**Dataset with only images with Blue Light**

**Extracted vector with partial sums of histogram bins from LBP image and some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation**

vector - partial LBP histogram sum1, partial LBP histogram sum2, partial LBP histogram sum3, partial LBP histogram sum4, contrast, homogeneity, energy, correlation

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 20 |  |
| **Fake** | 20 |  |
| Sum | 40 | 29 |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 28 | 28 | 28 |
| Classified wrong | 1 | 1 | 1 |
| Accuracy [%] | 96.55172413793103 | 96.55172413793103 | 96.55172413793103 |
| FAR [%] | 0 | 0 | 0 |
| FRR [%] | 3.4482758620689653 | 3.4482758620689653 | 3.4482758620689653 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 27 | 25 | 26 |
| Classified wrong | 2 | 4 | 3 |
| Accuracy [%] | 93.10344827586206 | 86.20689655172414 | 89.65517241379311 |
| FAR [%] | 6.896551724137931 | 13.793103448275861 | 10.344827586206897 |
| FRR [%] | 0 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 26 | 23 | 25 |
| Classified wrong | 3 | 6 | 4 |
| Accuracy [%] | 89.65517241379311 | 79.3103448275862 | 86.20689655172414 |
| FAR [%] | 6.896551724137931 | 13.793103448275861 | 6.896551724137931 |
| FRR [%] | 3.4482758620689653 | 6.896551724137931 | 6.896551724137931 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with only images with Green Light**

**Extracted vector with partial sums of histogram bins from LBP image and some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation**

vector - partial LBP histogram sum1, partial LBP histogram sum2, partial LBP histogram sum3, partial LBP histogram sum4, contrast, homogeneity, energy, correlation

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 23 |  |
| **Fake** | 23 |  |
| Sum | 46 | 28 |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 27 | 27 | 26 |
| Classified wrong | 1 | 1 | 2 |
| Accuracy [%] | 96.42857142857143 | 96.42857142857143 | 92.85714285714286 |
| FAR [%] | 3.5714285714285716 | 3.5714285714285716 | 3.5714285714285716 |
| FRR [%] | 0 | 0 | 3.5714285714285716 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 23 | 16 | 20 |
| Classified wrong | 5 | 12 | 8 |
| Accuracy [%] | 82.14285714285714 | 57.142857142857146 | 71.42857142857143 |
| FAR [%] | 17.857142857142858 | 42.857142857142854 | 17.857142857142858 |
| FRR [%] | 0 | 0 | 10.714285714285714 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 26 | 20 | 24 |
| Classified wrong | 2 | 8 | 4 |
| Accuracy [%] | 92.85714285714286 | 71.42857142857143 | 85.71428571428571 |
| FAR [%] | 7.142857142857143 | 10.714285714285714 | 3.5714285714285716 |
| FRR [%] | 0 | 17.857142857142858 | 10.714285714285714 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with only images with Red Light**

**Extracted vector with partial sums of histogram bins from LBP image and some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation**

vector - partial LBP histogram sum1, partial LBP histogram sum2, partial LBP histogram sum3, partial LBP histogram sum4, contrast, homogeneity, energy, correlation

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 23 |  |
| **Fake** | 23 |  |
| Sum |  | 46 |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 25 | 27 | 26 |
| Classified wrong | 2 | 0 | 1 |
| Accuracy [%] | 92.5925925925926 | 100 | 96.29629629629629 |
| FAR [%] | 3.7037037037037037 | 0 | 3.7037037037037037 |
| FRR [%] | 3.7037037037037037 | 0 | 0 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 22 | 27 | 27 |
| Classified wrong | 5 | 0 | 0 |
| Accuracy [%] | 81.48148148148148 | 100 | 100 |
| FAR [%] | 18.51851851851852 | 0 | 0 |
| FRR [%] | 0 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 25 | 27 | 27 |
| Classified wrong | 2 | 0 | 0 |
| Accuracy [%] | 92.5925925925926 | 100 | 100 |
| FAR [%] | 3.7037037037037037 | 0 | 0 |
| FRR [%] | 3.7037037037037037 | 0 | 0 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with mix of images with all lights**

**Extracted vector with partial sums of histogram bins from LBP image and some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation**

vector - partial LBP histogram sum1, partial LBP histogram sum2, partial LBP histogram sum3, partial LBP histogram sum4, contrast, homogeneity, energy, correlation

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** |  |  |
| **Fake** |  |  |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with only images with Blue Light**

**Extracted vector with some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for image enhanced with Sobel on x-axis, Sobel on y-axis and Laplacian**

vector - contrast for image enhanced with laplacian, homogeneity for image enhanced with laplacian, energy for image enhanced with laplacian, correlation for image enhanced with laplacian, contrast for image enhanced with sobel on x-axis, homogeneity for image enhanced with sobel on x-axis, energy for image enhanced with sobel on x-axis, correlation for image enhanced with sobel on x-axis, contrast for image enhanced with sobel on y-axis, homogeneity for image enhanced with sobel on y-axis, energy for image enhanced with sobel on y-axis, correlation for image enhanced with sobel on y-axis

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 20 |  |
| **Fake** | 20 |  |
| Sum | 40 | 29 |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 28 |  |  |
| Classified wrong | 1 |  |  |
| Accuracy [%] | 96.55172413793103 |  |  |
| FAR [%] | 0 |  |  |
| FRR [%] | 3.4482758620689653 |  |  |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 27 |  |  |
| Classified wrong | 2 |  |  |
| Accuracy [%] | 93.10344827586206 |  |  |
| FAR [%] | 0 |  |  |
| FRR [%] | 6.896551724137931 |  |  |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 24 |  |  |
| Classified wrong | 5 |  |  |
| Accuracy [%] | 82.75862068965517 |  |  |
| FAR [%] | 6.896551724137931 |  |  |
| FRR [%] | 10.344827586206897 |  |  |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with only images with Green Light**

**Extracted vector with some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for image enhanced with Sobel on x-axis, Sobel on y-axis and Laplacian**

vector - contrast for image enhanced with laplacian, homogeneity for image enhanced with laplacian, energy for image enhanced with laplacian, correlation for image enhanced with laplacian, contrast for image enhanced with sobel on x-axis, homogeneity for image enhanced with sobel on x-axis, energy for image enhanced with sobel on x-axis, correlation for image enhanced with sobel on x-axis, contrast for image enhanced with sobel on y-axis, homogeneity for image enhanced with sobel on y-axis, energy for image enhanced with sobel on y-axis, correlation for image enhanced with sobel on y-axis

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** |  |  |
| **Fake** |  |  |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 26 |  |  |
| Classified wrong | 2 |  |  |
| Accuracy [%] | 92.85714285714286 |  |  |
| FAR [%] | 3.5714285714285716 |  |  |
| FRR [%] | 3.5714285714285716 |  |  |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 22 |  |  |
| Classified wrong | 6 |  |  |
| Accuracy [%] | 78.57142857142857 |  |  |
| FAR [%] | 14.285714285714286 |  |  |
| FRR [%] | 7.142857142857143 |  |  |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 27 |  |  |
| Classified wrong | 1 |  |  |
| Accuracy [%] | 96.42857142857143 |  |  |
| FAR [%] | 3.5714285714285716 |  |  |
| FRR [%] | 0 |  |  |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with only images with Red Light**

**Extracted vector with some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for image enhanced with Sobel on x-axis, Sobel on y-axis and Laplacian**

vector - contrast for image enhanced with laplacian, homogeneity for image enhanced with laplacian, energy for image enhanced with laplacian, correlation for image enhanced with laplacian, contrast for image enhanced with sobel on x-axis, homogeneity for image enhanced with sobel on x-axis, energy for image enhanced with sobel on x-axis, correlation for image enhanced with sobel on x-axis, contrast for image enhanced with sobel on y-axis, homogeneity for image enhanced with sobel on y-axis, energy for image enhanced with sobel on y-axis, correlation for image enhanced with sobel on y-axis

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** |  |  |
| **Fake** |  |  |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 26 |  |  |
| Classified wrong | 1 |  |  |
| Accuracy [%] | 96.29629629629629 |  |  |
| FAR [%] | 3.7037037037037037 |  |  |
| FRR [%] | 0 |  |  |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 23 |  |  |
| Classified wrong | 4 |  |  |
| Accuracy [%] | 85.18518518518519 |  |  |
| FAR [%] | 11.11111111111111 |  |  |
| FRR [%] | 3.7037037037037037 |  |  |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 24 |  |  |
| Classified wrong | 3 |  |  |
| Accuracy [%] | 88.88888888888889 |  |  |
| FAR [%] | 7.407407407407407 |  |  |
| FRR [%] | 3.7037037037037037 |  |  |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with images with All Lights**

**Extracted vector with some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for image enhanced with Sobel on x-axis, Sobel on y-axis and Laplacian**

vector - contrast for image enhanced with laplacian, homogeneity for image enhanced with laplacian, energy for image enhanced with laplacian, correlation for image enhanced with laplacian, contrast for image enhanced with sobel on x-axis, homogeneity for image enhanced with sobel on x-axis, energy for image enhanced with sobel on x-axis, correlation for image enhanced with sobel on x-axis, contrast for image enhanced with sobel on y-axis, homogeneity for image enhanced with sobel on y-axis, energy for image enhanced with sobel on y-axis, correlation for image enhanced with sobel on y-axis

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** |  |  |
| **Fake** |  |  |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with only images with Blue Light**

**Process image with wavelet transformation (bior1.3) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 19 | 10 |
| **Fake** | 19 | 10 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 28 | 27 | 24 |
| Classified wrong | 1 | 2 | 5 |
| Accuracy [%] | 96.55172413793103 | 93.10344827586206 | 82.75862068965517 |
| FAR [%] | 0 | 3.4482758620689653 | 6.896551724137931 |
| FRR [%] | 3.4482758620689653 | 3.4482758620689653 | 10.344827586206897 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 26 | 24 | 24 |
| Classified wrong | 3 | 5 | 5 |
| Accuracy [%] | 89.65517241379311 | 82.75862068965517 | 82.75862068965517 |
| FAR [%] | 10.344827586206897 | 17.24137931034483 | 17.24137931034483 |
| FRR [%] | 0 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 27 | 21 | 23 |
| Classified wrong | 2 | 8 | 6 |
| Accuracy [%] | 93.10344827586206 | 72.41379310344827 | 79.3103448275862 |
| FAR [%] | 3.4482758620689653 | 6.896551724137931 | 3.4482758620689653 |
| FRR [%] | 3.4482758620689653 | 20.689655172413794 | 17.24137931034483 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right |  |  |  |
| Classified wrong |  |  |  |
| Accuracy [%] |  |  |  |
| FAR [%] |  |  |  |
| FRR [%] |  |  |  |

**Dataset with only images with Green Light**

**Process image with wavelet transformation (bior1.3) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 16 | 8 |
| **Fake** | 16 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 10 11 | 11 12 | 13 |
| Classified wrong | 6 5 | 5 4 | 3 |
| Accuracy [%] | 62.5 68.75 | 68.75 75 | 81.25 |
| FAR [%] | 18.75 12.5 | 6.25 0 | 12.5 |
| FRR [%] | 18.75 18.75 | 25 25 | 6.25 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 10 | 11 | 15 |
| Classified wrong | 6 | 5 | 1 |
| Accuracy [%] | 62.5 | 68.75 | 93.75 |
| FAR [%] | 31.25 | 6.25 | 6.25 |
| FRR [%] | 6.25 | 25 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 10 | 10 | 14 |
| Classified wrong | 6 | 6 | 2 |
| Accuracy [%] | 62.5 | 62.5 | 87.5 |
| FAR [%] | 6.25 | 6.25 | 6.25 |
| FRR [%] | 31.25 | 31.25 | 6.25 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 10 | 13 |
| Classified wrong | 5 | 6 | 3 |
| Accuracy [%] | 68.75 | 62.5 | 81.25 |
| FAR [%] | 18.75 | 6.25 | 12.5 |
| FRR [%] | 12.5 | 31.25 | 6.25 |

**Dataset with only images with Red Light**

**Process image with wavelet transformation (bior1.3) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 17 | 8 |
| **Fake** | 17 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 12 11 | 15 | 14 |
| Classified wrong | 4 5 | 1 | 2 |
| Accuracy [%] | 75 68.75 | 93.75 | 87.5 |
| FAR [%] | 18.75 18.75 | 6.25 | 12.5 |
| FRR [%] | 6.25 12.5 | 0 | 0 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 12 | 11 |
| Classified wrong | 5 | 4 | 5 |
| Accuracy [%] | 68.75 | 75 | 68.75 |
| FAR [%] | 31.25 | 25 | 31.25 |
| FRR [%] | 0 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 9 | 15 | 12 |
| Classified wrong | 7 | 1 | 4 |
| Accuracy [%] | 56.25 | 93.75 | 75 |
| FAR [%] | 18.75 | 6.25 | 18.75 |
| FRR [%] | 25 | 0 | 6.25 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 14 | 14 |
| Classified wrong | 5 | 2 | 2 |
| Accuracy [%] | 68.75 | 87.5 | 87.5 |
| FAR [%] | 25 | 12.5 | 6.25 |
| FRR [%] | 6.25 | 0 | 6.25 |

**Dataset with only images with All Lights**

**Process image with wavelet transformation (bior1.3) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 42 | 21 |
| **Fake** | 42 | 21 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 36 | 38 39 | 33 34 |
| Classified wrong | 6 | 4 3 | 9 8 |
| Accuracy [%] | 85.7 | 90.5 92.9 | 78.6 81 |
| FAR [%] | 7.1 | 9.5 7.1 | 19 14.3 |
| FRR [%] | 7.1 | 0 | 2.4 4.8 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 34 | 33 | 32 |
| Classified wrong | 8 | 9 | 10 |
| Accuracy [%] | 81 | 78.6 | 76.2 |
| FAR [%] | 19 | 19 | 19 |
| FRR [%] | 0 | 2.4 | 4.8 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 30 | 30 | 30 |
| Classified wrong | 12 | 12 | 12 |
| Accuracy [%] | 71.42857142857143 | 71.42857142857143 | 71.42857142857143 |
| FAR [%] | 14.285714285714286 | 19.047619047619047 | 16.666666666666668 |
| FRR [%] | 14.285714285714286 | 9.523809523809524 | 11.904761904761905 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 36 | 30 | 33 |
| Classified wrong | 6 | 12 | 9 |
| Accuracy [%] | 85.71428571428571 | 71.42857142857143 | 78.57142857142857 |
| FAR [%] | 9.523809523809524 | 26.19047619047619 | 19.047619047619047 |
| FRR [%] | 4.761904761904762 | 2.380952380952381 | 2.380952380952381 |

**Dataset with only images with Blue Light**

**Process image with wavelet transformation (db2) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 19 | 10 |
| **Fake** | 19 | 10 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 10 | 10 | 12 |
| Classified wrong | 10 | 10 | 8 |
| Accuracy [%] | 50 | 50 | 60 |
| FAR [%] | 20 | 35 | 25 |
| FRR [%] | 30 | 15 | 15 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 16 | 12 | 12 |
| Classified wrong | 4 | 8 | 8 |
| Accuracy [%] | 80 | 60 | 60 |
| FAR [%] | 20 | 35 | 40 |
| FRR [%] | 0 | 5 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 10 | 11 | 13 |
| Classified wrong | 10 | 9 | 7 |
| Accuracy [%] | 50 | 55 | 65 |
| FAR [%] | 20 | 15 | 35 |
| FRR [%] | 30 | 30 | 0 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 13 | 9 | 13 |
| Classified wrong | 7 | 11 | 7 |
| Accuracy [%] | 65 | 45 | 65 |
| FAR [%] | 30 | 30 | 35 |
| FRR [%] | 5 | 25 | 0 |

**Dataset with only images with Green Light**

**Process image with wavelet transformation (db2) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 16 | 8 |
| **Fake** | 16 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 13 | 12 |
| Classified wrong | 5 | 3 | 4 |
| Accuracy [%] | 68.75 | 81.25 | 75 |
| FAR [%] | 25 | 12.5 | 12.5 |
| FRR [%] | 6.25 | 6.25 | 12.5 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 12 | 12 |
| Classified wrong | 5 | 4 | 4 |
| Accuracy [%] | 68.75 | 75 | 75 |
| FAR [%] | 31.25 | 25 | 18.75 |
| FRR [%] | 0 | 0 | 6.25 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 8 | 10 | 11 |
| Classified wrong | 8 | 6 | 5 |
| Accuracy [%] | 50 | 62.5 | 68.75 |
| FAR [%] | 25 | 25 | 18.75 |
| FRR [%] | 25 | 12.5 | 12.5 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 9 | 13 |
| Classified wrong | 5 | 7 | 3 |
| Accuracy [%] | 68.75 | 56.25 | 81.25 |
| FAR [%] | 25 | 37.5 | 12.5 |
| FRR [%] | 6.25 | 6.25 | 6.25 |

**Dataset with only images with Red Light**

**Process image with wavelet transformation (db2) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 17 | 8 |
| **Fake** | 17 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 13 | 13 | 15 |
| Classified wrong | 3 | 3 | 1 |
| Accuracy [%] | 81.25 | 81.25 | 93.75 |
| FAR [%] | 12.5 | 18.75 | 6.25 |
| FRR [%] | 6.25 | 0 | 0 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 11 | 13 |
| Classified wrong | 5 | 5 | 3 |
| Accuracy [%] | 68.75 | 68.75 | 81.25 |
| FAR [%] | 31.25 | 31.25 | 18.75 |
| FRR [%] | 0 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 14 | 12 | 10 |
| Classified wrong | 2 | 4 | 6 |
| Accuracy [%] | 87.5 | 75 | 62.5 |
| FAR [%] | 0 | 18.75 | 12.5 |
| FRR [%] | 12.5 | 6.25 | 25 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 14 | 11 | 8 |
| Classified wrong | 2 | 5 | 8 |
| Accuracy [%] | 87.5 | 68.75 | 50 |
| FAR [%] | 0 | 25 | 12.5 |
| FRR [%] | 12.5 | 6.25 | 37.5 |

**Dataset with only images with All Lights**

**Process image with wavelet transformation (db2) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 42 | 21 |
| **Fake** | 42 | 21 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 35 | 32 | 36 |
| Classified wrong | 7 | 10 | 6 |
| Accuracy [%] | 83.33333333333333 | 76.19047619047619 | 85.71428571428571 |
| FAR [%] | 14.285714285714286 | 16.666666666666668 | 7.142857142857143 |
| FRR [%] | 2.380952380952381 | 7.142857142857143 | 7.142857142857143 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 38 | 29 | 32 |
| Classified wrong | 4 | 13 | 10 |
| Accuracy [%] | 90.47619047619048 | 69.04761904761905 | 76.19047619047619 |
| FAR [%] | 9.523809523809524 | 30.952380952380953 | 19.047619047619047 |
| FRR [%] | 0 | 0 | 4.761904761904762 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 33 | 22 | 28 |
| Classified wrong | 9 | 20 | 14 |
| Accuracy [%] | 78.57142857142857 | 52.38095238095238 | 66.66666666666667 |
| FAR [%] | 14.285714285714286 | 26.19047619047619 | 16.666666666666668 |
| FRR [%] | 7.142857142857143 | 21.428571428571427 | 16.666666666666668 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 34 | 24 | 24 |
| Classified wrong | 8 | 18 | 18 |
| Accuracy [%] | 80.95238095238095 | 57.142857142857146 | 57.142857142857146 |
| FAR [%] | 19.047619047619047 | 38.095238095238095 | 38.095238095238095 |
| FRR [%] | 0 | 4.761904761904762 | 4.761904761904762 |

**Dataset with only images with Blue Light**

**Process image with wavelet transformation (rbio3.1) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 19 | 10 |
| **Fake** | 19 | 10 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 15 | 16 | 19 |
| Classified wrong | 5 | 4 | 1 |
| Accuracy [%] | 75 | 80 | 95 |
| FAR [%] | 15 | 5 | 5 |
| FRR [%] | 10 | 15 | 0 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 16 | 15 | 17 |
| Classified wrong | 4 | 5 | 3 |
| Accuracy [%] | 80 | 75 | 85 |
| FAR [%] | 20 | 15 | 10 |
| FRR [%] | 0 | 10 | 5 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 14 | 11 | 13 |
| Classified wrong | 6 | 9 | 7 |
| Accuracy [%] | 70 | 55 | 65 |
| FAR [%] | 15 | 30 | 20 |
| FRR [%] | 15 | 15 | 15 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 12 | 10 | 12 |
| Classified wrong | 8 | 10 | 8 |
| Accuracy [%] | 60 | 50 | 60 |
| FAR [%] | 25 | 40 | 10 |
| FRR [%] | 15 | 10 | 30 |

**Dataset with only images with Green Light**

**Process image with wavelet transformation (rbio3.1) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 16 | 8 |
| **Fake** | 16 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 12 | 10 | 12 |
| Classified wrong | 4 | 6 | 4 |
| Accuracy [%] | 75 | 62.5 | 75 |
| FAR [%] | 12.5 | 37.5 | 18.75 |
| FRR [%] | 12.5 | 0 | 6.25 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 12 | 9 | 11 |
| Classified wrong | 4 | 7 | 5 |
| Accuracy [%] | 75 | 56.25 | 68.75 |
| FAR [%] | 25 | 31.25 | 25 |
| FRR [%] | 0 | 12.5 | 6.25 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 13 | 11 | 14 |
| Classified wrong | 3 | 5 | 2 |
| Accuracy [%] | 81.25 | 68.75 | 87.5 |
| FAR [%] | 12.5 | 31.25 | 6.25 |
| FRR [%] | 6.25 | 0 | 6.25 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 13 | 11 | 12 |
| Classified wrong | 3 | 5 | 4 |
| Accuracy [%] | 81.25 | 68.75 | 75 |
| FAR [%] | 12.5 | 31.25 | 18.75 |
| FRR [%] | 6.25 | 0 | 6.25 |

**Dataset with only images with Red Light**

**Process image with wavelet transformation (rbio3.1) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 17 | 8 |
| **Fake** | 17 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 13 | 16 | 15 |
| Classified wrong | 3 | 0 | 1 |
| Accuracy [%] | 81.25 | 100 | 93.75 |
| FAR [%] | 6.25 | 0 | 6.25 |
| FRR [%] | 12.5 | 0 | 0 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 12 | 14 |
| Classified wrong | 5 | 4 | 2 |
| Accuracy [%] | 68.75 | 75 | 87.5 |
| FAR [%] | 31.25 | 25 | 12.5 |
| FRR [%] | 0 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 13 | 13 | 14 |
| Classified wrong | 3 | 3 | 2 |
| Accuracy [%] | 81.25 | 81.25 | 87.5 |
| FAR [%] | 12.5 | 18.75 | 12.5 |
| FRR [%] | 6.25 | 0 | 0 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 13 | 16 | 14 |
| Classified wrong | 3 | 0 | 2 |
| Accuracy [%] | 81.25 | 100 | 87.5 |
| FAR [%] | 18.75 | 0 | 12.5 |
| FRR [%] | 0 | 0 | 0 |

**Dataset with only images with All Lights**

**Process image with wavelet transformation (rbio3.1) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 42 | 21 |
| **Fake** | 42 | 21 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 33 | 33 | 37 |
| Classified wrong | 9 | 9 | 5 |
| Accuracy [%] | 78.57142857142857 | 78.57142857142857 | 88.0952380952381 |
| FAR [%] | 9.523809523809524 | 9.523809523809524 | 7.142857142857143 |
| FRR [%] | 11.904761904761905 | 11.904761904761905 | 4.761904761904762 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 33 | 33 | 36 |
| Classified wrong | 9 | 9 | 6 |
| Accuracy [%] | 78.57142857142857 | 78.57142857142857 | 85.71428571428571 |
| FAR [%] | 21.428571428571427 | 21.428571428571427 | 14.285714285714286 |
| FRR [%] | 0 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 31 | 29 | 33 |
| Classified wrong | 11 | 13 | 9 |
| Accuracy [%] | 73.80952380952381 | 69.04761904761905 | 78.57142857142857 |
| FAR [%] | 16.666666666666668 | 16.666666666666668 | 7.142857142857143 |
| FRR [%] | 9.523809523809524 | 14.285714285714286 | 14.285714285714286 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 37 | 34 | 33 |
| Classified wrong | 5 | 8 | 9 |
| Accuracy [%] | 88.0952380952381 | 80.95238095238095 | 78.57142857142857 |
| FAR [%] | 7.142857142857143 | 11.904761904761905 | 21.428571428571427 |
| FRR [%] | 4.761904761904762 | 7.142857142857143 | 0 |

**Dataset with only images with Blue Light**

**Process image with wavelet transformation (bior2.4) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 19 | 10 |
| **Fake** | 19 | 10 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 17 | 13 | 18 |
| Classified wrong | 3 | 7 | 2 |
| Accuracy [%] | 85 | 65 | 90 |
| FAR [%] | 15 | 30 | 10 |
| FRR [%] | 0 | 5 | 0 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 12 | 12 | 16 |
| Classified wrong | 8 | 8 | 4 |
| Accuracy [%] | 60 | 60 | 80 |
| FAR [%] | 40 | 30 | 20 |
| FRR [%] | 0 | 10 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 15 | 14 | 12 |
| Classified wrong | 5 | 6 | 8 |
| Accuracy [%] | 75 | 70 | 60 |
| FAR [%] | 15 | 15 | 25 |
| FRR [%] | 10 | 15 | 15 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 13 | 12 | 12 |
| Classified wrong | 7 | 8 | 8 |
| Accuracy [%] | 65 | 60 | 60 |
| FAR [%] | 35 | 0 | 15 |
| FRR [%] | 0 | 40 | 25 |

**Dataset with only images with Green Light**

**Process image with wavelet transformation (bior2.4) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 16 | 8 |
| **Fake** | 16 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 14 | 13 | 12 |
| Classified wrong | 2 | 3 | 4 |
| Accuracy [%] | 87.5 | 81.25 | 75 |
| FAR [%] | 6.25 | 6.25 | 6.25 |
| FRR [%] | 6.25 | 12.5 | 18.75 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 11 | 12 |
| Classified wrong | 5 | 5 | 4 |
| Accuracy [%] | 68.75 | 68.75 | 75 |
| FAR [%] | 31.25 | 18.75 | 25 |
| FRR [%] | 0 | 12.5 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 10 | 12 | 11 |
| Classified wrong | 6 | 4 | 5 |
| Accuracy [%] | 62.5 | 75 | 68.75 |
| FAR [%] | 18.75 | 12.5 | 6.25 |
| FRR [%] | 18.75 | 12.5 | 25 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 10 | 8 | 13 |
| Classified wrong | 6 | 8 | 3 |
| Accuracy [%] | 62.5 | 50 | 81.25 |
| FAR [%] | 12.5 | 43.75 | 12.5 |
| FRR [%] | 25 | 6.25 | 6.25 |

**Dataset with only images with Red Light**

**Process image with wavelet transformation (bior2.4) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 17 | 8 |
| **Fake** | 17 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 14 | 16 | 14 |
| Classified wrong | 2 | 0 | 2 |
| Accuracy [%] | 87.5 | 100 | 87.5 |
| FAR [%] | 12.5 | 0 | 6.25 |
| FRR [%] | 0 | 0 | 6.25 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 12 | 10 | 14 |
| Classified wrong | 4 | 6 | 2 |
| Accuracy [%] | 75 | 62.5 | 87.5 |
| FAR [%] | 25 | 37.5 | 6.25 |
| FRR [%] | 0 | 0 | 6.25 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 15 | 13 | 14 |
| Classified wrong | 1 | 3 | 2 |
| Accuracy [%] | 93.75 | 81.25 | 87.5 |
| FAR [%] | 6.25 | 18.75 | 6.25 |
| FRR [%] | 0 | 0 | 6.25 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 14 | 12 | 14 |
| Classified wrong | 2 | 4 | 2 |
| Accuracy [%] | 87.5 | 75 | 87.5 |
| FAR [%] | 6.25 | 25 | 6.25 |
| FRR [%] | 6.25 | 0 | 6.25 |

**Dataset with only images with All Lights**

**Process image with wavelet transformation (bior2.4) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 42 | 21 |
| **Fake** | 42 | 21 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 39 | 35 | 33 |
| Classified wrong | 3 | 7 | 9 |
| Accuracy [%] | 92.85714285714286 | 83.33333333333333 | 78.57142857142857 |
| FAR [%] | 2.380952380952381 | 9.523809523809524 | 11.904761904761905 |
| FRR [%] | 4.761904761904762 | 7.142857142857143 | 9.523809523809524 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 34 | 31 | 31 |
| Classified wrong | 8 | 11 | 11 |
| Accuracy [%] | 80.95238095238095 | 73.80952380952381 | 73.80952380952381 |
| FAR [%] | 19.047619047619047 | 26.19047619047619 | 19.047619047619047 |
| FRR [%] | 0 | 0 | 7.142857142857143 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 36 | 33 | 35 |
| Classified wrong | 6 | 9 | 7 |
| Accuracy [%] | 85.71428571428571 | 78.57142857142857 | 83.33333333333333 |
| FAR [%] | 9.523809523809524 | 9.523809523809524 | 9.523809523809524 |
| FRR [%] | 4.761904761904762 | 11.904761904761905 | 7.142857142857143 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 31 | 30 | 34 |
| Classified wrong | 11 | 12 | 8 |
| Accuracy [%] | 73.80952380952381 | 71.42857142857143 | 80.95238095238095 |
| FAR [%] | 26.19047619047619 | 9.523809523809524 | 14.285714285714286 |
| FRR [%] | 0 | 19.047619047619047 | 4.761904761904762 |

**Dataset with only images with Blue Light**

**Process image with wavelet transformation (bior1.5) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 19 | 10 |
| **Fake** | 19 | 10 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 16 | 13 | 13 |
| Classified wrong | 4 | 7 | 7 |
| Accuracy [%] | 80 | 65 | 65 |
| FAR [%] | 15 | 20 | 25 |
| FRR [%] | 5 | 15 | 10 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 15 | 15 | 14 |
| Classified wrong | 5 | 5 | 6 |
| Accuracy [%] | 75 | 75 | 70 |
| FAR [%] | 20 | 25 | 30 |
| FRR [%] | 5 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 16 | 15 | 14 |
| Classified wrong | 4 | 5 | 6 |
| Accuracy [%] | 80 | 75 | 70 |
| FAR [%] | 10 | 15 | 5 |
| FRR [%] | 10 | 10 | 25 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 15 | 14 | 19 |
| Classified wrong | 5 | 6 | 1 |
| Accuracy [%] | 75 | 70 | 95 |
| FAR [%] | 15 | 20 | 5 |
| FRR [%] | 10 | 10 | 0 |

**Dataset with only images with Green Light**

**Process image with wavelet transformation (bior1.5) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 16 | 8 |
| **Fake** | 16 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 12 | 12 | 11 |
| Classified wrong | 4 | 4 | 5 |
| Accuracy [%] | 75 | 75 | 68.75 |
| FAR [%] | 12.5 | 6.25 | 18.75 |
| FRR [%] | 12.5 | 18.75 | 12.5 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 12 | 13 |
| Classified wrong | 5 | 4 | 3 |
| Accuracy [%] | 68.75 | 75 | 81.25 |
| FAR [%] | 31.25 | 6.25 | 6.25 |
| FRR [%] | 0 | 18.75 | 12.5 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 14 | 14 |
| Classified wrong | 5 | 2 | 2 |
| Accuracy [%] | 68.75 | 87.5 | 87.5 |
| FAR [%] | 12.5 | 0 | 6.25 |
| FRR [%] | 18.75 | 12.5 | 6.25 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 9 | 11 | 12 |
| Classified wrong | 7 | 5 | 4 |
| Accuracy [%] | 56.25 | 68.75 | 75 |
| FAR [%] | 31.25 | 31.25 | 18.75 |
| FRR [%] | 12.5 | 0 | 6.25 |

**Dataset with only images with Red Light**

**Process image with wavelet transformation (bior1.5) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 17 | 8 |
| **Fake** | 17 | 8 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 15 | 14 |
| Classified wrong | 5 | 1 | 2 |
| Accuracy [%] | 68.75 | 93.75 | 87.5 |
| FAR [%] | 18.75 | 6.25 | 12.5 |
| FRR [%] | 12.5 | 0 | 0 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 11 | 11 |
| Classified wrong | 5 | 5 | 5 |
| Accuracy [%] | 68.75 | 68.75 | 68.75 |
| FAR [%] | 31.25 | 31.25 | 31.25 |
| FRR [%] | 0 | 0 | 0 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 9 | 14 | 12 |
| Classified wrong | 7 | 2 | 4 |
| Accuracy [%] | 56.25 | 87.5 | 75 |
| FAR [%] | 31.25 | 12.5 | 25 |
| FRR [%] | 12.5 | 0 | 0 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 11 | 14 | 12 |
| Classified wrong | 5 | 2 | 4 |
| Accuracy [%] | 68.75 | 87.5 | 75 |
| FAR [%] | 25 | 12.5 | 25 |
| FRR [%] | 6.25 | 0 | 0 |

**Dataset with only images with All Lights**

**Process image with wavelet transformation (bior1.5) and get horizontal, vertical and diagonal detail of image and get some characteristics from Gray Level Coorence Matrix - contrast, homogeneity, energy, correlation for these three results**

vector - contrast for horizontal detail, homogeneity for horizontal detail, energy for horizontal detail, correlation for horizontal detail, contrast for vertical detail, homogeneity for vertical detail, energy for vertical detail, correlation for vertical detail, contrast for diagonal detail, homogeneity for diagonal detail, energy for diagonal detail, correlation for diagonal detail

|  |  |  |
| --- | --- | --- |
|  | **Trained** | **Tested** |
| **Live** | 42 | 21 |
| **Fake** | 42 | 21 |
| Sum |  |  |

**ANN:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 35 | 35 | 34 |
| Classified wrong | 7 | 7 | 8 |
| Accuracy [%] | 83.33333333333333 | 83.33333333333333 | 80.95238095238095 |
| FAR [%] | 9.523809523809524 | 9.523809523809524 | 11.904761904761905 |
| FRR [%] | 7.142857142857143 | 7.142857142857143 | 7.142857142857143 |

**SVM:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 34 | 33 | 30 |
| Classified wrong | 8 | 9 | 12 |
| Accuracy [%] | 80.95238095238095 | 78.57142857142857 | 71.42857142857143 |
| FAR [%] | 19.047619047619047 | 16.666666666666668 | 19.047619047619047 |
| FRR [%] | 0 | 4.761904761904762 | 9.523809523809524 |

**CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 37 | 34 | 30 |
| Classified wrong | 5 | 8 | 12 |
| Accuracy [%] | 88.0952380952381 | 80.95238095238095 | 71.42857142857143 |
| FAR [%] | 9.523809523809524 | 14.285714285714286 | 19.047619047619047 |
| FRR [%] | 2.380952380952381 | 4.761904761904762 | 9.523809523809524 |

**My CLF:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Otsu segmentation | Adaptive Gaussian Segmentation | Adaptive Mean Segmentation |
| Classified right | 36 | 32 | 32 |
| Classified wrong | 6 | 10 | 10 |
| Accuracy [%] | 85.71428571428571 | 76.19047619047619 | 76.19047619047619 |
| FAR [%] | 9.523809523809524 | 21.428571428571427 | 21.428571428571427 |
| FRR [%] | 4.761904761904762 | 2.380952380952381 | 2.380952380952381 |