SHADOW REMOVAL USING COLOR INVARIANT TECHNIQUE

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Abstract: A significant threat to farmers, consumers, the environment, and the global economy is posed by plant diseases. Pathogens and pests alone in India cause the loss of 35% of field crops, costing farmers money. Because many pesticides are poisonous and biomagnified, indiscriminate use of them poses a major health risk. Early disease detection, crop surveillance, and targeted treatments can prevent these negative impacts. Agricultural specialists typically detect diseases by looking at their outward symptoms. Farmers, meanwhile, have little access to professionals. Our initiative is the first collaborative, comprehensive platform for automatically diagnosing, tracking, and forecasting diseases. By capturing the afflicted plant sections, farmers may quickly and correctly identify illnesses and find remedies using a mobile app. The most recent Artificial Intelligence (AI) algorithms for cloud-based image processing enable real-time diagnosis. The AI model continuously improves its accuracy by learning from user-uploaded photographs and professional recommendations. The portal also allows farmers to communicate with regional specialists. Disease density maps with spread forecasts are produced for preventive interventions using a cloud-based repository of geo-tagged photos and micro-climatic variables. Experts can perform disease analyses using geographic visualizations using a web interface. In our studies, the AI model (CNN) was trained using substantial disease datasets, constructed from plant photos that were independently gathered over a 7-month period from numerous farms. Plant pathologists validated the results after using the automated CNN model to diagnose test images. Accuracy in identifying diseases of over 95% was attained. Our solution is a brand-new, adaptable, and available technology for disease management of various agricultural crop plants that can be used by farmers and industry professionals to produce crops in an environmentally friendly manner.

Index Terms: - Artificial Intelligence (AI), Plant pathologists, Automated CNN Model.

I Introduction

Shadows will appear and be a part of an object in an image when it is bright outside or when there is intense lighting. The presence of an item's shadow in an image can interfere with various crucial algorithms used in the domains of object recognition, segmentation, and object tracking. The outcome of picture processing can be considerably enhanced by eliminating the shadows.

Identifying and removing shadows is crucial when working with colored outdoor pictures. The local and relative absence of light causes shadows to form. First and foremost, a shadow is a localized reduction in the amount of light that reaches a surface. Secondly, they are a local change in the quantity of light that a surface rejects in the direction of the observer. The majority of approaches for segmenting and detecting shadows are based on image analysis.

But because of the complexity of the situation, some factors will affect the detection outcome, such as water and a low intensity roof because of the unique material because they are easily mistaken for shadows. In this study, a shadow detection test is presented, followed by a shadow removal method based on the energy function notion. The dimensions of the items and the lighting source's angles affect the shadow patterns. Problems with scene comprehension, object segmentation, tracking, and recognition may result from this. Over the past few decades, the field of shadow removal has received a lot of interest due to the negative consequences that shadows have on picture analysis. These applications include traffic monitoring, face recognition, image segmentation, and more. The loss of information for the surface hidden by shadows presents challenges for image matching, detection, and other applications, among other drawbacks. In order to identify shadows in digital photos and image sequences, a number of cues that suggest the presence of shadows in a visual scene are used. Since shadows can occasionally obscure photographs, shadow removal from the relevant image can be utilised for object detection, such as cancer screening, military object recognition, etc. The shadows in the photographs will be eliminated, making items more visible and easier to identify. When working with colour outdoor photographs, the challenge of detecting and removing shadows is crucial.

2 Literature survey

In many computer vision applications, the pre-processing step of shadow detection and removal is crucial. In the image segmentation process, the shadows could result in erroneous segments. Additionally, object detection algorithms may incorrectly identify shadows as objects. The detection of shadows in a picture has been proposed using a variety of pixel-based and region-based techniques. This section summarises some of the significant scientific studies on shadow reduction.

In comparison to the surroundings, shadowy parts are less lit. In their initial proposal, Howard and Drew [1] suggested a method to find the shadows by creating an illumination-invariant image in which the shadows are invisible. To find the shadow edges, the illumination-invariant image is combined with the original colour image. To obtain the shadow-free image, these edges are set to zero and the edge representation is reintegrated. In [2], it was suggested to eliminate shadows by employing numerous Retinex routes. Both the retinex technique and the Poisson equation-based reintegration require extensive computational resources.

It was suggested in [3] to remove shadows more quickly by averaging the outcomes of reintegration along a small number of image-based Hamiltonian routes. It has been demonstrated by Frédérick and Finlay that sealing the shadow edges before to reintegration helps reduce error propagation during reintegration. Reintegration occurs in the image that only once enters and exits the shadow region along Hamiltonian routes. However, reintegration using the Poisson equation [1] yields superior outcomes.

Three steps are used in [5] to remove the shadows. The result is a 1D shadow-free illumination invariant image. This leads to the generation of a 3D shadow-free colour image and a 2D colour representation. By repainting, the shadow edges are finally fixed. The shadow areas are said to differ from the non-shadow representation by a single constant that can be determined quickly, according to Friedemann and Finch [6]. It is calculated independently for the constants for the R, G, and B channels. The constant is set up so that when the shadow zone is added, it will lessen the contrast between it and its surrounds.

A method to identify shadows in a single monochromatic image using shadow invariant, shadow variant, and near-black features was proposed by Zhu et al. [11]. In [12], a trained decision tree classifier is employed to find the borders of shadow in pictures taken outside. After that, a Conditional Random Field (CRF)-based optimization groups the shadow edges. G u o, D an I and H o I e m [13] suggested using a region-based method to identify and eliminate shadows from an image. The image's segmented parts are categorised according to relative illumination, and the shadow and non-shadow portions are labelled using a graph-cut. To obtain an image without shadows, shadow-pixels are lit.

Tricolor Attenuation Model (TAM)-based shadow detection in a single image was suggested in [14]. Following the identification of the shadow, an invariant image is created and segmentation is then done on it. Next, the shadow is discovered using TAM. But the shadows are incorrectly assigned to the dark parts. A method to recognise and categorise the shadows in colour photographs was proposed by S a l v a d o r, C a v a l l a r o, and E b r a h I m I [15]. To identify shadows, luminance and colour data are used. This technique also divides the shadows into self- and cast-shadow categories. But for the approach to function, limitations are placed on the light source.

3 Implementation Study

Shadow detection and removal is an important pre-processing task in many of the computer vision applications. The shadows may give rise to false segments in the image segmentation process. Also, shadows may be wrongly detected as objects in object detection algorithms. Various pixel-based and region-based methods were proposed to detect the shadows in an image.

3.1 Proposed Methodology

In shadow removal and detection , we have to perform various types of blurring and sharpening operations so as to filter the input image and remove the unwanted and undesirable pictorial elements in a better manner .

These set of operations are not module dependent and can be applied as pre or post processing analysis.The major significant points of blurring and sharpening are :-

- Edges and other sharp transtitions in the gray level of an image contributesignificantly to the high-frequency contents of it's Fourier Transform
- Hence smoothing (blurring) is achieved in the frequency domain by attenuating a specified range of high-frequency components in the transform of a given image .

- We can employ various filters for this task like Ideal ,Butterworth ,Gaussian filters . These three filters cover the range from very sharp to very smooth filter order .The Butterworth has a parameter called Filter Order ,and for very high values of this parameter , Butterworth exhibits ideal Behavior.
- Image sharpening on the other hand can be achieved by a high-pass filtering process which attenuates the low frequency components without disturbing the high frequency information in the digital image .

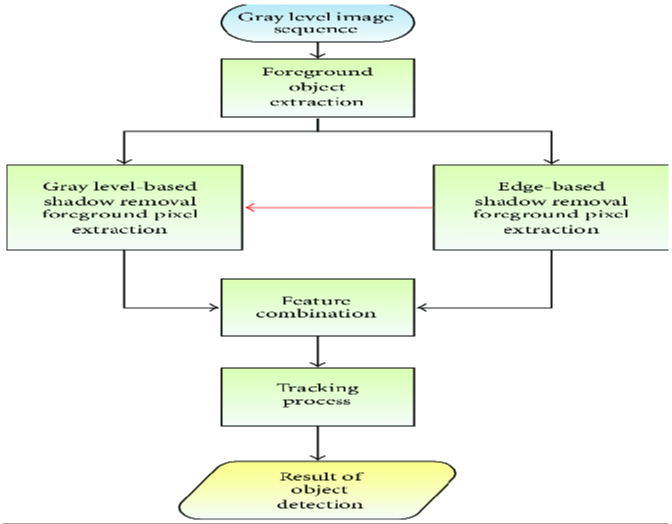

Fig1: System Architecture

4. Methodology

➢ Digital image processing is the use of computer algorithms to perform image processing on digital images .It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

➢ An image may be defined as a two-dimensional function, f(x, y), where x and y are *spatial* (plane) coordinates, and the amplitude of f at any pair of coordinates (x, y) is called the *intensity* or *gray level* of the image at that point.When x, y, and the amplitude values of f are all finite, discrete quantities, we call the image a *digital image*.The field of *digital image processing* refers to processing digital images by means of a digital computer.

➢ A digital image is composed of a finite number of elements, each of which has a particular location and value.These elements are referred to as *picture elements*, *image elements*, *pels*, and *pixels*. *Pixel* is the term most widely used to denote the elements of a digital image.

➢ Vision is the most advanced of our senses, so it is not surprising that images play the single most important role in human perception. However, unlike humans, who are limited to the visual band of the electromagnetic (EM) spectrum, imaging machines cover almost the entire EM spectrum, ranging from gamma to radio waves.

➢ They can operate on images generated by sources that humans are not accustomed to associating with images. These include ultrasound, electron microscopy, and computer-generated images.Thus, digital image processing encompasses a wide and varied field of applications.

➢ There is no general agreement among authors regarding where image processing stops and other related areas, such as image analysis and computer vision, start. Sometimes a distinction is made by defining image processing as discipline in which both the input and output of a process are images.

➢ For example, under this definition, even the trivial task of computing the average intensity of an image (which yields a single number) would not be considered an image processing operation.

➢ On the other hand, there are fields such as computer vision whose ultimate goal is to use computers to emulate human vision, including learning and being able to make inferences and take actions based on visual inputs.This area itself is a branch of artificial intelligence (AI) whose objective is to emulate human intelligence.

➢ The area of image analysis (also called image understanding) is in between image processing and computer vision. There are no clear-cut boundaries in the continuum from image processing at one end to computer vision at the other.

However, one useful paradigm is to consider three types of computerized processes in this continuum:

❖ low-level processing

❖ mid-level processing

❖ high-level processing

❖ Low-level processes involve primitive operations such as image preprocessing to reduce noise, contrast enhancement, and image sharpening.A low-level process is characterized by the fact that both

its inputs and outputs are images.

❖ Mid-level processing on images involves tasks such as segmentation (partitioning an image into regions or objects), description of those objects to reduce them to a form suitable for computer processing, and classification (recognition) of individual objects (e.g., edges, contours, and the identity of individual objects).

❖ Fig2

OTHER MORPHOLOGICAL OPERATIONS USED

There are four basic operations for morphological operation on a digital image. Those are: -

1. Erosion
2. Dilation
3. Opening
4. Closing.

- According to our different requirement, we use different type of these operations. For each operation we are having structuring element or mask. That mask is superimposed on the image.

- In case of erosion, masking is started from the central pixel of the image and moving outward. If mask is not completely superimposed on a processing pixel and its neighbors of the image, all image pixels under mask are discarded. Formally we can say that erosion shrinks or thins a component in a digital image.
- Similarly, dilation is operation which expands or thickens a component in a digital image. In case of dilation if mask is not completely superimposed on a processing pixel and its neighbors of the image, all image pixels which not under mask are selected.
- Opening generally smoothers the contour of an object and eliminate thin protrusions which is combination of erosion followed by dilation.
- Closing also tends to smooth sections of contours but fusing narrow breaks and long, thin gulfs and eliminating small holes and filling gaps in the contour which is combination of dilation followed by erosion.

5 Results and Evolution Metrices

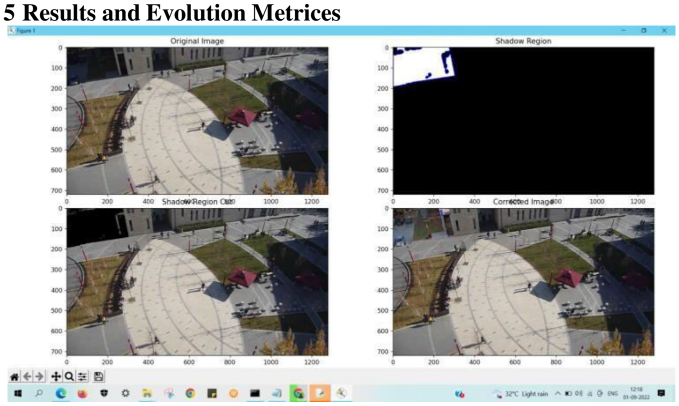

Fig1:

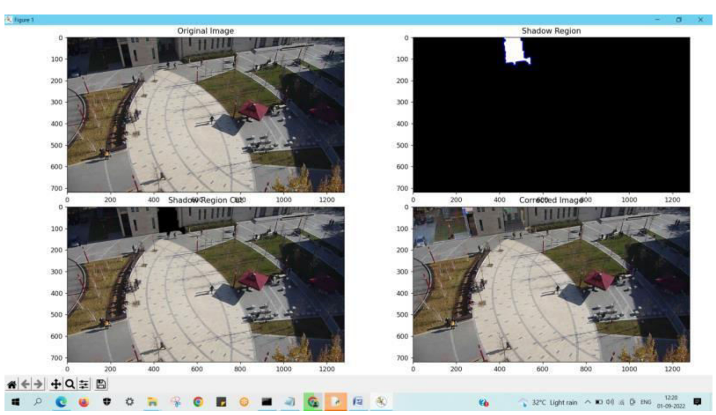

Fig2:

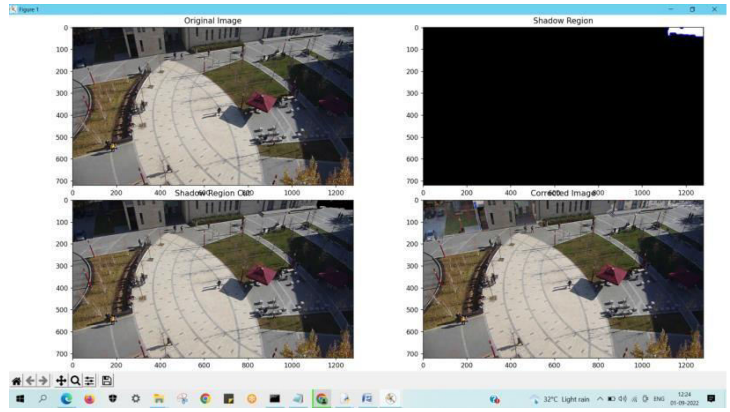

Fig3:

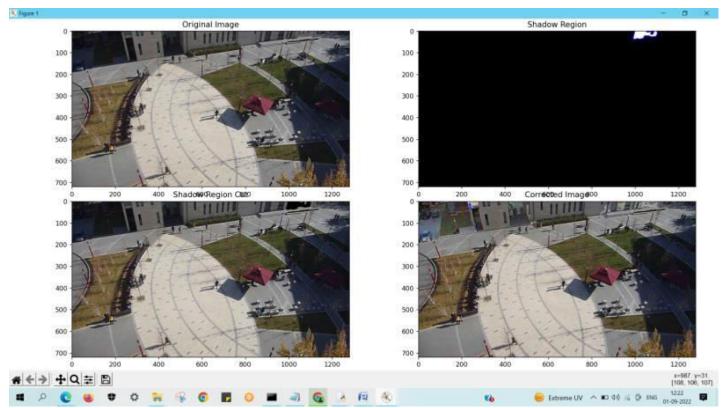

Fig4:

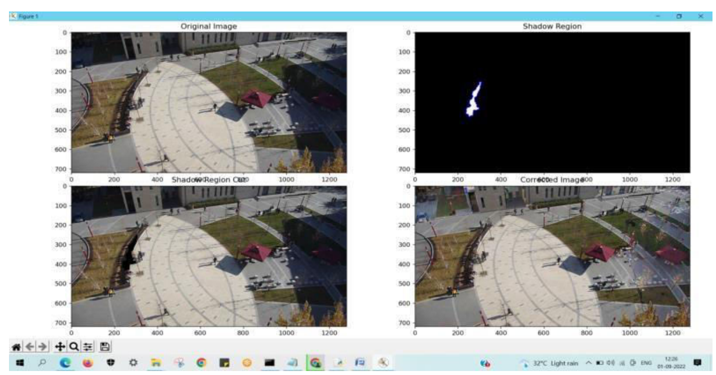

Fig5:

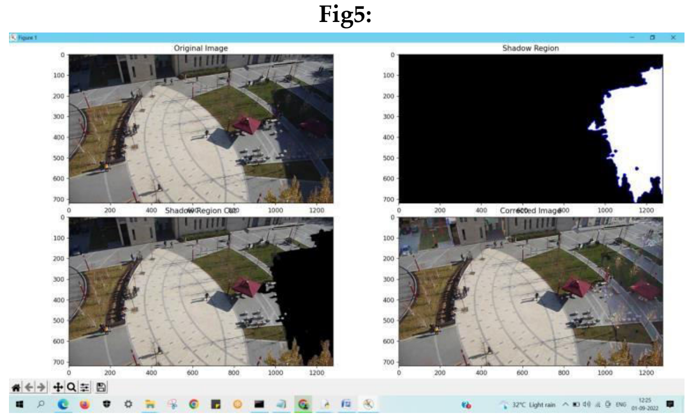

Fig6:

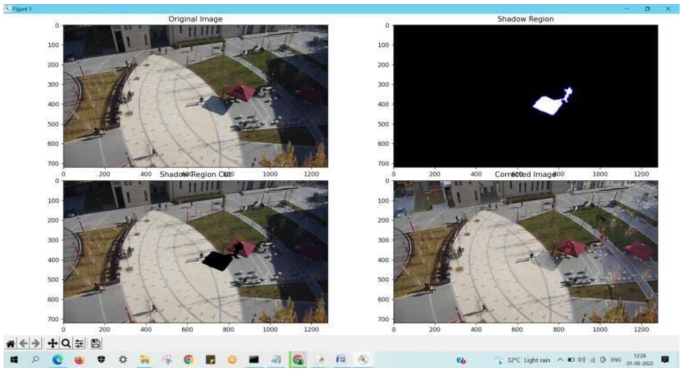

Fig7:

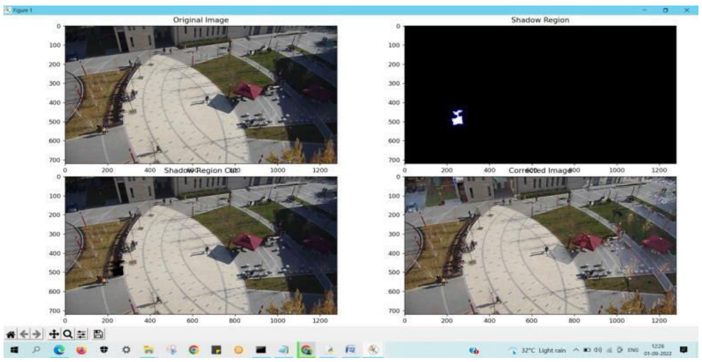

Fig8:

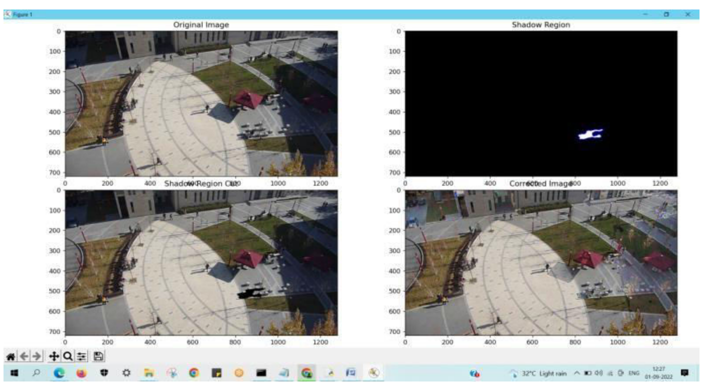

Fig9:

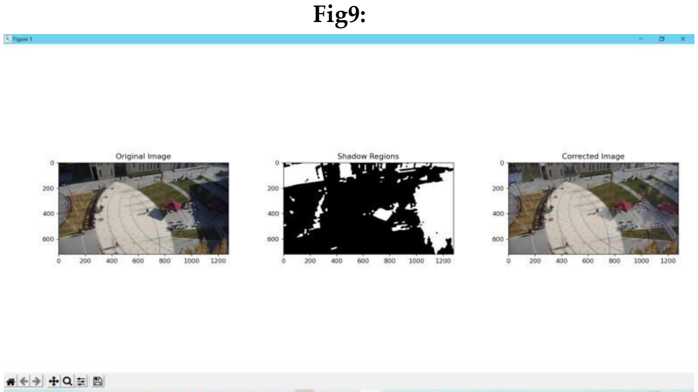

Fig10:

6 Conclusion

In this work, we have presented a simple algorithm for accurate, fully automatic, shadow detection and subsequent removal in images . It is based on increasing the regulated lightness of shadowed regions in an image by replication of colours in relation to neighbors of that pixel(Mean/Median Methods).The color of that part of the surface is then corrected so that it matches the lit part ofthe surface. It is also observed that The image can be segmented successfully into segments based on colors and gray scale values alone alone. This shows that it is possible to remove shadow from image without losing a large amount of pertinent data.The ability to correct shadow regions depends on an accurate and effective strategy of both detecting shadow and de-shadowing, both of which are fundamentally importantto our conception and understanding of producing a shadow-free image.The commonly used shadow detection techniques and de-shadowing methods in theshadow correction procedure are thresholding and recovery information in shadow, respectively. There is a need for classification of various algorithms that have been employed in shadow correction research to allow greater understanding of their disadvantages and advantages. Also, by increasing the amount of sensed data, particularly new data, there is a need to develop new shadow correction algorithms. In addition, a standard shadow correction tool should be added to photo editing software applications.

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