

Picture 1. This Youtube page is run though the Aesthetic UI -script and used as an example through this document

AE-2. Evaluation of UI Aesthetics

Introduction

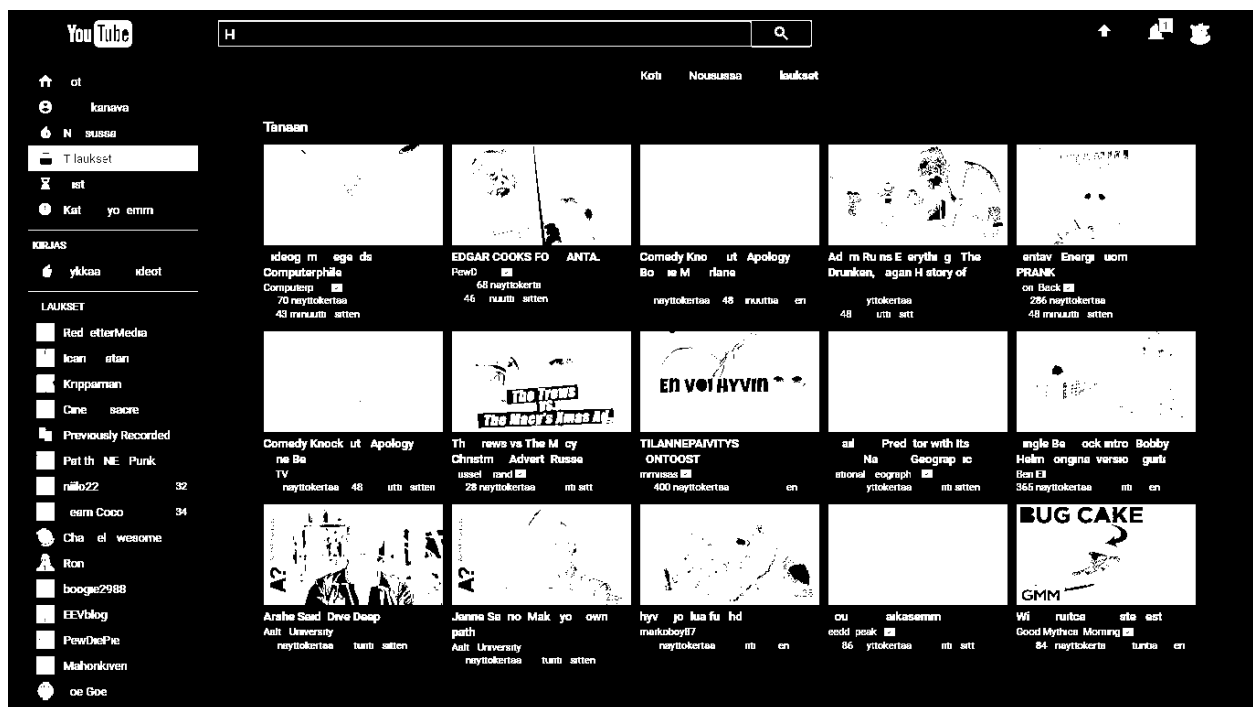
What is beauty and what does aesthetics mean in the context of UI design? To evaluate what is aesthetically pleasing there is a need for a set of definite criteria to base the evaluations on. Some criteria of aesthetics mentioned in the research paper were symmetry, visual clutter, contour congestion, figure-ground contrast, layout-quality, prototypicality and ease of grouping[1]. Clutter was chosen from these as the metric to be examined plus 3 extra criteria mentioned later.

As aesthetics is a subjective and complex higher-level subject I would consider it a moderate success if the Aesthetic UI-script is more accurate than blind luck, e.g. the script can predict a 'good' looking and a 'bad' looking website little over 50 % of the time.

The Metrics

The script measures four different metrics of an image and scores them based on each metric's own qualities.

The metrics are the number of items on the display or **clutteredness** e.g how many salient objects there are on a web page, the **color range** of the three main colors on the page and their distance to each other in CIE lab color space, **how sharp** or how in focus the image is and lastly **how nested** or how much hierarchy there is in the UI. Clutteredness and nestedness metrics are scored between 1-33 points where the perfect score is 33 for the perfect aesthetic result. Color range is scored between 5-18 points and image sharpness in 5-15 points range. In the end, all metric scores are added together to give the image an overall rating with max points of 99.



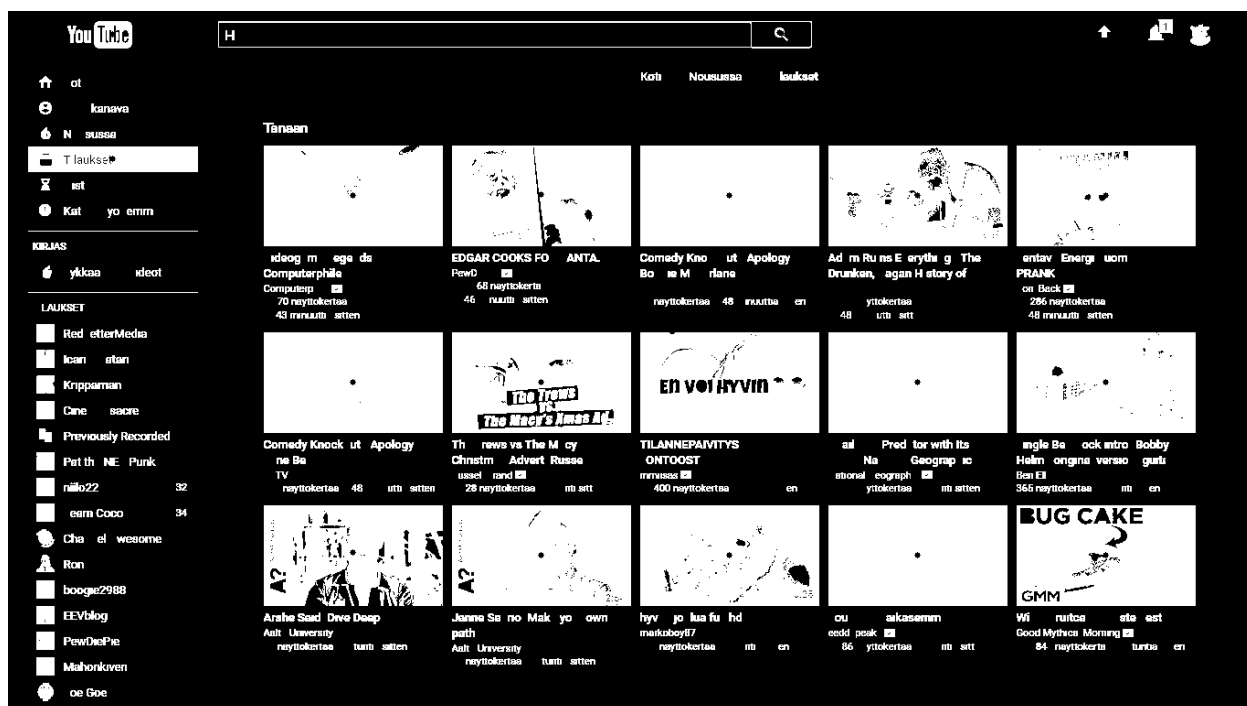
Picture2: Binary image of salient “hole-items found on the Youtube page

Clutteredness

To measure how many items there are on the screen and to further deduce how “cluttered” the display is, a saliency algorithm is used to get the salient “hole” parts of the image and then the number of these “holes” are calculated.

First the image's contrast is improved by running the CLAHE(Contrast Limited Adaptive Histogram Equalization)-algorithm[2]. This algorithm tries to equalize contrast in the whole image without burning in images with high intensity variations. This step is done to ensure the contrast variations don't disturb with the saliency-detection algorithm. Then using the salientregions python module, a binary image of

the original is produced and the salient parts are extracted from the image. This new binary image now has white contours or salient “holes” which number are calculated with a certain threshold to not account for too small spots. Testing this algorithm a “good” looking websites tended to have 14-19 of these salient items. With fewer items than that the page looked empty, and more than that and the amount of items became distracting. The 14-19 item range gets the image the perfect score of 33 points from this metric, lower or more than that lowers the score.

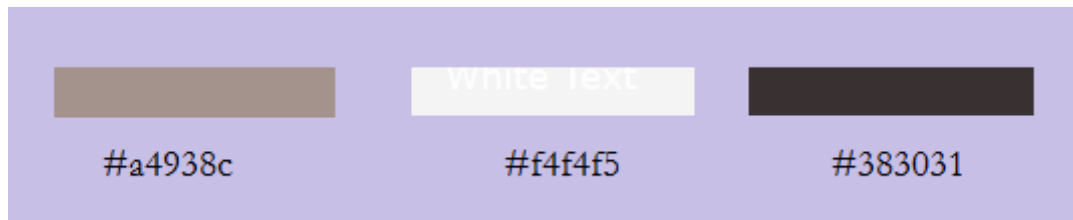


Picture 3: The salient “holes” found in the image are counted. This Youtube page has 21 items which gives 30/33 points ("Good amount of items on the page")

Color Range

To measure the color range the three dominant colors of the image are needed. This is done using an algorithm that uses k-clustering approach to cluster pixels into groups based on their color[3]. The resulting “centers” are the three dominant colors of the image. There is some amount of randomness to this clustering process, so the result may vary with different runs of the script. After finding the colors, the tree colors are compared together. Because humans perceive color differences differently than represented in the RGB color space, the dominant colors are translated to CIE lab color space, which is more accurate to the way humans perceive color differences[4]. The resulting delta-e difference is then used as the color distance. The first dominant color is compared to the second dominant color and the second dominant color to the third dominant color. The differences in the color distance are added together to

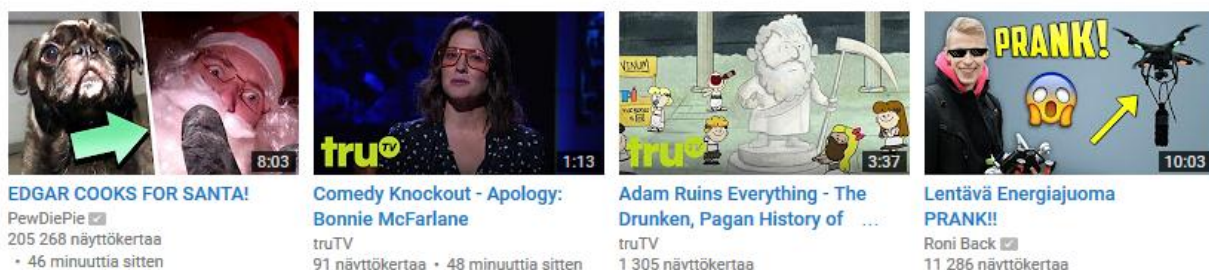
create a plain “distance” number. Scanning “good” looking websites an ideal color distance of 68-85 was decided, which means the dominant colors are perfectly spaced apart. Very colorful sites or sites with large color spectrums suffer from this metric hence the perfect score from this category is only 18 points. The farther the color distance is from the “perfect” range, the fewer points the site gets.



Picture 4: The three dominant colors found in the Youtube page. The sum of distances between them is 105.45 which give 15/18 points ("Color range is good")

Image Sharpness

To find out how “in focus” or how sharp the image is, an algorithm similar in traditional image processing is used. As with the clutteredness-metric, the image’s contrast is first improved by running the CLAHE-algorithm. This is done to minimize the evaluation errors caused by different contrast images. The sharpness is then estimated by the average gradient magnitude of the image which gives us a plain number to rate the images[5]. Deducing from “good” looking websites, the sharpness gradient range of 11-19 was decided. Smaller number than this and the page looks blurred or soft and larger than this the image looks too sharp. This metric is scored from 5-15 with 15 points given for the optimal sharpness.



Picture 5: The "sharpness"-factor or "in-focus"-factor for this youtube page is 16.92 which gives perfect 15 point sharpness score("Page looks perfectly sharp and in focus!")



Picture 6: The hierarchies generated by the script visualized on the image. This image has hierarchy of 10263, which gives max 33/33 points in the hierarchy-category ("Perfect amount of order on the page!")

Image Hierarchy

The last metric to be calculated is the hierarchy or the nestedness of an image. The script scans the image contours and gives them a hierarchy number based on if one contour is inside another[6]. The algorithm spits out a plain number which represents the “level of hierarchy” of the image. It’s difficult to say concretely what this number represents in a website, but by running the script on “good” looking websites the perfect range of 8000-12000 “hierarchyness” was decided. Fewer than this and the page doesn’t have enough “structures” or corners and more than this the site tends to look cluttered or has too many edge-like elements. The perfect range awards the site with 33 points and the farther the image falls from this perfect range the less points it gets.

Computing the Overall Score

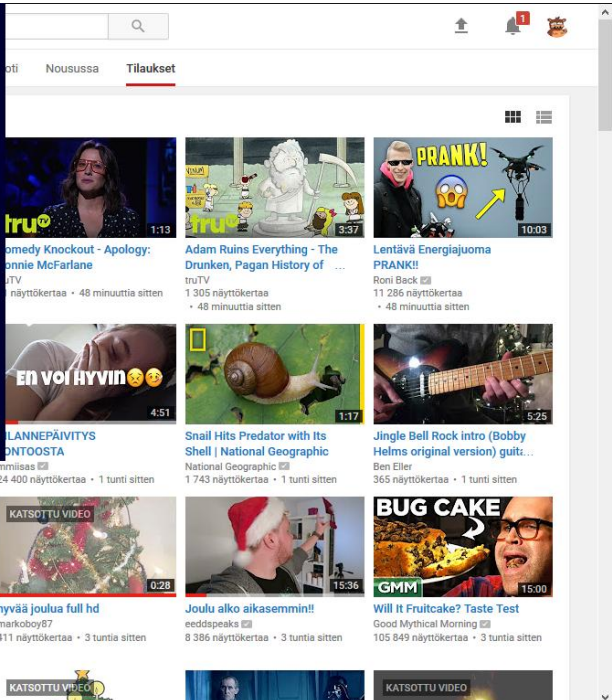
By computing these four metrics, *clutteredness*, *color range*, *image sharpness* and *image nestedness* and adding their points together an overall score is calculated. The websites are assigned to 5 different categories from excellent to poor based on their points. A perfect five star-rating is given to websites with and over 89 points. The different points for each category can be seen from the table below.

Points	Rating	Comment
89 - 99	*****	"A Very Good Looking Website! :)"
79 - 89	****	"A Good Looking Website!"
69 - 79	***	"An Average Looking Website!"
59 - 69	**	"A Below Average Looking Website!"
0 - 59	*	"A Poor Looking Website! :("

-Good amount of items on the page.
 -Colors range is good.
 -Page looks perfectly sharp and in focus!
 -Perfect amount of order on the page!

*Points for Clutteredness: 30/ 33
 *Points for Color Range: 15/ 18
 *Points for Sharpness: 15/ 15
 *Points for Hierarchy: 33/ 33
 Overall Score: 93 / 99 points

A Very Good Looking Website! :)

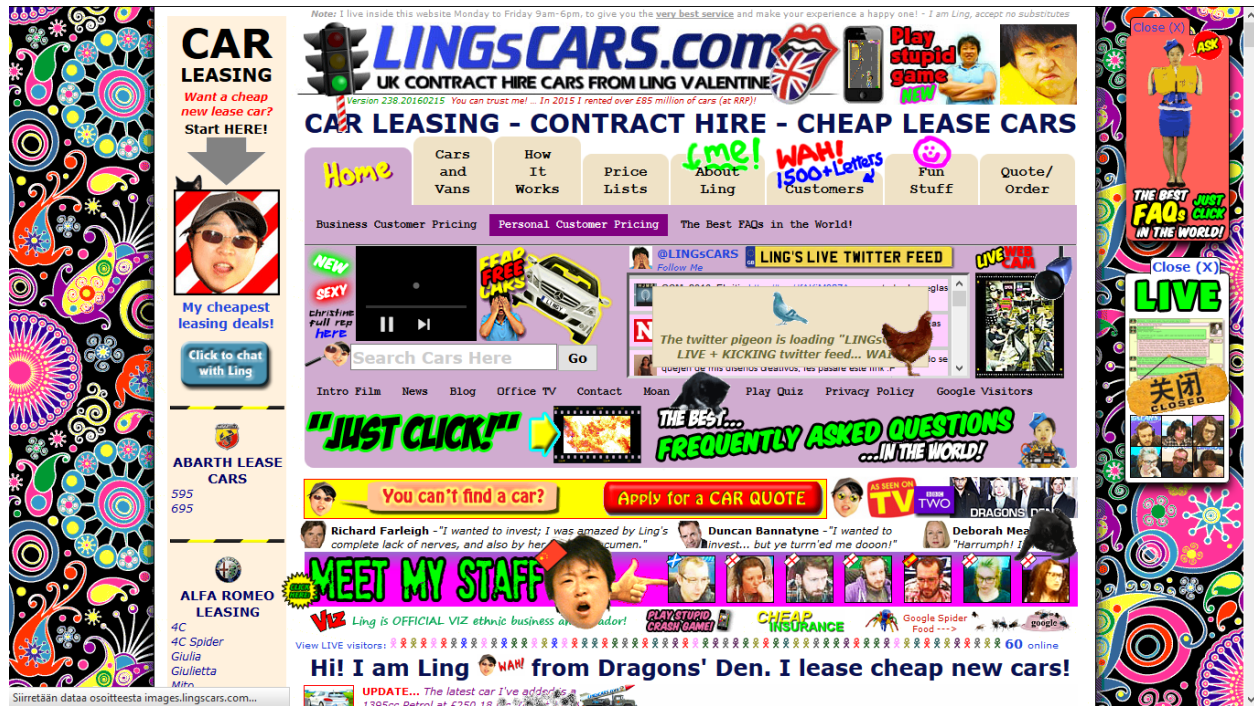


nilo22	32
Team Coco	34
Channel Awesome	10
Roni Back	3
boogie2988	5
EEVblog	4
PewDiePie	8
Mahonkivene	1
Joe Goes	3

Picture 7: If you run the script with the second argument as 1, the reasons and results are pasted on the output image.

The Examples

Here follows 13 examples of running the script on images of 13 different sites.



1. Lings Cars

<http://www.lingscars.com/>

- WAY too many items on the page.
- Colors are chosen perfectly!
- Page looks WAY too sharp!
- Page is a little too rigid-looking.

*Points for Clutteredness: 1/ 33

*Points for Color Range: 18/ 18

*Points for Sharpness: 5/ 15

*Points for Hierarchy: 23/ 33

Overall Score: 47 / 99 points

A Poor Looking Website! :(

*



2. Arngren

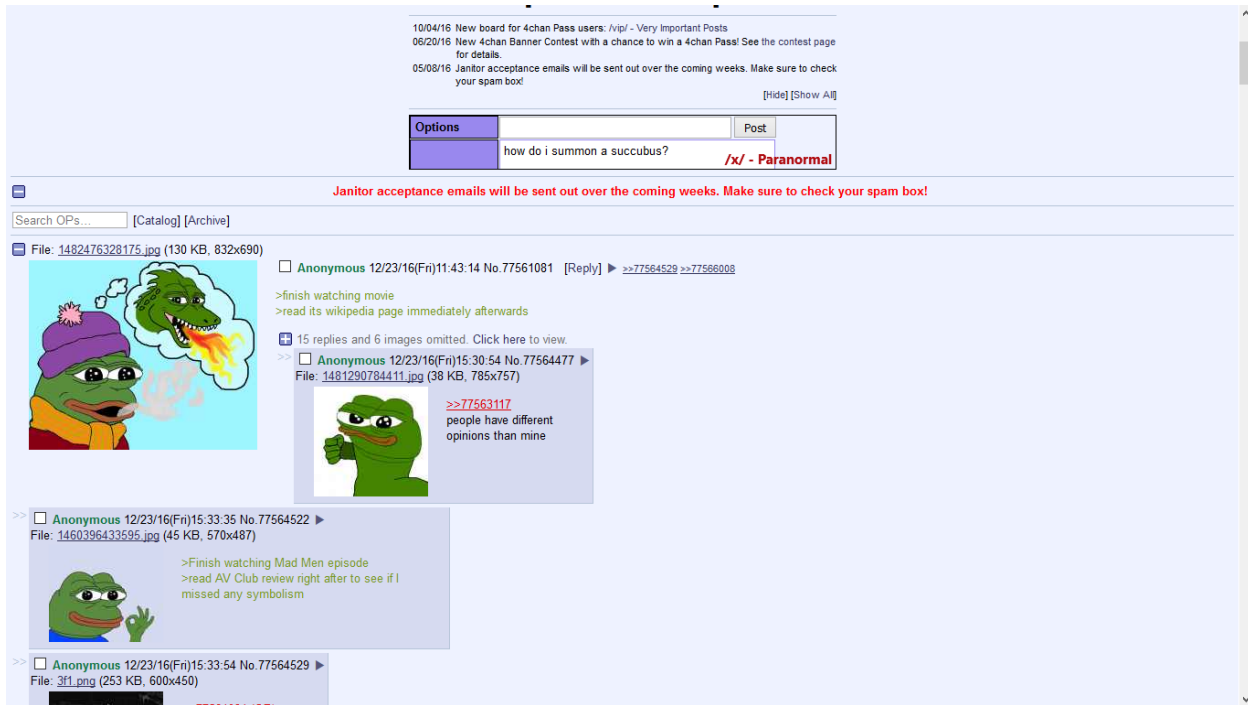
<http://www.arngren.net>

- WAY too many items on the page.
- Colors are chosen perfectly!
- Page looks WAY too sharp!
- Page is a little too rigid-looking.

- *Points for Clutteredness: 1/ 33
- *Points for Color Range: 18/ 18
- *Points for Sharpness: 5/ 15
- *Points for Hierarchy: 23/ 33

Overall Score: 47 / 99 points
A Poor Looking Website! :(

*



3. 4chan /tv/

<http://www.4chan.org/tv>

- Page has too many large connected areas.
- Colors are spread little too far apart.
- Page looks slightly soft.
- Page could be a bit more structured.

*Points for Clutteredness: 10/ 33

*Points for Color Range: 10/ 18

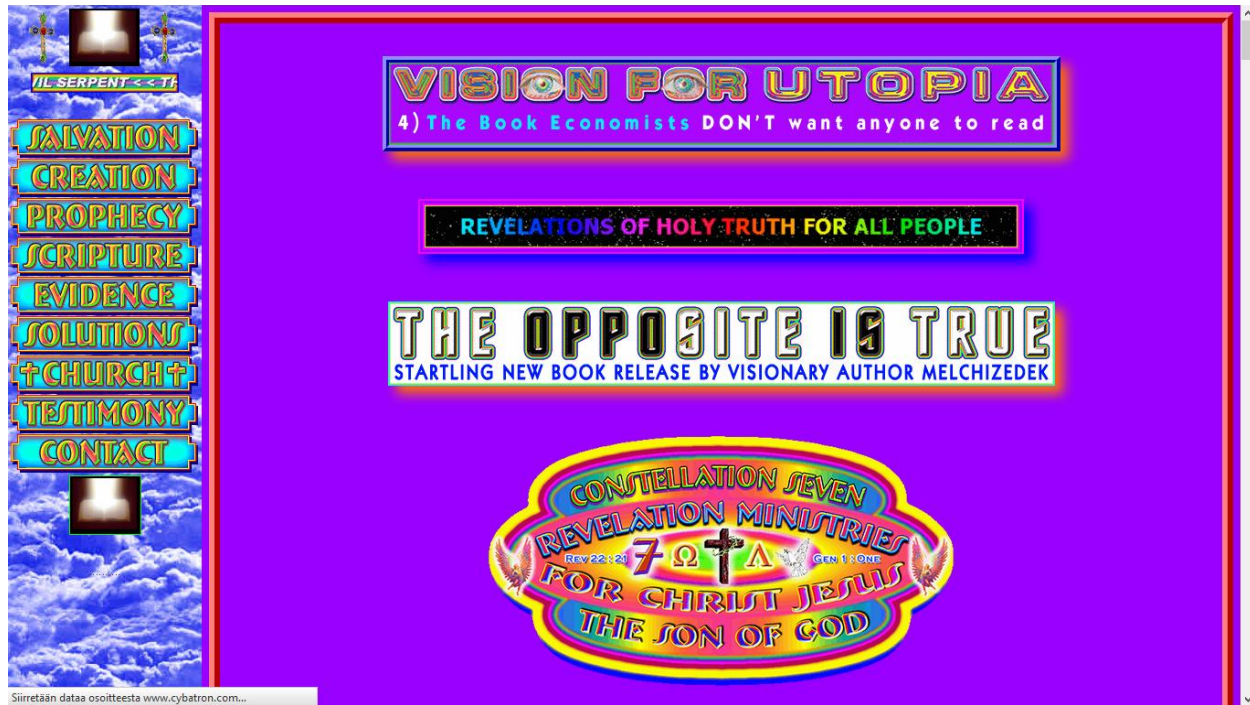
*Points for Sharpness: 10/ 15

*Points for Hierarchy: 25/ 33

Overall Score: 55 / 99 points

A Poor Looking Website! :(

*



4. Vision for Utopia

<http://www.constellation7.org/Constellation-Seven/Josiah/Index.htm>

- WAY too many items on the page.
- Colors are chosen perfectly!
- Page looks perfectly sharp and in focus!
- Page structure is good.

*Points for Clutteredness: 1/ 33

*Points for Color Range: 18/ 18

*Points for Sharpness: 15/ 15

*Points for Hierarchy: 30/ 33

Overall Score: 64 / 99 points

A Below Average Looking Website!

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5. Rudgwick Country Show

<http://www.rudgwicksteamshow.co.uk/>

- Good amount of items on the page
- Colors are chosen perfectly!
- Page looks perfectly sharp and in focus!
- Page has too much hierarchy.

*Points for Clutteredness: 30/ 33

*Points for Color Range: 18/ 18

*Points for Sharpness: 15/ 15

*Points for Hierarchy: 5/ 33

Overall Score: 68 / 99 points

A Below Average Looking Website!

**



6. James Bond Museum

<http://www.007museum.com/>

- Slightly too many items on the page.
- Color range is too large.
- Page looks perfectly sharp and in focus!
- Page could be a bit more structured.

*Points for Clutteredness: 22/ 33

*Points for Color Range: 5/ 18

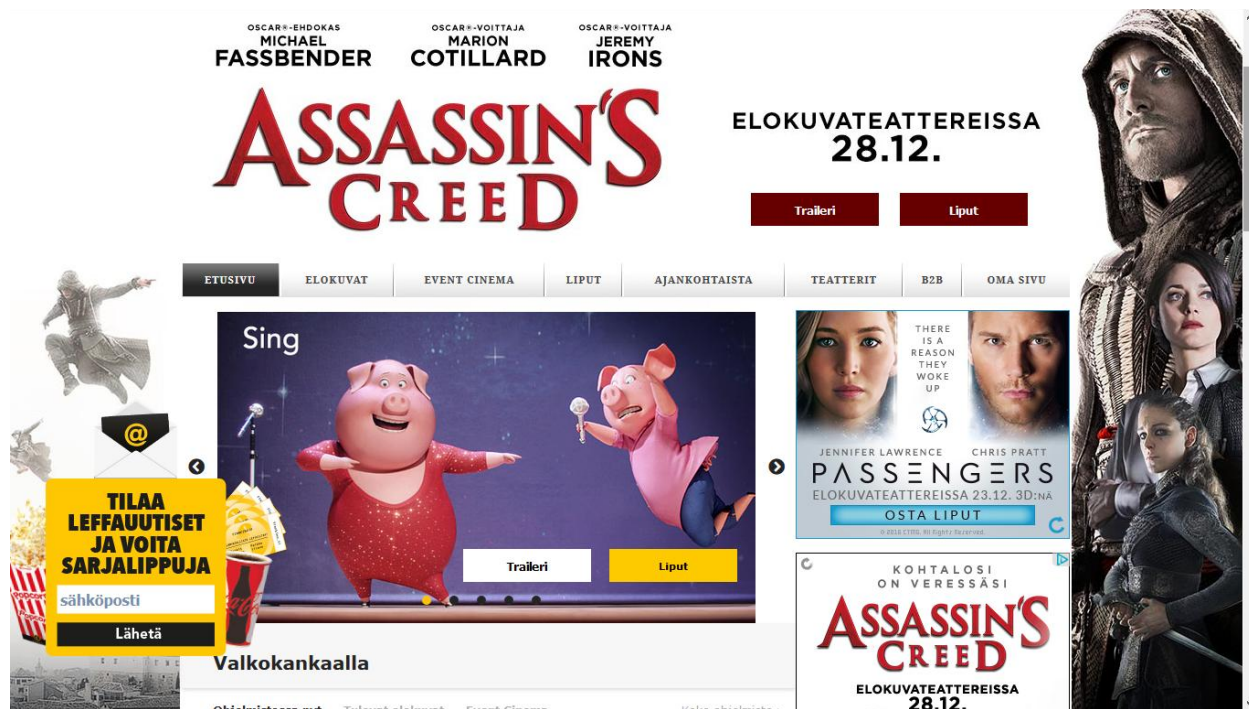
*Points for Sharpness: 15/ 15

*Points for Hierarchy: 25/ 33

Overall Score: 67 / 99 points

A Below Average Looking Website!

**



7. Finnkino

<http://www.finnkino.fi>

- Slightly too many items on the page.
- Colors are spread little too far apart.
- Page looks perfectly sharp and in focus!
- Page could be a bit more structured.

*Points for Clutteredness: 22/ 33

*Points for Color Range: 10/ 18

*Points for Sharpness: 15/ 15

*Points for Hierarchy: 25/ 33

Overall Score: 72 / 99 points

An Average Looking Website!



8. Eettee

<http://www.eettee.fi>

- Good amount of items on the page
- Colors are chosen perfectly!
- Page looks WAY too unfocused.
- Page could be a bit more structured.

***Points for Clutteredness: 30/ 33**

***Points for Color Range: 18/ 18**

***Points for Sharpness: 5/ 15**

***Points for Hierarchy: 25/ 33**

Overall Score: 78 / 99 points

An Average Looking Website!

SATAKUNNAN KANSA

Tee tilaus
Mainosmyynti

Uutiset ▼ Lisää ▼ Verotiedot Näköislehti Asiakaspalvelu ▼

Hae Kirjautu sisään

Katso video: Äkkiryhmä lauloi kauppakeskus Puuvillassa Maa on niin kaunista
SATAKUNTA 23.12. 18:34

Suden poikkeuslupien haku alkaa
SATAKUNTA 23.12. 13:17

Rautakorpi pudotti Ässien ja Lukon pelaajan MM-ryhmästä
KIEKKO 23.12. 15:53

SK testasi: Näin nopeasti

Porin seurakuntanuoret levittivät perjantaina kauppakeskus Puuvillan asiakkaille joululooa flash mobilla. Sinikka Hännikkälän saksofonisoitto...

Satakunnan Kansa lahjoitti ioulutervehdysten tuottoja

OSTA PÄÄSY KAIKKIIN SISÄLTÖIHIN NYT 2 KK VAIN 1990 €

AUTOTALLI.com Satakunnan VAIHTOAUTOT

Huittinen Lehtovuori Oy
Volkswagen, Jetta
9900 €

JÄTÄ ILMAINEN ILMOITUS

TUOREIMMAT UUTiset

18:34 Katso video: Äkkiryhmä lauloi kauppakeskus Puuvillassa Maa on niin kaunista
SATAKUNTA 18:34

17:39 Moskovan kisojen tuplavoittaja Miruts Yifter kuoli
URHEILU 17:39

17:15 Jos Suomeen laskeutuisi kaapattu lentokone...
17:15

AUTOTALLI.com Satakunnan VAIHTOAUTOT

Ford Mondeo
13940 €

rinta-jouppi.com

Chevrolet Trax
17900 €

rinta-jouppi.com

Toyota Verso
19800 €

JÄTÄ ILMAINEN ILMOITUS

www.autotalli.com/vaihtoot?utm_source=Satakunnan%20kansa&utm_medium=Banner&utm_content=autotalli_sk_2016_160x600_12-38&utm_campaign=Kohdenostot

9. Satakunnan Kansa

<http://www.satakunnankansa.fi>

- Slightly too many items on the page.
- Color range is good.
- Page looks perfectly sharp and in focus!
- Well structured page.

*Points for Clutteredness: 22/ 33

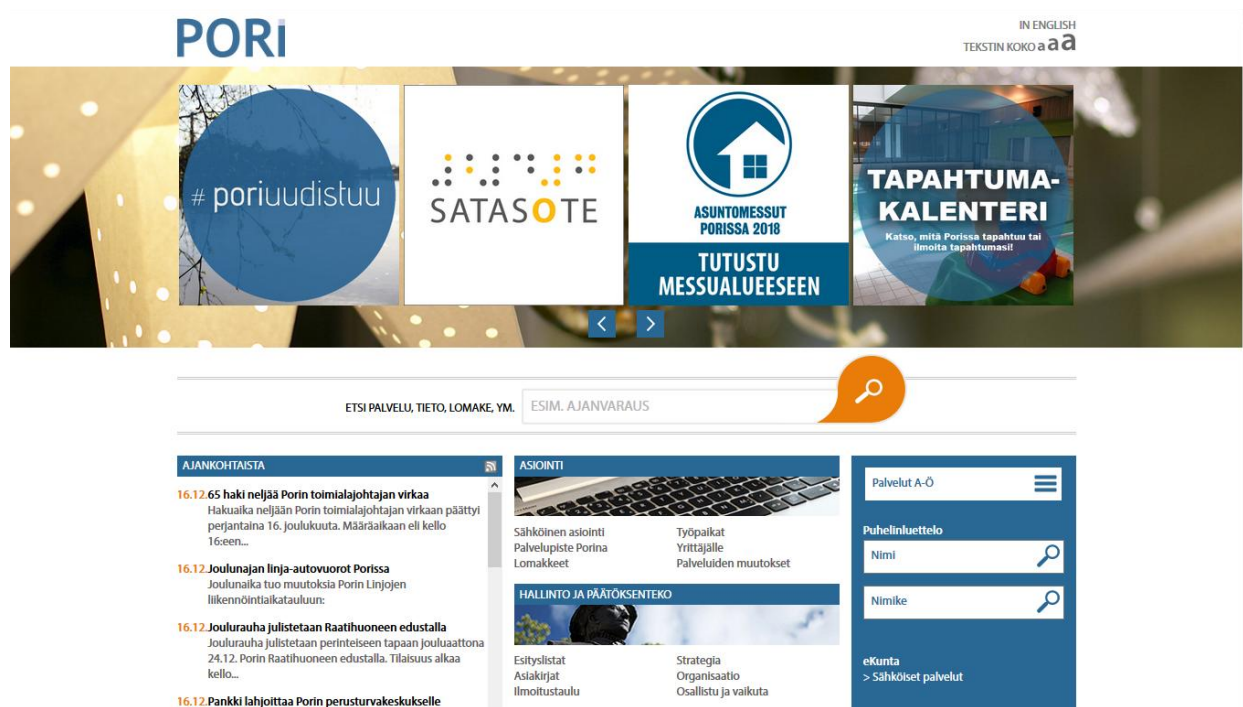
*Points for Color Range: 15/ 18

*Points for Sharpness: 15/ 15

*Points for Hierarchy: 30/ 33

Overall Score: 82 / 99 points

A Good Looking Website!



10. Pori

<http://www.pori.fi>

- Good amount of items on the page.
- Colors range is good.
- Page looks slightly soft.
- Page could be a bit more structured.

*Points for Clutteredness: 30/ 33

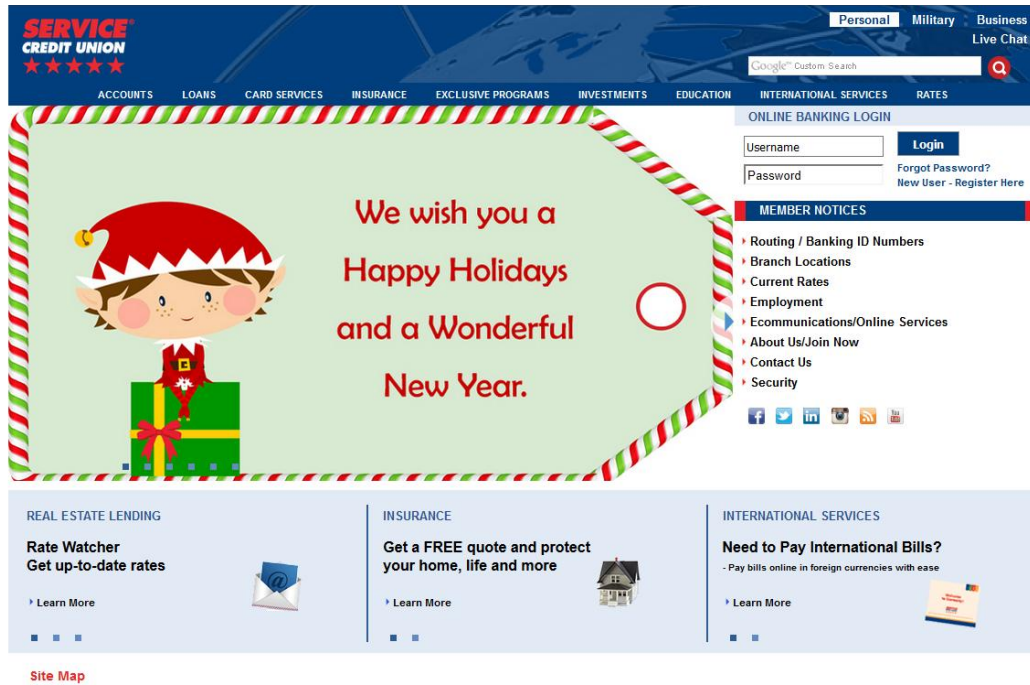
*Points for Color Range: 15/ 18

*Points for Sharpness: 10/ 15

*Points for Hierarchy: 25/ 33

Overall Score: 80 / 99 points

A Good Looking Website!



11. Service Credit Union

<https://www.servicecu.org/index.asp?expr=personal>

- Good amount of items on the page
- Colors range is good.
- Page looks slightly soft.
- Page could be a bit more structured.

*Points for Clutteredness: 30/ 33

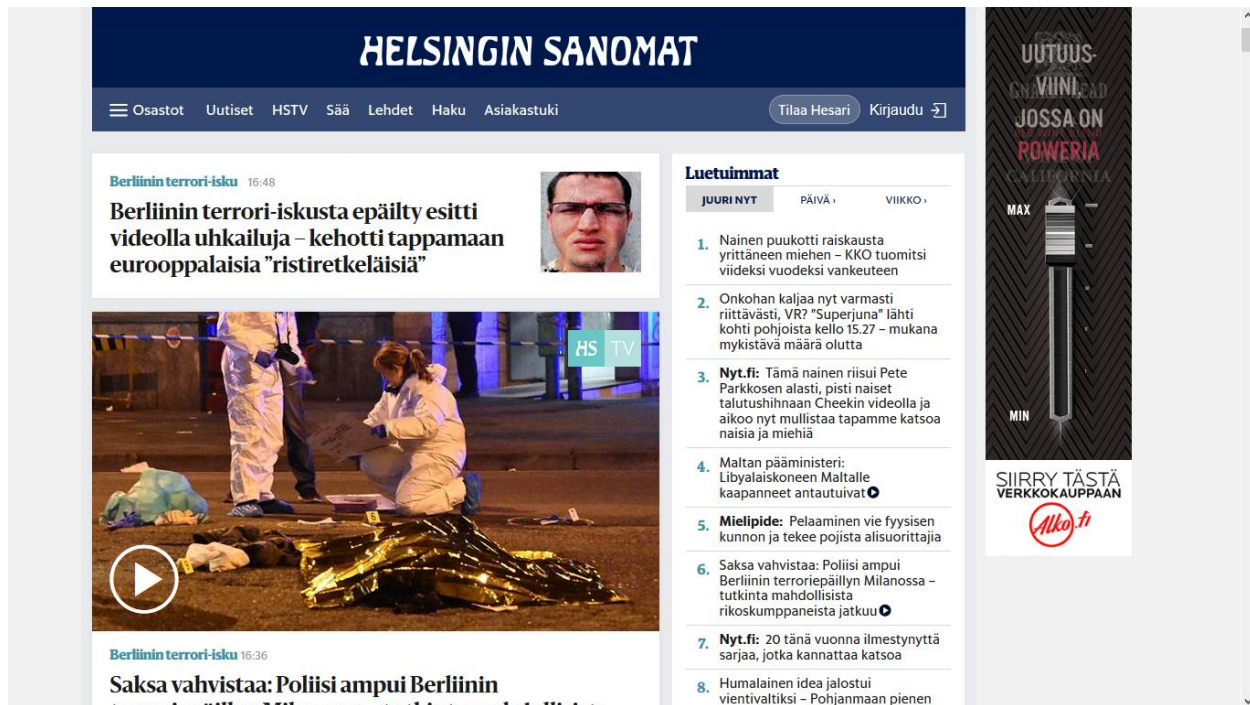
*Points for Color Range: 15/ 18

*Points for Sharpness: 10/ 15

*Points for Hierarchy: 25/ 33

Overall Score: 80 / 99 points

A Good Looking Website!



12. Helsingin Sanomat

<https://www.hs.fi>

- Perfect amount of items on the page!
- Colors range is good.
- Page looks perfectly sharp and in focus!
- Well structured page.

*Points for Clutteredness: 33/ 33

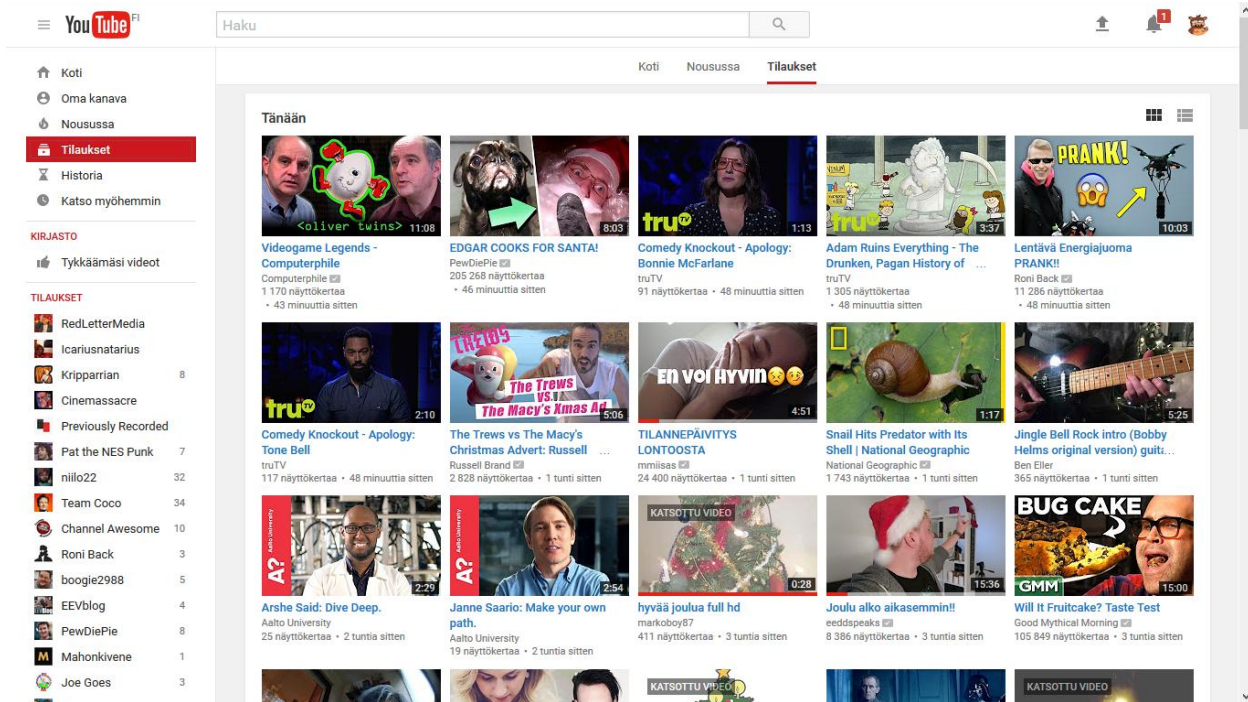
*Points for Color Range: 15/ 18

*Points for Sharpness: 15/ 15

*Points for Hierarchy: 30/ 33

Overall Score: 93 / 99 points

A Very Good Looking Website! :)



13. YouTube

<https://www.youtube.com>

- Good amount of items on the page.
- Color range is good.
- Page looks perfectly sharp and in focus!
- Perfect amount of order on the page!

*Points for Clutteredness: 30/ 33

*Points for Color Range: 15/ 18

*Points for Sharpness: 15/ 15

*Points for Hierarchy: 33/ 33

Overall Score: 93 / 99 points

A Very Good Looking Website! :)

Conclusions

The HS.fi(example number 12) was used as the design criteria for the scripts values for a “perfect”-looking website. This skews the script to award good scores to sites that are similar in design to hs.fi like newspaper and news sites.

The script seems to be quite good at recognising the clutter metric and scoring cluttered-looking sites more poorly. Tough sites with large pictures with many “objects” or “object”-looking items can get miscalculated as important items of the site and therefore as mark the site as cluttered.

The color range metric skews its scores towards sites which have a quite narrow color range. This punishes perfectly aesthetic looking sites with more fringe color schemes with large color variations.

The hiearchyness metric seems to work properly if the sites have a structure similar to news sites with quite many “edges”. Otherwise the script punishes points from a more unstructed or freeform layouts and designs with a poor rating.

The results and the reasons given by the script seem to be somewhat accurate but there are almost as many hits as misses. Pages similar in structure to newssites are more accurately rated than sites with more rare layouts and designs or color palettes. As the breadth of different web UI designs is vast and people have unique tastes of what is a an aesthetic looking website, the script is biased towards its design parameters.

The script seems to be better than “blind luck” which was the original design goal. To more properly examine this problem a lot more work hours could be dedicated finetuning the algorithm. I myself became fascinated by this problem and spent about 3 working days on the script and learning about different computer vision techniques.

Script Dependancies

To run the script properly you need to have Python version 2.7 and Open Computer Vision Library version 3.1 and a few other packages installed which I have specified in the README.txt-file. The modules can be easily installed by using Pythons package installer pip and running the proper “*pip install package*”-commands. After I had already done all the work for this script I realised that the assignment specifies that the script must run on an Aalto computer. I really hope that these packages can be installed on an Aalto computer and that script runs properly and all my work for this script has not been in vain. The script was tested running in Windows 10 machine with the correct packages installed. If there are problems I can help with you can mail me(erkka.virtanen@aalto.fi).

Going Forward

When trying to evaluate UI 's or website's aesthetics the task of evaluating could be simpler if the evaluation was made on the basis of the HTML-page code instead of an image. The HTML-page contains more information about what is dynamic content/static content and what are the relationships between different objects, pictures and links. Evaluating this relational data could provide a better platform to judge things like symmetry, item relations and complexity. This kind of approach was also mentioned in the paper[1]. Another solution could be to use the machine learning algorithms and feed the algorithm 'good' looking websites to teach it to recognise aesthetic looking designs.

References:

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Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI '15 (2015), 1163–1172

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<http://stackoverflow.com/questions/6646371/detect-which-image-is-sharper>

[6] *Contours Hierarchy*

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