Machine Learning-Based Approach for Person Re-Identification

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***Abstract*—The surveillance and security applications heavily depend on Person Re-Identification (Re-ID) which allows identity matching across different camera feeds. This research investigates a machine learning method which utilizes FFT together with Wavelet Transform to extract features after employing PCA as a reduction technique for dimensions. The approach features an efficient alternative to deep learning models through handcrafted features because it does not need large datasets or lots of computation power. The obtained information features undergo evaluation to determine their success in person identification. The outcomes from FFT and Wavelet Transform and PCA appear as tables to evaluate their influence on re-identification performance.**

***Index Terms*—Person re-identification, Fourier transform, Wavelet transform, Principal Component Analysis, Feature extraction, CMC curves, Rank-1 accuracy.**

I. Introduction

Person re-identification (Re-ID) proves essential for intelligent surveillance applications as it enables cross-camera identification of individuals. Deep learning based Re-ID models which rely on traditional approaches need large quantities of labeled datasets together with powerful computing systems thus becoming unusable in real-time operations with scarce resources.

A different method for image feature extraction utilizes conventional signal processing techniques which include Fourier Transform (FT) and Wavelet Transform (DWT). Through a series of transformations these features acquire better patterns of localized spatial frequencies which enhances their distinctiveness. The application of Principal Component Analysis enhances performance by applying dimensionality reduction on features to keep data variations that are most prevalent. Feature comparison will use Euclidean distance together with cosine similarity to establish individual rankings.

- **Feature Extraction using Fourier and Wavelet Transform**: The method employs Fourier and Wavelet Transform to enhance the features by examining frequency patterns and time-frequency relationships.
- **Dimensionality Reduction using PCA**: The use of PCA for dimensionality reduction creates efficient feature space reduced through PCA representation which remains informative.

Fig. 1. Sample images from the dataset showing person re-identification scenario.

II. Methodology

A. Dataset

Research tests are proposed for method through evaluation of data obtained specifically for person re-identification tasks. The images within this dataset display all three conditions which provide optimal conditions for testing re-identification methods. The acquired dataset excels at person recognition between different non-overlapping cameras particularly because it aids security together with law enforcement and retail analytics operations.

A total of more than **one million** images are present along with approximately **1250** unique identities. Identical identities contain different numbers of images that show variations in body positions and apparel types as well as environmental contexts. All collected images represent how cameras would capture subjects in actual monitoring conditions. This dataset contains images which have low resolution along with compression format while measuring **128 pixels by 256 pixels**. The images contain multiple light condition types that consist of daytime and nighttime and low-light scenarios and varying brightness levels. The images are in **JPG** format.

B. Feature Extraction

Fourier Transform (FFT): Through Fourier Transform image analysis shifts from spatial domain data to frequency domain data for identifying global patterns as well as reducing data repetition. Core edge information contained in high-frequency elements helps with re-identification tasks.

Wavelet Transform (DWT): The Wavelet Transform outperforms the Fourier Transform since it extracts spatial and

frequency data at various resolution levels. The preservation of image details and textures results from the analysis performed by this method.

C. Action Plan

- **Cumulative Matching Characteristic (CMC) Curves**: A standard metric that evaluates the probability of the correct match appearing in the top-k ranked candidates.
- **Rank-1 and Rank-5 Accuracy**: The percentage of times the correct individual is retrieved as the top-1 or within the top-5 predictions.

III. Results

The experimental data shows that using Fourier Transform together with Wavelet Transform produces better feature representation which results in superior re-identification outcomes. PCA application optimizes the feature collection through elimination of redundant elements which preserves discriminatory input.

Person	0001
Image	0001C1T0001F001.jpg
FFT Mean	1.274670523
FFT Variance	0.936214401
FFT Energy	83918.8265

TABLE I
FFT Features of the Image

Person	0001
Image	0001C1T0001F001.jpg
cA Mean	0.840504527
cA Variance	0.10939607
cA Energy	6683.392578
cH Mean	-0.00047676
cH Variance	0.00166837
cH Energy	13.66914845
cV Mean	-0.000111788
cV Variance	0.00094303
cV Energy	7.725405693
cD Mean	2.68094E-05
cD Variance	5.87813E-05
cD Energy	0.481542259

TABLE II
Wavelet Features of the Image

Image	0001C1T0001F001.jpg
PCA_Mean_1	-0.415159814
PCA_Mean_2	-0.354947858
PCA_Variance_1	-1.166083432
PCA_Variance_2	-0.351175746
PCA_Energy_1	-1.053917959
PCA_Energy_2	0.307892644

TABLE III
PCA Features of the Image

Key Observations:

- The structural patterns which Fourier Transform detects fail to identify specific features within images.
- The combination of Wavelet Transform maintains spatial features which enhances recognition accuracy rates.
- PCA conducts a complex reduction of calculations which maintains high accuracy standards.

IV. Conclusion

This study presented a feature extraction-based approach for person re-identification using Fourier and Wavelet transformations followed by PCA. The proposed methodology effectively reduces feature dimensionality and reduces computation power while preserving key discriminative information.

References

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