



A Literature Survey on Different Image Super Resolution Techniques

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Abstract— In this survey paper discuss on Different image super resolution techniques. In the current generation super image resolution is one of the important topic between researchers there are many challenges are presents in this area. In the last decade there are many research work purposed in the single image super-resolution (SISR) techniques. Single image super-resolution (SISR) is a classical image restoration problem which aims to recover a high-resolution (HR) image from the corresponding low-resolution (LR) image. In SISR problems, the given image is usually assumed to be a low-pass filtered and down-sampled version of an HR image. In this review paper discuss the various aspect of super image resolution. Machine learning play an important role in super image resolution. Their are different machine learning approach presented by different researchers. These method are discuss in this survey also give a comprehensive analysis of those method.

Keywords— Single Image Super-Resolution (SISR), Low-Resolution (LR), Artificial Intelligence (AI), State-of-the-art (SOTA), Two-Stage Network (TSN) etc ...

I. INTRODUCTION

In past few decades, single image super-resolution (SISR), that seeks for recover a large (HR) photograph from a low-resolution (LR) measurement, has become a popular issue in the field of image analysis. For recognition systems, single-image super-resolution is necessary, as well as several technologies have been implemented in recent decades. Due to their perceived achievement, these solutions seem to be frequently dependent on various of factors, as well as unique datasets and measurements. The procedure of creating high-resolution photos from low-resolution photos is called as super-resolution (SR). So look at it another way, LR refers for the a single photo input, HR refers for the actual data, then SR refers for such expected high resolution. High-resolution images have more pixel density than low-resolution images. With this feature, high-resolution images are desired for much real-life application because HR images provide more detail and information about the scene [2]. The object using single image super-resolution (SISR) is just to reconstruct the high-resolution frame from with a low-resolution frame inside this case. When high-frequency picture information

is generally being extracted from such a low-resolution visual, SISR becomes hard. The brightness of large pictures is reduced absent increased signals. SISR is indeed a poorly challenge even though a single low-resolution photo may generate in multiple high-resolution representations [2] [28].

A. Deep learning

Deep learning is an artificial intelligence (AI) activity essentially simulates human mind's analysis input information as well as structure formulation through order to make a decision. Usually called the deep learning model or deep convolution neural network. Deep learning, also every linear response to convert the incoming data it into increasingly abstract as well as model is an appropriate. The information inside a computer vision implementation can be a structure of images; a first truly representative layer might subjective the pixel density as well as convert seams; the middle level can really build or transmit side accommodations; the core layer can generate an eyes and mouth; and its fourth layer could represent however that image presented recognition. Significantly,]. Neural network is a type of learning algorithms primarily teaches the machine understand common sense. In machine learning, a software program comes to understand to

function trained data set on difficult and complicated information in the form of pics, word, or noise. The above methods could also fulfill state-of-the-art (SOTA) precision, and often achieving individual intelligence. Algorithms usually developed employing great selection data classified input and mixed human brain specifications. Similarly Expert Systems is a greatest platform under the computer technologies like voice assistants, skin evaluation, fully electric cars, etc.

Similarly Expert Systems is a greatest platform under the computer technologies like voice assistants, skin evaluation, fully electric cars, etc. Deep learning's performance requires continuous preparation about the body.

Deep teaching is based on that same learning of material as well as the understanding about situations.

The learning method is regarded named 'Deep,' that's because the artificial neural network quickly create levels of information from each passing decade. When time information becomes studied, an objective is to improve outcomes.

Since it is commonly accepted by personal information expert, that skill presentations as well as depths skill training were significantly improved because as quality of the information is risen.

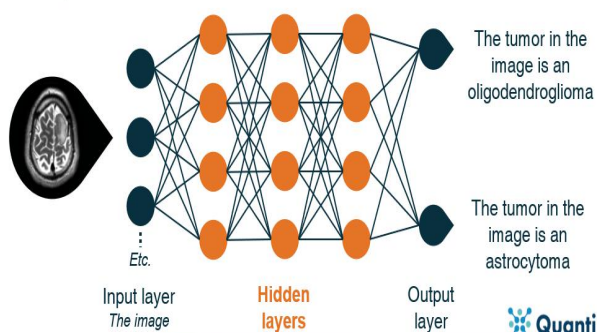


Fig 1. Deep Learning[29].

B. Advantages Of Deep Learning

- Capacity to produce additional features out from reduced train data present.
- Applying unsecured algorithms to include practical as well as predictable objective solutions seems to be a benefit.
- It decreases shorten the time necessary of classification techniques, and also one of the greatest time-consuming topics of cognitive computing.
- Its structure it became responsive to new but also hardworking on a number of difficulties as a result of successful practices.

II LITERATURE SURVEY

Yuzhuo Han1 et.al, “Two-stage Network For Single Image Super-Resolution”(2021), In this research

work authors presented a two-stage network (TSN).The one stage is learning how to transform LR images into LR images with high-frequency information. The other stage is learning how to transform LR images with high frequency information into HR images. Meanwhile, author presented a two-stage learning loss, network jointly learning how to transform LR images into LR images with high-frequency information and transform LR images with high-frequency information into HR images. Extensive experiments show TSN can reconstruct the clear super-resolution images with fewer parameters [26].

Younghyun Jo et.al, “Practical Single-Image Super-Resolution Using Look-Up Table”(2021), in this research work analyzer presented a simple and practical single-image SR method by using LUT (SR-LUT). Method is inherently faster as pre-computed HR values are just retrieved from the SR-LUT and a few calculations are conducted for the final output. Compared to bi-cubic interpolation, fast models run faster while achieving better quantitative performance by a good margin, and slow model shows the better visual quality with a little more runtime. Authors preferred in practical usages due to its speed and ease of implementation [25].

Chunmeng Wang et.al, “Fast image super-resolution with the simplified residual network” (2021), in this research work authors presented a simplified residual network for image super-resolution. Two-level residual network includes external residual level and internal residual level to learn more effective high-frequency information. They first introduce a Laplacian layer to process the input LR image with the Laplacian filter, which makes the input value closer to the residual value to speed up the training, and introduce the efficient channel-average layer instead of using the convolution filters. They achieve fast training speed with the soft gradient clipping (SGC) strategy. They approach improves the training and construction efficiency than the previous residual networks significantly.They evaluate approach from publicly datasets to show that it achieves real-time for UHD videos and satisfactory visual quality [24].

Tadahiro Taniguchi et.al, “Determining Utterance Timing of a Driving Agent With Double Articulation Analyzer” (2020), In this research work authors presented a method determining utterance timing by a driving agent is presented on the basis of an unsupervised hierarchical machine learning method called DAA .They performed two subjective evaluation experiments, and the experimental results showed that the presented method can determine better utterance timing than the baseline methods.

The DAA described. HMM-based latent variable models, a hierarchical Dirichlet process-hidden semi-Markov model, and other unsupervised morphological analyzers could be used on behalf of sticky HDP-HMM

and NPYLM, respectively. The integrated DAA recently presented by Taniguchi *et al.* could also be used. Even if a variant of the DAA is used, it is expected that similar results would be obtained if the method can estimate the latent double articulation structure of driving behavior. The experiments discussed in this paper were conducted in an offline manner. The online DAA method has already been developed as DAA-TP. However, owing to the limitation of the computational resources and in order to organize experimental conditions, they conducted the experiments in an offline manner and in virtual driving situations. On the basis of the results reported in this paper, they intend to develop a driving agent that predicts a driver’s future CCPs and determines the utterance timings in an online manner. They pointed out in the discussion of taking the cognitive load related to each driving word into consideration is important to improve the performance of the presented method. The investigation of the characteristics of each driving word is important. Bando *et al.* developed topic modeling methods for finding the topic of each driving word via latent Dirichlet allocation. Liu *et al.* presented the use of a deep learning method to investigate the driving behavior. Integrating such methods with the presented method will improve the performance of determining the utterance timings [23].

Yi Xu *et al.*, “Vector Sparse Representation of Color Image Using Quaternion Matrix Analysis” (2020), In this research work investigator presented a novel sparse model for color image using quaternion matrix analysis. It formulates a color pixel as a vector unit instead of a scalar quantity and consequently overcomes the lack of accuracy describing inter-relationship among color channels. The experiments of reconstruction, denoising, inpainting, and super-resolution on natural color images prove its advantages in effectively accounting for both luminance and chrominance geometry in images. The usage of the real part of quaternion seems insufficient: for three-channel color space, the real part is simply set to be zero. They believed that the physically meaningful real part will color information, the potential extension of quaternion sparse model to four-channel color space. CMYK, in which the real part may correspond to the black channel. Additionally, from the view of algorithm our K-QSVD algorithm does not guarantee global convergence. A dictionary learning

algorithm based on proximal method is presented which achieves global convergence. Inspired by that strategy [22].

Tao Yan *et al.*, “Automatic Distinction between COVID-19 and Common Pneumonia using Multi-Scale Convolutional Neural Network on Chest CT Scans” (2020), In this research work authors presented AI system shows a good diagnostic performance for the detection and differentiation of COVID-19 based on a small number of chest CT data. In many developing countries and small-scale hospitals, the number of chest CT scans of COVID-19 is limited, so the number of training samples for building a low-cost intelligent COVID-19 diagnosis system for their own use is always small., MSSP, MSCNN, and data augmentation are used together to alleviate the scarcity of training data to improve the diagnostic performance of the AI system. That order to defeat COVID-19 and encourage area. It believed that system can provide valuable support for radiologists and physicians in performing a fast and accurate diagnosis in the initial screening of COVID-19 and mitigate the heavy workload of them especially when the health system is overloaded [21].

Kai Zhang *et al.*, “Deep Unfolding Network for Image Super-Resolution” (2020), In this research work authors focused on the classical SISR degradation model and presents a deep unfolding super-resolution network. Inspired by the unfolding optimization of traditional model-based method, they design an end-to-end trainable deep network which integrates the flexibility of model based methods and the advantages of learning-based methods. The main novelty of the presented network is that it can handle the classical degradation model via a single model. Specifically, the presented network consists of three interpretable modules, including the data module that makes HR estimation clearer, the prior module that makes HR estimation cleaner, and the hyper-parameter module that controls the outputs of the other two modules. The presented method can impose both degradation constrain and prior constrain on the solution. Extensive experimental results demonstrated the flexibility, effectiveness and generalized ability of the presented method for super-resolving various degraded LR images [20].

TABLE 1. COMPERATION TABLE FOR RESOLUTION IMAGES

S.NO	REF.	YEAR	TOPIC	METHODS
1	26	2021	Two-stage Network For Single Image Super-Resolution	Single-Image Super-Resolution (SISR), Convolutional Neural Networks CNN-Based
2	25	2021	Practical Single-Image Super-Resolution Using Look-Up Table	Super-Resolution(SR)Method, DNN Based Methods

3	24	2021	Fast image super-resolution with the simplified residual network	Super-Resolution(SR)Convolutional Neural Network(CNN),Single-Image Super-Resolution (SISR),
4	23	2020	Determining Utterance Timing of a Driving Agent With Double Articulation Analyzer	Double Articulation Analyzer(DAA),
5	22	2020	Vector Sparse Representation of Color Image Using Quaternion Matrix Analysis	K-quaternion Singular Value Decomposition (QSVD), Orthogonal Matching Pursuit (QOMP), Super-Resolution(SR)
6	21	2020	Automatic Distinction between COVID-19 and Common Pneumonia using Multi-Scale Convolutional Neural Network on Chest CT Scans	Multi-Scale Convolutional Neural Network (MSCNN),
7	20	2020	Deep Unfolding Network for Image Super-Resolution	Single Image Super-Resolution (SISR), Convolutional Neural Network (CNN) based, USRNet

III. IMAGE SUPER RESOLUTION WITH NEURAL NETWORKS

A. 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 resample 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 below shows the stages in super-resolution process.

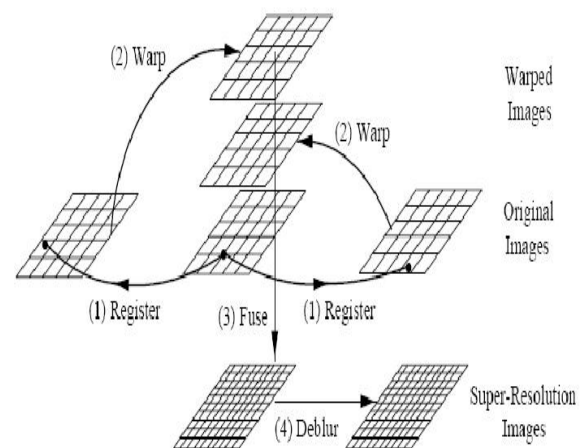


Fig. 2 The Stages In Super-Resolution Process

B. Image Registration

The multiple low resolution images can represent different view-points of the same scene and image registration deals with mapping corresponding points in these images to the actual points in original scene and transforming data into one coordinate system. Several types of transformations could be required for registration of images like affine transformations, biquadratic transformations or planar homographic transformations. This alignment involves geometric component as well as photometric component[35].

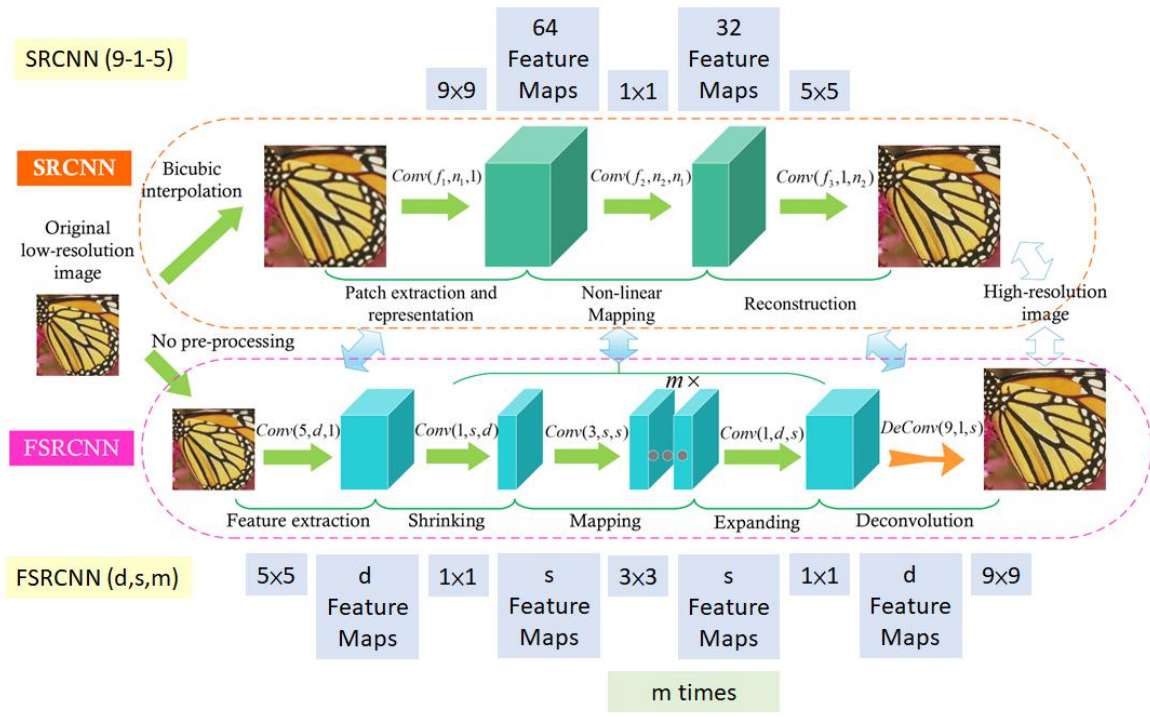


Fig. 3 Process of Super Resolution

IV. NEURON NETWORK

An Artificial Neuron Network (ANN), popularly known as Neural Network is a computational model based on the structure and functions of biological neural networks. It is like an artificial human nervous system for receiving, processing, and transmitting information in terms of Computer Science.

Basically, there are 3 different layers in a neural network:-

1. Input Layer (All the inputs are fed in the model through this layer)
2. Hidden Layers (There can be more than one hidden layers which are used for processing the inputs received from the input layers)
3. Output Layer (The data after processing is made available at the output layer)

Following is the manner in which these layers are laid.

A. Input Layer

The Input layer communicates with the external environment that presents a pattern to the neural network. Its job is to deal with all the inputs only. This input gets transferred to the hidden layers which are explained below. The input layer should represent the condition for which we are training the neural network. Every input neuron should represent some independent variable that has an influence over the output of the neural network[38].

B. Hidden Layer

The hidden layer is the collection of neurons which has activation function applied on it and it is an

intermediate layer found between the input layer and the output layer.

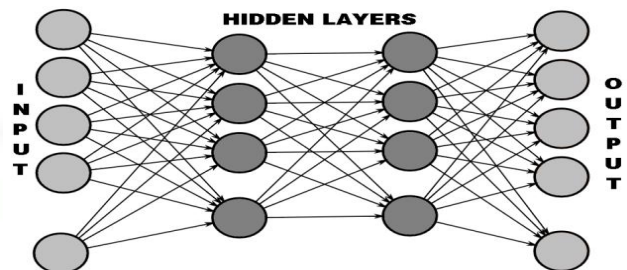


Fig. 4 Depicting The Different Layers Of A Neural Network

Its job is to process the inputs obtained by its previous layer. So it is the layer which is responsible extracting the required features from the input data. Many researches has been made in evaluating the number of neurons in the hidden layer but still none of them was successful in finding the accurate result. Also there can be multiple hidden layers in a Neural Network. So you must be thinking that how many hidden layers have to be used for which kind of problem.

C. Output Layer

The output layer of the neural network collects and transmits the information accordingly in way it has been designed to give. The pattern presented by the output layer can be directly traced back to the input layer. The number of neurons in output layer should be directly related to the type of work that the neural network was performing. To determine the number of neurons in the

output layer, first consider the intended use of the neural network[38].

V.CONCLUSION

In this survey paper discuss on different image super resolution techniques. In the literature review discuss various super image resolution techniques presented in the last decade. Also compare the previous methods. Single image super-resolution (SISR) is a classical image restoration problem which aims to recover a high-resolution (HR) image from the corresponding low-resolution (LR) image. In SISR problems, the given image is usually assumed to be a low-pass filtered and down-sampled version of an HR image. In this review paper discuss the various aspect of super image resolution . Also discuss the various machine learning approach play an important role in super image resolution. In future present a robust technique for image super resolution that is preserve the fine details of image and also improve the quality of the images.

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