

**Project Title**: Advanced Background Subtraction Using

Image Processing and Machine Learning

**Submitted By:** 1)Sayma Masoom (S24MTCG0020)

2)Preeti Kumari (S24MTCG0013)

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**Submitted To:** Dr. Sakshi Sharma

Background subtraction is a commonly studied area in computer vision and is mainly employed for object detection and segmentation of moving objects from video streams. It has widespread applications in surveillance, traffic surveillance, object tracking, and human-computer interaction. Numerous techniques have been introduced over the years to improve the accuracy and stability of background subtraction models.

Classical approaches depend upon statistical modeling of the background, e.g., the Gaussian Mixture Model (GMM), proposed by Stauffer and Grimson (1999). The method models the background using multiple Gaussian distributions so that it can learn changes in illumination and small movements. Yet another commonly employed algorithm is the Running Average Method that revises the background model based on the weighted average in time and thus keeps it straightforward and effective in a stationary scene. Furthermore, the use of Median Filtering estimates the background with an examination of median pixel intensity within consecutive frames that results in tolerance towards rapid motion changes.

As there have been progress in machine learning, more evolved methods have also appeared. SVMs have also been used to classify pixels either as background or foreground using the statistical features obtained. Random Forests have been utilized for the task of modeling background by using pixel intensity variations over time. All these have made use of machine learning for enhancing the performance of background subtraction methods in their ability to be adaptable.

The latest advancements include deep learning-based methods, which realize high accuracy in background subtraction. Convolutional Neural Networks (CNNs) find extensive application in segmenting dynamic backgrounds in cluttered environments. Autoencoders, another deep learning method, reconstruct the background from an input image and identify anomalies as foreground objects. State-of-the-art models such as U-Net and DeepLabV3+ have also been employed to realize accurate foreground-background segmentation, taking advantage of the deep learning capacity to realize spatial and contextual information.

Background subtraction is a critical real-time object detection technique. By combining conventional techniques with deep learning models, we can attain greater accuracy and robustness in dynamic scenes. Future enhancements involve hybrid models that merge deep learning and conventional techniques for improved performance.

This paper gives an overview of background subtraction, preprocessing steps, techniques used, and ML integration. Let me know if you require changes or further information!