Video Blur Detection

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Objective

Domain : Image Processing, Computer vision, Machine Learning

Study various blur detection techniques and provide a comparative performance of the available state-of-the-art methods for classification of blurry versus non-blurry video

Measure & compare performance in terms of precision, recall, f-measure, accuracy, execution time showing the effectiveness of Blur detection techniques.

DataSet

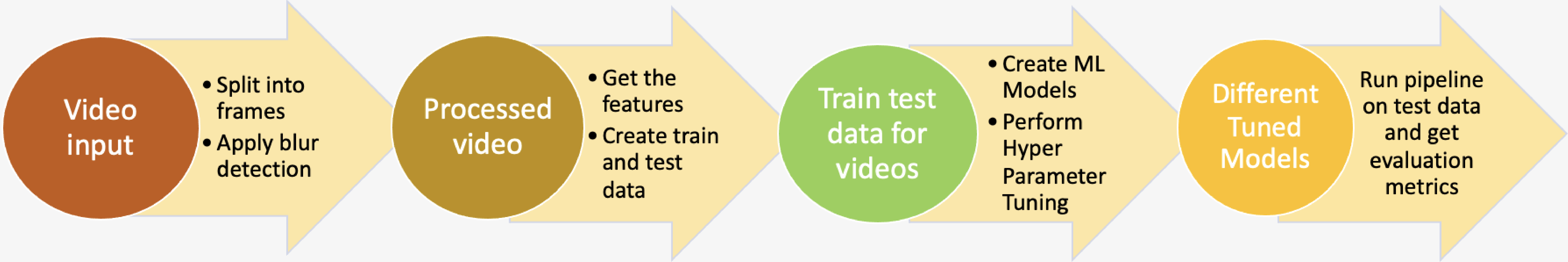
Description

- Train Data:
    - 18 Scenarios
    - 5 videos per scenario (No distortion + 4 distortion type)
    - 90 videos
- Test Data:
    - 7 Scenarios
    - 35 videos
- Each video is of 10 sec duration with uniform distortion.

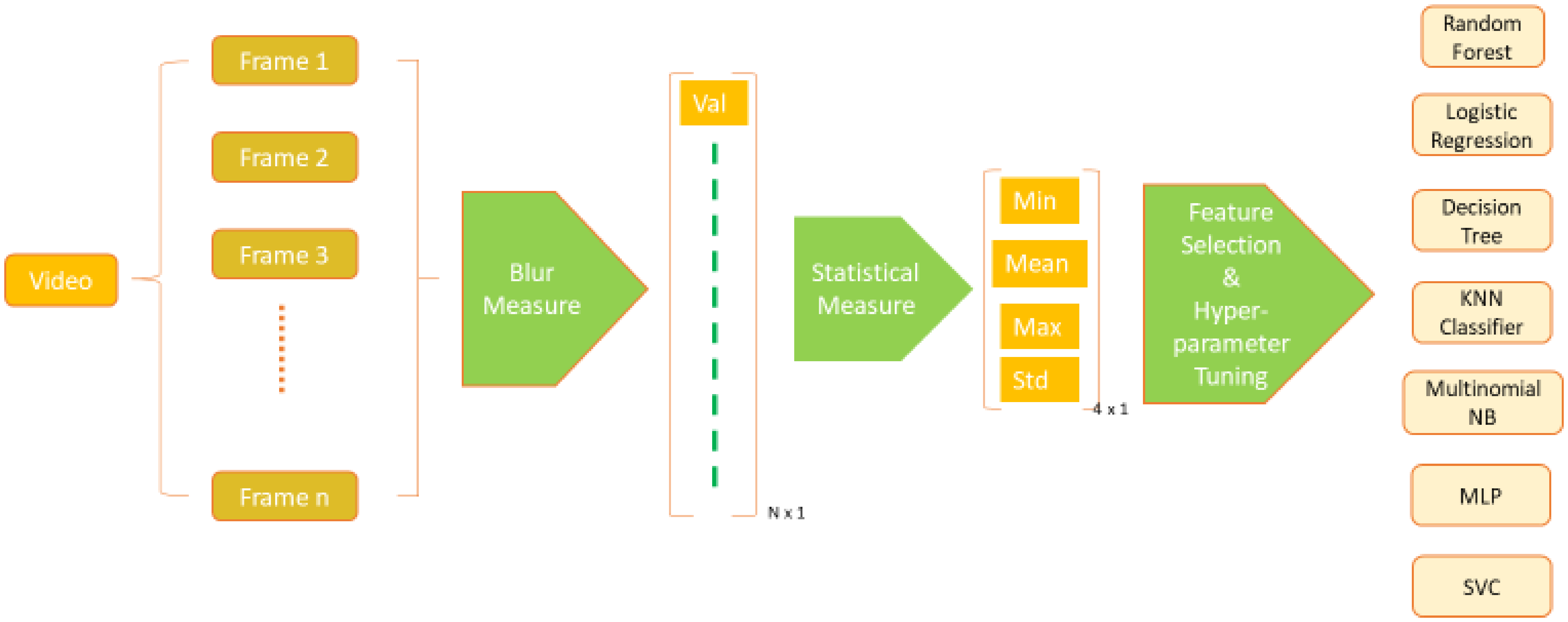
Dataset link

- https://vsquad2022.aliqureshi.info/index.html
- https://www.l2ti.univ-paris13.fr/VSQuad/

Process Flow



Detailed Flow



End to End Video Blur Detection Pipeline

Tools / Libraries

- Open CV
- Scikit Learn
- NumPy
- Pandas

Blur Detection Techniques

- Laplacian
- Modified Laplacian
- FFT - Fast Fourier Transform
- HWT
- Tenengrad

LAPLACIAN OPERATOR (LAP)

Features

- Laplace operator of a discrete function is obtained by making difference on the second derivative of Laplace operator in X and Y directions.
- Highlights regions of an image containing rapid intensity changes.
- High variance in intensity - sharp image
  Low variance in intensity - blurred image

Evaluation Metrics

Classifer	Features Used	Parameters	Accuracy	Recall	Precision	F1Score
Random Forest	min	Depth=2, Estimator=10	0.767	0.964	0.9	0.931
Logistic Regression	min	C = 0.1, l2, balanced	0.767	0.964	0.9	0.931
Decision Tree	min, mean, std	Balanced, depth=4, min split=3	0.821	0.928	0.928	0.928
KNN Classifier	min,mean,max	N_neigbours = 4	0.83	0.964	0.93	0.947
Multinomial NB	min,max	alpha = 1	0.696	0.964	0.87	0.915
MLP	mean, std	alpha=5e-3, hidden = (10,10,10)	0.839	0.964	0.93	0.947
SVC(Poly)	mean, std	C=10,balanced, degree = 2	0.839	0.964	0.93	0.947

Average Laplacian operation time per video : **17 sec**

MODIFIED LAPLACIAN OPERATOR (MLAP)

Features

- Compute local measures of the quality of image focus by getting the absolute values of the second derivatives.
- Instead of looking at variance, check for absolute value of filtered image.
- Higher the laplacian value (either +ve or -ve), higher the image sharpness

Evaluation Metrics

Classifer	Features Used	Parameters	Accuracy	Recall	Precision	F1Score
Random Forest	min	None, depth=2, estimator=30	0.5	1	0.8	0.889
Logistic Regression	min,mean,max,std	C=0.01, Balanced, l2	0.607	0.5	0.875	0.636
Decision Tree	min	Balanced, depth=2, split=2	0.5	1	0.8	0.889
KNN	min	Neighbours = 5	0.5	1	0.8	0.889
Multinomial NB	min	alpha = 10	0.5	1	0.8	0.889
MLP	min	adam, layer size=10, 0.001	0.5	1	0.8	0.889
SVC(Poly)	min	C=1,None, degree=3	0.5	1	0.8	0.889

Average Modified Laplacian operation time per video : **19 sec**

Implication: The modified laplacian has a low accuracy score as compared to Laplacian, indicating that the features are less discriminative

FAST FOURIER TRNASFORM (FFT)

Features

- Algorithm for computing the Discrete Fourier Transform, used to decompose an image into its sine and cosine components.
- Transform Image from spatial domain to frequency domain.
- calculates the frequencies in the image at different points.
  higher frequencies - more sharpness
  lower frequencies - more bluriness

Evaluation Metrics

Classifer	Features Used	Parameters	Accuracy	Recall	Precision	F1Score
Random Forest	min,max	Depth=4, Estimator=30,balanced	0.767	0.964	0.9	0.931
Logistic Regression	min,mean	C= 0.01,Balanced, l2	0.75	0.928	0.896	0.912
Decision Tree	max,std	Balanced, depth=3, min split=2	0.73	0.89	0.89	0.89
KNN	max	Neighbours = 2	0.803	0.89	0.925	0.91
Multinomial NB	std	alpha = 1	0.5	1	0.8	0.89
MLP	min,mean,max,std	alpha=0.05, hidden layer=10	0.642	1	0.848	0.918
SVC(Poly)	mean	balanced, degree = 2, C = 1	0.75	0.928	0.896	0.912

Average FFT operation time per video : **95 sec**

HaarWavelet Transform (HWT)

Features

- Classifies an image as blurred or sharp by splitting it into N x N tiles, applying several iterations of the 2D HWT to each tile, and grouping horizontally, vertically, and diagonally connected tiles with pronounced changes into tile clusters.
- Images with large tile clusters are classified as sharp. Images with small tile clusters are classified as blurred

Evaluation Metrics

Classifer	Features Used	Parameters	Accuracy	Recall	Precision	F1Score
Random Forest	min,max	Depth=2, Estimator=30,None	0.767	0.964	0.9	0.931
Logistic Regression	min	C=1,None, l2	0.75	0.928	0.896	0.912
Decision Tree	max	Balanced, depth=4, min split=4	0.803	0.898	0.925	0.9
KNN	max or mean_std	neighBour = 2	0.75	0.928	0.896	0.912
Multinomial NB	max	alpha = 10	0.5	1	0.8	0.889
MLP	min,max	adam,(10,10), 5e-3	0.767	0.964	0.9	0.931
SVC(poly)	mean,std	Balanced, degree = 3, C = 0.01	0.857	0.857	0.96	0.905

Average HWT operation time per video : **76 sec**

TENENGRAD

Features

- Both the horizontal and vertical gradient component when combined, generates the magnitude (measure of change of brightness) for a given pixel

- Sharper images will produce larger gradient magnitudes when compared with blurry images

Evaluation Metrics

Classifer	Features Used	Parameters	Accuracy	Recall	Precision	F1Score
Random Forest	mean,std	balanced, depth=2, estimators = 30	0.75	0.928	0.896	0.912
Logistic Regression	mean,std	balanced, l2, C = 10	0.73	0.89	0.892	0.892
Decision Tree	max	Depth=3, min split=3, None	0.696	0.964	0.87	0.915
KNN	max	neighbours = 3	0.696	0.964	0.87	0.915
Multinomial NB	mean,max	alpha = 1	0.57	1	0.823	0.903
MLP	max,std	1e-3, (10,10,10), adam	0.625	0.964	0.843	0.9
SVC(Poly)	max	Balanced, C = 0.01, Degree = 2	0.732	0.892	0.892	0.892

Average Tenangrad operation time per video : 68 **sec**

Summary

Blur Detection Technique	Classifer	Features Used	Parameters	Accuracy	Recall	Precision	F1Score	Execution Time (sec)
FFT	Random Forest	min,max	Depth=4, Estimator=30,balanced	0.767	0.964	0.9	0.931	95
Laplacian	SVC(Poly)	std	C=10,balanced, degree = 2	0.839	0.964	0.93	0.947	17
Modified Laplacian	Random Forest	min	None, depth=2, estimator=30	0.5	1	0.8	0.889	19
HWT	MLP	min,max	adam,(10,10), 5e-3	0.767	0.964	0.9	0.931	76
Tenengrad	KNN	max	neighbours = 3	0.696	0.964	0.87	0.915	68
FFT + laplacian + modified laplacian	**Randome Forest**	**min**	**depth =2, estimators = 10, none**	**0.857**	**1**	**0.933**	**0.9657**	**131**
Laplacian + modified laplacian	**Random Forest**	**Laplacian(max, std), Modified Laplacian(mean)**	**Depth = 4, estimator = 30**	**0.857**	**1**	**0.933**	**0.9657**	**36**

Combination of the features provides us the best results

References

1Pagaduan, Roxanne A., Ma Christina R. Aragon, and Ruji P. Medina. "iblurdetect: Image blur detection techniques assessment and evaluation study." In Proceedings of the International Conference on Culture Heritage, Education, Sustainable Tourism, and Innovation Technologies-CESIT, pp. 286-291. 2021.

Project Code:
https://github.com/RonakDedhiya/Video_Blur_Detection

Dataset link:
•https://vsquad2022.aliqureshi.info/index.html
•https://www.l2ti.univ-paris13.fr/VSQuad/

Thank you!