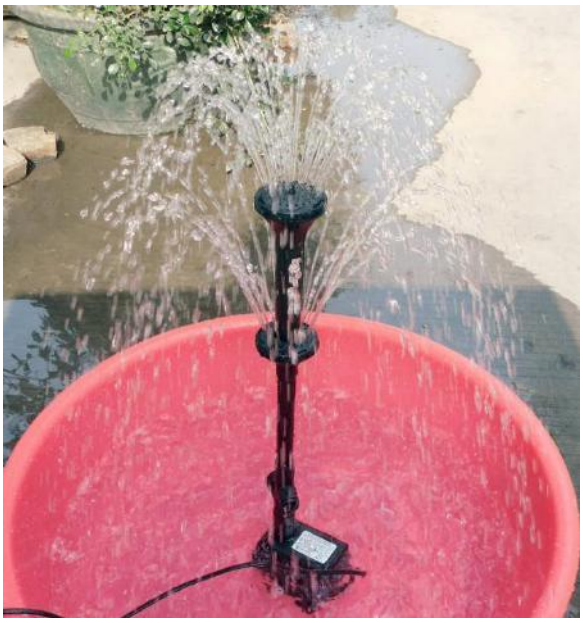


Figure 5. Spraying of the pesticide

So, when the pest is detected the respectable pesticide sprayer will turn on and sprays the pesticide over the field.

7. RECOMMENDATIONS:

From this paper, it can be seen that by using this system we can eradicate the disease causing pests or insects in the early stage that is when they enter the field or when they lie on the leaves at that time itself we can eliminate the pests and also if we extend this we can apply this to large area lands then there will be no damage in the crop outcome will be more. By this there will be no wastage of pesticide, no manual work, and by Sprays pesticide necessarily. Due to this we will have best quality and quantity of yield.

8. CONCLUSION:

The purpose of this paper is to enhance the use of IoT devices such that we can create a developed society with automation and advancement they are very secure and functional. In this paper we have proposed the monitoring of the field and automation in spraying the pesticides by using the IoT devices by this we can eliminate the disease causing pests in the early stage and reduce the wastage of pesticide, reduce the manual work. Now the crop obtained will be healthy, and due to less usage of pesticide the yield will be more organic. So, we have proposed this system in order to enhance the advancement in the Agricultural field and by providing the functional architecture and working overview of the devices.

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