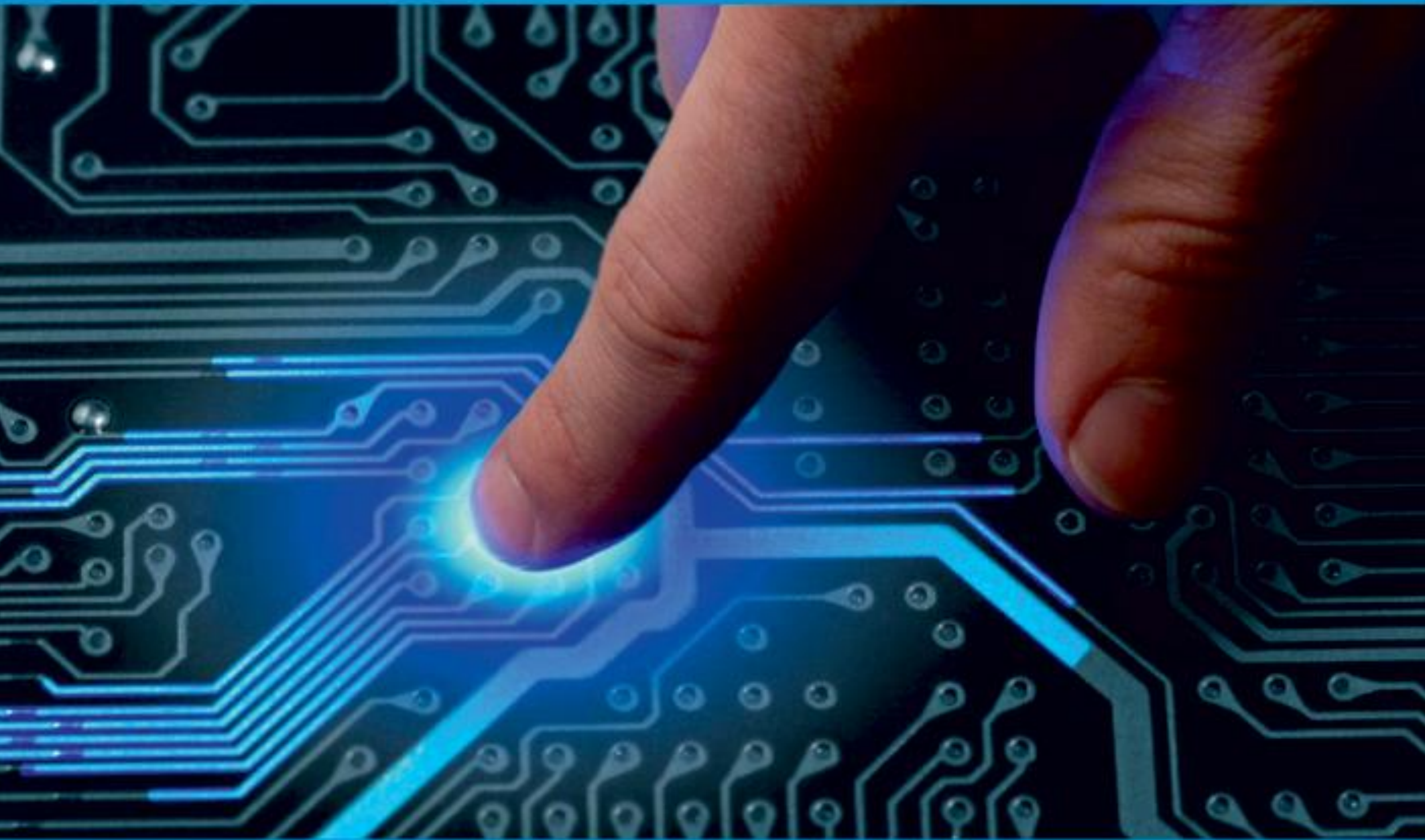
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 5, May 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105038 |

Smart Irrigation and Pesticide Management Using Worm Detection

Kaustubh Shinde, Rameshwar Dhore ,Shreyas Kaldate,Pravin Kalyankar,Suraj Dudhabhate

Faculty, Dept. of Computer, Sinhgad Institute of Technology & Science Pune, India

Students, Dept. of Computer, Sinhgad Institute of Technology & Science Pune, India

ABSTRACT: Nowadays smart irrigation is becoming increasingly popular to reduce water wastage and increase crop yield. The major problem of such systems is that they can only detect the moisture in the soil but they cannot detect the presence of worms in the crops. This paper proposes a smart irrigation system with worm detection to detect the moisture present in the soil that it detects the presence of worms in the crops using cameras and provides real-time feedback to the irrigation system. The system incorporates a machine-learning algorithm to detect worms and spray pesticides. The results demonstrate that the system can effectively detect the worms present on the crops and spray pesticides improving the crop yield.

KEYWORDS: Smart Irrigation, Worm Detection, Soil quality, Machine learning, Iot, mask R-CNN.

I. INTRODUCTION

The spread of farming practices globally has been prompted by the rising demand for food items, which is a crucial sector of the global economy. Traditional agricultural methods, however, frequently rely on ineffective water management and can damage the health of the soil, resulting in a decrease in crop production. A potential answer to these problems is the deployment of smart irrigation systems. In order to optimize water use and boost crop yield, these systems use Iot technology to monitor environmental factors, soil moisture levels, and plant development patterns, and components, incorporating the applicable criteria that follow.

1.1 Modernizing Agriculture

Utilizing Iot technology to optimize water use in agriculture, smart irrigation is a creative and environmentally responsible method of managing water resources. By keeping an eye on the weather, plant development patterns, and soil moisture levels, it seeks to decrease water waste and increase agricultural output. Worms present on crops are one of the major causes that reduce the amount of crop yield. The usage of worm identification as a component of a smart irrigation system has come to light in this area.

1.2 Iot and Smart Irrigation

Smart irrigation systems that use Iot technology offer real-time monitoring and control of water usage, helping farmers to effectively manage their water resources. These systems can also include other sensors, such as weather sensors, that offer useful information about the environment in addition to soil moisture sensors. Machine learning algorithms can be used to analyze this data in order to find patterns and adjust the watering plan accordingly.

Another example of how Internet of Things (Iot) technology can be utilized to enhance agricultural practices is the use of cameras for worm identification in smart irrigation systems. By examining the visual patterns of the soil and relaying this information to the irrigation system, in the same way, cameras may also identify the presence of worms. As a result, water waste is decreased and the irrigation schedule can be modified based on the soil's quality.

The integration of Iot technology and cameras for worm detection present on crops can also provide valuable insights into crop health. The data collected by the system can be used to spray pesticides which helps farmers make good decisions about water and spray pesticide management practices.

II. SYSTEM DESIGN

Sensors, cameras, an Iot platform, and a control system make up the four key parts of the system architecture of a smart irrigation system that uses cameras and Iot technologies to identify worms.

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1. Sensors: The sensors are used to gather information on the temperature, humidity, and other external factors as well as the moisture content of the soil. These sensors can be positioned all over the farm and can wirelessly transfer data to the Iot platform.
2. Cameras: The usage of the cameras allows for the detection of worms in the soil. Wi-Fi or other wireless communication protocols can connect these cameras to the Iot platform.
3. Iot Platform: The data from the sensors and cameras are gathered and analyzed at the Iot platform's central hub. This platform, which can be on-site or cloud-based, uses machine learning algorithms to analyze the data and offer insights about the health of the soil, crops, and water use.
4. Control System (Raspberry Pi): The Raspberry Pi can be connected to several sensors, including a camera for worm identification, ambient sensors, and soil moisture sensors. The Raspberry Pi can be connected to these sensors and cameras via GPIO pins or additional interfaces like USB, I2C, or SPI. To find patterns and identify trends in soil moisture levels, environmental factors, and the presence of worms on the crops, machine learning algorithms can be applied to the data gathered. "Fig 1.1" demonstrates the architecture of Raspberry Pi.

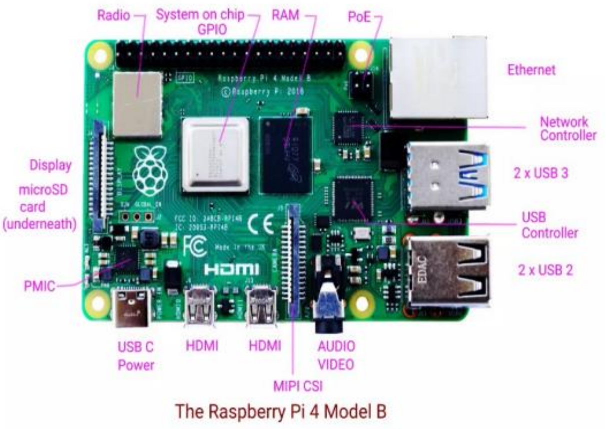

Fig.2.1.Raspberry Pi

III. MATHEMATICAL MODEL

Let S be the whole system S = {I,P,O}
I – input
P – procedure
O – output
Input(I)
Using sensor it will Detect humidity, soil moisture.

And by using mask R-CNN for images segmentation includes: detection , localization & classification etc..
I = {Dataset of Images}
Procedure(P)
Detect Worm Present/Absent
P = {I, Take data and apply mask R-CNN }
if worms present,

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Detect the type of worm and notify to the farmer

else

Crop is healthy

Use Raspberry Pi for further Controls based on the decision of the algorithm

Output(O)

O = {Smart Irrigation using raspberry pi}

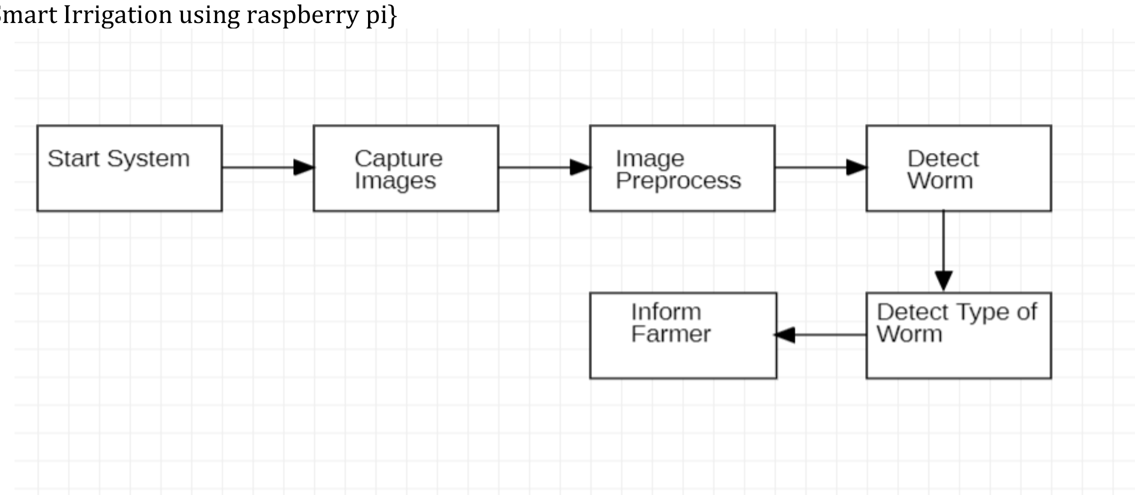

Fig 3.1. Mathematical Model

IV. SYSTEM ARCHITECTURE

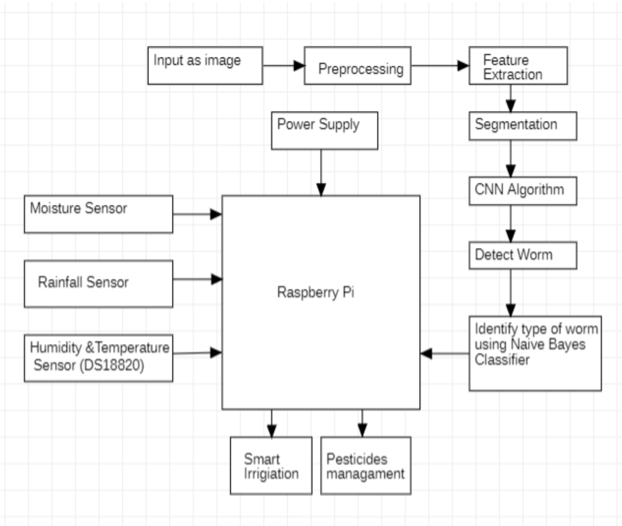

Fig.4.1 System Architecture

The system architecture is demonstrated in the 'Fig 4.1'

Working :

CNN-Based Worm Detection: Algorithms based on deep learning called Convolutional Neural Networks (CNNs) can be utilized for picture recognition and classification applications. CNNs have demonstrated encouraging results in

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worm identification as well as the detection of pests and illnesses in crops. Here is an overview of how CNNs can be used for worm detection on crops:

1. Image Collection: Crop images can be captured with cameras that have high-resolution cameras. To get a wide collection of shots, these pictures might be taken from different perspectives and distances.
2. Data Preprocessing: To feed the collected photos into the CNN model, the images must be preprocessed to standardize their sizes, color spaces, and orientation. Resizing, normalization, and color conversion are a few examples of image preprocessing.
3. Training the Model: The data is then separated into training, validation and test sets after being gathered and preprocessed. The validation set is used to improve the CNN model after it has been trained on the training data set. Until the model acquires adequate accuracy the same process is repeated.
4. Worm Detection: Once the CNN model is trained, it can be used to detect the presence of worms in crops. It can classify images into two classes - crops with worms and crops without worms using mask R-CNN. The type of worm will get Classified.
5. Integration with Smart Irrigation: A smart irrigation system can use the output of the R-CNN model to change the irrigation schedule, and pesticide spraying schedule based on the type of worm .The detected worm information will be send to the farmer and he will choose the related pesticide. To maintain ideal soil moisture levels, the system can alter water usage such that it is increased in areas with worms and decreased in areas with healthy crops. In conclusion, farmers may have access to a potent tool for pest control through the application of CNNs for worm identification on crops. Utilizing CNNs in conjunction with intelligent irrigation systems can increase crop output, decrease the need for toxic pesticides, and optimize water use, making agriculture more productive and sustainable.

V. OUTPUT

Fig 5.1 : Home Page

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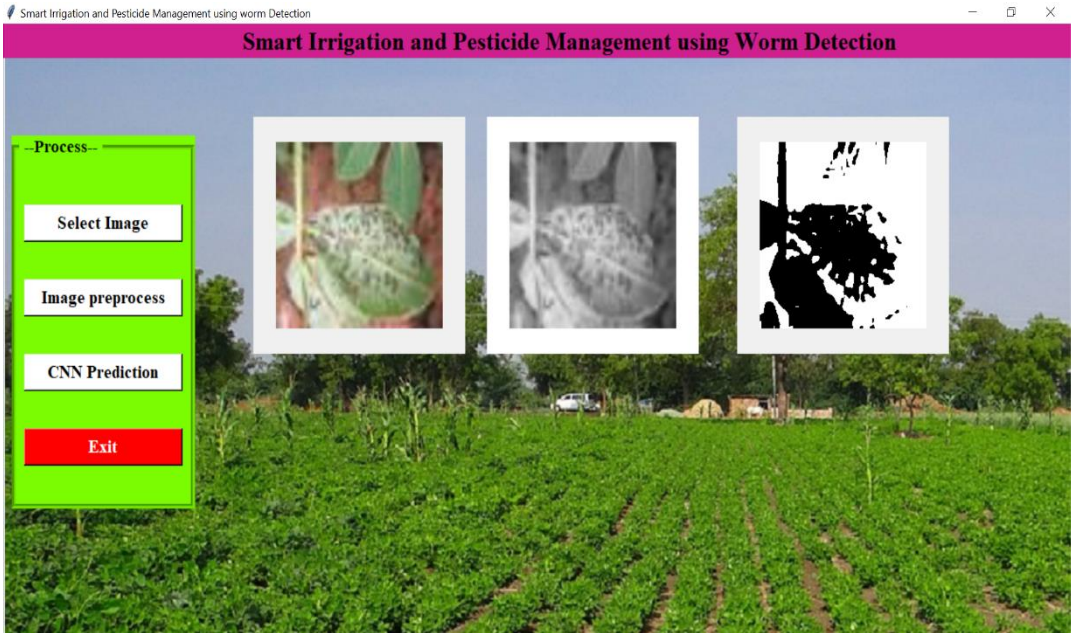

Fig 5.2 Image Selection

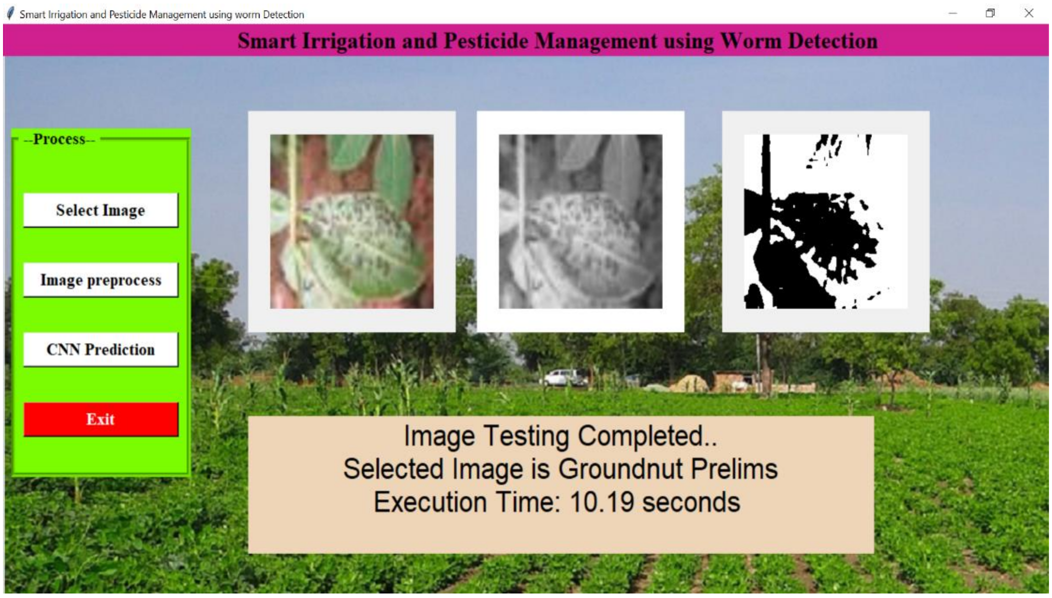

Fig 5.3. Worm 1 Detected

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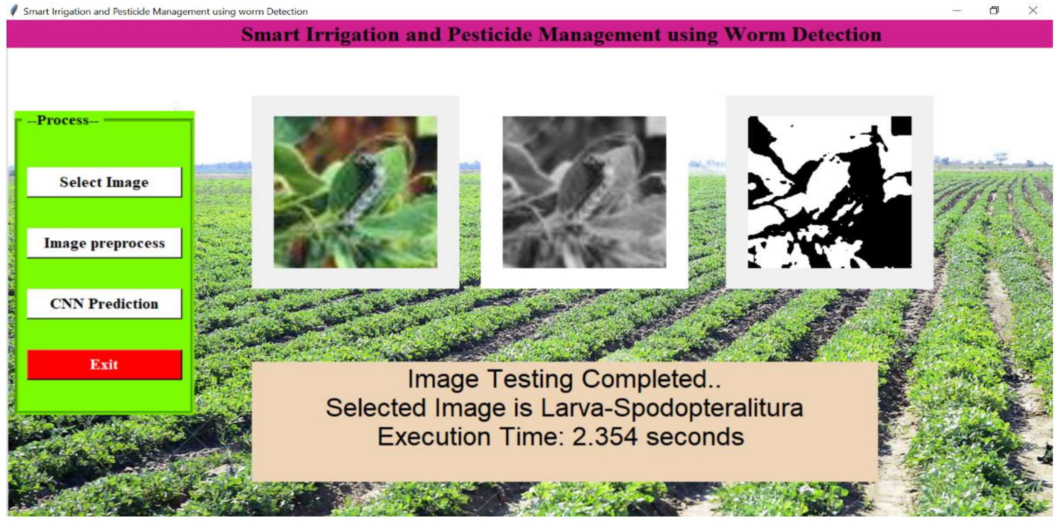

Fig 5.4. Worm 2 Detected

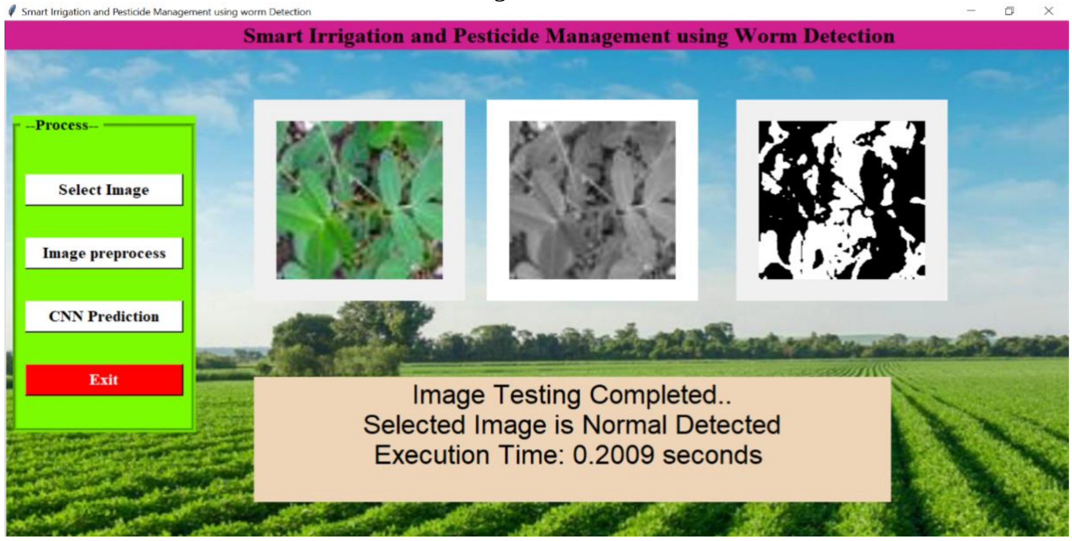

Fig 5.4. Normal Detected

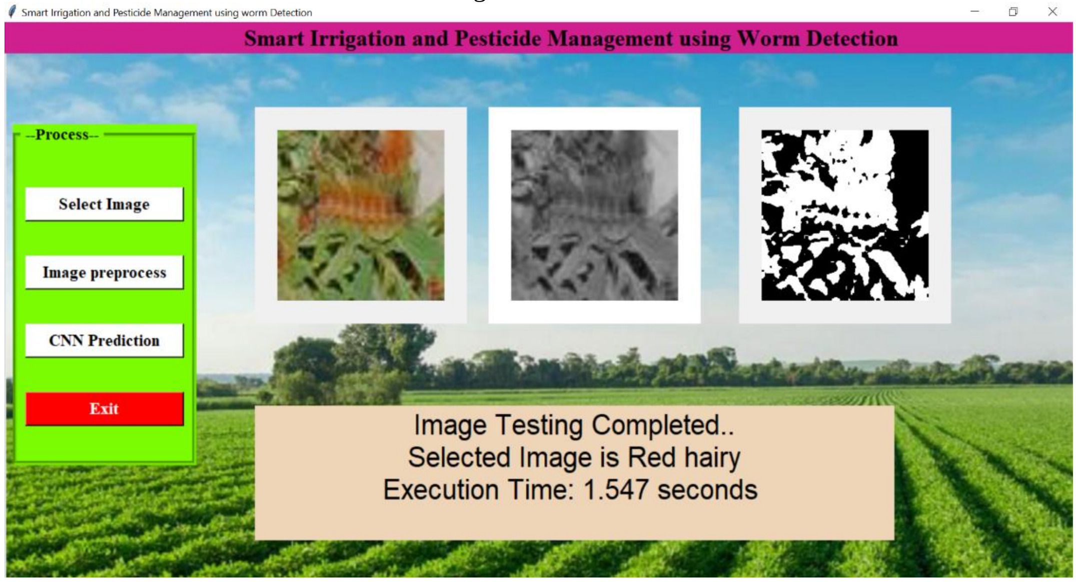

Fig 5.5. Worm 3 Detected

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VI. FUTURE SCOPE & INCREMENTATIONS

Plant-based worm detection systems have a promising future as they offer an environmentally-friendly and non-toxic solution for managing plant pests. Here are some potential areas for future scope and incrementation for plant-based worm detection:

1. Integration with Artificial Intelligence (AI): AI algorithms can be integrated with plant-based worm detection systems to improve the accuracy of detection and reduce false positives. Machine learning algorithms can learn to identify specific worm species by analyzing their unique features and movements, which can be captured using sensors.

2. Sensor technology: Advances in sensor technology can lead to the development of more sophisticated and accurate detection systems. For example, infrared sensors can be used to detect heat signatures from worms, or acoustic sensors can be used to detect the sounds produced by worms as they move.

3. Data analytics: The data generated by plant-based worm detection systems can be analyzed to identify trends and patterns in worm infestations. This can help farmers to make informed decisions about when to apply treatments and how to prevent future infestations.

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Impact Factor: 8.379

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