ENHANCED METHOD FOR BLUR REMOVAL USING FOURIER BURST WIENER and GAUSSION METHODS

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Abstract: **One issue that causes blurry shots and ruins many photos is camera shake. This makes the objects in the picture indistinct. To provide a better visualisation of the image, deblurring techniques including conventional blind deconvolution and the convolution of a sharp image with a uniform blur kernel are applied. For the motion route during shaking, it commonly imposes frequency-domain limitations on the image. such cameras. Motions attempt to provide a clear sight by adhering to the prescribed course. No such mechanism exists that consistently or eliminates the blurring equally. Thus, the concept of weighted fourier burst accumulation is introduced in this study. a technique for addressing the camera shaking issue. The proposed algorithm performs a weighted average in fourier domain. The weights are determined by the magnitude of the Fourier spectrum.**
Keywords – Camera shake, fourier burst, fourier spectrum.

I. INTRODUCTION

The fundamental tenet of photography is that when light strikes an object to be caught, reflected photons gather on the camera's sensor, creating an image. When more photons arrive at the sensor's surface during the exposure time, the image will have good quality. One may observe that if the scene or the camera moves, the photons will gather in the nearby pixels, producing a fuzzy image. If one can see the wobbly effect in an image, it is considered to be blurred. The movement of the subject or the imaging device causes an image to appear shaken. A wrong focus might also result in blurring. The appearance of streaking from quickly moving objects in a video or animation is known as motion blur. The majority of amateur photographers' favourite photos are often ruined by camera shake. If camera wobble appears in the shot for any reason, the photographer has "lost" that moment, which cannot be recreated under controlled circumstances or replicated with various camera settings. In this camera shake direction which eventually leads to blurring of the images in the single direction. Camera shake can be described as a blur kernel.

II. BACKGROUND

For photographers, camera shake in which an unsteady camera results in fuzzy photos is a persistent issue. Camera wobble has become highly noticeable with the rise in consumer digital photography, especially with the popularity of compact, high-resolution cameras whose little weight can make them challenging to hold steady hold steadfastly enough. One of the most difficult issues in image processing is erasing camera shaking blur. Although a number of picture restoration algorithms have emerged in the past ten years that function exceptionally well, the scene still has a significant impact on how well they work.

In the upcoming sections we will be looking through the implementation, the methodology and the design of the algorithm.

III. LITERATURE SURVEY

Image restoration is the process of recovering an image from a blurred and noisy image. In this paper[1] they have applied image Sharpening to a blurred image. For analysis Gaussian blur is used. In this the process starts by taking an input image. Then the image is resized. Resizing is done because at times the dimensions of the image won't be as per the requirement and also there will be unwanted components. So those unwanted pixels are discarded from the image . it can be done in photo editor program like photoshop. and RGB Channel separation is applied. This is a tool to separate red, green, and blue in an image and the result of this will be grayscale image so there will be 3 images corresponding to blue, red and green respectively. Next step is gaussian blurring aka gaussian smoothing. This will slightly blur the image. This is a pre-processing stage which helps to enhance different scales of image structure. And finally blur removal is done using angle estimation and de-convolution.

In this paper[2], a novel method is proposed that uses an align and average technique to extract the true image from the blurred one in photographs shot in low light or with a short exposure, among other factors, which blur the image. Because each image in a burst is blurred differently, burst images are considered here. Here, weights based on the size of the Fourier spectrum have been applied to a weighted average of the burst images in the Fourier domain. The procedure begins with registering the burst images, after which image correspondences are considered to estimate the dominant homograph connecting each burst image. The SURF algorithm is used for this. The resultant filtered image is then sharpened using a Gaussian process after noise removal using NLMEANS.

This paper[3] introduces a weighted Fourier burst accumulation method for resolving the camera shake issue. In the Fourier domain, it computes a weighted average. The weights are determined by the magnitude of the Fourier spectrum.

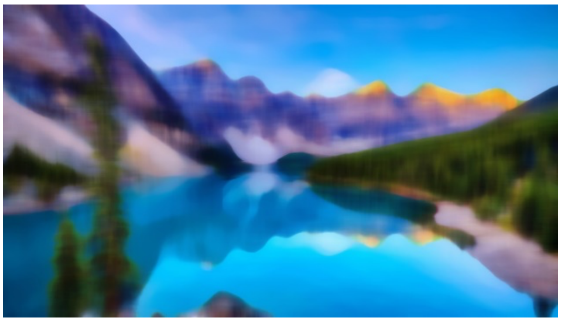
This paper[4] presents a method that eliminates camera shake blur by merging Fourier information from surrounding frames in a video. A consistent registered version of temporally adjacent frames has been produced from an input video frame. Following that, block wise Fourier domain fusion using weights based on the Fourier spectrum magnitude is performed on the collection of consistently registered frames.

The method used in the proposed work[5] uses a single original input image, in which a blur is added with a known PSF value. By performing a dual Fourier transform on this blurred image, it is possible to determine the blur parameters such as the blur length and blur angle. The blurred image is divided into smaller sub images after restoration, with the premise that each sub image is evenly blurred, which is determined by computing the PSNR value. A local parametric blur model is created using these estimated blur parameter values, namely blur length and blur angle. Then, these models are deconvolved using hazy sub images. This algorithm produces a rebuilt, original, blur-free image as its output. The suggested method meets the vital need for clear photographs in many major fields and provides an efficient solution to the most typical problem of fuzzy images.

IV. CONCEPTS USED

1. Average blur:

An average filter averages all the pixels in the region around the central pixel, averages them all together, and then replaces the central pixel with the average. We smooth a pixel by taking the average of the area around it and replace it with the value of its immediate neighbourhood. This enables us to lower the level of detail and noise by merely using the average. We will convolve our image using a M x N normalised filter—where M and N are both odd integers to get our desired average blur.



2. Gaussian blur:

The high standard deviation of the pixels in these photos simply indicates that there is significant variance within groupings of pixels. Due to the two-dimensional nature of photographs, Gaussian blur utilises two mathematical functions (one for the x-axis and one for the y-axis) to produce a third function, also referred to as a convolution. A Gaussian blur is applied by convolving the image with a Gaussian function.

3. Median blur:

Like other averaging techniques, the median blur operation averages data. The median of all the pixels in the kernel area serves as the image's new centre component in this case. This method cleans up the noise while processing the edges. The function applies a median filter with a ksize–ksize aperture to smooth an image. An image with several channels is independently processed for each channel. Operation in place is supported.

4. Restoration filters:

Restoration Filters are the kind of filters that are applied to noisy images to estimate the original, clear image. It could include blurring techniques or operations that work in reverse to create the opposite of blur. A different filter is employed during the restoration procedure than during the enhancing step. The type of restoration filters used in this paper are weiner filter and inverse filter.

(i)Weiner filter:

For images with additive noise and blur, the Wiener filter is the MSE (Minimum Mean Square Error Filter)-optimal stationary linear filter. It is necessary to assume that the signal and noise processes are second-order stationary in order to calculate the Wiener filter (in the random process sense). Typically, Wiener filters are used in the frequency domain. One uses the Discrete Fourier Transform (DFT) to extract X from a degraded image, x(n,m) (u,v). By adding the Wiener filter G(u,v) to the product of X(u,v), one can estimate the original image spectrum:

$$\hat{S}(u,v) = G(u,v)X(u,v)$$

The picture estimate is then derived from its spectrum using the inverse DFT. These spectra are used to define the Wiener filter:

H(u,v) = Fourier transform of the point-spread function (PSF)

$P_s(u,v)$ = Power spectrum of the signal process, obtained by taking the fourier transform of the signal autocoreelation

$P_n(u,v)$ = Power spectrum of the noise process, obtained by taking the fourier transorm of the noise autocorrelation.

The weiner filter is :

$$G(u,v) = \frac{H^*(u,v)}{|H(u,v)|^2 + \frac{P_n(u,v)}{P_s(u,v)}}$$

Since they need operating in the frequency domain, Wiener filters are relatively slow to apply. To acquire an impulse response g and speed up filtering, one can take the inverse FFT of the Wiener filter G(u,v) (n,m). A convolution mask can be created by spatially truncating this impulse response. Although it may be faster, the spatially truncated Wiener filter is less effective than the frequency domain version.

i) Inverse filter:

The process of getting a system's input from its output is known as inverse filtering. Once the degradation function is established, restoring the original image is the most straightforward procedure. The criterion for the inverse filter is that the mean square of the noise is a minimum.

$$\text{Inverse Filter} = \frac{P_{ij}^*}{|P_{ij}|^2}$$

When the noise factor n_{ij} can be ignored, the inverse filter in theory offers a precise solution to the issue. However, there are many challenges with this solution in real life. The inverse filter is always a singular function, to start. The inverse filter is typically ill-conditioned even if it is not single, which is equally poor. Here, as (i,j) grows, the magnitude of P_{ij} rapidly decreases to zero, causing $1/|P_{ij}|^2$ to acquire extraordinarily large values very soon. This has the consequence of amplifying S_{ij}'s (often) noisy high frequency components. This may result in a restoration f_{ij} where the noise in s_{ij} predominates. Therefore, the inverse filter can only be applied when:

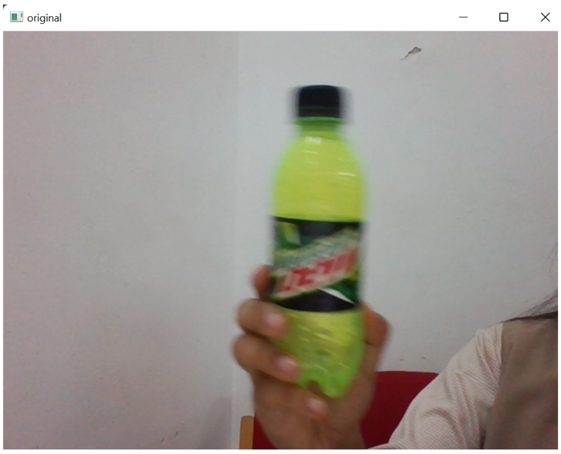
a) The filter is non-singular
b) The signal to noise ration (SNR) of the data is very large(ie $\|P_{ij} \otimes \otimes f_{ij}\| >> \|n_{ij}\|$

5. Fourier transform: A Fast Fourier transform is an algorithm that computes the discrete Fourier transform of a sequence, or its inverse. Fourier analysis converts a signal from its original domain to a representation in the frequency domain and vice versa

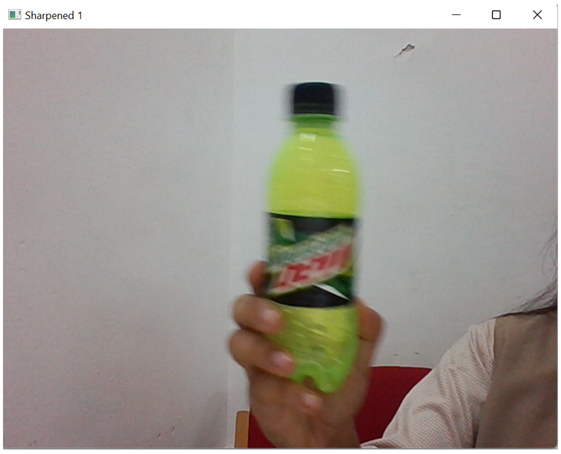
   The fast Fourier transform (FFT) is a computationally efficient method of generating a Fourier transform. The main advantage of an FFT is speed, which it gets by decreasing the number of calculations needed to analyze a waveform.

   The FFT is used in digital recording, sampling, additive synthesis, and pitch correction software. The FFT's importance derives from the fact that it has made working in the frequency domain equally computationally feasible as working in the temporal or spatial domain.

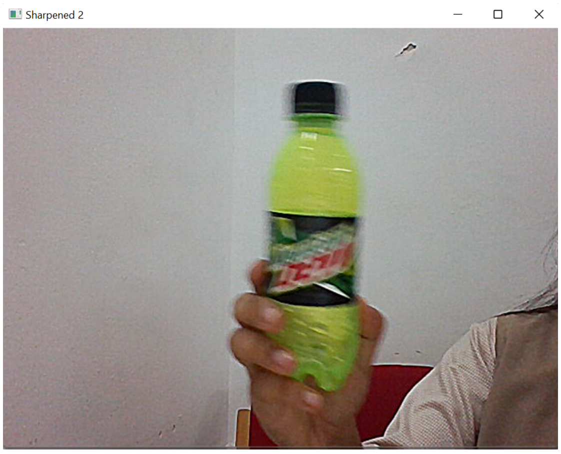
V. RESULTS



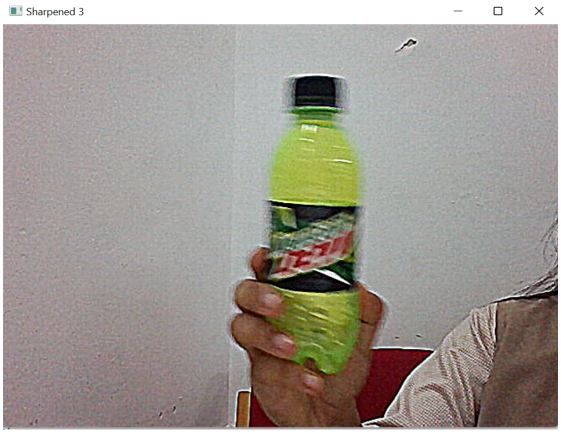
Fig(1):Original Image



Fig(2):Sharpened image 1



Fig(3):Sharpened image 2



Fig(4):Sharpened image 3

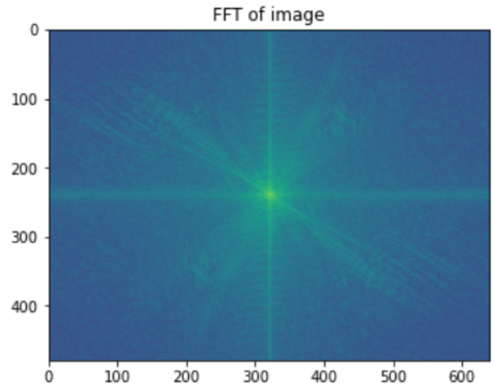
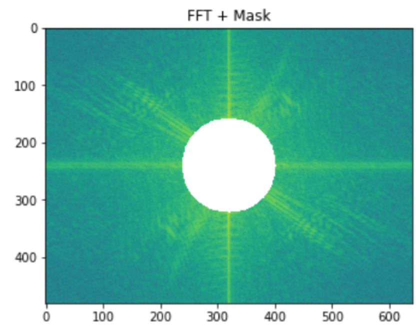
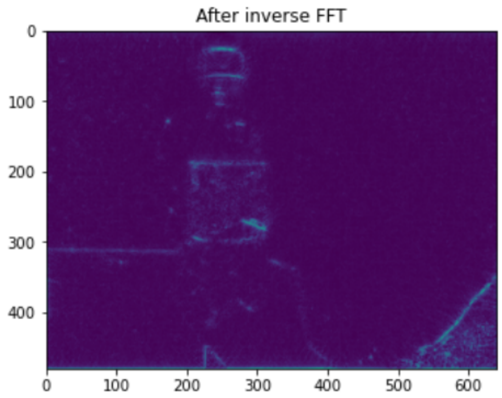


Fig (5): FFT of image

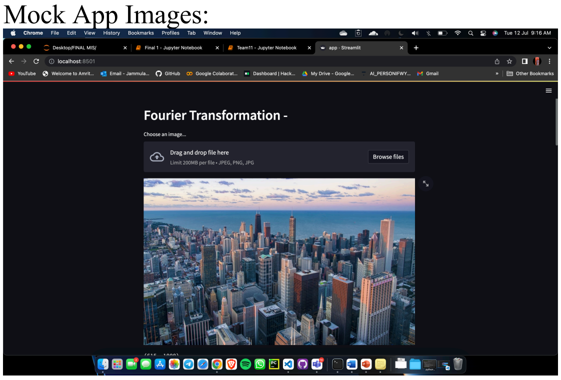


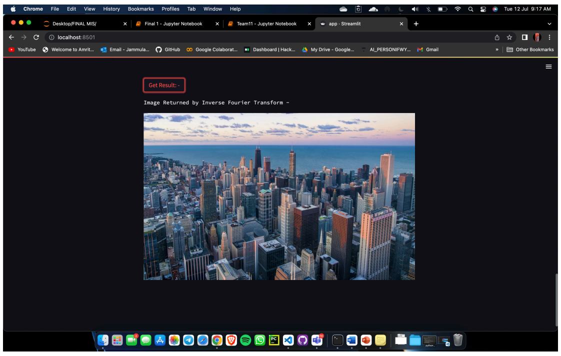
Fig(6): FFT +Mask of the image



Fig(7): Inverse FFT of the image

Mock App Images:





VI. CONCLUSION

Hence, we have applied different types of blur to our image and we have seen that we have restored the image using the two techniques inverse filter and wiener filter.

VII. FUTURE SCOPE

The future scope of this paper is to extend the mock application into a fully functional website which gives all the information regarding the images such as the percentage of blur, an option for what all types of blur to infer in a dialog box and then proceed to get the desired output.

VIII. REFERENCES

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