Visual Aesthetics and Interaction Design

Abstract

Visual aesthetics of interaction design influences both pragmatic and hedonic properties of interactive product. Relations between aesthetics and interaction design have been already well researched. Has been proved, that aesthetical appearance of interface adds attractiveness, helps to engage users and will be positively remembered providing better user experience (UX).

This paper describes research thesis about relations between visual aesthetics of interface and interaction quality product. Goal of study is to build the model of interface aesthetics which could predict aesthetical value of product by analysing interface layout. Hypothesis of study is to show that aesthetical interaction design does not only provide better UX but also increases usability.

Keywords and keyphrases

Aesthetics is originally not considered as part of information and communications technology (ICT), but these two disciplines are connected through certain aspects which can shortly be described via keywords. List contains selection of ICT terms that are related to aesthetics. Common keywords between other areas of ICT indicate also possible connections to the aesthetics!

Main focus of this study is on Interaction design but ICT includes many more areas of interest. Following keywords may help to make quick relations to other branches of ICT. Keywords are listed in order of appearance in text (see bold printface).

Interaction design (ID), User experience (UX), Interaction quality, Usability, Interface layout, Visual design, Human Computer Interaction, Social semantics, Language, Interaction flow, user engagement, accessibility, user profile, display, input devices, user, context of use, informational content, platforms, media, interaction logics, information architecture, usability metrics, accessibility, user engagement, affordances, first impression, learnability, Human centered design, human factor, disabled use, visual information, media, printer, monitor, graphics projector, graphics adapter, driver, color management, color profiles, compatibility, visual data, data formats, archiving data, sustainability, ubiquitous computing, channels of information, standardisation.

Introduction

There are no clear instructions for making nice looking visual design. Beauty depends on many aspects, starting with person who looks at the object and ending with style, accepted at present moment of time (Fernie 1995). Absolute truth can not be revealed, but there exist some guidelines that are called composition rules (Freeman 2007). Few talented people create masterpieces intuitively, but if others follow composition rules, the work will be done attractively as well.
**Visual Image**

Significant part of **Human Computer Interaction** (HCI) is based on visual image --- the interface that user sees. Visual design of image may hold different kind of information. For example text has two meanings: first one is readable message and second one is called visual message. Visual message contains shape, colour and position of letters in layout and it exists in every picture, animation or even 3D scene. In this example the visual form of letters in text affects its meaning at least in 3 ways:

1. Attracts viewers’ attention (e.g. red color in black text or bold print face).
2. Please viewers emotionally via fancy or elegant shape.
3. Makes text more readable via clear and simplistic shape

This example was about good design, but bad design has exactly opposite effect.

Visual message provides quicker way of delivering information. Instead of reading the label user needs to have a look at the image (Figure 1) to understand what it means. If the **social semantics** are clearly defined, then written message could be entirely removed without affecting the content of message. Sometimes the usability of certain objects needs to be international. In this case visual message helps to overcome **language** problem.

![Figure 1.](image)

Interaction designer can attract users, help to understand interface logics and make the product easier to use, by meaningful composing of visual message. Composing the image in graphic design means page layout: arranging objects, cropping and framing, choosing colour, etc. The practical purpose of the well composed image is to send intended visual message to the viewer. Good composition helps viewers (users) to understand this message, which in interaction design, leads to smooth **interaction flow**.

**Aesthetics of Interaction Design**

Beauty is in the eye of the beholder. Aesthetics of visual image trigger emotions in person, who looks at the image (**Xenakis 2012**). Part of HCI, which deals with user’s emotions is User Experience (UX) (**Sutcliffe 2010**). Designing for user experience has two aspects: pragmatic and...
hedonic. Pragmatic side deals with usability, user engagement and accessibility. Hedonics are about emotions like first impression and satisfaction. The same principles of Interaction design apply when designing for aesthetics. Pragmatics are about guiding users attention on the screen and making objects more visible, but hedonics describe attractiveness and pleasure of product’s use.

Outcome of Aesthetics Study

Goal of this study is to explain relations between visual aesthetics of interface and interaction design. Alas, interaction design is not directly measurable. Therefore we need something that is related to interaction design and can be evaluated.

In statement of study goal, aesthetic value is the result of human perception. Nevertheless, not only perception plays role while judging beauty, but also interpretation of perceived information. The aesthetics and UX behave similarly while interpreting. Some methods of evaluating UX are also used for assessing aesthetics (http://www.allaboutux.org/). Result depends on person’s previous experience, cultural background, education, age and many more factors which are together represented as user profile. This paper focuses on main aspects of interaction design which are related to human perception of beauty in the context of user profile.

UX is exactly the right phenomenon that could be evaluated --- it is related to aesthetics (Sutcliffe 2010) and at the same time it reflects qualities of interaction. So the study goal can be rephrased: to explain relations between visual aesthetics of interface and UX.

Main hypothesis that needs to be proved is: More aesthetical interface provides better UX. Additional hypothesis that follows after first one is proved would be even stronger claim: More aesthetical interface provides better usability.

Not only the fact that more aesthetical interfaces provide better usability is necessary to prove but it is also important to explain how these two phenomena are related. These relations will be practical outcome of study --- the model of interface aesthetics. The model will be discussed later in methodology part.

Interaction Design

Even unprofessional users can notice, when some functionality does not work properly in interaction process. Shortages in aesthetical level are more difficult to notice. People do not pay attention to aesthetics of single product but they will compare aesthetics when they already have previous similar experience with other products. Having used more than one product, users can easily tell, which one they like more (De Angeli et al 2006). Comparing experiences makes aesthetics more important, therefore is UX chosen as main connection point between aesthetics and interaction design.

User Experience

Best way to approach UX seems to be from two directions, first from the user’s judgement of
their experience and, secondly, from the design perspective to enquire which features or qualities might deliver a high-quality user experience (Sutcliffe 2010). Aesthetics is connected to both of these sides. Users side is about perception and interpretation of beauty and designers side is about creating aesthetical interfaces. Conception of UX, when explained from perspective of usage process, has three main components: **informational content, the user and context of use** (Figure 2). UX exists when all three parts are present. Interface aesthetics can be described in exactly the same way. Previously mentioned user side is the blue circle which represents human being with all perceptual, cognitive, emotional and affective capabilities. Content(green) represents interactive product with graphical design, interaction logics, information architecture and defined purpose of product. Context(red) means both user profile and conditions of use. Conditions of use depend on **displays, input devices, platforms and media** but also on surrounding environment.

![Venn Diagram](image)

**Figure 2.**

UX has both pragmatic and hedonic properties. UX pragmatics is represented as overlapping area of blue and green circles (Figure 3). Pragmatic properties can be measured as **usability metrics:**

- Time to task.
- Number of errors.
- Effort made (e.g mouse clicks)

Pragmatics of UX include effectiveness and efficiency of completing interactive task which is calculated upon usability metrics.

UX hedonics are located in non-overlapping blue area (Figure 3) of UX. Hedonics contain
emotions, perceived by users during products use. UX Hedonics can be evaluated with empirical study or also by biometrical measurements.

The non-overlapping part of usability exists without user and it contains **accessibility** and interaction logics. This part is not considered as UX, because user is missing or usage will not occur. Reasons may be different (e.g. faulty interface or messy documentation), but even useless product might contain aesthetics and provide pleasure without completing intended task.

![Diagram of User Experience and Usability](image)

Figure 3.

**User engagement, affordances, first impression, learnability** are most important aspects of interaction design. These aspects, similarly to usability, also overlap the UX-s blue circle (Figure 3). Showing, how aesthetics influence UX, might reveal more ideas for improving user engagement and learnability, provide better first impression and increase the choice of affordances.

*User engagement*

For avoiding bigger mistakes in interface design, Alistair Sutcliffe brings up guide rules that concern user engagement (UE) [Sutcliffe 2010]. The purpose of these rules is to keep the user interacting till the necessary task is completed. To do this, user needs to be in state of mental flow. Maintaining flow state means not to be bored by too simple task or frustrated when task is too difficult. Too simple tasks need some challenging ideas that rise additional interest and complex tasks must provide some encouragement not to quit before the end.

Aesthetics play crucial role, when focusing users attention and trying to attract user with positive first impression. Even if new and unfamiliar design seems a bit confusing and its functionality is unclear, more aesthetical, new design will be chosen by most users. Aesthetics will help to keep interaction process flowing smoothly with providing new affective emotions during the rest of the
usage. This phenomenon is mostly used in computer games (van Vugt et al 2006)

Affordances
Interactive objects or items are designed to afford user some “goodies” or new opportunity for action. Many everyday items have more than one affordances, for example plastic bottle can be used to hold liquid, but also to play the bottle spinning game. Exactly the same happens with interaction design. Aesthetics help to explain the purpose of some objects when it’s use appears unclear. It becomes most obvious when designer uses symbols instead of text. Symbols and pictograms are perceived faster, but can be often misunderstood in different cultural background. That is why designer’s knowledge about aesthetics in context of user profile is important. Meanwhile, the creative design of pictograms can cheer up users and provide better UE. Van Vugt et al describe an experiment where good looking and ugly characters were provided to users of Sims2 game (van Vugt et al 2006). As a result, ugly characters showed lower scores and the game was dropped more often with ugly characters, even when good looking characters had less affordances (e.g. being clumsy).

Learnability
Users do not like to read large amount of small text that explains how to deal with certain interfaces. Instead of studying the manual, before using new product first time, they start action with all hopes on their intuition. Intuition is mostly based on previous experience, but it also contains a little “unexplainable” knowledge from ancestors. Must be mentioned also that intuition often fails during first use. Second time of use would certainly be more successful, but sadly often happens that product is considered “not usable” and cast aside already after first attempt. To avoid this, designer may find help from aesthetics. Composition rules represent so called Classical Aesthetics and help to predict many important issues (Lavie and Tractinsky 2004) for example:
  ● What spots on interface are noticed first?
  ● What way moves user’s gaze on layout?
  ● What objects are perceived as group?

More creative kind of visual design principles are explained by expressive (Lavie and Tractinsky 2004) aesthetics, for example:
  ● Meaningful pictures.
  ● Guiding shapes.
  ● Color coded messages.
  ● Attractive photos, animations or 3D scenes.
Creativity of designer with combining classical and expressive aesthetics may help to achieve better learnability.

Aesthetics
Interaction design principles of visual layout were explained in previous chapter. Knowledge about esthetical composition is important as well for explaining connections between interactivity and aesthetics. Guide rules as design advice for interaction, are brought up by Alistair Sutcliffe,
which concern aesthetics of visual image (Sutcliffe 2010). These rules are based on psychology of visual perception. Creative idea is certainly most important while designing but sometimes, when in doubt, is good to be supported by guide rules of design. Designer may also need to walk through initial design for finding problems. In such cases are following rules very useful.

**Judicious use of colour**

Colour use should be balanced and low saturation pastel colours should be used for backgrounds. Designs should not use more than 2-3 fully saturated intense colours. Yellow is salient for alerting, red/green have danger/safety positive/negative associations (color coded messages), and blue is more effective for background. Low saturated colours (pale shades with white) have a calming effect and are also useful for backgrounds. Colour is a complex subject in its own right.

**Gestalt effects:**

there are several visual patterns (Figure 4) which we recognize and interpret instinctively. These phenomena are known as ‘Gestalt’ effects in perceptual psychology.

**Depth of field:** use of layers in an image stimulates interest and can attract by promoting curiosity. Use of background image with low saturated colour provides depth for foreground components.

**Use of shape:** use of curved shapes conveys an attractive visual style, in contrast to blocks and rectangles which portray structure, categories and order in a layout.

**Visual structure and organization:** dividing an image into thirds (Right, Centre, Left or Top, Middle, Bottom) provides an attractive visual organization while rectangular shapes following the golden ratio (height/width = 1.618) are aesthetically pleasing.
**Closure:**
we naturally see the complete object such as a circle, even if it is not complete.

**Good continuation:**
items organized in a visual sequence or on a curve are perceived to be related or belong to a structure.

**Similarity:**
objects which share visual attributes (colour, size, shape) will be seen as a category or group.

**Proximity:**
objects which are placed close together and separate from others are perceived as a group.

**Präganz:**
the tendency to ascribe meaning to images based on similarity to images we remember.

**Symmetry:**
symmetrical visual layouts, e.g., bilateral, radial or rotational organization that can be folded over to show the symmetrical match, have pleasing effects.

**Figure ground:**
the juxtaposition of visual features or grouping of shapes causes higher-order structures to
emerge from the image. This effect can be used with verbal priming to create surprise when the structure is not immediately apparent.

**Aesthetics Dimensions**

The terms “classical aesthetics” and “expressive aesthetics” are here explained once again, but now in aesthetics point of view.

*Classical Aesthetics* - pertains to aesthetic notions that presided from antiquity until the 18th century. These notions emphasize orderly and clear design and are closely related to many of the design rules advocated by usability experts.

*Expressive Aesthetics* - created by the designer’s creativity and originality and by the ability to break design conventions.

Classical aesthetics dimension is important for making interface design more pleasing and attractive. Expressive aesthetics is used as designers creative idea for engaging users and guiding them in interaction process.

Antonella De Angeli, Alistair Sutcliffe & Jan Hartmann ([De Angeli et al 2006](#)) took two interactive web sites with exactly the same content for comparison. One traditional, menu based and other metaphor-based. The metaphor-based interface was preferred on the expressive aesthetic dimension and was rated as more engaging. The menu based interface had better usability; it elicited more positive memories, and was perceived as providing better content.

There have been a research of connections between interaction related affordances and design aesthetics ([Xenakis 2012](#)). Conclusions were, when given a choices, in first glimpse, users always decide to try better looking, more aesthetical option. Only, when, the choice turn out to be wrong (affordances not good), the other options will be chosen. Both aesthetics and affordances are considered to be measures of product success, each one for the role it plays in the design process. Thus, designers always want to know, how they could use these two ostensibly distinct theoretical elements in order to provide effective ways of interaction through their products ([van Vugt et al 2006](#)). An aesthetically pleasing appearance is only a part of a successful product. The other part is understandability and usability, which are more important than attractiveness. These two parts of design should go ‘hand in hand’ because focusing on aesthetics could blind the designer to the lack of usability. Designers incorporate interactive potentialities to artifacts as interactive affordances that confirm the dynamic presuppositions of interaction and reduce the design-uncertainty.

**Style**

When some images look similar, it may be expressed, as the same style. In the visual arts, style is a “...distinctive manner which permits the grouping of works into related categories.” ([Fernie 1995](#)). Historically certain periods have the same style, which describes how aesthetics was understood these days. Renaissance, Classicism, Romanticism, Art Nouveau, Art Deco etc. are most important in Europe’s history. Modern styles change very quickly. Renaissance lasted 3-4 centuries, classicism 2 centuries, Art Nouveau and Art Deco some 20-30 years. Human nature needs fresh ideas, thus new styles appear from time to time. Aesthetic preferences in interaction design change faster, even in 2-3 years, because new ideas become available through new technologies. Such developments cause the need for regular renewing of design.
Research Methods

For studying relations between Interaction design and aesthetics, properties of both instances need to be evaluated. Two different ways of evaluating aesthetics are objective and subjective approach (Altaboli and Lin 2011). Assessable aspects in interaction design is UX with its hedonic and pragmatic properties.

Research plan (Figure 5)

Literature review was planned to answer initial research questions:
- What is the connection between interface aesthetics and interaction design?
- How to evaluate interface visual aesthetics?
- How to evaluate usability and UX?

Empirical study of comparing objective and subjective methods for evaluating aesthetics was conducted to answer research questions:
- How to improve existing model of interface aesthetics?

Empirical study of simultaneous evaluating interface aesthetics, UX and usability with mixed methods to answer research question:
- How are related interface aesthetics usability and UX?

Additional literature review to answer possible upcoming research questions. Some of those questions are already up:
- How is color of layout objects affecting interface aesthetics?
- How to use image analysis for retrieving layout data for aesthetics evaluation?
- How to embed weights of measures into the model?

Confirmatory empirical study of comparing modelled aesthetics value and UX. This study needs large sample of objects to compare. The study question is:
- Is the improved model of interface aesthetics applicable?
Evaluating Aesthetics

Objective evaluation of visual aesthetics means that assessment is conducted through analysis of interface layout --- the size, shape and placement of objects on the screen, number of objects, their lightness and color. Subjective methods use person’s emotional response to aesthetic stimuli. Overview of different evaluation methods is listed by Pajusalu (Pajusalu 2012).

Objective methods:

1. Counts based method - aesthetical value depends on number of objects in layout.
2. Model of visual aesthetics (Ngo et al 2003) - 14 measures that describe layout are calculated using properties of balance, equilibrium, symmetry, sequence, cohesion, unity, proportion, simplicity, density, regularity, economy, homogeneity, rhythm, order and complexity.
3. Aesthetic colouring system (Zhang et al 2009) --- a method to produce aesthetically pleasing colour schema for interface layout.
4. Measuring the physiological changes (Strebe 2011) - the physiological parameters like heart rate, skin conductance, gaze movements can be recorded during aesthetic experiment. These changes are not directly controlled mentally by test person, so the method can be called objective. Still this method assess person’s response to visual
stimuli, therefore it can be named subjective as well.

**Subjective methods:**
1. Classical aesthetics - Questionnaire in structured form to find out the aesthetical value according to classical aesthetics.
2. Expressive aesthetics - Questionnaire in structured form to find out the aesthetical value according to expressive aesthetics.
3. VisAWI ([Moshagen & Thielsch 2010](#)) - Questionnaire which includes 4 aspects of aesthetics: simplicity, diversity, colorfulness and craftsmanship.
4. Interface criticism ([Bardzell 2009](#)) - subjective method, which includes also aesthetical measures. Interface criticism is a method based on literary and art criticism traditions.

The only method that allows to evaluate the aspect of style.

**Evaluating Interaction Design**
The overlapping of UX and usability allows to bind them together for studying and separate the aspects of hedonics and pragmatics. Hedonic properties of interaction express users emotions during use. Pragmatics are about measuring physical parameters. Hedonics can include large number of different properties that may evoke either positive or negative emotions while using interactive product. Here are listed few: satisfaction, pleasure, attractiveness, trust, aesthetics (Beauty). Methods for evaluating hedonics are:
1. Questionnaire - survey, structured questions, open questions.
2. Interview - personal interview, group interview, focus group, structured or open.
3. Observation - taking notes, audio recording, video recording.
4. Recording physiological changes - eye tracking, skin conductance, ECG, EEG.

Pragmatics means measuring time, counting errors, registering successful operations etc. Most important measures of usability are:
1. Accessibility - finding out any issues that can restrict to use product by purpose or make it unusable at all. For example support for disabled people and compliance with different web browsers or devices.
2. Time to task - how long it took to complete the task?
3. Errors made - how many errors happened during use?
4. Success to task - was the task completed successfully?
5. Effort made - how many operations user completed for completing the task? (mouse clicks, keystrokes, lever movements etc)

**Conclusions**
Measurable aspects are now brought out for both visual aesthetics and interaction design. Let’s call these aspects as connection points between aesthetics and interaction design. Next step for future study will be to define exactly, which connection points and in what way are related. Before to start collecting data is necessary to define objects for evaluating, choose the methods and find test users. Following are general remarks and suggestions for further study.
Objects for Evaluation

Interactive objects are everywhere and most of them have visual interfaces. Using one type of interfaces (web pages seem to be most convenient to study) might not give reliable data for all cases of HCI. The same is for appearance of visual interface, which is not always static picture, but mostly includes animations and 3D scenes. The scope of study is growing dangerously wide to handle properly. Therefore seems wise to split it into subsections and keep in mind that result is valid only for certain subsection. Certain aesthetical or interactive aspects can be chosen knowingly to target certain connection points.

Choosing the Methods

The choice of Methods allows to separate desired connection points. WisAWI method, Classical andExpressive aesthetics methods are developed for evaluating aesthetics. AttrakDiff method [6] is developed for evaluating UX. These methods are ready to use and proved to work well. Creating completely new questionnaires and conducting interviews include risk with asking wrong questions. The questions must be worded carefully and new questionnaires piloted prior to data collection to make sure the correct connection point is targeted. Audio and video recording on usability tests and observation sessions is always recommended.

User Profile

Easy way to conduct user studies is convenience sample, but doing so, the validity of data will be limited. Correct procedure would be to choose test users accordingly with objects for evaluation. Leading questions can be added to questionnaire for specifying user profile: age, gender, education, computer experience, etc.

The Model of Interface Aesthetics

As the ultimate goal of aesthetics study, all possible correlations between connection points will be collected. This collection will be structured and called The Model of Interface Aesthetics. The model is meant to allow evaluating visual aesthetics via image analysis and mathematical calculations. Existing model of visual aesthetics (Ngo et al 2003) could be good starting point for developing it further. The model of interface aesthetics can help Interaction designers to create aesthetic prototypes. Authors hope is that the model can provide practical help at least in initial state of interface design and save at least one round of expensive and time consuming user study.
Figure 6. Model of interface aesthetics

**Relations of Aesthetics to Different Areas of ICT.**

Interface visual aesthetics as the research problem is related to all areas which include HCI. Interaction process was already analysed previously and here follows short description of human factor and machine (computer) factor.

**Human Centered Design**

The same issue is sometimes also referred as user centered design. Designing for people stresses aesthetics for several reasons. None of designers create deliberately ugly artefacts but slight difference on aesthetic level plays sometimes crucial role in products use. Interactive product has its primary purpose — afford a way to complete the intended task. If designer gives too much attention to aesthetics, it may negatively affect products primary purpose.

When designing for human, all personal properties are important to consider. People perceive things differently and they also think differently. They might be disabled in some way that
restrikes interacting. Most common, --- concerning **visual information** --- are sight disabilities e.g. color blindness and short vision.

**Media and Output Information**

Passing information in aesthetical form provides additional value to the user. The issue is not so much about individual users but output devices and information carriers. Visual form of information can be presented very differently: screen and paper are most common **media**. Which means that **printers**, **monitors** and **graphics projectors** are responsible for correct representation of aesthetics. This involves developing **graphics adapters** and printer **drivers**. Also **color management** systems and **color profiles** play important role in presenting visual information.

Important issue is **compatibility** of **visual data formats** when **archiving data**. It is important to make sure the data is still **sustainable** and retrievable after longer period of storage. Last (but not least) issue is multitude of platforms and **ubiquitous computing**. Different devices and platforms carry its own, implemented aesthetics. When the same original information is passed through those **channels of information**, its final visual appearance will be different. As a conclusion, there are a definite need for more world wide **standardisation** to reach better results.

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