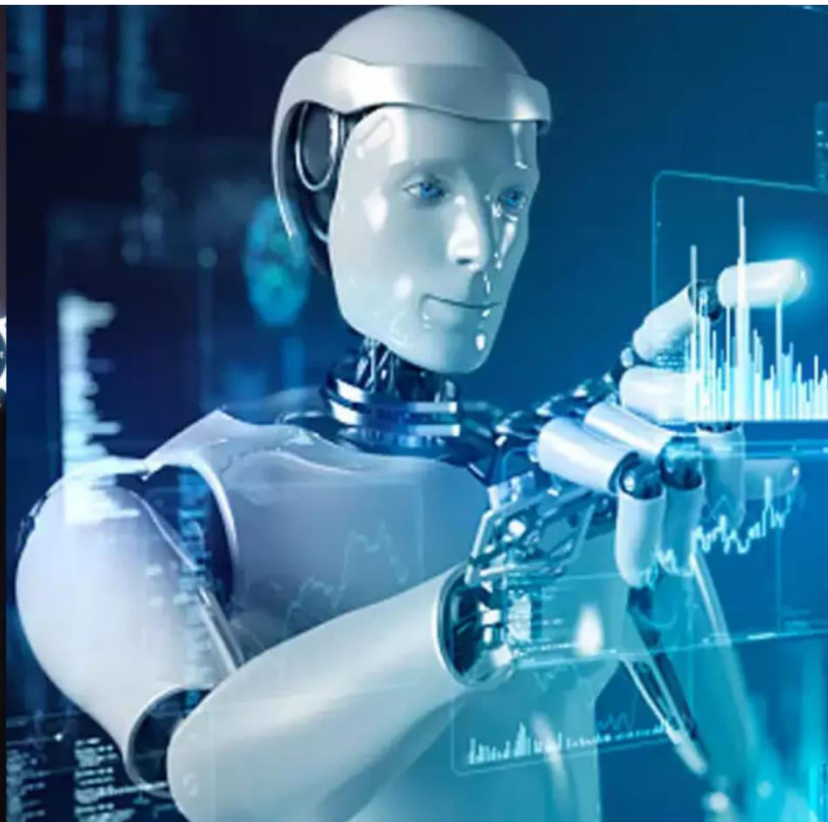




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An Improved Approaches for Image Enhancement Implementing Single Scale and Multi-Scale Retinex

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ABSTRACT: Image Enhancement techniques applied with Retinex theory are implemented to overcome the problems arrived during enhancing the image suffering from bad visual effects which happens due to Low Light or poor lighting conditions. But it is not above to stop there instead we can effectively retrieve the hidden valid information behind it. Particularly images taken in medical, weather forecast may also be a lifesaving factors if happens at the right time. Image Enhancement transforms one image representation to another without changing the content. Sometime two different methods can be implemented on same image to verify the output representation during enhancement. Image enhancement may also subject to be having strongest matches to find a clear and well defined image and also to attend versatile image versions. The first important step is preprocessing. Some atmospheric noise can also be effectively removed using Image Enhancement which removes the unwanted data present in the image and helps in retrieval of accurate information from the image which can be further processed for effective approaches in analysis. When considering the areas like AI, Robotics and other areas optimization can be used to retrieve the exact matching within limited experimenting timing. In this research paper we optimize the problem color distortion using Filters and also we extend enhancement implementing SSR and MSR to save the color distortion happens during image Enhancement. We also estimate the Histogram from the input taken that provides a maximum details available in the image which modifies the actual content of the image. This method also help us by providing valid details of the input image when we utilize in post processing that too during image segmentation. We also overcame the problem of local blurring, artifacts that had appeared while applying Gaussian Filters. We suggest implementing image restoration with image enhancement where the input image is changed to the HSI method where the intensity channel alone has been enhanced. We has also included a color restoration method for enhancing the RGB color representation of the image using the linear restoration algorithm to enhance the hue and representation in the Image is constant. By using this in the proposed method we can attain the best color representation.

KEY WORDS: Image Enhancement, Gaussian surround function, Single Scale Retinex (SSR), Multi-Scale Retinex(MSR), Color Restoration, Color Enhancement

I. INTRODUCTION

Image pre-processing is an important and needed task before performing the experiment in the image. The Enhancement technique includes basic technique to filter the conscious data that is needed for the information extraction. Here the unwanted noise present in the atmosphere which occurs due to the radiation effect by nature which are unavoidable are been measure here and they are been exposed to the corrective measures like geometric latitude and longitude distortion occurs due to the geometric effects are been removed and then they are been implemented to radiometric removal which removes the unwanted sensor effects and as an output we can achieve the proposed image by performing the Enhancement. The visual interpretation can also be performed in image enhancement the increase the contrast present in the image when viewing the pattern representation of the image. As a next important step is to improve the appearance of the image. This can be effectively achieved by applying filters

Pre-processing based on Enhancement:

In Image Enhancement the next important as applied to our research paper is Transformation of the image which as

same as enhancement but more effective. This happens because enhancement alone apply a single way and time slot for enhancement function but comparing to the Transformation we can implement a bulk of data that too combining from multiple bandwidth of the images. Various operation like basic arithmetic functions are been effectively applied transform the original image to a new pre-calculated image for effective screen display. The multichannel images can be effectively traced using the basic compound analysis .The another important process in image pre-processing with respect to Retinex is to identify and also to classify the representation of the pixel present in the images which give a clear understanding based on the background and the information hidden pixel by pixel behind the image. We effectively process we can conclude with a study based on the statistical analysis of the pixel representation present in the input images. After this they can be subjected to be performed with digital classification. They are effectively called as Supervised processing or classification which are effectively called as standards when applied in the image we can transfer the input images to different aspects of application without changing the content of the image. This format is approved by committee on earth observing satellites for universal exchanging data based on image.

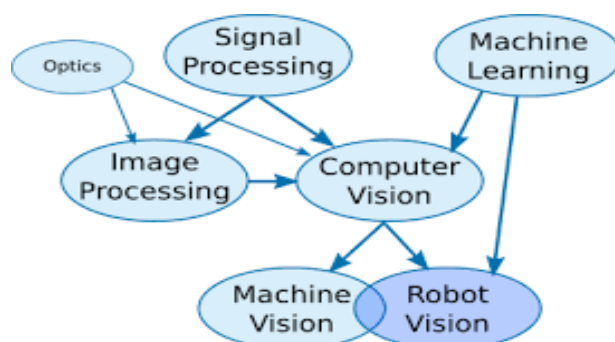


Fig 1: Systematic view of pre-processing

II. THE RETINEX THEORY

The observation of human vision and understanding the information present in the image always happens to be a level of unbalanced when compared been between computer and human as shown in Fig 2. This caused the need to concentration of the retinex theory .The retinex always comes with an handful of solutions based on color perception of the human eye that may happens due to the low light effect can be applied with efficient algorithms to enhance the local image and to improve its contrast. This variation happens due to the viewing the object by eye and sending the image to brain it names and fix the color for the input image which is represent by the brain .But this occurs due to the effect of illumination variation. The pre-processed input image is when subjected to the retinex it works with the elimination of or removal of unwanted illumination effects that exactly results in a clear and mutually understandable image between human and the computer .Basically they deals with two important factors when the input image is classified. The first is the reflection and the second is the illumination of the image .To do so with the methods the image taken is been pre-processed as mentioned above then it is further segmented into pixel representation by which we can achieve the atomic level of information present in the image .The first thing to be worked is the color Consistence of the image to attain the actual color representation by removing the noise and to enhance the low light present in the image.

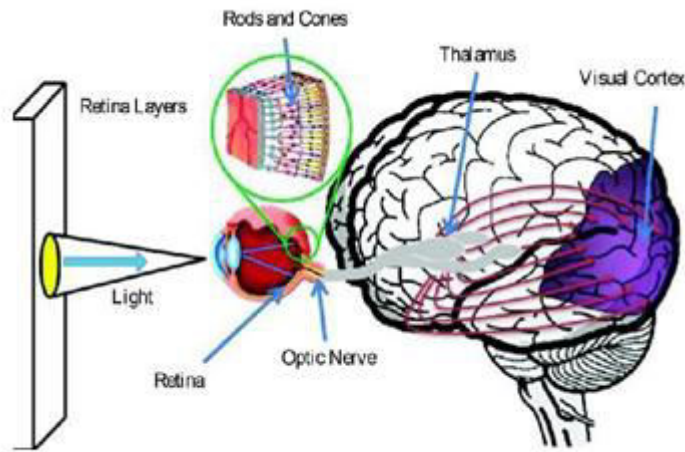


Fig 2: Viewing process of the image by human Eye

2.1 Color Image Segmentation:

In the amount of the R, G, B defined is been calculated to map it in the 3 channel of the RGB representation. Here the color depth is been tracked which helps to understand the maximum color combination the input image is composed of .And this is then been represented in the bit where each bit representation consist of two color values black and white. If the input image results with greatest bit representation then we result up with the accurate color representation and this can be matched with the pre calculated table of RGB to track the difference between the original images the table value and finally from the difference value we can estimate the noise and the low light representation.



Fig 3: Impact of Low Light Representation

The color estimation can be done by using the below estimation formula where D is difference value. The width and the difference are noted as w and d respectively .The n is the estimated new color value

$$D = \sum_{i=1}^n w_i d_i$$

(1)

From the above equation (1) the weight of the new estimated color is calculated by applying the below equaion.

$$w_i = \frac{l_i^{-1}}{\sum_{i=1}^n l_i^{-1}}$$

(2)

2.2 Deep Segmentation Technique: Segmentation often divides the image into many categories that too based on their pixel characterization. With the help of this method they only concentrate on clearing the unwanted illumination and reflection complements that don't strive to match neither components estimated in segmentation parameters. It also has three broad categories in segmentation. The first method is semantic which try to matches the predefined patterns .The second is the instance which matches the predefined patterns and also in advance it matches the subcategories in residing in the predefined patterns .The third on is the panoptic combines the above mentioned two methods together and also represent all the specification and label them separately. When comparing all the three segmentation process the third method provide us a clear and well- defined representation all the object present in the image .It also have a collective predefined object that mostly matched all the real world application when used it provide all the` unpredicted object hidden in the image is matched .The Retinex method is initiated sequence of process as explained in section 3, 3.1&3.2 are considered to be the basic pre-processing method in Image Enhancement they are further processed using the following mechanisms. The Input original image which can be affected with noise can be treated in the following methods Which as first exposed to RGB color restoration then they are processed in separate RGB channels to identify the color Patterns and to also identify the present of color count present in the image after this they are implemented to Gaussian Function

Gaussian Surrounded Function (GSF)

When cameras are utilized to shoot image using out of focus lens then the image suffers from shadowed image or blurry appeared image where this can't be used to calculate or even to predict the information when it is subject to a lifesaving processed image .It should be either calculated to be predicted or the blurry surface should be exactly smoothed. We can apply this Gaussian blur on the particular input image which immediately apply a smooth misty layer on the input image which automatically create an complete new layer over the image which tends to be exposed to a foggy atmosphere.

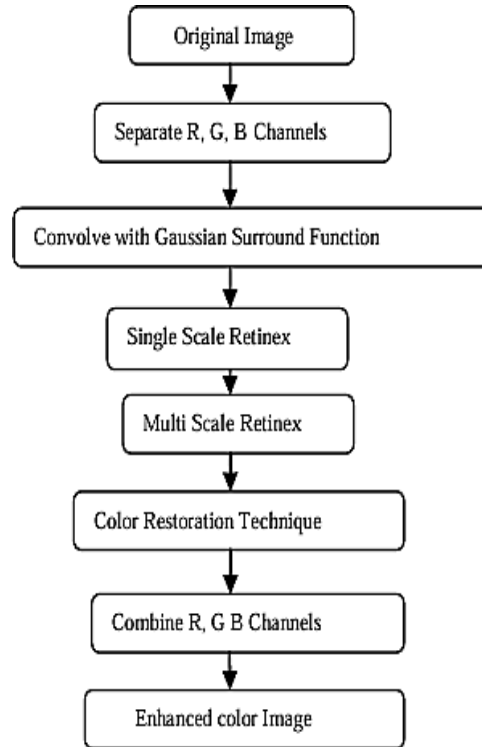


Fig 4: Sequence of Implementation process

This Function has an median pixel point which calculate the height with reference to the central midpoint of the image by gradually calculating the neighbouring pixel we can able to create the outline of the foggy image by which we can drive the actual information of the hidden behind the noise area present in the image. This process can be estimated in both 2D and 3D based image .The following equation can be utilized to calculate the Gaussian effect for 2D.

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2}{2\sigma^2}}$$

The below equation can be implemented for 3D image to calculate Gaussian effect

$$G(x, y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

The parameters brig out the unique features to make the image noise free and project the hidden objects present in the input image. This function improve the perception of the image even it was shoot in the low light environment and adjust the image towards the actual information so that results are more accurate.



(a) Original Image

(b) Gaussian Surround Function

Fig 5: Comparison of image using Gaussian Filter Effects

In Gaussian surround Function all the complete image will be utilized in order to process the pixel calculation. The outlying pixel will be ignored by which the make an effective calculation without unwanted calculation which may spoil the expected output unknowingly. This method mostly supports and be effective during the edge-detecting mechanism in the image enhancement.

III. SINGLE SCALE RETINEX

This is a unique method applied mainly to enhance the lowlight based images to be sharpened. The brightness, sharpness and the contrast of an image are been improved by applying non-linear spatial transform which results dynamic range compression and color constancy in parallel. They use much application for general photography. It is the member of the surround function the resultant output is been processed by calculating the variation from the input point to the centre point. The average is considered to be surrounded value to be processed further. This can be estimated by using the below formula.

$$R_i(x, y) = \log(I_i(x, y)) - \log(I_i(x, y) * F(x, y))$$

In the above specified equation an s, r are two factors represent the illuminence and reflection when applied provides a variation in the above mentioned formula and can be rewritten as

$$R_i(x, y) \simeq \log \frac{S_i(x, y)r_i(x, y)}{S_i\bar{r}_i}$$

IV. MULTI-SCALE RETINEX

One of the successful centre surround image filter. The color correction has be considered to the tremendous output. It can also be auto implanted for color restoration and the contrast binding when applied on the input image. Even the image is shooting with low light it achieves the color by calculating the value available in the present input image. We can even perform gradient representation by applying wavelet format. This process can be applied effectively in felids like medicine for CT images. They calculate the top frequency components from the image even they appeared to blurry at the beginnings stage, thy can be furthered corrected with edge detecting process. The formula is extended from Jacobson's method of enhancement. Here R is considered to be retinex with applied multi scale retinex (MSR).

$$R_{MSR_i} = \sum_{n=1}^N w_n R_{n_i}$$

4.1 Multi -scaling Color Restoration (MSCR) Sometime color assumption with be a very big problem in computer

and also with human. They are Gary world assumption which gives us as better approximation of illuminant in scenes, Gary assumptions is not completely solved we can consider that their performances are low. It has a neural network to associate with it. Image which has a repeated color if implemented here produces a bad results because this method need a wide extended rage of color represents image to find the dominant color of the input image. This method can be implied on both 2D and 3D represented matrix representation. Here x, y are the smoothening parameters with corresponding to the wavelet.

$$\psi^1(x, y) = \frac{\partial}{\partial x} \phi(x, y) \quad \text{and} \quad \psi^2(x, y) = \frac{\partial}{\partial y} \phi(x, y).$$

4.2 Multi-scaling Contrast Enhancement (MSCE)

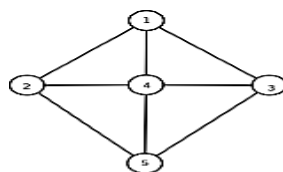
Different transformation can be made or planned with different measurement. In the input image the linier stretching will be performed with the edges. We can take the input image as f and the edge as A_{2i} , then constant and the corresponding variable is been stretched as shown in the below equation

$$k \cdot \mathcal{A}_{2j}(f) \stackrel{\text{def}}{=} \left\{ [(x_i, y_i); k \nabla_{2j} f(x_i, y_i)] \right\}$$

Using this equation we can reconstruct the gradient and the wavelet on the edges to make a defined outline of the object and the outer region parallel

V. APPLICATION OF RANDOM PATH WALK

This random path method is applied to make the edge detection more accurate where even it produce a much more effective output. After examining the position of the edges the fixed distribution is are chosen to make a chain. By introducing the factors we can get answers to time travelled to reach the corresponding node and also the exact time to cove the complete graph represented in the input image. Even at some extend the graph exposed as undirected can also be considered.



$$P = \begin{pmatrix} 0 & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & 0 \\ \frac{1}{3} & 0 & 0 & \frac{1}{3} & 0 \\ \frac{1}{3} & 0 & 0 & \frac{1}{3} & 0 \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \end{pmatrix}$$

Fig 6: Graph extended along Random Path Walk

Here P represent probability of the visit to for a vertex to each the edge in the graph. They are permutations when walk through the edge detection helps to find the next neighbouring pixel in the image. This method schedules the available edges as the path then the random path walk is processed here to visit the edges. By doing so we can find the availably to extend the edges which is hidden behind the image usually happens during image taken in lowlight.

Research Process Dataset

The study includes here is effectively applied on same set of image taken in 500x500 photography pixels it also ensure that the image is taken in low light environment. The image has a structure of full HD 1920X1080 resolution image. The same image is been tested in all situation to check the feasibility.

Experimental Results

Table 1: Result of Image Quality with Metrics

1	12.355	36.9085	30.6476	66.2931
2	17.6841	40.1372	41.9368	67.0082
3	19.3482	29.6073	26.5534	64.7167
4	18.1363	31.5507	31.9188	67.4371
5	11.8475	34.4849	27.4205	64.7396
6	10.7188	20.9313	19.8918	65.5351
7	29.1959	37.9548	36.3184	66.2019
9	11.0124	27.7723	25.6905	64.5207

Retinex output: The resultant output we had obtained by implementing the image taken in various environments to the retinex the based SSR and MSR .By we have to make sure that the input image has implemented in the entire prepressed task as we had mentioned in the beginning of this paper .By doing so we can obtain the expected result if not we may again face the consequence of blurry and noise influenced images. The below image

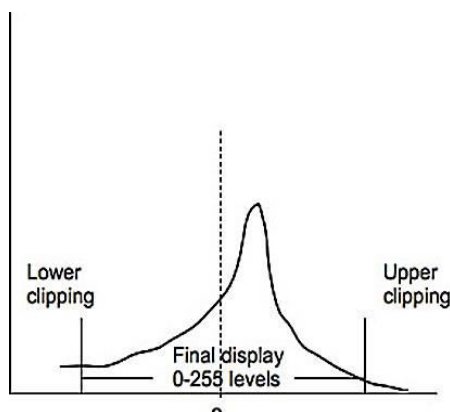


Fig 7: Histogram for Retinex Output

Shows us the histogram of the general presentation of the Retinex. We have also applied various constants value to view the behaviour of the retinex at various stages.

Histogram of SSR and MSR

Image	SSR	MSR	MSRCS	Method Of This Research
constant	N	σ_1 σ_2 σ_3	α β w_n	G b
value	3	15 80 250	125 46 1/3	192 -30

After calculating the constant variations we also implemented out methods SSR and MSR in histogram

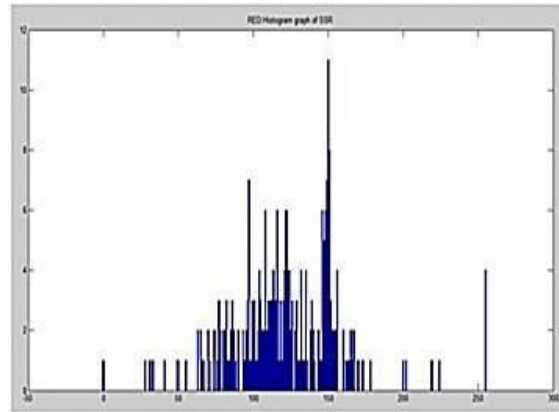


Fig 8: Histogram of SSR

We can see the output of the SSR histogram provides a non-adaptive values and the improved growth show us the presence of the noise information included in the input image .The dynamic range is been enhanced to view the details present in the input image and also the intensity of the image and we can also proceed to

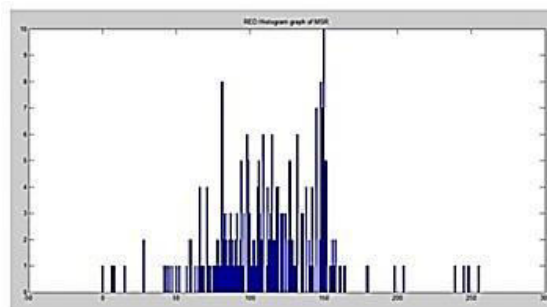
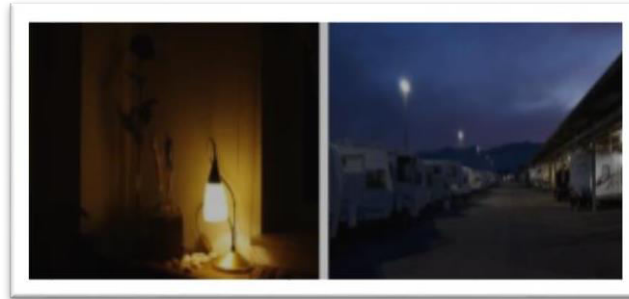


Fig 9: Histogram of MSR

check the appearance of the image and its quality and we had obtained the below shown results. When comparing the two methods SSR and MSR we can view that MSR had many advanced enchantmenttechnique which actually combines SSR with it to produce the good impressed output using retinex. Dynamic Range compression is been used here to fix the neighbour pixel that helps in image enhancement, in SSR the Gaussian Filter helps to overcome to identify the outline to fix the boundary of the image .The next issue in enhancing is with color of the input image because hitting the exact color is the challenging task in image processing .This problem has been solved using MSCR technique

**(a)Original Image****(b)Impact after applying SSR****Fig10: Comparing the effect of Original Imagewith SSR**

The Experiment result also shows some output image to show the MSR effect produce the better result when compared with SSR .Also we have implement MSR with its extended advance technique as mention in MSCR & MSCE. We have two important factors like gain and offset helps MSR to attain the RGB color which was actually present in the input image .We also see the proof that MSR also attain its surround function value to calculate the neighbour pixel which was actually don by SSR. The color balancing shows new spectrum of color estimation should be need to match the color impression present in the input image .To do so the MSR need to have an extended spectrum of color representation to match the color consequence .As a result we can see a blurry and color matching osculation in MSR result this happens due to low light effect and the contrast adjustment problem faced by the input image. An Improved Approach in Image Enhancement using Multi-Scaling Retinex is implemented in this proposed method which finally produces a tremendous change in the information retrieval process in the below figure the first image shows the impact of having Smokey and blurriness ,this problem is reduced when it is applied with multi retinex color restoration technique process and in further it is applied with contrast enhancement which produce a tremendous change in color restoration and also clear information retrieval is done successfully when comparing all the other output the contrast enhancement produce the best output than SSR.

**(a) Resultant output using MSR****(b) Resultant output using MSRCR****(c) Resultant output using MSRCR****Fig 11: Performance of MSR**

VI. CONCLUSION

The experiments established that the proposed method presented acceptable presentation in numerous quantitative assessments associated with other reasonable deep-learning methods. It is predictable that the proposed method can be applied to various intelligent imaging systems to obtain a high-quality image. Compare to existing Pseudo code Algorithm the proposed method utilizing metrics such as MSR, MRCR, PSNR and VIF metrics, Retinex Heterogeneous Method find out the brightness of image, brightness of the distortion, blocking can well restore the brightness distribution. The values of the RGB present in each and every pixel of the image are been clearly enhanced to show the reflectance present in each and every node. The proposed method of MSR proceeds to detects error and also it extend to find the variations present between original image and the processed images which gives us more efficient output than the classic methods. When computing the parameter based on MSR on particular correspondent regions the pixel by pixel separations are been able to process the intensity of two images It also act as an estimator and this estimator try to identify the unobserved quantity present in the image. It also calculate measures the average of the square of the errors which helps us to find the noise free image. The proposed method in Retinex using MSRCE helps us to find the difference between the estimators and estimated and also when applied to contrasted images color balance is corrected and also the shadow zones are not present.

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