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| **Feature** | **Relative importance** | **Computational implementation** | **Description** | **Feature group** | **Reference** |
| *f1* | 0.724 | $\frac{1}{MN} \sum\_{n}^{ }\sum\_{m}^{ } $*IH(m, n)* | Average hue across the whole image (in HSV color space) | Color | 1, 2 |
| *f2* | 0.456 | $\frac{1}{MN} \sum\_{n}^{ }\sum\_{m}^{ } $*IS(m, n)* | Average saturation across the whole image (in HSV color space) | Color | 1 |
| *f3* | 0.876 | $\frac{1}{MN} \sum\_{n}^{ }\sum\_{m}^{ } $*IV(m, n)* | Average value across the whole image (in HSV color space) | Color | 1 |
| *f4* | 0.592 | $\frac{1}{MN} \sum\_{n}^{ }\sum\_{m}^{ } $*IS\_(m, n)* | Average saturation across the whole image (in HSL color space) | Color | 2 |
| *f5* | 0.733 | $\frac{1}{MN} \sum\_{n}^{ }\sum\_{m}^{ } $*IL\_(m, n)* | Average brightness across the whole image (in HSL color space) | Color | 2 |
| *f6* | 0.338 | $$\sqrt{\left(h-h0\right)T A\left(h-h0\right)}$$ | Colorfulness using quadratic-form distance | Color | 1 |
| *f7* | 0.455 | *emd(D1, D0, {dij|1 < i,j < 64})* | Colorfulness using earth mover’s distance | Color | 1 |
| *f8* | 0.761 | *min(hmax)* | Value of most frequent hue | Color | 4 |
| *f9* | 0.614 | *std(var(I’H\_))* | Standard deviation of colorfulness | Color | 4 |
| *f10* | 0.285 | *# of {i|h(i) > C • Q}* | Number of hues present | Color | 2 |
| *f11* | 0.470 | *# of {i|h(i) > c • Q}* | Number of hues missing | Color | 2, 4 |
| *f12* | 0.270 | *max(||ch(i) – ch(j)||al) with i, j ∈ {i|h(i) > C • Q}* | Hue contrast across image | Color | 2 |
| *f13* | 0.357 | *max(||ch(i) – ch(j)||al) with i, j ∈ {i|h(i) < c • Q}* | Contrast between missing hues across image | Color | 2, 4 |
| *f14* | 0.451 | *= Q/N where N = # of PH* | Number of pixels belonging to most frequent hue | Color | 2 |
| *f15* | 0.357 | *20 – # of {i|h(i) > C2 • Q} with C2 = 0.05* | Number of significant hues in image | Color | 23 |
| *f16* | 0.554 | $\min\_{α}$ *F1,α,* | Distance to 1st hue model | Color | 2, 4 |
| *f17* | 0.463 | $\min\_{α}$ *F2,α,* | Distance to 2nd hue model | Color | 2, 4 |
| *f18* | 0.523 | $\min\_{α}$ *F3,α,* | Distance to 3rd hue model | Color | 2, 4 |
| *f19* | 0.554 | $\min\_{α}$ *F4,α,* | Distance to 4th hue model | Color | 2, 4 |
| *f20* | 0.521 | $\min\_{α}$ *F5,α,* | Distance to 5th hue model | Color | 2, 4 |
| *f21* | 0.509 | $\min\_{α}$ *F6,α,* | Distance to 6th hue model | Color | 2, 4 |
| *f22* | 0.528 | $\min\_{α}$ *F7,α,* | Distance to 7th hue model | Color | 2, 4 |
| *f23* | 0.495 | $\min\_{α}$ *F8,α,* | Distance to 8th hue model | Color | 2, 4 |
| *f24* | 0.519 | $\min\_{α}$ *F9,α,* | Distance to 9th hue model | Color | 2, 4 |
| *f25* | 0.199 | $$\left\{\begin{array}{c}maxk\in \{j|Fj,α(j),TH\} k if ∃k\in \{1, …, 9\}, Fk,α(k) < TH\\k0 if ∀k Fk,α(k) \geq TH\end{array}\right\}$$ | Best fitting hue model | Color | 2 |
| *f26* | 0.809 | $\frac{1}{MN} \sum\_{m}^{ }\sum\_{n}^{ } $*L(m, n)* | Arithmetic average of brightness | Color | 2, 3 |
| *f27* | 0.800 | *exp(* $\frac{255}{MN} \sum\_{m}^{ }\sum\_{n}^{ } $*log(∈ +* $\frac{L(m, n)}{255}$*))* | Logarithmic average of brightness | Color | 2 |
| *f28* | 0.444 | *b - a + 1* | Brightness contrast across image (100 bin histogram) | Color | 2 |
| *f29* | 0.708 | *b2 – a2* | Brightness contrast across image (255 bin histogram) | Color | 3 |
| *f30* | 0.901 | *H90W90/HW* | Area of bounding box containing 81% of edge energy | Texture | 2 |
| *f31* | 0.922 | *1 – H98W98; H98 and W98 ∈ [0, 1]* | Resized area of bounding box containing 96.04% of edge energy | Texture | 23 |
| *f32* | 1.165 | *ds – dp* | Similarity measure of high frequency edges spatial distribution | Texture | 23 |
| *f33* | 0.739 | *(|Sr|L1 + |Sg|L11 + |Sb|L11)/3* | Sum of edges | Texture | 4 |
| *f34* | 0.814 | $\frac{1}{MN} \sum\_{m}^{ }\sum\_{n}^{ } $*(RH(m, n) + RS(m, n) + RV(m, n))/3* | Range of texture | Texture | 4 |
| *f35* | 0.767 | $\frac{1}{MN} \sum\_{m}^{ }\sum\_{n}^{ } $*(DH(m, n) + DS(m, n) + DV(m, n))/3* | Average standard deviation of texture | Texture | 4 |
| *f36* | 0.476 | *entropy(Ir)* | Entropy of red matrix Ir | Texture | 4 |
| *f37* | 0.630 | *entropy(Ig)* | Entropy of green matrix Ig | Texture | 4 |
| *f38* | 0.862 | *entropy(Ib)* | Entropy of blue matrix Ib | Texture | 4 |
| *f39* | 1.138 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{1}^{H}$*(m, n) +* $C\_{1}^{V}$ *(m, n) +* $C\_{1}^{D}$*(m, n))* | Wavelet feature level 1 for H | Texture | 1 |
| *f40* | 0.744 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{2}^{H}$*(m, n) +* $C\_{2}^{V}$ *(m, n) +* $C\_{2}^{D}$*(m, n))* | Wavelet feature level 2 for H | Texture | 1 |
| *f41* | 0.957 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{3}^{H}$*(m, n) +* $C\_{3}^{V}$ *(m, n) +* $C\_{3}^{D}$*(m, n))* | Wavelet feature level 3 for H | Texture | 1 |
| *f42* | 0.892 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{1}^{H}$*(m, n) +* $C\_{1}^{V}$ *(m, n) +* $C\_{1}^{D}$*(m, n))* | Wavelet feature level 1 for S | Texture | 1 |
| *f43* | 0.600 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{2}^{H}$*(m, n) +* $C\_{2}^{V}$ *(m, n) +* $C\_{2}^{D}$*(m, n))* | Wavelet feature level 2 for S | Texture | 1 |
| *f44* | 0.626 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{3}^{H}$*(m, n) +* $C\_{3}^{V}$ *(m, n) +* $C\_{3}^{D}$*(m, n))* | Wavelet feature level 3 for S | Texture | 1 |
| *f45* | 1.060 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{1}^{H}$*(m, n) +* $C\_{1}^{V}$ *(m, n) +* $C\_{1}^{D}$*(m, n))* | Wavelet feature level 1 for V | Texture | 1 |
| *f46* | 0.932 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{2}^{H}$*(m, n) +* $C\_{2}^{V}$ *(m, n) +* $C\_{2}^{D}$*(m, n))* | Wavelet feature level 2 for V | Texture | 1 |
| *f47* | 0.590 | $\frac{1}{|C|L1 } \sum\_{m}^{ }\sum\_{n}^{ } $*(*$C\_{3}^{H}$*(m, n) +* $C\_{3}^{V}$ *(m, n) +* $C\_{3}^{D}$*(m, n))* | Wavelet feature level 3 for V | Texture | 1 |
| *f48* | 1.073 | $\sum\_{i=40}^{42} $*fi,* | Wavelet feature level 1 (avg) | Texture | 1 |
| *f49* | 0.704 | $\sum\_{i=43}^{45} $*fi,* | Wavelet feature level 2 (avg) | Texture | 1 |
| *f50* | 0.832 | $\sum\_{i=46}^{48} $*fi* | Wavelet feature level 3 (avg) | Texture | 1 |
| *f51* | 0.730 | *max* $\left(2\frac{m^{'}- \left[\frac{M}{2}\right]}{M};2\frac{n^{'}- \left[\frac{N}{2}\right]}{N}\right)$ | Blur measure | Texture | 2, 3 |
| *f52* | 0.640 | $\frac{1}{\left(\left[\frac{2M}{3}\right]- \left[\frac{M}{3}\right]+1\right)\left(\left[\frac{2N}{3}\right]- \left[\frac{N}{3}\right]+1\right)}$$\sum\_{m= \left[\frac{M}{3}\right]}^{\left[\frac{2M}{3}\right]} \sum\_{n= \left[\frac{N}{3}\right]}^{\left[\frac{2N}{3}\right]} $*IH(m, n)* | Average hue (rule of thirds, HSV) | Color | 1 |
| *f53* | 0.367 | $\frac{1}{\left(\left[\frac{2M}{3}\right]- \left[\frac{M}{3}\right]+1\right)\left(\left[\frac{2N}{3}\right]- \left[\frac{N}{3}\right]+1\right)}$$\sum\_{m= \left[\frac{M}{3}\right]}^{\left[\frac{2M}{3}\right]} \sum\_{n= \left[\frac{N}{3}\right]}^{\left[\frac{2N}{3}\right]} $*IS(m, n)* | Average saturation (rule of thirds, HSV) | Color | 1 |
| *f54* | 0.689 | $\frac{1}{\left(\left[\frac{2M}{3}\right]- \left[\frac{M}{3}\right]+1\right)\left(\left[\frac{2N}{3}\right]- \left[\frac{N}{3}\right]+1\right)}$$\sum\_{m= \left[\frac{M}{3}\right]}^{\left[\frac{2M}{3}\right]} \sum\_{n= \left[\frac{N}{3}\right]}^{\left[\frac{2N}{3}\right]} $*IV(m, n)* | Average value (rule of thirds, HSV) | Color | 1 |
| *f55* | 0.711 | $\frac{1}{\# of \{(m, n)|\left(m, n\right)\in FR\}}\sum\_{\left(m, n\right)\in FR}^{ } $*IH\_(m, n)* | Average hue for focus region (HSL) | Color | 2 |
| *f56* | 0.496 | $\frac{1}{\# of \{(m, n)|\left(m, n\right)\in FR\}}\sum\_{\left(m, n\right)\in FR}^{ } $*IS\_(m, n)* | Average saturation for focus region (HSL) | Color | 2 |
| *f57* | 0.771 | $\frac{1}{\# of \{(m, n)|\left(m, n\right)\in FR\}}\sum\_{\left(m, n\right)\in FR}^{ } $*IL\_(m, n)* | Average brightness for focus region (HSL) | Color | 2 |
| *f58* | 1.066 | # of *L* | Number of color based clusters formed by K-Means (LUV) | Objects | 1 |
| *f59* | 0.367 | *# of {si|# of si > MN/100}* | Number of segments *si* larger than 1% of the image (*i* in [1,5]) | Objects | 1 |
| *f60* | 0.488 | *(# of s1)/MN* | Ration of size of largest segment to size of whole image | Objects | 1 |
| *f61* | 0.486 | *(# of s2)/MN* | Ration of size of 2nd largest segment to size of whole image | Objects | 1 |
| *f62* | 0.454 | *(# of s3)/MN* | Ration of size of 3rd largest segment to size of whole image | Objects | 1 |
| *f63* | 0.549 | *(# of s4)/MN* | Ration of size of 4th largest segment to size of whole image | Objects | 1 |
| *f64* | 0.539 | *(# of s5)/MN* | Ration of size of 5th largest segment to size of whole image | Objects | 1 |
| *f65* | 0.217 | *10 \* r + c, ∀∈ {1}* | Block containing centroid of 1st cluster | Objects | 1 |
| *f66* | 0.136 | *10 \* r + c, ∀∈ {2}* | Block containing centroid of 2nd cluster | Objects | 1 |
| *f67* | 0.097 | *10 \* r + c, ∀∈ {3}* | Block containing centroid of 3rd cluster | Objects | 1 |
| *f68* | 0.013 | *10 \* r + c, ∀∈ {4}* | Block containing centroid of 4th cluster | Objects | 1 |
| *f69* | 0.059 | *10 \* r + c, ∀∈ {5}* | Block containing centroid of 5th cluster | Objects | 1 |
| *f70* | 0.605 | $\frac{1}{\# of s1 }$$\sum\_{\left(m, n\right)\in s1 }^{ } $*IH(m, n)* | Average hue of largest segment (HSV) | Objects (Color) | 1 |
| *f71* | 0.603 | $\frac{1}{\# of s2 }$$\sum\_{\left(m, n\right)\in s2 }^{ } $*IH(m, n)* | Average hue of 2nd largest segment (HSV) | Objects (Color) | 1, 2 |
| *f72* | 0.545 | $\frac{1}{\# of s3 }$$\sum\_{\left(m, n\right)\in s3 }^{ } $*IH(m, n)* | Average hue of 3rd largest segment (HSV) | Objects (Color) | 1, 2 |
| *f73* | 0.463 | $\frac{1}{\# of s4 }$$\sum\_{\left(m, n\right)\in s4 }^{ } $*IH(m, n)* | Average hue of 4th largest segment (HSV) | Objects (Color) | 1 |
| *f74* | 0.506 | $\frac{1}{\# of s5 }$$\sum\_{\left(m, n\right)\in s5 }^{ } $*IH(m, n)* | Average hue of 5th largest segment (HSV) | Objects (Color) | 1 |
| *f75* | 0.429 | $\frac{1}{\# of s1 }$$\sum\_{\left(m, n\right)\in s1 }^{ } $*IS(m, n)* | Average saturation of largest segment (HSV) | Objects (Color) | 1, 2 |
| *f76* | 0.459 | $\frac{1}{\# of s2 }$$\sum\_{\left(m, n\right)\in s2 }^{ } $*IS(m, n)* | Average saturation of 2nd largest segment (HSV) | Objects (Color) | 1, 2 |
| *f77* | 0.357 | $\frac{1}{\# of s3 }$$\sum\_{\left(m, n\right)\in s3 }^{ } $*IS(m, n)* | Average saturation of 3rd largest segment (HSV) | Objects (Color) | 1, 2 |
| *f78* | 0.396 | $\frac{1}{\# of s4 }$$\sum\_{\left(m, n\right)\in s4 }^{ } $*IS(m, n)* | Average saturation of 4th largest segment (HSV) | Objects (Color) | 1 |
| *f79* | 0.316 | $\frac{1}{\# of s5 }$$\sum\_{\left(m, n\right)\in s5 }^{ } $*IS(m, n)* | Average saturation of 5th largest segment (HSV) | Objects (Color) | 1 |
| *f80* | 0.682 | $\frac{1}{\# of s1 }$$\sum\_{\left(m, n\right)\in s1 }^{ } $*IV(m, n)* | Average value of largest segment (HSV) | Objects (Color) | 1 |
| *f81* | 0.471 | $\frac{1}{\# of s2 }$$\sum\_{\left(m, n\right)\in s2 }^{ } $*IV(m, n)* | Average value of 2nd largest segment (HSV) | Objects (Color) | 1 |
| *f82* | 0.378 | $\frac{1}{\# of s3 }$$\sum\_{\left(m, n\right)\in s3 }^{ } $*IV(m, n)* | Average value of 3rd largest segment (HSV) | Objects (Color) | 1 |
| *f83* | 0.343 | $\frac{1}{\# of s4 }$$\sum\_{\left(m, n\right)\in s4 }^{ } $*IV(m, n)* | Average value of 4th largest segment (HSV) | Objects (Color) | 1 |
| *f84* | 0.321 | $\frac{1}{\# of s5 }$$\sum\_{\left(m, n\right)\in s5 }^{ } $*IV(m, n)* | Average value of 5th largest segment (HSV) | Objects (Color) | 1 |
| *f85* | 0.544 | $\frac{1}{\# of s1 }$$\sum\_{\left(m, n\right)\in s1 }^{ } $*L(m, n)* | Average brightness of largest segment (HSV) | Objects (Color) | 2 |
| *f86* | 0.411 | $\frac{1}{\# of s2 }$$\sum\_{\left(m, n\right)\in s2 }^{ } $*L(m, n)* | Average brightness of 2nd largest segment (HSV) | Objects (Color) | 2 |
| *f87* | 0.260 | $\frac{1}{\# of s3 }$$\sum\_{\left(m, n\right)\in s3 }^{ } $*L(m, n)* | Average brightness of 3rd largest segment (HSV) | Objects (Color) | 2 |
| *f88* | 0.334 | $\sum\_{i=1}^{5} \sum\_{j=1}^{5} $*|h(i) – h(j)|* | Average color spread among top 5 patch hues | Color | 1 |
| *f89* | 0.354 | $\sum\_{i=1}^{5} \sum\_{j=1}^{5} $*||h(i) – h(j)||al* | Average complimentary colors among top 5 patch hues | Color | 1 |
| *f90* | 0.367 | *x1 =* $\frac{1}{\# of s1 }$$\sum\_{\left(m, n\right)\in s1 }^{ } $*x(m, n)* | Horizontal coordinate of mass center for largest segment | Objects | 2 |
| *f91* | 0.190 | *x2 =* $\frac{1}{\# of s2 }$$\sum\_{\left(m, n\right)\in s2 }^{ } $*x(m, n)* | Horizontal coordinate of mass center for 2nd largest segment | Objects | 2 |
| *f92* | 0.135 | *x3 =* $\frac{1}{\# of s3 }$$\sum\_{\left(m, n\right)\in s3 }^{ } $*x(m, n)* | Horizontal coordinate of mass center for 3rd largest segment | Objects | 2 |
| *f93* | 0.133 | *͞y1 =* $\frac{1}{\# of s1 }$$\sum\_{\left(m, n\right)\in s1 }^{ } $*y(m, n)* | Vertical coordinate of mass center for largest segment | Objects | 2 |
| *f94* | 0.096 | *͞y2 =* $\frac{1}{\# of s2 }$$\sum\_{\left(m, n\right)\in s2 }^{ } $*y(m, n)* | Vertical coordinate of mass center for 2nd largest segment | Objects | 2 |
| *f95* | 0.091 | *͞y3 =* $\frac{1}{\# of s3 }$$\sum\_{\left(m, n\right)\in s3 }^{ } $*y(m, n)* | Vertical coordinate of mass center for 3rd largest segment | Objects | 2 |
| *f96* | 0.418 | $\frac{1}{\# of s1 }$$\sum\_{\left(m, n\right)\in s1 }^{ } $*((x(m, n) – ͞x1 )2 + ((y(m, n) – ͞y1 )2)* | Mass variance for largest segment | Objects | 2 |
| *f97* | 0.346 | $\frac{1}{\# of s2 }$$\sum\_{\left(m, n\right)\in s2 }^{ } $*((x(m, n) – ͞x2 )2 + ((y(m, n) – ͞y2 )2)* | Mass variance for 2nd largest segment | Objects | 2 |
| *f98* | 0.421 | $\frac{1}{\# of s3 }$$\sum\_{\left(m, n\right)\in s3 }^{ } $*((x(m, n) – ͞x3 )2 + ((y(m, n) – ͞y3 )2)* | Mass variance for 3rd largest segment | Objects | 2 |
| *f99* | 0.062 | $\frac{1}{\# of s1 }$$\sum\_{\left(m, n\right)\in s1 }^{ } $*((x(m, n) – ͞x1 )3 + ((y(m, n) – ͞y1 )3)* | Mass skewness for largest segment | Objects | 2 |
| *f100* | 0.152 | $\frac{1}{\# of s2 }$$\sum\_{\left(m, n\right)\in s2 }^{ } $*((x(m, n) – ͞x2 )3 + ((y(m, n) – ͞y2 )3)* | Mass skewness for 2nd largest segment | Objects | 2 |
| *f101* | 0.109 | $\frac{1}{\# of s3 }$$\sum\_{\left(m, n\right)\in s3 }^{ } $*((x(m, n) – ͞x3 )3 + ((y(m, n) – ͞y3 )3)* | Mass skewness for 3rd largest segment | Objects | 2 |
| *f102* | 0.453 | $\frac{1}{MN}\sum\_{k=1}^{R} $*I* $\left(\frac{area(pk)}{area(gk)}> δ\right)$ *\* |area(pk)|* | Shape convexity feature | Objects | 2 |
| *f103* | 0.360 | $$*(||h(i) – h(j)||al)* | Hue contrast between segments | Objects (Color) | 2 |
| *f104* | 0.524 | $$*(|s(i) – s(j)|)* | Saturation contrast between segments | Objects (Color) | 2 |
| *f105* | 0.509 | $$*(|l(i) – l(j)|)* | Brightness contrast between segments | Objects (Color) | 2 |
| *f106* | 0.332 | $$*(|b(i) – b(j)|)* | Blur contrast between segments | Objects | 2 |
| *f107* | 0.167 | $$\frac{\sum\_{(m, n)\in M6 M7 M10 M11 }^{ } (C(m, n) + C(m, n) + C(m, n))}{\sum\_{i=1}^{16} \sum\_{(m, n)\in Mi}^{ } (C(m, n) + C(m, n) + C(m, n))}$$ | Low depth of field indicator for hue (HSV) | Texture | 1 |
| *f108* | 0.103 | $$\frac{\sum\_{(m, n)\in M6 M7 M10 M11 }^{ } (C(m, n) + C(m, n) + C(m, n))}{\sum\_{i=1}^{16} \sum\_{(m, n)\in Mi}^{ } (C(m, n) + C(m, n) + C(m, n))}$$ | Low depth of field indicator for saturation (HSV) | Texture | 1 |
| *f109* | 0.068 | $$\frac{\sum\_{(m, n)\in M6 M7 M10 M11 }^{ } (C(m, n) + C(m, n) + C(m, n))}{\sum\_{i=1}^{16} \sum\_{(m, n)\in Mi}^{ } (C(m, n) + C(m, n) + C(m, n))}$$ | Low depth of field indicator for value (HSV) | Texture | 1 |