A Survey on Adaptive Techniques of Image Superresolution

Antim Patel[1], Kishori Shekoker[2]

[1] Master Student, Computer, Sigma College of Engineering, Gujarat, India
[2] Assistant Professor, Sigma College of Engineering, Gujarat, India

ABSTRACT

Abstract: Superresolution is a concept to increase the resolution. The main objective is super-resolving low resolution of a leaf diseased images. Plant diseases can cause significant reduction in both quality and quantity of agricultural products. This restrict the growth of plant and reduces quality and quantity of plant and eventually cause major reduction in economic production. The naked eye observation of experts is the traditional approach which is too much time consuming. Thus automatic disease detection systems are developed but here need arise for high definition input images. Superresolution is the cheap solution of this problem. In many practical applications super resolution algorithms are applied but the results obtained are not really satisfactory, being affected by relevant artifacts like blurring, over smoothed or sharped and jaggies. Here ICBI: Iterative Curvature Based Interpolation combined with NEDI: New Edge Detection Interpolation is described for super resolving. Further to remove over smoothing or over sharping, PSO: Particle Swarm Optimization technique is applied. Using a cost function, the image pixels are classified using the Particle Swarm Optimization technique. The cost function measured similarity/dissimilarity among pixels using not only the intensity values, but also the positions of the pixels. The detection technique enforced PSO based clustering, which is very simple and robust. The filtering operator Gabor filter and Log filter are used to restore only the noisy pixels keeping noise free pixels intact. Finally, corrected image is generated which can be used for agricultural applications like leaf disease detection system, leaf identification system and such others.

Keyword: *- Super resolution, Adaptive techniques, FCBI, NEDI , ICBI, PSO*

1. Introduction

For better performance in image analysis, a common need arises of high resolution. High pixel density is offered by high resolution image and thereby the image has more details then the original image.

The central aim of Super-Resolution (SR) is to generate a higher resolution image from lower resolution images. High resolution image offers a high pixel density and thereby more details about the original scene. The need for high resolution is common in computer vision applications for better performance in pattern recognition and analysis of images. High resolution is of importance in medical imaging for diagnosis. Many applications require zooming of a specific area of interest in the image wherein high resolution becomes essential, e.g. surveillance, forensic and satellite imaging applications.

However, high resolution images are not always available. This is since the setup for high resolution imaging proves expensive and also it may not always be feasible due to the inherent limitations of the sensor, optics manufacturing technology. These problems can be overcome through the use of image processing algorithms, which are relatively inexpensive, giving rise to concept of super-resolution. It provides an advantage as it may cost less and the existing low resolution imaging systems can still be utilized.

1.1 Super-resolution

Super-resolution is based on the idea that a combination of low resolution (noisy) sequence of images of a scene can be used to generate a high resolution image or image sequence. Thus it attempts to reconstruct the original scene image with high resolution given a set of observed images at lower resolution.

The general approach considers the low resolution images as resulting from resampling of a high resolution image. The goal is then to recover the high resolution image which when resampled based on the input images and the imaging model, will produce the low resolution observed images. Thus the accuracy of imaging model is vital for super-resolution and an incorrect modeling, say of motion, can actually degrade the image further.

The observed images could be taken from one or multiple cameras or could be frames of a video sequence. These images need to be mapped to a common reference frame. This process is registration. The super-resolution procedure can then be applied to a region of interest in the aligned composite image. The key to successful super-resolution consists of accurate alignment i.e. registration and formulation of an appropriate forward image model. The figure 1 below shows the stages in super-resolution process.

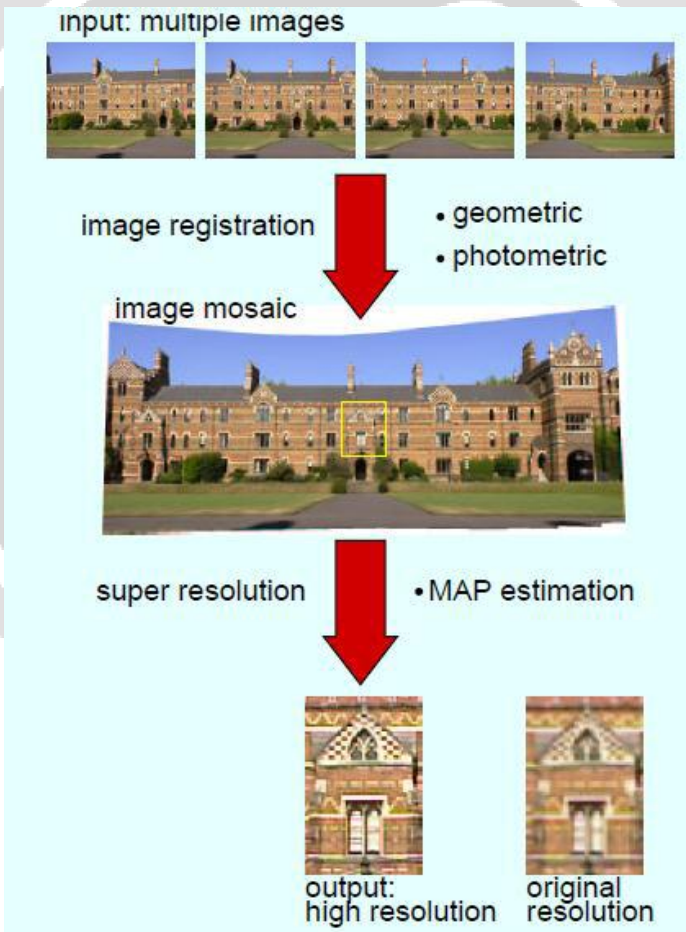


Figure 1: Stages in super-resolution [1]

1.2 Super Resolution Techniques

As per the super resolution imaging analysis is concerned, there are two main domains i.e. Frequency domain and Spatial domain approach for image registration. In our case, the results of the spatial domain are very much better in visual quality as well as in analytical parameter also than the frequency domain, which typically failed to adequately register images. By the nature of frequency domain, Fourier transform methods are limited to only global motion models. In the early stages, most of the research work is carried out under frequency domain approach but as more general degradation models were considered; later research has tended to concentrate almost exclusively on spatial domain formulations.

Basically, image super resolution can be obtained in two categories- Non-adaptive SR & Adaptive SR in spatial domain approach.

A. Non-adaptive Image SR

Non-adaptive image SR techniques are based on direct manipulation on pixels instead of considering any feature or content of an image. These techniques follow the same pattern for all pixels and are easy to perform and have less calculation cost. Various non-adaptive techniques are nearest neighbour. bilinear and bicubic. But these techniques having some drawbacks such as problems of blurring of edges or artifacts around edges. It stores only low frequency component of an original leaf image also produces blurry images quality. Mainly it misses the required information from super resolved infected leaf image. To overcome these, we approached for Adaptive Image SR for our agricultural information for more accuracy.

B. Adaptive Image SR.

This technique considers image features like intensity value, edges as well as texture information's. It also provides better visual image quality result as it preserves high frequency components from an original infected leaf image, so it is much easier for detection and classification accuracy. Various adaptive SR techniques are NEDI, DDT. FeBI, Learning based approach. Only main drawback is it requires much more computational time. So, here, we have worked over this problem while maintaining the SR quality of an infected leaf image. So, as far as infected leaf image problems are concerned, adaptive image SR approach is much better in practice and advantageous. Machine learning based detection and recognition of plant diseases can provide clues to identify and treat the diseases in its early stages. Comparatively, visually identifying plant diseases is expensive, inefficient, and difficult. Also, it requires the expertise of trained botanist. There are several methods for measuring leaf area, however, in practice, it is used mainly three: the human evaluation, the method of leaf dimensions and the methods which use devices such as plan meter and area integrator. Nevertheless, these methods require extensive work and are time-consuming. Moreover, they have some degree of inaccuracy. And, the measurement techniques are not performed in the most cases by a farmer, but by an expert (agronomist), which delays the diagnosis. With the advances in computing, especially in the graphics processing, it is possible to develop alternative methods for determining the damaged leaf area. Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products.

1.3 Plant diseases analysis and its symptoms

The RGB image feature pixel counting techniques is extensively applied to agricultural science. Image analysis can be applied for the following purposes [3]:

- To detect plant leaf, stem, and fruit diseases.
- To quantify affected area by disease.
- To find the boundaries of the affected area.
- To determine the colour of the affected area
- To determine size & shape of fruits.

1.3.1. Bacterial disease symptoms [6].

The disease is characterized by tiny pale green spots which soon come into view as water- soaked. The lesions enlarge and then appear as dry dead spots as shown in figure 1(a), e.g. bacterial leaf spot have brown or black water-soaked spots on the foliage, sometimes with a yellow halo, generally identical in size. Under dry conditions the spots have a speckled appearance. Infected plants have brown or black water-soaked spots on the foliage, sometimes with a yellow halo, usually uniform in size. The spots enlarge and will run together under wet conditions. Under dry conditions the spots have a speckled appearance. As spots become more numerous, entire leaves may yellow, wither and drop. Members of the Prunus family (stone fruits, including cherry, plum, almond, apricot and peach) are particularly susceptible to bacterial leaf spot. The fruit may appear spotted or have sunken brown areas.

1.3.2. Viral disease symptoms [6].

Among all plant leaf diseases, those caused by viruses are the most difficult to diagnose. Viruses produce no telltale signs that can be readily observed and often easily confused with nutrient deficiencies and herbicide injury. Aphids, leafhoppers, whiteflies and cucumber beetles insects are common carriers of this disease, e.g. Mosaic Virus, Look for yellow or green stripes or spots on foliage, as shown in figure 1(b). Leaves might be wrinkled, curled and growth may be stunted. Pathogen-caused leaf spot diseases, particularly those of stone fruit trees and such vegetables as tomatoes, peppers, and lettuce are of two types, those caused by bacteria and those caused by fungus. Leaf spotting of either kind is generally similar in appearance and effect. Prevention and treatment of both kinds often involve the same practices.

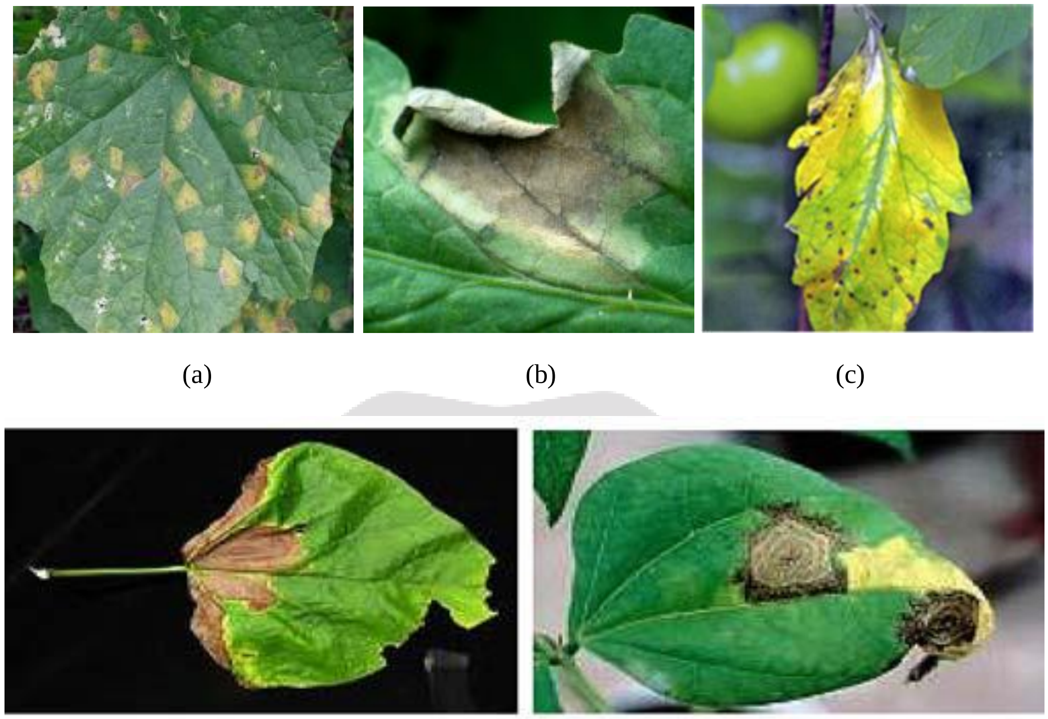
(a)

(b)

Figure 1: Bacterial and Viral disease on leaves: (a) Bacterial leaf spot and bacterial disease in rose and beans leaf, (b) Mosaic virus, sun burn disease in lemon leaf, early scorch disease in banana leaf.

1.1.3 Fungal disease symptoms [6].

Among all plant leaf diseases, those caused by fungus some of them are discussed below and shown in figure 2, e.g. Late blight caused by the fungus Phytophthora infesters shown in figure 2(a). It first appears on lower, older leaves like water-soaked, gray-green spots. When fungal disease matures, these spots darken and then white fungal growth forms on the undersides. Early blight is caused by the fungus Alternaria solani shown in figure 2(b). It first appears on the lower, older leaves like small brown spots with concentric rings that form a bull’s eye pattern. When disease matures, it spreads outward on the leaf surface causing it to turn yellow. In downy mildew yellow to white patches on the upper surfa12. These areas are covered with white to greyish on the undersides as shown in figure 2(c).



(a) (b) (c) (d) (e)

Figure 2: Fungal disease on leaves: (a) Late blight, (b) Early blight, (c) Downy mildew, (d) Late scorch disease in beans leaf, (e) Fungal disease in bean leaf

2. LITERATURE SURVEY

A brief survey on literature for many research papers from different journals is given below:

2.1 Adaptive Image Superresolution for Agrobased Applicaion[1]

Author: S. B. Kasturiwala, S. A. Ladhake
Description:
Super resolution is a concept to increase the resolution. The proposed work preserves fine edges of SR images without applying complex mathematical algorithms based on wavelet, fast curve let, etc. Paper have validated the proposed scheme over 9 infected leaf images of various crops like soybean, cotton, rose, citrus family etc. The concept is most useful for agricultural expert for helping the farmers for exact leaf disease detection and accurate remedial actions.
Iterative curvature-based interpolation technique focuses on estimation of direction and based on second order derivatives. Main purpose of introducing ICBSR technique to minimize the artifacts presented in image compare to other technique like patch based learning and other adaptive and nonadoptive SR techniques. ICBSR technique has lower computational cost then other non-adaptive techniques. Image magnification generally results in loss of image quality. Therefore, image magnification requires interpolation to read between the pixels. Generally, the enlarged images suffer fTom imperfect reconstructions, pixelization and jagged contours. The proposed system provides error-fTee high resolution for real time infected leaf images. The basic idea behind the system comprises two basic steps: ICBSR technique is a combination of two techniques. In first technique, the new pixels are computed by interpolating along the direction (FCBI, Fast Curvature Based Interpolation). In second technique, we modified the interpolated pixels using iterative method with energy term for edge preservation purpose.

First technique, FCBI is same the Data Dependent Triangulation interpolation technique, but instead of taking the average value of two opposite neighbour pixels, we consider second order derivatives in two diagonal direction I_{11} and 1_{22} and compute new pixel values in such a direction where the estimated derivative is low.
In second technique, the energy term is sum of the curvature continuity, curvature enhancement and is levels curves. First we compute, for each new pixel, the energy function U(2i+l; 2j+l) and the two modified energies U+(2i+l;2j+l) and U-(2i+l;2j+l), i.e. the energy values obtained by adding or subtracting a fixed value called threshold value to the local pixel value 1(2i+l;2 j+l) [14] and assign this intensity value to pixel. This procedure is iteratively repeated until the sum of the modified pixels at the current iteration is lower than a fixed threshold value. Overall procedure for ICBSR technique is as follows:

Advantages:

Preserves fine edges of SR images. Less computational time as compared to complex multi frame SR algorithms like reconstruction and registration.

Limitation:

Experimental result shows that the proposed method has low PSNR valuei. E. 32.09.

2.2 Enlargement of image based upon Interpolation Techniques [2].

Author: K. Sreedhar Reddy, K. Rama Linga Reddy

Description:

A new method (ICBI, Iterative Curvature Based Interpolation) based on a two-step grid filling and an iterative correction of the interpolated pixels obtained by minimizing an objective function depending on the second order directional derivatives of the image intensity is presented. The high quality of the images enlarged with the new method is demonstrated with objective and subjective tests, and PSNR for ICBI is 30.085 dB. Implementation is done by creating several steps of the algorithm using kernels, so different blocks of the image can be executed in parallel and the execution of the different steps is synchronized. Comparison between ICBI with FCBI in two cases that is PSNR (Peak Signal to Noise Ratio) test and time calculations is shown.
Image magnification generally results in loss of image quality. Therefore, image magnification requires interpolation to read between the pixels. Generally, the enlarged images suffer from imperfect reconstructions, pixelization and jagged contours. The proposed system provides error-free high resolution for real images. The basic idea behind the system comprises two basic steps:

i) Fast Curvature Based Interpolation (FCBI) which involves the filling of missing values after zooming and
ii) Iterative Curvature Based Interpolation (ICBI) which involves the modification of the filled values. The results obtained from the simulation shows that the proposed interpolation algorithm improves the quality of the image both subjectively and objectively compared to the previous conventional techniques.

Advantages:

Computation is done in parallel based. It is less time consuming**.**

Future Work:

Applying ICBI for real time applications.

2.3 Computational efficient scheme for Real-time Artifact-Free Image Up-Scaling [3].

Author: G. Rangamma, V. Anuradha

Description:

Adaptive and nonadoptive techniques such as NEDI and ICBI methods are described. NEDI is well known interpolation method providing good results but computationally heavy. The high quality of the images enlarged with the new method is demonstrated with objective and subjective tests. The second method is a new up scaling method Iterative Curvature Based Interpolation-ICBI, based on a twostep grid filling and an iterative correction of the interpolated pixels obtained by minimizing an objective function depending on the second order directional derivatives of the image intensity.
The idea of ICBI is rather simple: in the two step filling method described in above Section, after the computation of the new pixel values with a simple rule (in our case we take the average of the two neighbors in the direction of lowest second order derivative, an algorithm we called FCBI, Fast Curvature Based Interpolation), we define an energy component at each new pixel location that is locally minimized when the second order derivatives are constant. We then modify the interpolated pixel values in an iterative greedy procedure trying to minimize the global energy. The same procedure is repeated after the second interpolation step. Images obtained with this method do not present the evident artifacts , adding additional terms to reduce the image smoothing and heuristics to deal with

sudden discontinuities, we obtained results that compare favorably with other edge based techniques, with a computational cost that is compatible with real time applications.

Algorithm:
Overall procedure for ICBI technique is as follows:

Step1: Put original pixels in the enlarged grid at locations 2i,2j

Step2: Insert pixels at locations 2i+1,2j+1 with the FCBI method

Step3: Apply iterative correction until the image variation is above a given threshold

Step4: Insert pixels in the remaining locations with the FCBI method

Step5: Apply iterative correction to the added pixels

Step6: Repeat the whole procedure on the new image for further enlargements

Advantages:
Removes sampling artifacts, even if it does not enhance strongly lines and contrasted edges. It has low computational complexity that allowed to obtain real time performances.
Limitation: Results appear a bit over smoothed.

2.4 Denoising of Digital images through PSO based pixel Classification [4].
Author: Somnath Mukhopadhyay, Jyotsna Kumar Mandal
Description:
De-noising method is presented where the detection and filtering is based on unsupervised pixels' classification. The noisy image is grouped into subsets of pixels with respect to their intensity values and spatial distances. Using a novel fitness function, the image pixels are classified using the Particle Swarm Optimization technique. The distance function measured similarity or dissimilarity among pixels using not only the intensity values, but also the positions of the pixels. The filtering operator restored only the noisy pixels keeping noise free pixels intact. Four types of noise models are used to train the digital images and these noisy images are restored using the proposed algorithm.

PSO is a population based stochastic optimization technique modelled on the social behaviour of bird flocks. In PSO, the algorithm maintains a population of particles, where each particle represents a potential solution of the optimization. Each particle is assigned a randomized velocity. The particles are then flown through the problem space. The aim of PSO is to find the particle position that results in the best evaluation of a given fitness function. Each particle keeps track of the following information in the problem space: *xi*, the current position of the particle; *vi*, the current velocity of the particle; and *yi*, the personal best position of the particle which is the best position that it has achieved so far. This position yields the best fitness value for that particle. The fitness value of this position is called pBest. There is another parameter simulated by PSO, called global best (gBest). For gBest, the best particle is determined from the entire swarm. The best value tracked by the global version of the PSO is the overall best value (gBest), obtained so far by any particle in the population.

The PSO changes the velocity of each particle at each time step so that it moves toward its personal best and global best locations. The algorithm for implementing the global version of PSO is as follows:

1. Initialize population of particles with random positions and velocities on a d-dimensional problem space.

2. For each particle, evaluate the desired optimization fitness function of d variables.

3. Compare particle's fitness with its personal best value (pBest). If the current fitness is better than pBest, then the pBest value is set equal to the current value and the pBest location equal to the current location in the multidimensional space.

4. Compare fitness evaluation with overall previous best value of populations. If the current value is better than the global best (gBest), set gBest to the current value of current particle and set the global best position to the position of current particle.

5. Change the velocity and position of the particle according to Equations (1) and (2), respectively.

$$v_p(i + 1) = h(i) * v_p(i) + \Psi_p * r_p * (x_{pbp}(i) - x_p(i)) + \Psi_g * r_g *((x_{gbp}(i) - x_p(i)) \quad (1)$$

$$x_p(i + 1) = x_p(i) + v_p(i + 1) \quad (2)$$

Ψ_p and Ψ_g are the positive learning factors respectively. rp and rg are random numbers in [0, 1]. i is the generation number in [1, IMAX]. IMAX is the maximum number of generations. h(i) € [0,1] is the inertia factor. fpB(i) and fgB(i) are the pBest value and gBest values at ith generation, respectively. xpB(i) and xgB(i) are the personal and global best positions of pth particle at ith generation respectively.

6. Loop to step 2 until a termination criterion is met. The criterion is usually a sufficiently good fitness or a maximum number of iterations.

Advantages:
It suppresses salt-and pepper noise as well as random-valued-noise. It can deal the high density of impulses in the digital images. Easy to implement. Experiments shows that the proposed operator gives better restoration results compared to conventional operators such as standard median filter (SMF), adaptive median filter (AMF), directional weighted median filter (DWMF), efficient decision based algorithm (EDBA), improved efficient decision based algorithm (IDBA), boundary discriminative noise detection (BDND), boundary discriminative noise detection by elimination (BDNDE) and fuzzy based decision algorithm (FBDA).
Limitation:
To determine the optimal values of the user parameters like number of cluster centers and the number of generations. The parameter set of the algorithm is not automatically determined. Algorithm may not work well if the noise is not salt-and- pepper or random-valued-noise with the digital images.

2.5 PSO based Motion Deburring for Single Image [5].
Author: Chunhe Song, Hai Zhao, Wei Jing, Hongbo Zhu
Description:
Paper addresses the issue of non-uniform motion deblurring due to hand shake for a single photograph. The blurred image is considered as a weighted summation of all possible poses, and proposed to use a PSO (particle swarm optimization) to optimize the weighed parameters of the corresponding poses after building the motion model of the camera, and an alternatively optimizing procedure is used to gradually refine the motion kernel and the latent image. The main issue of using a PSO for deblurring is that it is generally impossible to obtain the ground true of the observed blurred image, which must be used as the input of the PSO algorithm. In this paper, a non-linear structure tensor with anisotropic diffusion is used to smooth the texture while keeping the salient edges in the image.
The PSO algorithm was first described by Kennedy and Eberhart [1996]. The basic PSO (BPSO) algorithm begins by scattering a number of "particles" in the function domain space. Each particle is essentially a data structure that keeps track of its current position x and its current velocity v . Additionally, each particle remembers the "best" position it has obtained in the past, denoted $i\ p$. The best of these values among all particles (the global best remembered position) is denoted $g\ p$.
Advantages:
Removes non-uniform motion blur without any hardware support.
Limitation:
The early period of the deburring process depends on the edges of large scale objects in the predicted image. If these edges are far away from their 'true' position in the latent image, method may fail. Experiments shows that to improve the stability of the algorithm, larger number of particles are need to be used.

2.6 Detection of Leaf Diseases by Image Processing [6].
Author: S.P. Patil, V.P. Kumbhar, D.R. Yadav, N.S. Ukirade
Description:
Paper introduces a new approach for detecting plants leaf diseases. It is very sensitive and accurate method in the detection of plant diseases, which will minimize the losses and increases the economical profit. It includes four steps: Image Acquisition, Image Pre-processing, Features Extraction and Neural Network based Classification. Iterative curvature-based interpolation technique focuses on estimation of direction and based on second order derivatives. Main purpose of introducing ICBI technique to minimize the artifacts presented in image compare to

other technique like NEDI and other linear and non-linear interpolation techniques. ICBI technique has lower computational cost then other non-adaptive techniques. ICBI technique is a combination of two techniques. In first technique, the new pixels are computed by interpolating along the direction (FCBI, Fast Curvature Based Interpolation). In second technique, we modified the interpolated pixels using iterative method with energy term for edge preservation purpose.

First technique, FCBI is same the Data Dependent Triangulation interpolation technique, but instead of taking the average value of two opposite neighbor pixels, we consider second order derivatives in two diagonal direction and compute new pixel values in such a direction where the estimated derivative is low.
In second technique, the energy term is sum of the curvature continuity, curvature enhancement and iso-levels curves. First we compute, for each new pixel, the energy function U(2i+1; 2j+1) and the two modified energies U+(2*i*+1*;*2*j*+1) and U-(2*i*+1*;*2*j*+1), i.e. the energy values obtained by adding or subtracting a fixed value called threshold value to the local pixel value I(2*i*+1*;*2*j*+1) [2] and assign this intensity value to pixel. This procedure is iteratively repeated until the sum of the modified pixels at the current iteration is lower than a fixed threshold value.
Future Work:
The future work focuses to develop the real time detection of diseases followed by diagnosis of the disease.

3. Proposed System

We propose an Image Super resolution Method that will provide high resolution image for given low resolution image for leaf for agricultural application. Proposed method will generate a cost value from super resolved image and threshold value from original image. By comparing the cost with threshold necessary correction will be applied by PSO algorithm. Finally, corrected SR image is generated without blurring, over smoothed and over sharped noise. Work flow of proposed system is given in fig 3.

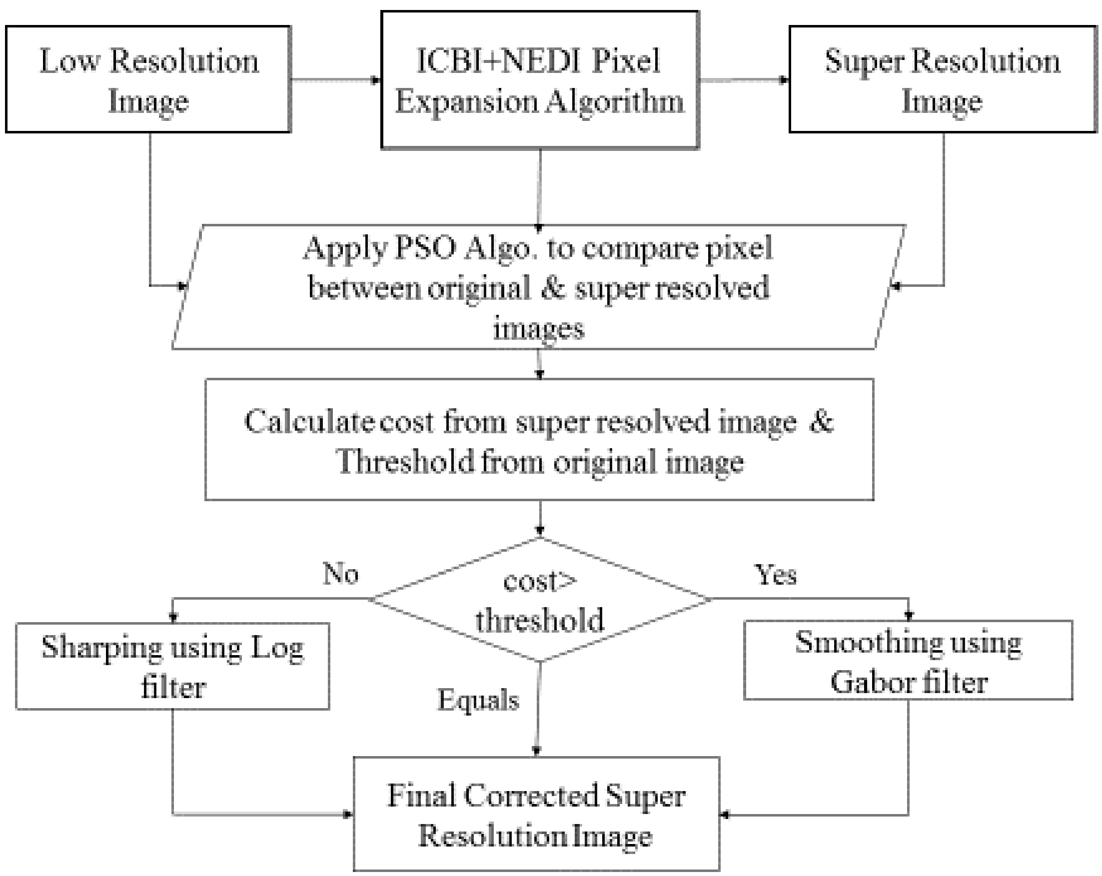


Figure 3: Block diagram of Proposed method

4. Conclusion

Plants are economical important for agricultural countries like India which is affected normally by bacterial, viral or fungal diseases that appears on leaf and stem. Today's agricultural application need HR images for their better functioning of detection and classification. The proposed Image Super resolution method will provide high resolution noise-free image of leaf image for agricultural applications.

References

[1]. Sanket B. Kasturiwala, S. A. Ladhake," Adaptive Image Superresolution for Agrobased Applicaion", International Conference on Industrial Instrumentation and Control, IEEE-28 May 2015.

[2]. K. Sreedhar Reddy, K. Rama Linga Reddy, "Enlargement of image based upon Interpolation Techniques", International Journal of Advanced Research in computer & Communication Engineering, 2013.

[3]. G. Rangamma, V. Anuradha, "Computational efficient scheme for Realtime Artifact-Free Image Up-Scaling", International Journal of Scientific Engineering & Technology Research, 2014.

[4]. Somnath Mukhopadhyay, Jyotsna Kumar Mandal, "Denoising of Digital images through PSO based pixel Classification", Central European Journal of computer Science-Springer, 2013.

[5]. Chunhe Song, Hai Zhao, Wei Jing, Hongbo Zhu, "PSO based Motion Deblurring for Single Image", The ACM Guide to Computing Literature-NY USA, 2011.

[6]. Somnath Mukhopadhyay, Jyotsna Kumar Mandal, "Denoising of digital images through PSO based pixel classification", Central European Journal of computer Science, Springer-18 November 2013.

[7]. S. Arivazhagan, R. Newlin shebiah, S. Ananthi, S. Vishnu Varthini, "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features", Department of Eletronics and Communcation Engineering-March 2013.

[8]. Ms. Kiran R. Gavhale, Prof. Ujwalla Gawande," An Overview of the Research on Plant Leaves Disease detection using Image Processing Techniques", Journal of Computer Engineering-Jan 2014.

[9]. Khushal Khairnar , Rahul Dagade, "Disease Detection and Diagnosis on Plant using Image Processing – A Review", International Journal of Computer Applications- 2014.

[10]. Vijai Singh, Varsha, A K Misra, "Detection of unhealthy region of plant leaves using Image Processing and Genetic Algorithm", International Conference on Advances in Computer Engineering and Applications-2015.

[11]. S. Patil, V. Kumbhar, D. Yadav, N. Ukirade, " Detection of Leaf Diseases by Image Processing", International Journal of Advanced Research in Electronics and Communication Engineering-2015.

[12]. Santanu Phadikar and Jaya Sil, "Rice Disease Identification using Pattern Recognition Techniques", Proceedings of 11th International Conference on Computer and Information Technology, IEEE-Dec 2008.

[13]. Ms. Kiran R. Gavhale and Prof. Ujwalla Gawande, "An Overview of the Research on Plant Leaves Disease detection using Image Processing Techniques", IOSR Journal of Computer Engineering-Jan 2014.

[14]. Dheeb Al Bashish, Malik Braik, and Sulieman Bani-Ahmad, "A Framework for Detection and Classification of Plant leaf and Stem Diseases", International conference on signal and Image Processing, Chennai, India- Feb 2012.

[15]. P. Revathi, M. Hemalatha," Cotton Leaf Spot Diseases Detection Utilizing Feature Selection with Skew Divergence Method", International Journal of Scientific Engineering and Technology-Jan 2014.

BIOGRAPHIES

	He has completed his B.E from Mahatma Gandhi Institute of Technology and research Center-Navsari, Gujarat and he is pursuing master degree in computer engineering in aSigma Institute of Engineering, Vadodara. He is interested in research work mainly related to image processing and agricultural activities.
	She is working as head of department in sigma institute of engineering, Vadodara for computer department at present. Networking, wireless communication and image processing are the areas of her research and interest.