AI in Agriculture

Introduction

Agriculture is one of the most important sectors of the global economy, and technological advancements have been transforming the way we produce food. One such technology is Artificial Intelligence (AI), which has revolutionized the way we approach agriculture. With the help of AI, we can now detect and diagnose plant diseases much more quickly and accurately than before, which has significant implications for both farmers and consumers.

AI and Agriculture: AI is a broad field that encompasses many different technologies, including machine learning, computer vision, and natural language processing. These technologies can be used to analyze large amounts of data quickly and accurately, allowing us to identify patterns and make predictions about future outcomes.

One of the most promising applications of AI in agriculture is disease detection. Plant diseases are a major challenge for farmers, as they can significantly reduce crop yields and quality. Traditional methods of disease detection involve visual inspection, which can be time-consuming and error-prone. AI, on the other hand, can quickly analyse large amounts of data and identify patterns that are invisible to the human eye.

AI for Disease Detection: AI-based disease detection systems typically involve the use of machine learning algorithms to analyze images of plants and identify signs of disease. These algorithms are trained on large datasets of images that have been annotated with information about the type of disease present, the severity of the symptoms, and other relevant factors.

Once the algorithm has been trained, it can be used to analyse new images of plants and identify signs of disease. The system can also be integrated with other technologies, such as drones or robots, to automate the process of data collection and analysis.

Benefits of AI in Agriculture: The use of AI for disease detection in agriculture has many benefits, including:

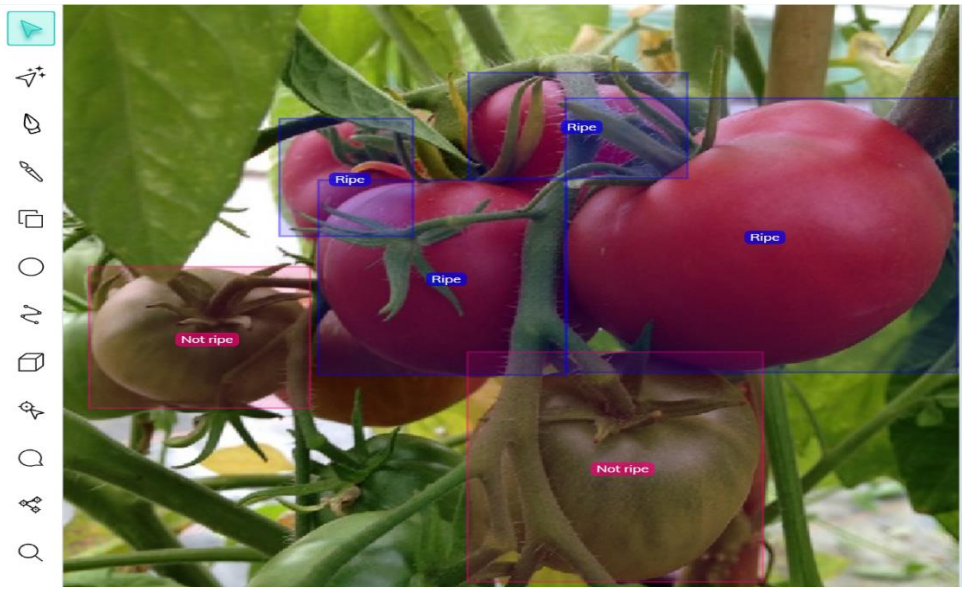
1. Early detection of diseases: AI can identify signs of disease much earlier than traditional methods, allowing farmers to take action before the disease has a chance to spread and cause significant damage.

2. Increased accuracy: AI can analyse large amounts of data quickly and accurately, reducing the likelihood of false positives or false negatives.
3. Reduced costs: AI-based disease detection systems can be more cost-effective than traditional methods, as they require less labour and can be used to cover larger areas of land.
4. Improved crop yields: By detecting diseases earlier and more accurately, farmers can take action to prevent the spread of disease and improve crop yields.

Different applications of AI in agriculture

1. Plant disease detection - AI can detect diseases in plants by analyzing images of leaves and other plant parts. The analysis is based on machine learning algorithms that have been trained on thousands of images of healthy and diseased plants. By comparing the uploaded image to the trained dataset, the AI tool can diagnose plant diseases and provide recommended treatment options. This can help farmers take timely action and prevent crop damage, reducing losses and improving crop yields.
2. Precision agriculture: By using this program, farmers can precisely identify which areas of their crops are affected by disease. This allows them to take targeted action to address the disease and minimize damage to the rest of the crop.
3. Plant breeding: The ability to accurately detect and classify plant diseases can be used to breed plants that are more resistant to specific diseases. This could lead to the development of more resilient crops and better food security.
4. Early detection: Early detection of plant diseases is crucial for effective disease management. This program can be used to quickly identify diseases before they spread too far, allowing for early intervention and better control.
5. Crop monitoring - AI can monitor crops continuously, providing information about their growth, water and nutrient requirements, and overall health. This information can be used to optimize crop yield and reduce waste. For example, AI can analyze satellite imagery to track crop growth and detect abnormalities, such as drought stress or nutrient deficiencies. This data can be used to adjust irrigation and fertilization schedules, ensuring optimal crop growth.
6. Pest detection: AI can be used to detect pests and diseases in crops by analysing images of leaves and fruits. This can help farmers identify infested areas early, allowing for targeted treatment and prevention.

7. Yield prediction: AI can be used to predict crop yields by analysing historical data on weather, soil quality, and crop rotation. This can help farmers make informed decisions about planting and harvesting, improving overall productivity.
8. Soil analysis - AI can analyze soil samples to provide information about soil quality, nutrient content, and other factors that affect crop growth. This can help farmers make informed decisions about soil management and fertilization, improving crop yields and reducing waste. AI can also be used to analyze historical data to predict soil degradation and identify areas that require remediation.
9. Livestock monitoring: AI can be used to monitor the health and behaviour of livestock by analysing sensor data from wearable devices. This can help farmers identify potential health issues early, allowing for prompt treatment and prevention of disease.
10. Predictive analytics: Using historical data on weather patterns, crop yields, and disease outbreaks, AI models can predict the likelihood of future outbreaks.



Picture of AI using in field of agriculture: first picture is about using drones for spray pest in farm; and second is using AI for detecting if the vegetable is ripe or not ripe.

Impact of AI in agriculture

AI is transforming agriculture by helping farmers detect plant diseases more accurately and efficiently using image analysis and environmental data. this leads to better crop yields, reduced pesticide use, and more sustainable food systems. The following are some major Impact of AI in agriculture.

1. Increase in Disease detection: By using AI-powered disease detection tools, farmers can quickly identify and isolate infected plants, reducing the spread of disease and minimizing crop losses. This can help improve crop yields and overall food production, as well as reduce the use of pesticides and other chemicals in agriculture.
2. Increased efficiency and productivity: AI can optimize agricultural practices by using data from various sources such as sensors, drones, and satellites. By analyzing this data using machine learning algorithms, AI can predict crop yield, reduce waste, and lower production costs. For example, AI can predict weather patterns and adjust irrigation schedules accordingly, reducing water usage and improving crop health. Similarly, AI can analyze soil data to determine nutrient content and pH levels, enabling farmers to make informed decisions about fertilization and soil management. This increased efficiency and productivity can help farmers save time and money, while also increasing crop yields and profitability.
3. Improved crop quality: AI can monitor crops continuously, providing information about their growth, water and nutrient requirements, and overall health. This information can be used to optimize crop yield and reduce waste. For example, AI can analyze satellite imagery to track crop growth and detect abnormalities, such as drought stress or nutrient deficiencies. This data can be used to adjust irrigation and fertilization schedules, ensuring optimal crop growth and improving the quality of the harvest.
4. Reduced environmental impact: AI can help reduce the environmental impact of agriculture by optimizing resource usage and reducing waste. For example, by using AI to predict weather patterns and adjust irrigation schedules, farmers can reduce water usage and minimize the risk of over-irrigation. Similarly, by using AI to monitor crops and detect abnormalities, farmers can reduce the use of pesticides and other chemicals, minimizing their impact on the environment.
5. Increased food security: AI can help increase food security by improving crop yields and reducing waste. By optimizing agricultural practices and improving crop quality, AI can help ensure that more food is produced with less waste. This can help increase

the availability and affordability of food, especially in areas where food security is a concern.

Overall, the impact of AI in agriculture has been significant and has the potential to transform the industry in the coming years. By improving efficiency, quality, and sustainability, AI can help farmers save time and money, while also increasing crop yields and profitability.

About this Project:

Plant Disease Detection is developed in Python. This project meets the results by the means of Image Segmentation and Channel Separation. In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as image objects). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

The proposed system includes Automatic detection of the diseases by just seeing the symptoms on the plant leaves. Therefore making it easier as well as cheaper. This uses machine vision to provide image based automatic process control, inspection, and robot guidance.

We use OpenCV, a free to use yet powerful Computer Vision Library which supports Python. The given image of a plant leaf kept on a white background is channel separated to get Red, Green, and Blue channel images. Blue channel being throughout the leaf, seems to be less useful. Hence, Red and Green Channel Images are used to get an image that contains less of the leaf and more diseased part. The Disease Image and the Alpha Channel is used to calculate the Percentage Disease by using the following formula:

$Percentage\ Disease$ = (Number of black pixels in Disease Image*100)/ Number of black pixels in Alpha Channel

Tkinter is used to create a window to get the Processing Factor input via a slider with values ranging from 0 to 255.

Technologies and Tools Used:

- PyCharm,
- Tkinter,

• OpenCV

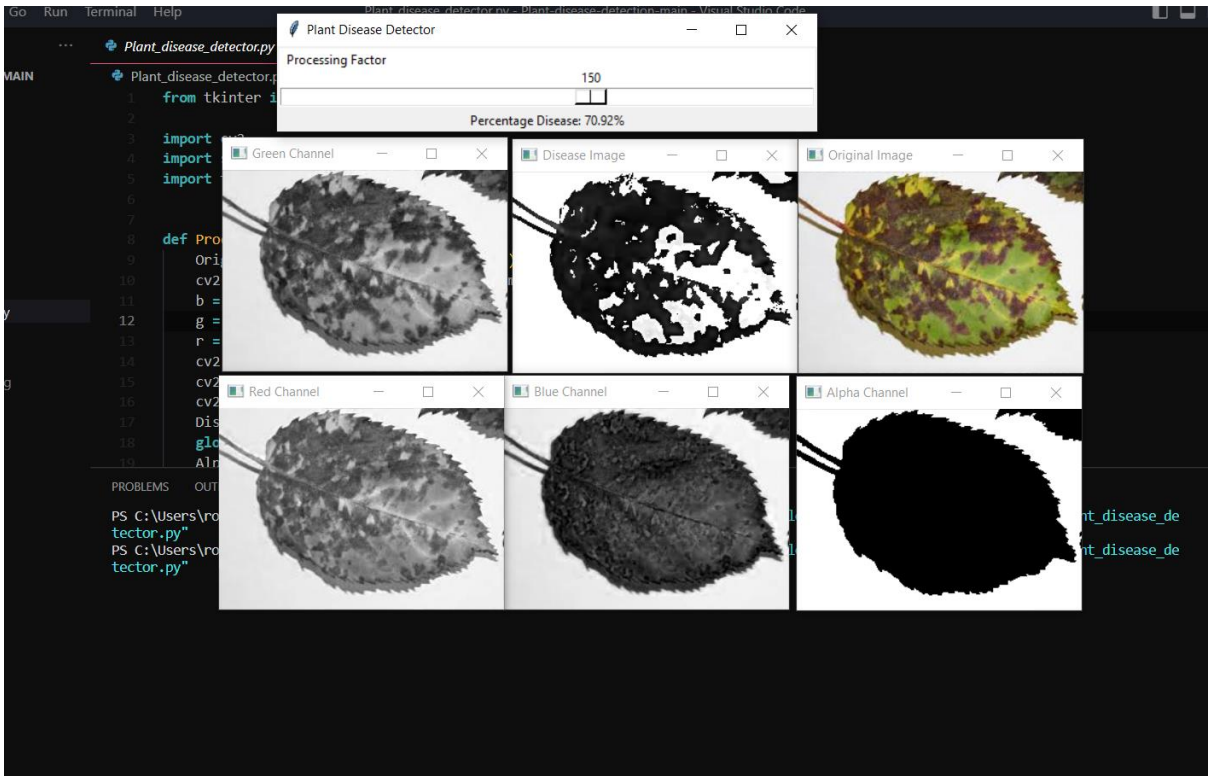
IMPLEMENTATION

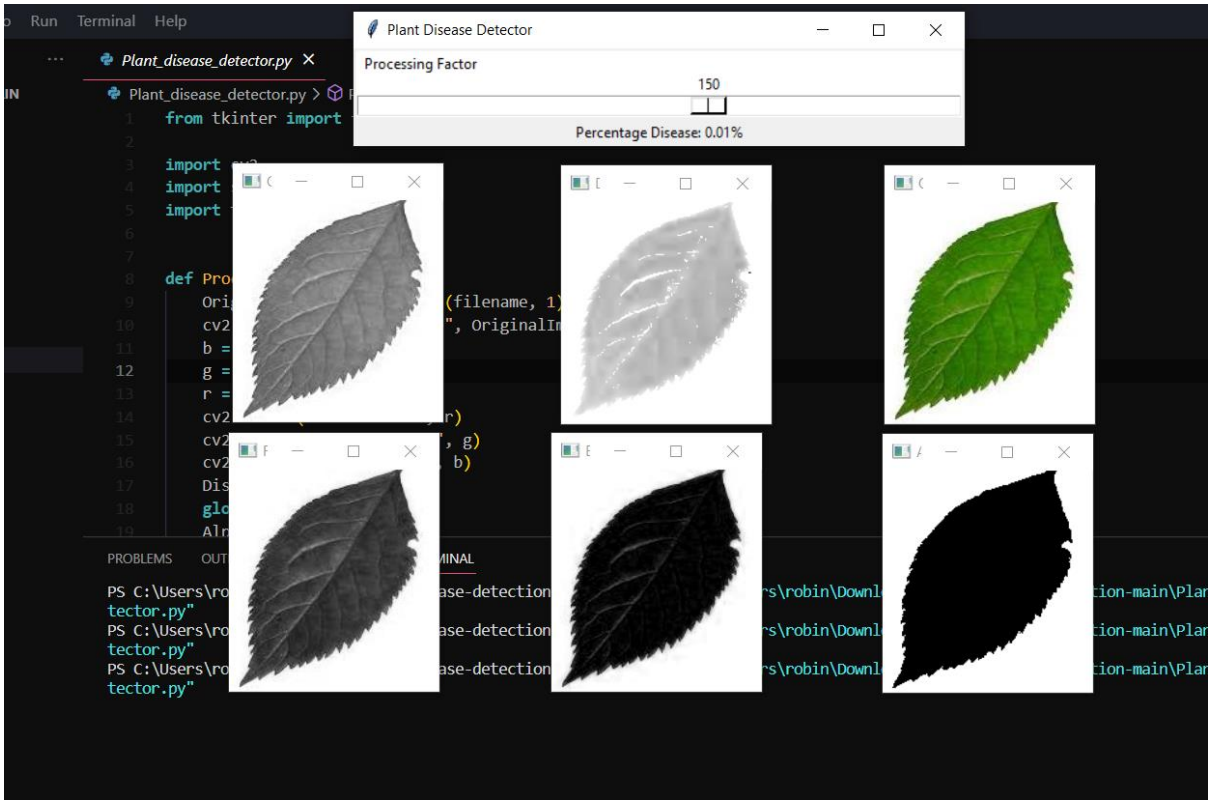
```
from tkinter import filedialog

import cv2
import sys
import tkinter


def ProcessImage(self):
    OriginalImage = cv2.imread(filename, 1)
    cv2.imshow("Original Image", OriginalImage)
    b = OriginalImage[:, :, 0]
    g = OriginalImage[:, :, 1]
    r = OriginalImage[:, :, 2]
    cv2.imshow("Red Channel", r)
    cv2.imshow("Green Channel", g)
    cv2.imshow("Blue Channel", b)
    Disease = r - g
    global Alpha
    Alpha = b
    GetAlpha(OriginalImage)
    cv2.imshow("Alpha Channel", Alpha)
    ProcessingFactor = S.get()
    for i in range(0, OriginalImage.shape[0]):
        for j in range(0, OriginalImage.shape[1]):
            if int(g[i, j]) > ProcessingFactor:
                Disease[i, j] = 255
    cv2.imshow("Disease Image", Disease)
    DisplayDiseasePercentage(Disease)
    S.bind('<ButtonRelease-1>', ProcessImage)
    MainWindow.mainloop()
```

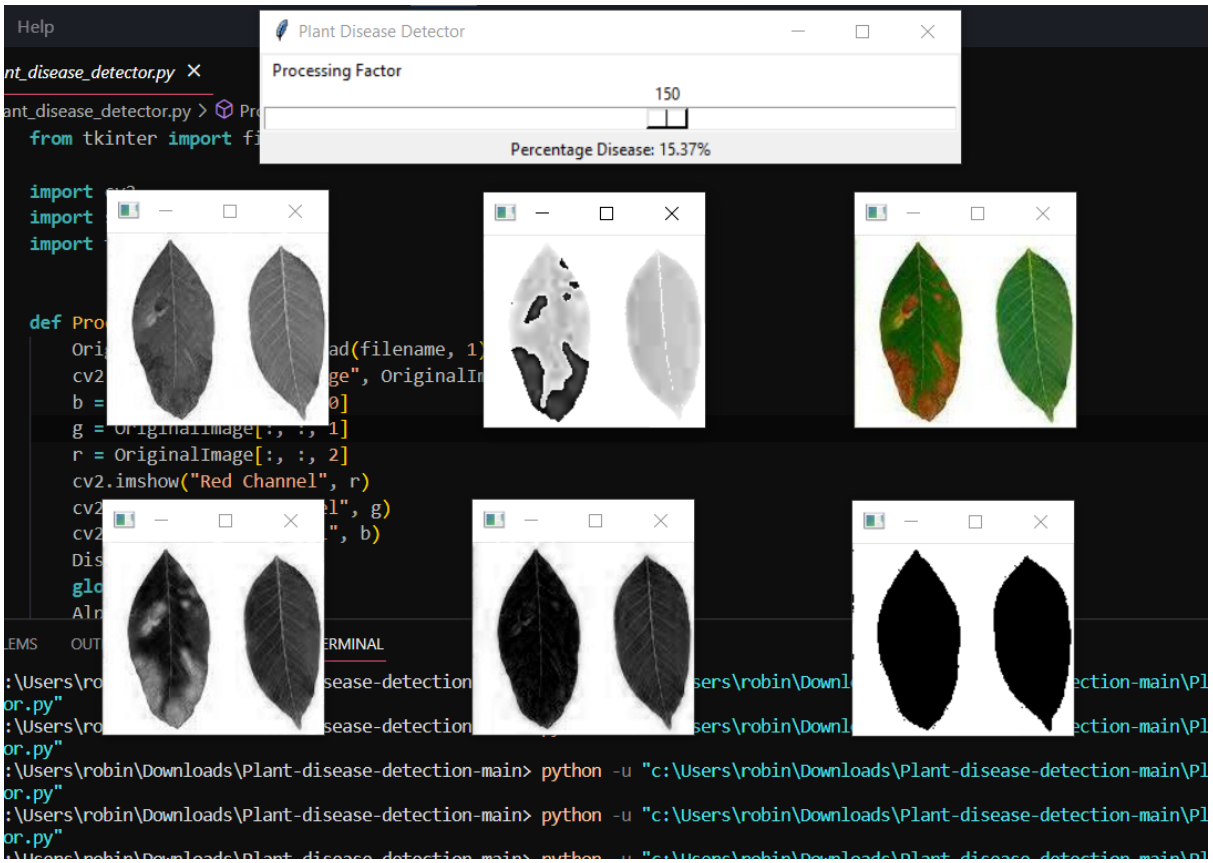
```
def GetAlpha(OriginalImage):
    global Alpha
    for i in range(0, OriginalImage.shape[0]):
        for j in range(0, OriginalImage.shape[1]):
            if OriginalImage[i, j, 0] > 200 and OriginalImage[i, j, 1] > 200 and OriginalImage[i,
j, 2] > 200:
                Alpha[i, j] = 255
            else:
                Alpha[i, j] = 0


def GetFile():
    if len(sys.argv) > 1:
        return sys.argv[1]
    else:
        return filedialog.askopenfilename(title="Select Image")


def DisplayDiseasePercentage(Disease):
    Count = 0
    Res = 0
    for i in range(0, Disease.shape[0]):
        for j in range(0, Disease.shape[1]):
            if Alpha[i, j] == 0:
                Res += 1
            if Disease[i, j] < S.get():
                Count += 1
    Percent = (Count / Res) * 100
    DiseasePercent.set("Percentage Disease: " + str(round(Percent, 2)) + "%")


Alpha = None
MainWindow = tkinter.Tk()
MainWindow.title("Plant Disease Detector")
```

```
S = tkinter.Scale(MainWindow, from_=0, to=255, length=500,
orient=tkinter.HORIZONTAL,
                  background='white', fg='black', troughcolor='white', label="Processing Factor")
S.pack()
S.set(150)

DiseasePercent = tkinter.StringVar()
L = tkinter.Label(MainWindow, textvariable=DiseasePercent)
L.pack()

filename = GetFile()
if filename != "":
    ProcessImage(None)
else:
    print("No File Found!")
    print("Seriously man,can you be little serious about this.")
    exit(0)
```

Screenshots:




Plant Disease Detector
Processing Factor
150
Percentage Disease: 0.01%
Plant_disease_detector.py
from tkinter import
import
import
import
def Pro
PROBLEMS
OUT
PS C:\Users\ro
tector.py"
PS C:\Users\ro
tector.py"
PS C:\Users\ro
tector.py"


Plant Disease Detector
Processing Factor
150
Percentage Disease: 15.37%
Help
from tkinter import
import
import
import
def Pro
cv2.imshow("Red Channel", r)
:\Users\robin\Downloads\Plant-disease-detection-main> python -u "c:\Users\robin\Downloads\Plant-disease-detection-main\Pl
or.py"
:\Users\robin\Downloads\Plant-disease-detection-main> python -u "c:\Users\robin\Downloads\Plant-disease-detection-main\Pl
or.py"

Further Scope

AI in agriculture for disease detection is a very important and promising research area that can help improve crop yield and quality. Our AI can use techniques such as artificial neural networks to analyze images of plants and identify diseases and pests. AI can also help farmers to monitor the health of their crops and provide timely and accurate diagnosis and treatment suggestions.

Some of the crops that AI can help detect diseases and pests are rice, wheat, maize, cotton, tomato, peas, potato, cucumber, cassava, berries, peach, grapes, olives, mango, banana, apple, sweet pepper, tea**,** etc. AI can also handle different types of diseases and pests such as fungal infections, bacterial infections, viral infections, insect damage, nutrient deficiency, etc.

The future scope of AI in agriculture for disease detection is to develop more robust and efficient models that can work in different environments and conditions. AI can also integrate with other technologies such as drones, sensors and IoT devices to provide more comprehensive and real-time information about the crops. AI can also leverage big data and cloud computing to enhance its learning and prediction capabilities. AI can also collaborate with human experts and farmers to provide more personalized and interactive solutions.

Conclusion

In conclusion, we want to conclude that AI in agriculture is and will be the greatest success for the agricultural industry as it is a revolutionary idea which will change the world in a better way then every. After the implementation of ai in agriculture, every word will be automatic due to which man power will be saved which can be further used in technical field.