Here are short, structured descriptions for each of the 12 experiments, including what they are, how they work, and their use cases:

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1. **Noise Removal Using Mean and Gaussian Filters**

* **Definition**: Techniques to smooth images by reducing noise.
* **How it Works**: Mean filter replaces each pixel with the average of neighboring pixels; Gaussian filter does similar but gives higher weight to central pixels using a Gaussian kernel.
* **Use Case**: Denoising images in photography, medical imaging, and pre-processing before edge detection.

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2. **Histogram Equalization for Contrast Enhancement**

* **Definition**: A method to enhance the global contrast of images.
* **How it Works**: Redistributes image intensity values to span the full intensity range, making dark areas darker and bright areas brighter.
* **Use Case**: Enhancing images in poor lighting, improving visibility in satellite and medical images.

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3. **Image Segmentation Using Thresholding Techniques**

* **Definition**: Dividing an image into regions based on intensity levels.
* **How it Works**: Pixels are grouped into classes based on a threshold value; methods include global, adaptive, and Otsu thresholding.
* **Use Case**: Object detection, medical image analysis, and machine vision.

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4. **Edge Detection Using Sobel, Prewitt, and Canny Operators**

* **Definition**: Identifying boundaries within images.
* **How it Works**: Sobel and Prewitt use gradient masks to detect edges; Canny adds noise filtering, gradient calculation, and edge tracking by hysteresis.
* **Use Case**: Feature extraction, object recognition, and computer vision.

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5. **Character Segmentation from an Image**

* **Definition**: Separating individual characters in a text-containing image.
* **How it Works**: Involves binarization, noise removal, and connected component analysis to isolate characters.
* **Use Case**: Optical character recognition (OCR), license plate recognition, document digitization.

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6. **Object Counting and Measurement in ‘rice.tif’ Image**

* **Definition**: Identifying and counting objects in an image.
* **How it Works**: Binarization followed by morphological operations and labeling algorithms to detect individual grains.
* **Use Case**: Quality control in agriculture, industrial inspection.

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7. **Image Convolution Using a 3x3 Mask**

* **Definition**: A filtering operation for feature extraction or enhancement.
* **How it Works**: A 3×3 kernel (mask) is slid over the image to apply transformations such as sharpening or blurring.
* **Use Case**: Edge detection, noise reduction, texture analysis.

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8. **Speech-to-Text Conversion Using Google Speech Recognition API**

* **Definition**: Converting spoken words into written text.
* **How it Works**: Audio input is processed via Google’s cloud service which uses neural network-based acoustic and language models.
* **Use Case**: Voice assistants, automated transcription, accessibility tools.

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9. **Comparative Analysis of Speech Feature Extraction Techniques (MFCC, PLP, LPC)**

* **Definition**: Methods to extract distinguishing features from speech signals.
* **How it Works**:

  * **MFCC**: Captures human hearing characteristics using Mel scale and DCT.
  * **PLP**: Enhances MFCC using psychoacoustic models.
  * **LPC**: Models vocal tract using linear predictive coding.
* **Use Case**: Speech recognition, speaker identification, audio classification.

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10. **Implementation of Real-Time Continuous Speech Recognition System Using VAD and Google API**

* **Definition**: Live transcription of speech using voice activity detection (VAD).
* **How it Works**: VAD detects speech segments, which are sent to Google API for transcription.
* **Use Case**: Real-time voice control, live captioning, AI assistants.

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11. **Evaluation and Comparison of Pitch Estimation Algorithms (YIN, PYIN, CREPE, SWIPE)**

* **Definition**: Techniques for estimating the pitch of a speech or musical signal.
* **How it Works**:

  * **YIN/PYIN**: Autocorrelation-based; PYIN uses probabilistic models.
  * **CREPE**: Deep learning-based.
  * **SWIPE**: Frequency domain harmonic matching.
* **Use Case**: Music analysis, voice tone analysis, speech synthesis.

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12. **Text-Dependent Speaker Identification Using MFCC and Cosine Similarity with GMM**

* **Definition**: Identifying a speaker from a specific phrase.
* **How it Works**: Extract MFCC features and compare them using cosine similarity and Gaussian Mixture Models.
* **Use Case**: Voice biometrics, access control, personalized AI responses.