

# Salient Design Identity Development with Topology and Fraction in the Contour of Radiator Grilles

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## Abstract

**Background** Nowadays identity is one of the significant issues for the automotive industry. And Salient design identity is becoming even more important for multi-brand oriented paradigms in the recent domestic automotive field.

**Methods** This paper analyzed automotive brands to clarify salient design factors by comparing the contours of radiator grilles. For the analysis, a number of shapes were categorized with topology and fraction and mapped into shape organizing rules.

**Results** The shape elements were mapped with topology and fraction for salient design identity in the contour of radiator grilles and analyzed to identify get salient elements for shape organizing concepts.

**Conclusions** Two properties for salient design elements were derived from common-feature sets: visual primitives and proportions. Therefore, the set of salient design identity features were categorized to topologic shapes and fraction elements, which can be used for evident design identity in the contour of radiator grilles.

**Keywords** Salient Design Identity; Contour; Topology; Fraction; Visual Primitives

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## 1. Introduction

A clear design identity is one of the significant issues in nowadays for both of automotive industry and automobile itself, by escalating brand forward market paradigm in the global automotive industry with the result of multi-national mega mergers. Generally, a brand is one of basic marketing tool to promote products at the capitalism-oriented market places in the contemporary consumer society. And a brand oriented design identity is going to become even more important with recently sailing out independent brand for premium marketing in the domestic automotive industry. And brand forward paradigm requires strategic approaches toward clearer design identity to automotive designers. For the separate brand as a distinguished quality, presence of clear and well-defined brand identity is an essential factor.

The brand identity is the set of desired associations with the brand that strategists working with wishing to establish and maintain (Asker David, 2000). The brand identity uses physical qualities of the product as well as the company's mission statement, corporate identity, customer experience, and the perceived success of the company by others to represent what the brand stands for (Cagan & Vogel, 2002). Hence, the design identity is important factor for consumers and markets, especially in case of placing brand oriented designs by using frontal image of cars, but the design strategies may be changed with the decision on the macroscopic point of view of the frontal image whose characters be appealed to consumers.

Moreover, a salient design identity can provide a visual language that supports all facets of the design by supporting all participants of the design process on the point of preservation of brand identity.

This paper has goals to turn out a basic topological way to develop salient design identity with contour of radiator grilles, for the purpose to establish some algorithm which can be provided a tool to make salience design identity.

For the goal, reviews mainly contour of radiator grilles of cars of the traditional European premium brands and as well as later sailed Japanese and Korean premium brands to clarify basic elements with contour of radiator grilles to extract salience identity.

The comparison begins with the differences between the concepts of uniformity and unity, and the concepts can explain ways of similarity in contour of radiator grille for brand oriented design. For the comparison, the scope was set with recent models of the major premium brands. The survey had been progressed by comparing topological treatments for brand differences new brands than traditional brands that does not have strategical shape for the brand identity.

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## 2. Uniformity and unity

Most studies on style have focused on either identifying significant forms that manifest a style (Ackerman, 1963) or reviewing their developing background (Pothorn, 1982), and other notions, which differ from identifying forms and syntax, have concentrated on the study of

the ways of doing things (Sparshott, 1965). A pattern of the same ways of doing things defines a style.

Gombrich (Gombrich, 1968) not only mentioned that style is any distinguishable way in which an act is performed or an artifact is made, but also centered more on choices from alternatives. If any forms or features repetitiously occurred, they might be perceived as certain styles, and the styles might be seen as concepts of uniformity or unity. These two concepts might be frequently confusing; hence, they are different by the degrees of similarities.

For instance, a military troop wears exactly same uniforms of same design elements and colors, only difference may exist in size to be fit individual physical dimensions of soldier. These can be explained as characteristics of ‘uniformity’ (Figure 1).

However, the group of people called ‘Red Devils’ who cheering Korean soccer players, wearing red colored clothing. But their clothing are not exactly same; just they are looked similar with reddish colors, and this can be described as ‘unity’ (Figure 2).



Figure 1 Uniformity of military troops



Figure 2 Unity of Red Devils

The differences between uniformity and unity can be analyzed either shapes by topology and fraction with numbers of primitives, and proportions by which inclination of shapes might be changed. The characteristics of uniformity and unity can be analyzed as the table (see Table 1).

Table 3 The comparative summary of interview findings

		Uniformity	Unity
topology	visual primitives	identical	similar
	total shape	identical	similar
fraction	details	identical	variable
	total proportion	identical	variable

It reveals uniformity of all individuals in the group with elements of contents; however the other group does not. Nevertheless of the appearances of them in case of unity, the individual members share common factors for similarities, and the contents of details can be changed with individuals. The variety of the individual characteristics could be one of the advantages of unity.

In perceiving unity with common elements, portions of common element hypothetically might be treated as equally important to balance out the visual bias and different focuses of attention; therefore, to verify the portions of common elements, minimum two individuals are necessary to calculate portion of majority in the common factors between the elements.

The minimum percentage of the major element between the individuals can be calculated; the formula consisted of a square root of the number of individuals which has common elements between them, and the minimum percentages of individual portion of coherence can be calculated by multiplying half at the square root. The finished formula is shown as below:

$$\{\sqrt{(1+1)}\} \times 1/2 \times 100 \approx 70.7(\%)$$

According to the formula, at least 70 % of majority portion is necessary between the two individuals of which has different attributes that can be perceived as unified characteristics. It can be also applied to the colors of the 'Red Devils' as minimum 70% of red color portions in hue to make their colors look similar nonetheless of the variety of the styles of their clothing.

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### 3. Case Study

#### 3. 1. Evolutions in the brand

One of the most representative automotive brands have been developed brand identity with radiator grilles is BMW. The two rounded rectangle shapes are called as 'Kidney grille' originated from the '303' model in 1933. The shapes have been kept to current 7 series G11 model.

The contour of the radiator grille had been changed with body shapes and structures with lowered hood and unified fenders by wider proportions. The headlights are also integrated to the frontal body volumes either. And the styling character of the radiator grilles have either changed into more dynamic proportion and shapes.

As observed on selected models in this part, albeit that they have totally different styling characters and body dimensions, similarity could be discovered on all the BMW models. The two rounded rectangle shapes are the only element that has not been changed, but they have been differ in proportions and details with the product concepts of each model such as the electric vehicles and luxury sedans.

Whatever the details are, the whole image of radiator grille of the kidney shapes, the two rounded rectangles are perceived as fixed brand identity with basic shape syntax. Albeit the whole proportions and details of the outer frames and louvers inside of the rounded rectangles have been changed thoroughly in recent models, all the variations are considered as BMW brand designs.



Figure 3 BMW 303, 1933



Figure 4 BMW i3, 2016



Figure 5 BMW 7er, G11, 2015

### 3. 2. Development by visual primitives

Audi employed a large sized radiator grille unified upper and lower grilles from the D3 A8 2005 year model to improve perceptibility. It is called as '*Mono-frame*' radiator grille originated from the shield shaped radiator grilles of 1930s' *Wanderer* models. And the Mono-frame radiator grille is used to improve perceptibility of the brand to third party by reducing visual primitives which are basic element of visual languages with shapes (Koo, 2007).



Figure 6 Audi A8 D3, 2004



Figure 7 Audi A8 D3, 2005



Figure 8 comparison of grilles as visual primitives



Visual languages may be classified in terms of the visual primitives, dimensions, and relations they employ. And primitives are used in a language may be purely graphical, mixed (graphical primitives and textual symbols), or purely textual. On the end of this spectrum lie completely visual languages and at the other end are completely textual language (Marriott & Meyer, 1998).

Keeping in evolving brand character for changes of vogue as a consumer product from the market and time, the details does not influenced to the whole visual language though.

In the context of visual primitives, the design of the Mono-frame radiator grille changed in its detail on the D4 model, as also the detailed contour of the grille changed to chamfered rectangle with thinner frame than before, without changing the whole image.



Figure 9 Audi A8, D4, 2014

### 3. 3. Developments for separate brands

Toyota launched separate premium brand '*Lexus*' in 1989 and they have been developing different styling elements to Toyota products. Since there had not been any brand identities in Toyota brand, they share practical characters with valued prices without any common brand identity element or brand oriented strategies.

They began to set brand oriented styling strategy from 2010 year models for premium brand Lexus with '*Spindle grille*' which is originated from the contracted shaped frames of looming machine of which was firstly developed by Toyoda Company in 1920s. And the brand signature, the outer shape has been applied to recent Lexus models. Nonetheless of the details of the louvers or ribs changed according to the characters of each model, the contracted contour is still commonly being used.

However, contracted contoured radiator grilles are used in Toyota cars either. It can be observed on 2016 Toyota *Camry XV50* model whose grille contour looks alike to the Lexus

models (Figure 12). Another version of Toyota radiator grille can be observed on 2016 *Yaris* XP 150 compact car whose grille is slightly different to the one of the *Camry*, with more curved and divided look.

The other version also can be observed on larger passenger car Toyota *Avalon* XX40, the flagship model of the brand. In 2016 year model, completely separated grille shapes are observed. As the flagship model, Toyota differentiated the *Avalon* model with separated shape treatment. The grille of *Avalonis* clearly distinguished to the other Toyota and Lexus models in this case.



Figure 10 Lexus ES, GSV60, 2017 F



Figure 11 Toyota Camry, XV50, 2016



Figure 12 Toyota Yaris, XP150, 2016



Figure 13 Toyota Avalon, XX40, 2016

### 3. 4. Similarities in different brands

Hyundai Motor Company is one of the most fast grown public automotive manufacturers in the global market for the last two decades. The company separately sailed out another premium brand ‘*Genesis*’ in 2015 as the Toyota did with ‘*Lexus*’ in 1989. With the separate brand ‘*Genesis*’, brand oriented styling strategy employed with ‘*Crest grill*’ whose shape is similar to emblem of the noble family of western medieval society, was placed.

Similar to the recent Lexus case, Genesis brand employed a unified to the overall shape of radiator grille to the Genesis models as their brand signature. Before the change of design strategy, Hyundai motor company had been run without any actual brand identity elements until 2009, but began to promote styling character with ‘*Fluidic Sculpture*’ with organic shape treatments, also promoted brand slogan to present value per price oriented identity strategy as ‘*Modern premium*’.

And the Hyundai brand began to use counter trapezoidal contoured ‘*Cascading radiator grille*’ on the Hyundai brand cars such as *i30*, and *IG Grandeur*.



Figure 14 Genesis G80, DH, 2015



Figure 15 Genesis G90, HI, 2016



Figure 16 Hyundai, i30, JD, 2016



Figure 17 Hyundai, IG, 2017

## 4. Analysis of the Cases

### 4. 1. Analysis by contours

The characteristics of radiator grilles of BMW brand can be analyzed with contours of two rounded rectangles. And on this paper the shapes are temporarily named as 'a' to 'd'. The early model type 'a' has been evolved to recent model 'd'. All shapes are same in the topological concept with rounded rectangles. And the two of visual primitives can be perceived as same brand images.

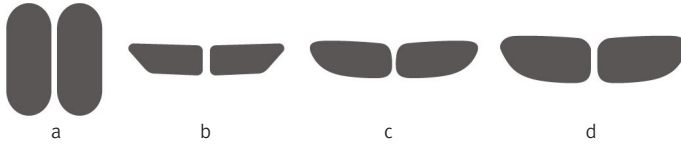


Figure 18 Analysis of BMW grilles

Table 2 Analysis of kidney grilles

		a	b, c, d
topology	visual primitives	2	←
	total shape	rounded rectangles	←
fraction	details	rounded	chamfered
	total proportion	narrow	wide

In perceiving radiator grille images for brand recognition, all types must have minimum 70% of similarity in areas of the shapes. And hypothetically are treated as same and salient to balance out the visual bias and different focuses of attention; therefore, to simplify this formula, S is set to a whole brand character, then the intersection of the shapes can be described as the formula:

$$S = a \cap b \cap c \cap d$$

And the opposite intersection might be stood which means all shapes have unity regardless of times and detailed shapes.

$$d \in c \in b \in a \in S$$

On the other example, Audi brand employed different syntax by which enforce the brand character. From the early type grille 'α', the brand character had changed to type 'g' from 2005 model year with lesser visual primitives and more areas for more clear and robust impression by larger 'Mono-frame' radiator grille. The syntax related to similarity between each elements which can be analyzed to:

$$\begin{aligned} \alpha (e+f) &\in g \in h \\ h &\in g \neq \alpha (e+f) \end{aligned}$$

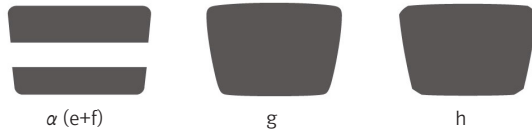


Figure 19 Analysis of AUDI grilles

Table 3 Analysis of kidney grilles

		$\alpha$	$g, h$
topology	visual primitives	2	1
	total shape	rectangles	←
fraction	details	rounded	chamfered
	total proportion	slim/wide	square

However as shows the formula, the opposite cannot be included as elements, which means the  $g$  and  $h$  are topologically different nonetheless they have been evolved from  $\alpha$ .

Toyota and Lexus have been set different syntaxes from 2010 year models with differently combined shape primitives at different positions. Different shape primitives such as  $i, j$ , and  $k$  are combined and then  $\beta, \gamma_1, \gamma_2$ , and  $\delta$  are resulted. For the Lexus grille type  $\beta$  is made by  $i+j$ , and Toyota grille for *Camry* type  $\gamma_1$  is made by  $i+k$ .

However Toyota grille for compact car *Yaris* of type  $\gamma_2$  is made by combining other primitive 'k'  $asi+k$  while Toyota grille type  $\delta$  for flagship *Avalon* is made of same primitives as Lexus grille of type  $\beta(i+j)$ , but the primitives are not combined, instead the 'i' and 'j' are just included as element as  $i \& j$ . Even though the total areas of the grilles are not closer to 70% with the separated shapes either. The relations among grilles can be included one direction, and the opposite cannot included as elements. These can be defined as formula:

$$\beta(i+j) \ni \gamma_1(i+k) \ni \gamma_2(i+k) \ni \delta(i \& j)$$

$$\delta(i \& j) \neq \gamma_2(i+k) \in \gamma_1(i+k) \neq \beta(i+j)$$

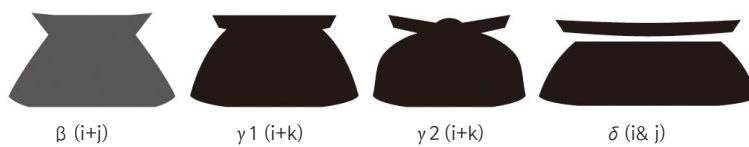


Figure 20 Similarity in grilles of Lexus, Toyota

Table 4 Analysis of spindle grilles

		$\beta$	$\gamma_1, \gamma_2, \delta$
topology	visual primitives	1	1 (2)
	total shape	contracted	separated
fraction	details	less curved	more curved
	total proportion	square	square/wide

The formulas verify topological dissimilarities between Lexus and Toyota brand nonetheless they are using similar shape elements.

Thus, Hyundai and Genesis brands separately employed different types of radiator grilles



as ‘Crest’ and ‘Cascading’. However, they can be analyzed to basically identical trapezoidal counters. Albeit those are varied with the details; these two types of brand grille contours can be conceived as the same topological attributes.

In Genesis brand, ‘l’, ‘m’ type grilles are being used currently, and the other ‘n’, ‘o’ are used for Hyundai brand. And these two groups have differences only in details and they can be perceived as similar in total shapes and as well as their areas. The same topological relations can be defined as the formula as this;

$$l = m \ni n = o$$

And the opposite also can be included as elements as the above topological relations;

$$o = n \in m = l$$



Figure 21 Similarity in grills of Genesis and Hyundai

Table 5 Analysis of Genesis and Hyundai grilles

		l, m	n, o
topology	visual primitives	1	←
	total shape	counter trapezoidal	←
fraction	details	convex	concave
	total proportion	square	low/wide

As founded in the analysis, the two types of radiator grilles of ‘Crest’ and ‘Cascading’ have the same topological structures with minor differences in details and they might be perceived as same identity designs; nevertheless that they have differences in proportions and details.

#### 4. 2. Developing salient identity

Though topology does not depend upon minor transformation such as interconnection or continuity, it deals with general space and relations among characters can be defined on the topologic space. The concepts can be dealt with general topology such as open and closed set, continuity, convergence, utmost limit, compactness, connectivity, phased shapes (Strasser, Klein & Rau, 1991).

However, for the differences in dimension between individual design elements, more than 15% of point differences are necessary (Dodson & Nolan, 2002) to be perceived as different brands or objects. This ratio could be stand simultaneously with the ratio of majority by 70.7% which was calculated in advance at the chapter 2. It might be presented as a hypothesis the range of similarity and dissimilarity as a new intersection formula;




$$R(p \& q) > 15 (\%)$$

$$S(P \cap Q) \geq 70.7 (\%)$$

The temporary names of 'p' and 'q' in the formulas mean two different shapes, and 'P' and 'Q' mean the sets of features in both in this models. The 'R (p&q)' is the size difference between the objects p and q. The 'S (P∩Q)' is the common set of features in both objects and areas. As discussed in advance, portion of majority should have minimum 70 % of in qualities to have the unity. The qualities of the degree can be decided by physical dimensions such as length, width, area, or portion of specific shapes.

The shape of radiator grille can be developed to different topological rules having less than 70% of differences in area and topology with less or more corners than the other shape as the table 6 shows. The contour of radiator grille currently used on models of Genesis and Hyundai brand are shapes of 'm' and 'o' both are same shape on the view of topologic analysis with the numbers of corners. Therefore, the researcher suggest a discretionary radiator grille shape with less number of corners in table 6 for having salient design difference.

Table 6 Topological differences of shapes

	shape m	shape o	discretionary shape
shapes			
number of corners	6	6	5

## 5. Conclusion

For salient design identity with a contour of radiator grille, any shape elements or features to be regarded as salient design identity if they have the following properties:

- (1) Total shape should be generated topologically by different numbers of visual primitives for salient identity and a contextual relationship with other features;
- (2) It has a form or composition distinguished by some particular configuration with portion of more than 70%;
- (3) It has clear differences in proportion or size more than 15% point to get clearly distinguished.

Of course, features can change over time due to changes in social context, convention, custom, knowledge, mental image, and personal preferences. For instance, Kidney grille of BMW changed from earliest model design, which was developed for different body proportion, to the current 5 series throughout the model career.

Each period shared some different sets of features and proportions. Changes do occur with special intentions, but topologically all they might have same structure. Thus, for developing salient design identity, topology and fraction concepts are systematically considered either during early styling developing process.

On the view of topologic analysis, the two type of grilles of 'Crest' and 'Cascading' for Genesis and Hyundai brand, both have same syntax, can be perceived as basically same design, nevertheless they have different details and proportions for different brands.

According to the result of the analysis, the researcher suggest a discretionary shaped

contour of radiator grille to change design identity with shape element for Hyundai and Genesis brand. Hence, one of them should be changed to have different topological syntax for salient design identity.

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