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PERFORMANCE OF VIDEO STREAMING BASED ON CANNY EDGE DETECTION ALGORITHM

Nikhil Soni Jabalpur Engineering College, Jabalpur, MP
Namrata Sahayam Jabalpur Engineering College, Jabalpur, MP

ABSTARCT –
In this paper, an enhanced Canny edge detection algorithm is proposed to achieve efficient and robust edge detection. The algorithm addresses limitations of the ordinary Canny method by introducing four key improvements. Firstly, the decomposition of the 2-D Gaussian filter into independent row and column filters allows for parallel computation of image gradients, leading to a substantial reduction in computation time. Secondly, the method employs dual thresholds to identify strong and weak edges, emphasizing the inclusion of weak edges in the output only if they are connected to strong edges. The proposed methodology involves the decomposition of the Gaussian filter, parallel computation of image gradients, and the strategic use of dual thresholds. The paper highlights the significance of edge detection in image processing, emphasizing the extraction of main features from image edges to reduce data processing while retaining essential structural properties. The experimental results showcase a novel approach to image processing using edge detection and morphological image processing, specifically applied to detecting inflammation. The incorporation of the canny edge detection method is emphasized for its efficiency and effectiveness. The experimental findings demonstrate the efficacy of the proposed approach, revealing an excellent accuracy percentage of 97.618%. Sensitivity and specificity are reported at 98%, indicating a high level of precision in edge detection. The computational efficiency is noteworthy, with a processing time of 0.86 seconds. Additionally, the walking speed is reported at 2.12 seconds, further highlighting the efficiency of the proposed algorithm. the paper introduces a significant improvement to the Canny edge detection algorithm, enhancing its performance in terms of computation time and accuracy. The methodology, involving the decomposition of the Gaussian filter and the strategic use of dual thresholds, proves effective in edge detection for image processing. The experimental results, particularly in the context of detecting inflammation, demonstrate the practicality and efficiency of the proposed approach.

Key words:
edge detection, Image restoration, Canny Edge, Image resolution, Contour, Gaussian filter

I INTRODUCTION

Edge detection is the concept for a set of mathematical methods whose aim is to identify the points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. Edges typically occur on the boundary between 2 regions Edge is defined as the boundary pixels that connect two separate regions with changing image amplitude attributes such as different constant luminance and tristimulus values in an image. Edge detection is a well developed field on its own within image processing.[9] The main features can be extracted from the edges of an image which significantly reduce the amount of data to be processed while preserving the important structural properties of an image [12]. The example of an original image . Video moving target detection is one of the basic problems of intelligent video processing [1-2]. It provides support for the following target classification, behaviour understanding and soon, and it is widely Used in the military and social security Fields. In traditional moving target detection methods, three frames difference method is easy to operate, and has good real-time performance, it could extract the target by differencing the consecutive two frames, but in this process, it could be a hole phenomenon on condition that the gray value is closely of consecutive frames in the same location.[5] Especially when some parts of the target are not move, the difference results would be edge absence heavily, in this case, the morphological filling operation is not work well on obtaining a whole target. Image after edge detection are shown in Fig.1 respectively below

Fig. 1 edge detection

Use line features to detect text objects in videos. First, an improved canny detector with two phase thresholding is performed to compute edges in the image. All edge lines are expressed as lists using an 8-connected component algorithm and the non-text lines are eliminated by geometric constraints. Then, height, area, centre position, and edge density are extracted from the bounding box of each line in the list to form a line vector graph. By grouping all theneighboring lines together based on the line vector graph using the 8-connected component algorithm again, the image is divided into several isolated regions with closely distributed lines. After removing non-text regions by distribution and number of edges and region aspect ratio, the final text regions are extracted. By combining this method with the temporal redundancy of video [8][9][3]

II RELATED WORK

Xiaojing Liu [1] Traditional three frames difference target detection algorithm is easy to be a hole phenomenon, especially when the holes appear in the target edges, the final binary image would be edge absence heavily, so it is difficult to obtain the whole target through morphological processing. Therefore, this paper proposes an adaptive edge extraction algorithm to obtain the target edges, which would make an edge supplement for the detection result of the three frames difference algorithm and then obtains the complete moving target through the morphological processing. This algorithm acquires the model parameters adaptively according to the moving characteristics of target, which could improve the accuracy and integrity of edge extraction. An experimental study performed shows that the proposed approach could extract moving targets from video sequences quickly and effectively.

EDGE-BASED APPROACHES: Edges are a reliable feature of text regardless of colour/intensity, layout, orientations, etc. Edge strength, density and the orientation variance are three distinguishing characteristics of text embedded in images, which can be used as main features for detecting text. Edge-based text extraction algorithm is general-purpose method, which can quickly and effectively localize and extract the text from both document and indoor/ outdoor images. Text tends to have complex shapes and high contrast with the background. The algorithms in this category reaching this by looking for edges in the image. Alignment, size, and orientation features of the edges are used to discriminate text regions from other “edge” portions of an image. Edge detection is the process of localizing pixel intensity transitions. The edge detection has been used by object recognition, target tracking, segmentation, and etc. Therefore, the edge detection is one of the most important parts of image processing and video processing analysis of various video image edge detection methods.[4][10][7]

The Discrete Cosine Transform (DCT) is a mathematical transformation commonly used in signal processing and image compression. It is similar to the more well-known Fourier Transform but uses only real numbers and cosine functions. The DCT is widely used in image and video compression algorithms, such as JPEG (Joint Photographic Experts Group) compression. The 1D Type-II DCT of a sequence xn of length N is defined as follows:

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$$X_k = \sum_{n=0}^{N-1} x_n \cos\left(\frac{\pi}{N} k \left(n + \frac{1}{2}\right)\right)$$

The 2D Type-II DCT for an image is an extension of the 1D DCT to two dimensions. For an image of size $N \times M$, the 2D DCT is defined as:

$$X_{kl} = \sum_{n=0}^{N-1} \sum_{m=0}^{M-1} x_{nm} \cos\left(\frac{\pi}{N} k \left(n + \frac{1}{2}\right)\right) \cos\left(\frac{\pi}{M} l \left(m + \frac{1}{2}\right)\right)$$

Here,x_{nm} are the pixel values of the image, and X_{kl} are the DCT coefficients. The resulting coefficients represent the spatial frequency components of the image.

In the context of image and video processing, the DCT is often used for compression purposes. In applications like JPEG compression, the DCT is applied to image blocks, and the most important coefficients (those representing low-frequency components) are retained, while the less important ones are quantized or discarded. This process helps achieve compression while maintaining acceptable visual quality.

CANNY EDGE ALGORITH

Canny edge detection is a popular image processing technique used to detect edges in an image while reducing noise. It was developed by John F. Canny in 1986 and has since become a standard algorithm in computer vision and image processing. The Canny edge detector is known for its ability to provide accurate edge detection with good localization and minimal response to noise.

The Canny edge detection algorithm involves several key steps:

Gaussian Smoothing: Apply a Gaussian filter to the input image to reduce noise and eliminate small details that are not significant for edge detection.

Gradient Calculation: Compute the image gradients using convolution with Sobel or Prewitt operators. These operators estimate the intensity changes in the horizontal and vertical directions.

Gradient Magnitude and Direction: Calculate the gradient magnitude and direction at each pixel. The gradient magnitude represents the strength of the edges, and the direction indicates the orientation of the edges.

Non-Maximum Suppression: Identify local maxima in the gradient magnitude. For each pixel, compare its gradient magnitude with the magnitudes of its neighbors along the gradient direction. If it is a local maximum, keep the value; otherwise, set it to zero.

Edge Tracking by Hysteresis: Apply double thresholding to classify pixels as strong, weak, or non-edges. Define a high threshold (strong edge) and a low threshold (weak edge). Pixels with gradient magnitudes above the high threshold are considered strong edges. Pixels with gradient magnitudes between the low and high thresholds are considered weak edges. Pixels below the low threshold are considered non-edges. Perform edge tracking by connecting strong edges and weak edges that are connected to strong edges. Mark connected weak edges as strong edges.

Pixels that are still weak edges after edge tracking are typically considered noise and discarded.

Final Edge Map: The result is a binary image where strong edges are preserved, and weak edges connected to strong edges are included. Non-edge pixels are set to zero.

III PROPSOED SYSTEM

Hybridizing the Discrete Cosine Transform (DCT) with canny edge detection represents a sophisticated approach to image processing, merging two distinct techniques to enhance the overall quality and feature extraction capabilities of digital images. The DCT, commonly employed in image compression, serves to transform spatial image data into frequency components, allowing for more efficient representation. When combined with Canny edge detection, which identifies significant changes in intensity to delineate edges, the resulting hybrid algorithm can provide a robust solution for image analysis.

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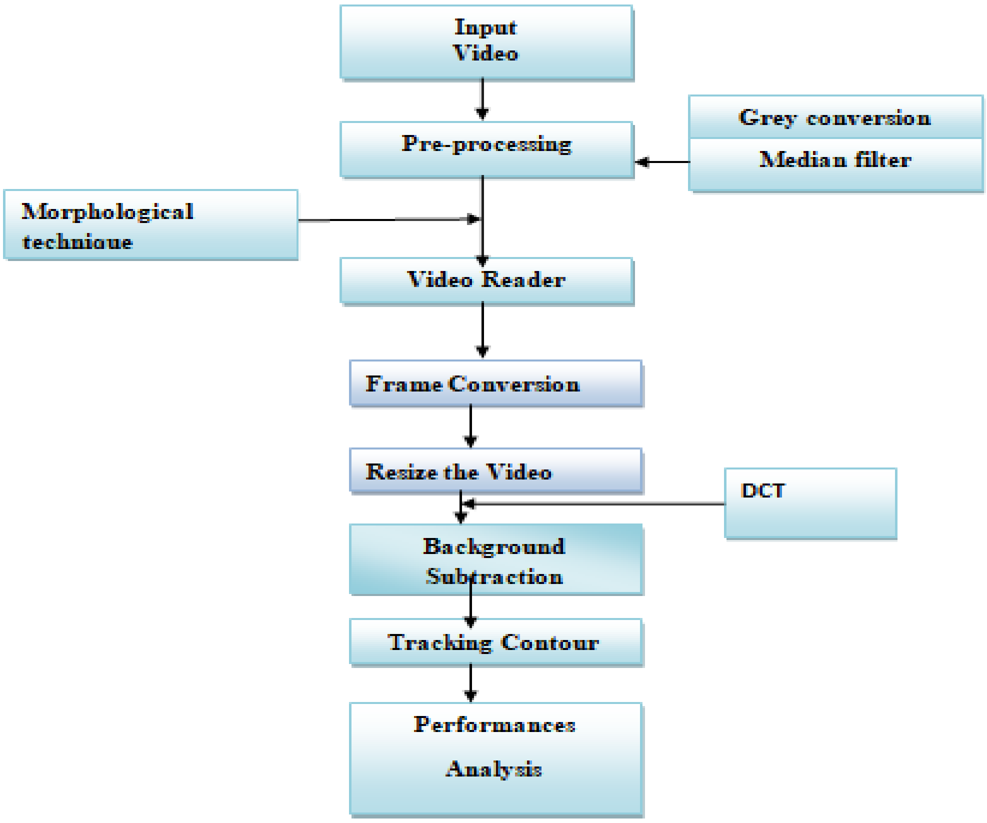

fig.4.1 propose flow diagram

In this hybrid approach, the DCT acts as a pre-processing step, capturing frequency information that is crucial for preserving image details. This transformed representation is then subjected to Canny edge detection, which highlights edges with high precision, ensuring that relevant features are accurately identified. The synergy between these two techniques allows for a more comprehensive understanding of image structure, balancing the advantages of frequency-based analysis with edge localization. The hybrid DCT-Canny method is particularly effective in scenarios where both fine details and edge information are essential, such as in medical imaging, object recognition, and computer vision applications. By fusing the strengths of DCT and Canny edge detection, this approach aims to produce images with reduced noise, enhanced edge clarity, and improved overall visual quality, offering a versatile solution for a wide range of image processing tasks.

IV Module Description

Video Input: The input is a video, which is essentially a sequence of images (frames) played in rapid succession to create the illusion of motion.

Pre-processing: Pre-processing involves various techniques to enhance the quality of the video frames before further analysis. This may include tasks such as noise reduction, contrast adjustment, or color normalization.

Grey Conversion: Converting the video frames to grayscale simplifies the data and reduces computational complexity while retaining essential intensity information. Grayscale images are often preferred for edge detection tasks.

Median Filter: The median filter is a spatial domain filter used to reduce noise in images. It replaces each pixel's value with the median value of its neighbourhood, effectively smoothing out small variations and outliers.

Video Reader: This step involves reading the processed video frames for subsequent analysis. Video readers extract individual frames from the video sequence for further manipulation.

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Frame Conversion: this step involves converting the frames from one color space to another or adjusting their format to meet the requirements of subsequent processing steps.

Resize the Video: Resizing the video frames can be done to standardize the input size, reduce computational costs, or adapt the video for specific requirements of subsequent algorithms.

Background Subtraction: Background subtraction is a crucial step in video analysis, especially for object tracking. It involves distinguishing between the foreground (moving objects) and the background. This process helps identify and isolate objects in motion.

DCT- In the background subtraction section of the code, the frames are converted to grayscale using the rgb2gray function. After this conversion, the Discrete Cosine Transform (DCT) is applied to the grayscale frames. The DCT is often used in image processing for various purposes, including compression, feature extraction, and denoising.the absolute difference between the DCT-transformed current frame (fr_dct) and the DCT-transformed background frame (bg_dct) is computed. This difference is used as a measure to identify significant changes between the current frame and the background.

meanshift_diff = abs(double(fr_dct) - double(bg_dct));

Based on the difference obtained using DCT, a foreground mask (fg) is generated. Pixels in the foreground mask are set to the corresponding pixel values in the current frame if the DCT difference is significant (greater than 40), otherwise, they are set to 0.

Tracking Contour with Canny: After background subtraction, the canny edge detection algorithm is applied to track contours or edges in the foreground objects. The Canny edge detector identifies significant changes in intensity, outlining the boundaries of objects in the frame. This step is particularly useful for tracking moving objects and extracting their shapes

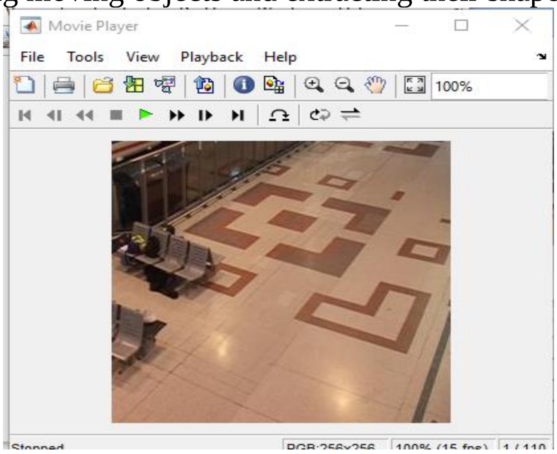

Fig .4.2 video movie

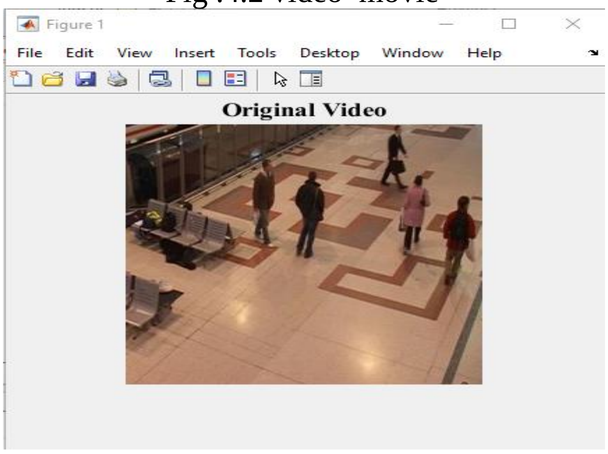

Fig .4.3 original video dataset

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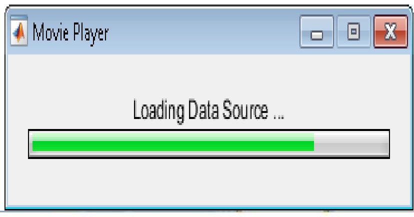

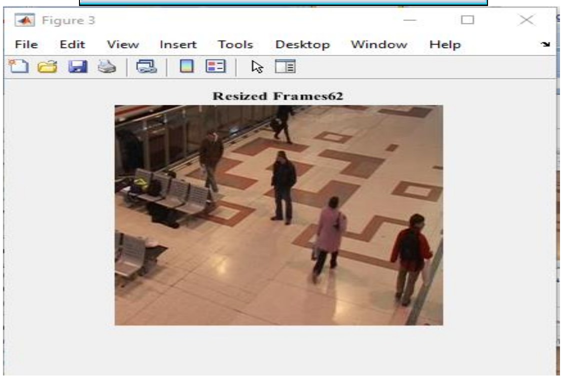

fig.4.4 resized frame

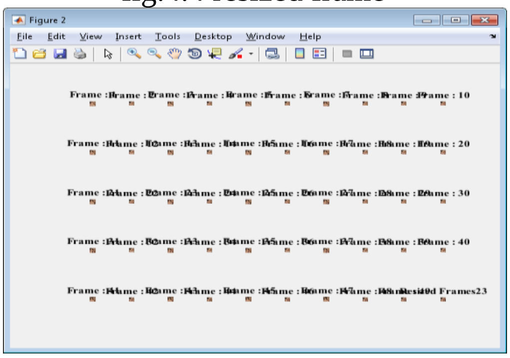

Fig. 4.5 resizes frames

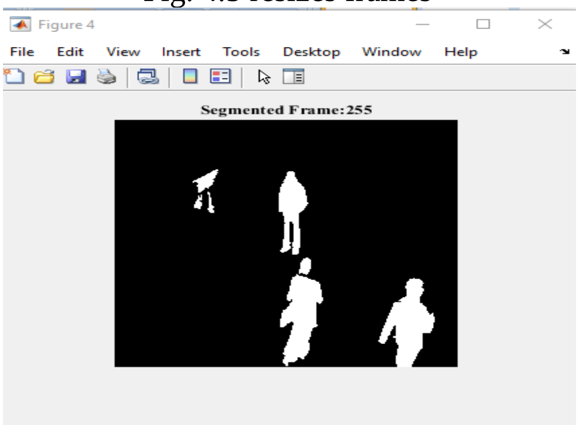

Fig .4.6 segmented frames

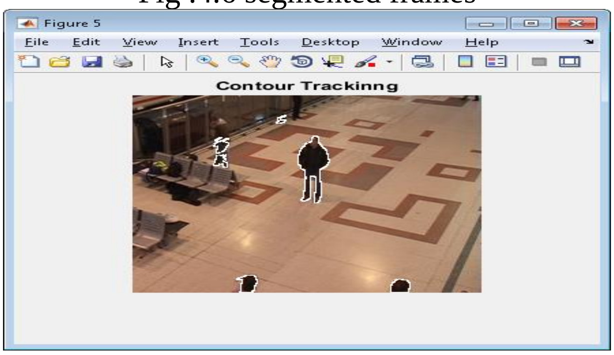

Fig 4.7 contour tracking

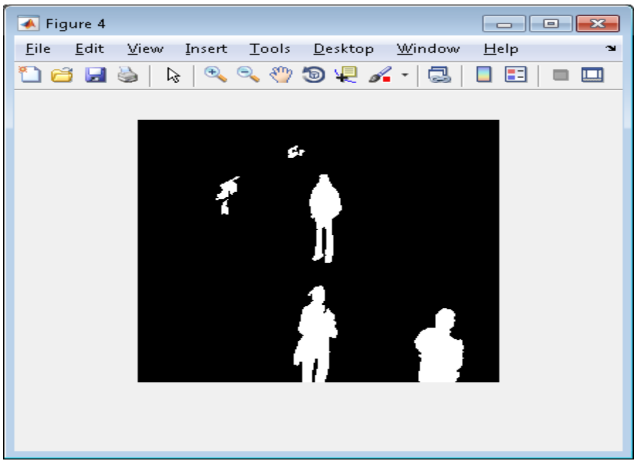

Fig. 4.8 edge detection result

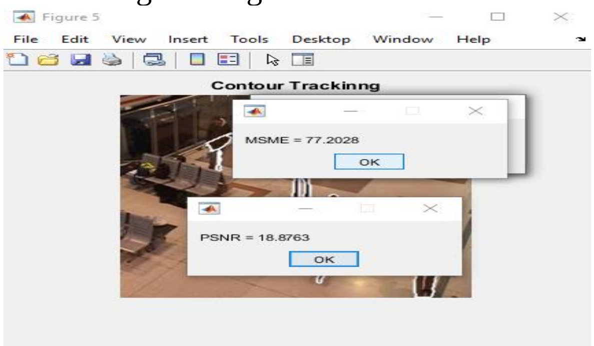

fig.4.9 PNSR and MSE result

V Performance Analysis

Peak Signal-to-Noise Ratio (PSNR) and Mean Squared Error (MSE) are commonly used metrics to evaluate the quality of image or video compression. PSNR measures the quality of the reconstructed signal, while MSE quantifies the average squared difference between the original and reconstructed signals.

1. **Peak Signal-to-Noise Ratio (PSNR):** PSNR is a metric that measures the quality of reconstruction in terms of signal-to-noise ratio. It is expressed in decibels (dB) and is defined as:

$$\mathrm{PSNR} = 10 \cdot \log_{10}\left(\frac{\mathrm{MAX}^2}{\mathrm{MSE}}\right)$$

Where:

- MAXMAX is the maximum possible pixel value (e.g., 255 for an 8-bit image).
- MSEMSE is the Mean Squared Error.

2. **Mean Squared Error (MSE):** MSE is a measure of the average squared difference between the original and reconstructed signals. It is calculated as follows:

$$\mathrm{MSE} = \frac{1}{N}\sum_{i=1}^{N}(I(i,j) - K(i,j))^2$$

Where:

- N is the total number of pixels in the image.
- $I(i,j)$ is the intensity of the pixel at position i,j) in the original image.
- $K(i,j)$ is the intensity of the pixel at position (i,j) in the reconstructed (compressed) image.

	PSNR(Db)	MSE
Proposed work	18.87	77.2
Existing work [16]	3.84	26825

Table 1 Evaluation Results of Algorithm

The Peak Signal-to-Noise Ratio (PSNR) and Mean Squared Error (MSE) values provided offer a quantitative comparison between the proposed work and an existing method (referred to as [31]). These metrics are commonly used to assess the quality of image or signal reconstruction, with higher PSNR values and lower MSE values indicating better reconstruction fidelity. PSNR (Peak Signal-to-Noise Ratio):

The proposed work has a significantly higher PSNR (18.87 dB) compared to the existing work (3.84 dB). A higher PSNR suggests that the proposed work provides better fidelity in reconstructing the signal, indicating less distortion or noise in the output compared to the existing method.

The proposed work has a substantially lower MSE (77.20) compared to the existing work (26825). A lower MSE value indicates that the proposed method yields smaller average squared differences between the original and reconstructed signals, further supporting the notion of improved reconstruction quality.

VI CONCLUSIONS

In conclusion, the hybridization of the Discrete Cosine Transform (DCT) with Canny edge detection presents a powerful and sophisticated approach to image processing. By combining the frequency-based analysis capabilities of DCT with the precise edge localization provided by Canny edge detection, this hybrid algorithm offers a robust solution for enhancing the overall quality and feature extraction capabilities of digital images.

The utilization of DCT as a pre-processing step proves instrumental in capturing essential frequency information, crucial for preserving intricate image details. This transformed representation is then seamlessly integrated with Canny edge detection, which excels in identifying significant changes in intensity to delineate edges with high precision. The synergy between these two techniques results in a comprehensive understanding of image structure, effectively balancing the advantages of frequency-based analysis and edge localization.

The hybrid DCT-Canny method demonstrates particular effectiveness in scenarios where both fine details and edge information are vital, such as in medical imaging, object recognition, and computer vision applications. This amalgamation of strengths from DCT and Canny edge detection aims to produce images with reduced noise, enhanced edge clarity, and improved overall visual quality. As a versatile solution, it holds great potential for a wide range of image processing tasks.

In essence, the described hybrid approach represents a cutting-edge methodology in image processing, contributing to advancements in fields requiring sophisticated analysis and interpretation of visual data. Its versatility and ability to address diverse application areas underscore its significance in pushing the boundaries of image processing techniques.

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