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Smart Agricultural System for Pests Detection Using IOT

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ABSTRACT
Artificial intelligence and image recognition technologies are combined with environmental sensors and the Internet of Things (IoT) for pest identification. In India, about 70% of population depends upon farming and one third of the nation's capital comes from farming. Currently all over the world, it is found that around 50% of the farm produce never reach the end consumer due to wastage. Smart farming is an emerging concept, because IoT sensors capable of providing information about soil pH, soil moisture, temperature, humidity. The proposed design has been developed with acoustic sensor and PIR sensor. To achieve automatic recognition of agricultural pests, we developed a pest recognition system based on image processing technique. The image segmentation technique is used to detect the presence of pests in leaf images.
Index Terms: Artificial intelligence (AI), Internet of Things (IoT), Pest Monitoring, Acoustic, PIR sensor.

I. INTRODUCTION

The information you provided highlights the critical importance of managing pests and diseases in crop production and the significant economic impact they can have on farmers. Early detection of pest hotspots and timely application of pesticides are crucial for mitigating losses and optimizing crop yields.
In this context, the integration of deep learning and image recognition technologies in agricultural production offers promising solutions. Deep learning models, especially convolution neural networks (CNNs), have shown remarkable efficiency in diagnosing crop diseases from images. These models can be trained on a vast dataset of images of healthy and diseased plants to learn to recognize patterns and characteristics associated with different diseases and pests.
By deploying deep learning-based image recognition systems in the field, farmers can quickly and accurately detect the presence of diseases and pests on their crops. This allows for timely intervention, such as targeted pesticide application, reducing the need for excessive and indiscriminate pesticide use, which can be harmful to the environment and costly for the farmers.
The fact that the deep learning model achieved an 83.5% recognition rate is encouraging, but it's essential to continually improve and fine-tune the model to achieve even higher accuracy levels. This can be done through regular updates and retraining with new and diverse datasets to account for variations in environmental conditions and the appearance of different disease and pest types.

By reducing the dependence on plant protection technicians, the image recognition system empowers farmers to address crop issues promptly and make informed decisions regarding crop management. This not only improves productivity but also helps farmers optimize the use of resources and reduce overall costs. Furthermore, the ability of the deep learning model to monitor, diagnose, and prevent crop growth issues in real-time can have a transformative effect on agriculture. Early detection and intervention can save crops from substantial damage and increase the likelihood of achieving healthy yields.

As more farmers adopt these technologies, especially in regions where agriculture is a significant source of income, there is potential for substantial positive economic and environmental impacts. By minimizing crop losses and optimizing resource usage, sustainable agricultural practices can be promoted, leading to better livelihoods for farmers and ensuring food security for the population. Overall, the combination of deep learning, image recognition, and IoT technologies has the potential to revolutionize agriculture, making it more efficient, sustainable, and resilient to pests and diseases. Continued research, development, and implementation of such solutions are essential for the future of global food production.

II. EXISTING SYSTEM

The challenges in early detection of diseases and pests in agriculture can have significant implications for crop productivity and overall agricultural sustainability. The current methods, such as pheromone-based glue traps, have limitations in detecting pests at low densities and may not provide timely detection to prevent significant damage. Manual pest identification, relying on the expertise of trained individuals, is time-consuming and requires continuous monitoring. Moreover, human error and subjective judgments can lead to inaccuracies in pest identification, which can result in delayed or inadequate responses to pest outbreaks. The absence of a pest monitoring system for Ginger highlights the need for specialized solutions tailored to different crops. Generalized approaches may not effectively address the unique challenges posed by specific crops and pests.

The disadvantages of the existing system, as mentioned, include:

Delayed Detection: The current system only identifies pests after they have already affected the plants. Early detection is crucial to prevent the rapid spread of pests and to implement timely control measures.

Increased Pesticide Usage: In the absence of timely detection, farmers may resort to increased pesticide usage as a reactive measure to control pests. This can lead to the overuse of chemicals, negatively impacting the quality of the crop produced, as well as posing environmental and health risks.

To address these issues, the development of advanced pest monitoring and detection systems using modern technologies, such as AI-powered image recognition and IoT, can significantly improve the efficiency and accuracy of pest identification. Here are some potential solutions:

1. Automated Pest Detection: Utilizing image processing techniques and AI algorithms, automated systems can analyze images of crops to identify pests and diseases accurately. These systems can quickly scan large areas and provide real-time alerts when pests are detected, enabling farmers to take immediate action.
2. IoT-Enabled Sensors: Deploying IoT sensors in the fields can provide valuable data on environmental conditions, such as temperature, humidity, and soil moisture, which can influence pest behavior. Integrating this data with pest detection systems can improve the accuracy of predictions and aid in early pest detection.

3. Crop-Specific Solutions: Tailoring pest detection and monitoring systems to specific crops, like Ginger in this case, can account for the unique pest profiles and challenges faced by each crop, leading to more effective pest management.
4. Precision Pest Control: Early and accurate pest detection allows for targeted and precise application of pesticides, reducing overall pesticide usage and its negative impacts on crop quality and the environment.

By leveraging technology and data-driven approaches, the agriculture industry can move towards proactive and sustainable pest management practices. Early detection and precise control of pests can significantly improve crop yields, reduce costs, and promote environmental sustainability.

III. PROPOSED SYSTEM

Our proposed system for automatic pest detection and classification in agriculture sounds promising and has several advantages. By utilizing modern technologies like Raspberry Pi, IR sensors, and ultrasonic sensors, you can create an efficient and user-friendly solution for farmers to monitor pest infestations and plant growth. Let's take a closer look at the advantages you mentioned:

1. Early Detection of Pests: Early detection is crucial in pest management as it allows farmers to take timely action to control and prevent further infestations. By identifying pests at an early stage, farmers can minimize crop damage and reduce the cost and amount of pesticides used for harvesting.
2. Reduced Pesticide Usage: With early detection of pests, farmers can apply targeted and localized pesticide treatments only where they are needed, rather than blanket spraying the entire crop. This targeted approach helps minimize the environmental impact and potential harm to non-target organisms.
3. Easy to Use: Your proposed system seems user-friendly and accessible to ordinary farmers. The integration of sensors with Raspberry Pi and the option to receive pest detection alerts via email and view them on PC or mobile devices make it convenient for farmers to monitor their crops remotely.
4. Enhanced Crop Management: The combination of pest detection and the ability to measure plant growth using ultrasonic sensors can provide valuable insights into the overall health and development of crops. This information can help farmers optimize their agricultural practices and make informed decisions for better crop management.
5. Cost-Effectiveness: By reducing pesticide usage and increasing the efficiency of pest detection and control, your proposed system can potentially save farmers money in the long run. Improved crop yields and reduced crop losses contribute to increased profitability in agriculture.
6. Technology Adoption: Introducing modern technologies like IoT sensors and Raspberry Pi in agriculture can encourage technology adoption among farmers, leading to more sustainable and efficient farming practices.

While the proposed system holds great potential, it's essential to thoroughly test and validate its accuracy and reliability in real-world farming scenarios. Additionally, considering factors such as weather conditions, pest species diversity, and variations in plant types will be crucial for the success of the system.

Overall, the proposed system can contribute significantly to improving pest management practices in agriculture, leading to enhanced crop yields, reduced pesticide usage, and better resource management.

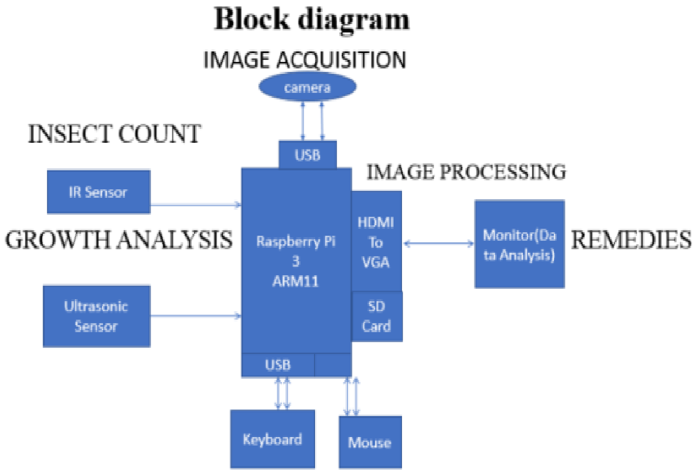

Image Acquisition:

The first stage of any imaginative and prescient device is the photo acquisition stage. After the photo has been received, Various techniques of processing can be carried out to the photograph to perform the various extraordinary vision obligations required today. Virtual photo acquisition is the creation of photographic pictures, such as of a physical scene or of the indoors Shape of an object. A digital picture may be created immediately from a bodily scene by way of a digicam or comparable tool.

Image Processing and classification:

The image processing is a method to perform some operations on an image, with the intention to get a stronger image. It could be done with the aid of the usage of OpenCV(Open Source Computer Vision Library) and Python. It's far a type of signal processing wherein input is an photo and output can be picture or function/capabilities related to that image.

Image processing basically consists of the following three steps:

- uploading the images through images acquisition equipment
- studying and manipulating the image
- Output

Image class is possibly the most crucial part of virtual picture analysis. The reason of the Class process is to categorized all pixels in virtual pix.The goal of image category is to perceive and portray, as a unique gray stage (or shade), the functions occurring in a picture in terms of the item or form of landcover these functions sincerely constitute at the floor.

Detection and Remedies:

Once image processing and type is done, the machine intimates to the user if it is a bad insect which influences the crop. Additionally, it proposes the pesticides which may be used for the eradication of such pests.The intimation message is dispatched to the user by e-mail so they can be able to view the message in both mobile and personal computer.

Growth Analysis:

Ultrasonic sensors are a device that could degree the distance to an object via the usage of sound waves. It measures the distance via sending out a valid wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time among the sound wave being generated and the sound wave bouncing returned, it's miles feasible to calculate the distance among the sonar sensors and the object. It's miles crucial to understand that some gadgets might not be detected through ultrasonic sensors. That is due to the fact some items are fashioned or located in the sort of way that the sound wave bounces off the item, however are deflected far from the Ultrasonic sensor. It is also viable for the object to be too small to reflect enough of the sound wave back to the sensor to be detected.

Insect Count:

An infrared sensor is an electronic device that's used to feel certain traits of its Environment by both emitting and/or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. IR Sensors paintings via the usage of a selected light sensor to hit upon a pick out mild wavelength in the Infra-red (IR) spectrum. By using an LED which produces mild at the equal wavelength as what the sensor is searching out, you could observe the intensity of the obtained light. Whilst an item is near the sensor, the mild from the LED bounces off the item and into the light sensor. This effects in a massive bounce inside the intensity, which we already recognize can be detected the use of a threshold.

IV. CONCLUSION

In this paper, the automatic detection is used for image processing. One of a kind picture processing techniques have been used to stumble on and extract the pest inside the captured picture. By means of this approach the pest may be diagnosed in its early degree. For this reason, we are able to lessen the use of pesticides has been multiplied which in flip reduces the great of crop produced. The correct disease detection and category of the plant leaf image could be very critical for the successful cultivation of cropping and this could be done the use of photograph processing. This paper discussed numerous techniques to phase the sickness of the plant. This paper mentioned class strategies to extract the functions of inflamed leaf and the class of plant illnesses through Raspberry Pi.

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