Metaphorical Parametric Model for Brand Mark Design

Towards a Universal Model of Computational Visual Communication Design

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Abstract—Visual communication design involved with two aspects of visual representation, namely, information and expression. The idea of building a computational model for visual communication design has been developed for many years. However, this objective has only been partially fulfilled as most of the solutions are focused on showing information rather than expression. Lakoff and Johnson have claimed that “human thought processes are largely metaphorical.” Thus, a computational model for visual communication based on the concept of conceptual metaphor is proposed. As brand mark design is considered as a challenging design type that demands the representation of both information and expression, the first attempt of the development of this new model is targeted for this specific type of design. In this paper, the Metaphorical Parametric Model (MPM) is proposed as a computational model to represent brand mark design. The MPM is a type of model which represents the semantic structure rather than the synthetic structure of conceptual components. The components of an MPM is assembled based on the concepts of metaphorical relations which could be signified by spatial relations between the related objects. All objects and relations defined in the MPM are parametrically controllable which could be generated as different visual forms to represent both information and a wide range of metaphorical expressions.

Keywords – visual language; visual communication design; conceptual metaphor; metaphorical expression;

I. INTRODUCTION

The idea of formalizing visual communication design as a model of visual language has been carried out by art and design partitioners for many years. In general, the focus of these partitioners can be divided into two major groups—those focused on the communication of information [1, 2, 3, 4, 5] and on the communication of expressions [6, 7, 8]. Brinton [1] stated that: “The principles for a grammar of graphics presentation are so simple that a remarkably small number of rules would be sufficient to give a universal language.” With the advent of computing, his idea of making a universal visual language for graphic representation has been partially fulfilled. However, most of the previous research works are limited to the presentation of quantitative information such as variable data printing [9], automatic layout [10], font matching [11] or data visualisation [12]. Although there are some attempts on creating algorithms for generative art [13, 14] or generative design [15, 16], most of them are only focusing on the synthesis

of visual forms but not generate works based on the creative concepts or the concept behind the expressions. Yet, there is no well-established approach to represent both information and expressions.

As an attempt to create a universal computational model which can generate designs to present information as well as express emotion, this paper proposes the Metaphorical Parametric Model (MPM) for generating visual communication design. Since brand mark design is related to both information and expression, it has been considered as “one of the most difficult to perfect [17]”; it is chosen as the topic for an initial trial.

The paper is organized as follows: Section II describes the theoretical framework of the MPM. Section III presents the model of Metaphorical Parametric Model (MPM). The concept of how to represent visual objects for making metaphorical expressions will also be discussed. Section IV proposes the concepts of Metaphorical Relations (RM) and Metaphorical Expressions (ME). In Section V, an existing brand mark will be recreated to illustrate the process of generating designs with MPM and RM. Section VI further discusses the concept of MPM. Section VII concludes this paper and future development will be suggested.

II. BACKGROUND

In the following paragraphs, the theoretical framework of the MPM will be introduced and described. The major concepts include the theories of image schema, conceptual metaphor, visual metaphor and visual rhetorics.

A. Conceptual Metaphor as the foundation of language

The Conceptual Metaphor Theory (CMT) brought forward by Lakoff and Johnson in their seminal book “Metaphor We Live By” states that, “Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature [18, p. 3].” CMT tries to investigate the fundamental cognitive problem and considers that it is the conceptual metaphor rather than language as the foundation of thoughts.

According to these authors, conceptual metaphors are different from the linguistic ones but specific cognitive concepts embedded in our bodily experience. By learning from the interactions with the environment, infant gains experience which structures the mind and formulates the “image schema”. Johnson [19] explained that the image schema is not an abstract, finite proposition, concept or concrete image but an evolving

pattern of our imaginatively structured experience. It is not only connected to perceptual phenomena but also our understanding of more abstract domains of our experience through imaginative metaphoric and metonymic projections. Image schema is now well accepted and the concept has been confirmed by research in cognitive sciences and developmental psychology [20, 21, 22] and as many as sixty-six image schemas are identified by Risch [23]. He explained that many information graphics are based on the principle of image schema whereas people's early perceptual experience of spatial relations such as "containment", "path-following" and "object dynamics" become generalized and formalized subconsciously. Eventually, these frameworks will be adapted and utilized in different types of information graphics.

Lakoff and Johnson [18] have differentiated three different types of conceptual metaphor based on the nature of the source domain of the mapping namely, the ontological, structural, and orientational metaphors.

Structural metaphor: this type of metaphor is grounded in systematic correlation within our experience. The concept is expressed with another different structured, clearly defined or well familiar concept such as "ARGUMENT IS WAR" in which all the corresponding concepts belong to the same structure, e.g. attack, indefensible, strategy, win, gain ground, etc., could be used as metaphorical expressions to form a systematic way of talking about the battling aspects of arguing.

Oriental metaphors: in this type of metaphor, the mapping is focused on adopting the structure of one concept rather than a whole system of concepts of the corresponding object. Most of these are related to spatial orientation such as up-down, in-out, front-back, on-off, deep-shallow, or central-peripheral related to the physical environment; hence, the orientational metaphor represents a spatial orientation concept such as HAPPY IS UP and resulted as an expression like "I'm feeling up today."

Ontological metaphors: the concept is based on the mapping of a source in the physical world to the target which could be an activity, emotion or idea. Take the "INFLATION IS AN ENTITY" as an example, by taking inflation as an entity, it allows us to quantify, identify it, take it as a cause and act upon it as the "Inflation is lowering our standard of living" or "Inflation is hacking us into a corner." Thus, this is physical to abstract mapping.

Grady [24] noticed that a wide range of conceptual metaphors had been recognized but he wondered why do some elements of domains get mapped, but not the others. Eventually, he distinguished two major types of metaphor namely, correlation-based metaphor and resemblance metaphors. The source domain of correlation-based metaphor is based on recurring sensory experience. He also noticed that the correlation-based metaphor evolved with the process of mapping the structures of the source domain to a target domain, so there is a "directionality" which is not symmetrical. Within the group of correlation metaphor, Grady described that there are primary source concepts which allow us to map the concrete experience such as "heaviness" to the abstract target concept "difficulty" or "brightness" to "happiness. Thus, the recurring correlated mapping concept between "up" and "good" is defined as primary metaphor "GOOD IS UP". According to Grady, primary metaphors are the basic structure that can be combined to form a larger structure called complex metaphors.

B. Conceptual Metaphor Theory could be based on embodied experience, contextual issues, social and cultural conditions

However, after many years of development, the original conceptual metaphor theory has been updated and transformed.

Szwedek [25] has criticized that structural and orientational metaphors are based on existing objects, thus metaphors are basically ontological. Moreover, Hernández and Pérez, [26] also argue that metaphor is not fundamentally ontological as explained by Lakoff and Johnson [18], image schema and primary metaphor are more fundamental.

In a special issue of the retrospective of conceptual metaphor after thirty years of its development, Riccardo and Morgagni [27] mentioned that some authors such as Leezenberg [28] suggested that embodied concepts do not come from an individual's experience only but largely shaped by the social, cultural and linguistic practice. Regarding the influence from society and culture, authors such as Brandt, Deignan and Cameron [29, 30] have pointed out that the conceptual metaphor is not all dependent on bodily experience but conditions affected by the context. All these lead to the direction that the CMT should concern with the conceptual patterns affected by cultural practices and contextual issues. Based on the experimental research and empirical work of different researchers, plenty of evidence [31, 32, 33] reveals that people understand certain domains through the other domains more often than through the language. It has been found that people talk and think about time in term of space and motion but not from the opposite direction.

C. From Conceptual Metaphor Theory to Visual Metaphor and Visual Rhetoric

Schilperoord, Maes, and Ferdinandusse [34] described that people tend to organize objects as cohesive configurations according to the century-old gestalt theory [35], hence, designers often deliberately utilize these grouping principles for their aesthetic and communication purposes. The principle involved with making visual expressions through the manipulation of metaphorical relations between concepts is defined as symmetric object alignment (SOA) in advertisements.

Through the integration of the concept of primary metaphor and the principle of SOA, Ortiz [36] explained that the formal configuration of visual metaphor in pictorial advertising could be distinguished as three types: the first type is the fusion of different objects into a single hybrid image; the second one resulted as one single object but the other is suggested by context; while the third one show at least two objects at once.

Regarding the nature between the aligned object chosen for the alignment, three different kinds have been suggested, including the alignment of different objects, the alignment of incompatible objects and the alignment of identical objects.

So, based on various combinations of the formal structures and the selected objects, the authors have analyzed a series of advertisement and identified five types of primary metaphors commonly found in advertisements which include "SIMILARITY IS ALIGNMENT", "SIMILARITY IS PROXIMITY", "THE NATURE OF AN ENTITY IS ITS SHAPE", "CONSTITUENTS ARE CONTENTS", and "CATEGORIES/SETS ARE BOUNDED SPATIAL REGIONS".

Ortiz summarised that the nature of SOA could be either metaphorical or literal. The SOA is metaphorical when the object conveys the idea of similarity and belongs to the same category; also, when the alignment, proximity, shape, inclusion, and space indicate the presence of primary metaphors which are grounded by experiences. The SOA is literal if the element presented does not seem similar but merely shows objects different from the others.

D. Metaphor in information visualization

Risch [23] made a comprehensive discussion on the use of image schema and metaphor for the visualisation of information. He identified two types of metaphor which could be extended to the direction of making metaphorical expressions. He argued that there are two distinctive types of graphics namely analogical graphics and metaphorical graphics. Analogical graphics depicts the inherent spatial relations form the source to the target of the same domain such as the mapping of the length of line to a dimension. On the hand, metaphorical graphics, expressing non-spatial concepts in spatial terms through the functional alignment with image schemas. In conclusion, he proposed that “the standard inventory of image schemas derived from linguistic and cognitive studies can serve as the basis for developing a kind of visualization “grammar.” Such a grammar would employ graphical analogues of image schematic patterns as syntactic elements that relate concepts expressed using conventional signifiers such as text, colour, and symbology”.

III. CORPUS ANALYSIS OF BRAND MARKS

Pragglejaz Group (2007) has proposed the “metaphor identification procedure” (MIP) for identifying the metaphorically used words in discourse. They described that different researchers will handle the materials and process differently based on their purpose whereas some may do a large corpus while the experimental psycholinguists may only verify or identify the target words or discourse in small sources.

For this study, due to the nature of the corpus is visual form rather than text, the corpus analysis demands the judgement of human rather than the processing of computers. Thus, under the constraint of time and resource, a flexible and pragmatic approach is adopted. The process focuses on two key issues including:

- The identification of the elements and structures of brand mark designs.
- The identification of the use of the theories of conceptual metaphor and visual rhetorics in brand mark design.

Two sets of books [37, 38] with collections of approximately 8000 brand marks are chosen. Though one of the publishers of these books is from Japan while the other is from Korea, the samples in the collections are selected from worldwide. In general, these type of books are used by designers for reference, most of the samples in the collections were well selected by editor with design expertise. Hence, the samples in these collections consist of the choice of two different groups of experts who would screen for professional grade design samples. Those digital files distributed with the book is another crucial factor to consider the choice of these collections. Thus, all the brand marks can be loaded into the database for the corpus analysis without extra preparation work beforehand.

Two fresh graduate design assistants have been assigned to identify the shapes and objects found in each sample. All the shapes found in the samples are deconstructed and identified

as one or more of the shapes listed in the code book which is compiled based on the literature review. During the analysis of the corpus, if any shape extracted from the mark cannot be classified as a shape listed in the code book, the new item will be added to the code book until all the unique shapes were recorded. The objective of this task is to identify the smallest essential set of shape required for brand mark design. Other than the basic geometric shapes, the assistants have to identify and record the object represented by these basic shapes. Here, the basic shapes are defined as the simple, primitive forms found in brand marks, they may or may not resemble any object found in reality. However, these forms mostly appear as geometric shapes or distinctive types of shapes which could be represented by mathematical equations. On the other hand, objects could be either physical entities or graphic representations, they could be either natural or manmade objects. Thus, two small circles on a circle may signify a human face as Fig. 1 when they are reading as a single object. On the other hand, the same configuration could be considered as two small circles overlay on the upper part of a larger circle if they are perceived as separated shapes. In such a case, both the circle and human face will be an entry as shape and object respectively.

Figure 1. Two dots enclosed in a circle, forming a human face

From the result of the analysis, certain distinctive patterns are noticeable, part of the findings are listed and discussed as follow:

TABLE I. SUMMARY OF THE BRAND MARK ANALYSIS

Item	Count
Total number of brand marks analysed	8095
Total Object count	23738
Unique object identified	1538
Geometric Shapes	11784 (49.65%)
Organic Shapes	1195 (50.35%)

As TABLE I shown above, nearly half of the shapes in the corpus are abstract forms and mostly can be considered as geometric shapes. These brand marks may consist of one or more components which may appear as abstract forms, iconic objects or a combination of both. The findings reflect that both geometry and iconic shapes are essential for brand mark design. Since geometric shapes do not depict specific objects but mostly perceived as abstract forms, they can be used as components of design to represent a wide range of objects or topics. In many cases, it is the composition and arrangement of these objects that constitute the meaning of the brand marks. The figure listed above indicates that without using complex forms or many objects, it is possible to generate a wide range of brand marks in the collections with a small set of objects using geometric shapes.

In the second phase, the metaphorical properties and metaphorical expressions prevail in these marks will be analysed. Since the first hundred of the most frequently used objects in the corpus accounts for 67% of total object count, this study will focus on these 100 objects for further analysis instead of going over thousands of objects for efficiency. As the metaphorical expressions of each object are affected by the conditions, context and culture, it is expected that the annotations done

by assistants may not be precise and comprehensive if judged from different perspectives. However, because of the analysis of this part is not aimed for making an exhaustive analysis of the metaphorical features of the corpus but rather use it as a strategy to identify how the theories of conceptual metaphor are utilised in brand mark design. So, even though we notice the limitation of the corpus analysis, we focus on how to represent the objects and their semantics identified in the analysis for the purpose of building the computational models. Nevertheless, we have considered that in-depth annotations of a wide range of metaphorical properties of many objects by participants of different cultural backgrounds are necessary in future.

The result of the corpus inventory and analysis indicates that the objects used in the brand mark designs consist of either iconic or abstract forms. These designs may consist of single or more items in which several basic components could be combined together as an abstract or iconic object. Thus, based on the background theories described above and the result of the analysis just mentioned, the current study proposes the MPM model for the purpose of generating brand mark designs.

Metaphorical Parametric Model (MPM) is a type of two-dimensional model specifically designed for making visual metaphorical expressions based on conceptual metaphor theory and visual rhetoric. Instead of representing the synthetic structure of a specific object, it represents the semantic components and the semantic relations in between. In applications, the synthetic process of MPM is guided by its semantic components. Thus, through different combinations of parametric settings of the MPM, different forms could be generated to signify a wide range of metaphorical expressions.

A. MPM Types

MPM consists of two different types of entity namely element and compound. An element is a single, simple and distinctive visual object while a compound is composed of two or more components which could be either an element or another compound.

B. Elements and Metaphorical Properties

Based on the analysis of the configurations of the samples, approximately sixty primary components are encoded as the “elements” of the MPM currently. An element is the most common and essential form found in a specific domain; it is a simple, abstract, and geometric-like two-dimensional object generated by certain geometric logic and equations while each form is controlled by one or more parameters. Elements can be classified as two types, namely line and shape. The major difference between line and shape is that a line is defined as an open path in the system; therefore, it has no enclosed area. However, both types could suggest different expressions according to the art and design theories introduced by Kandinsky and Klee [6, 7, 8].

Among all graphic forms, both line and shape could trigger cognitive responses. Though experiments with the imaging from fMRI, Larson, Aronoff, Sarinopoulos and Zhu [39] has recognized that the data support the idea that visual threat can be triggered by a simple downward V-shape with no reference of the other contextual or affective cues. Besides, the test of the associations of meanings between the downward-pointing and upward-pointing triangles also support the hypothesis that simple geometric forms convey emotions. These results signify that our brains could detect the stimulus of the geometric shapes with much less stimulus information than earlier studies.

Thus, as indicated in TABLE II, with different parameters, a single element such as the Archimedean Spiral or Trapezium could suggest a wide range of possible expressions as listed. Regarding the semantics of lines and shapes, many results and findings done by researchers such as the study of lines by Ibáñez and Delgado-Mata [40] and the study on shape by Blazhenkova and Kumar [41] can be adapted to guide the parametric settings of the MPM for signifying the intended expressions.

TABLE II. GENERATED FORMS OF VARIOUS MPM AND THEIR POSSIBLE METAPHORICAL EXPRESSIONS

Archimedean Spiral					
Regular		Offsetted		Outward	
Possible Metaphorical Expressions (Respectively)					
regular	harmony	graceful	living	springy	dynamic
hypnotic	gentle	organic	biological	cheerful	changing
cryptic	intricate	nature	structural	extroverted	unexpected
mysterious	infinity	exquisite	dynamic	excited	energetic

Trapezium					
Asymmetric		Large width/ high ratio		Complex	
Possible Metaphorical Expressions (Respectively)					
free spirited	distinct	structured	precise	opposing	focused
unrestricted	individual	geometric	absolute	conflicting	complicated
open	intentional	dignified	strong	against	difficult
independent	anarchic	historic	bold	contradict	agitated

C. Compounds

A “compound” of MPM is a two-dimensional visual object formed by two or more components assembled with some specific relations. A component of a compound can be either an element or another compound. A compound only provides two or more semantic placeholders for holding objects, it has no definite synthetic form other than encoded with a set of semantic relations controllable by parameters. In general, a set of default parametric settings which matches with the perceptions of most of the people will be assigned to the initial form of the compound.

When different objects are used to substitute the default sets or different parameters are assigned to the compound, the result could be quite distinct from the default settings. Fig. 2 is the conceptual diagram of the compound “sun”. The top right version in Fig. 3 is the “sun” generated with the default settings. With different parameters, even without changing the objects assigned to the placeholders, the other variants in Fig. 3 become quite departed from the default version.

Figure 2. The conceptual structure of a compound “Sun”

Figure 3. Sun generated with different parameters

As the components and the parameters in the compound “sun” can be switched according to the semantics required, it can be used to constructed different design as shown in Fig. 4 and 5. in which the concept of the sun is still retained but the visual form and expression are different.

Figure 4. Existing brand mark recreated using compound “sun” on the right, original design on the left

Figure 5. The other existing brand marks that could be represented by the compound “sun”

D. Deconstruction and Construction of Compounds

To create a compound, the target object should be deconstructed as the relevant units and put together as a conceptual structure matched with the perception of most of the people or the target audience. Depending on the background, cultures or the shared experience, different people may have a different perception of the structure of the object. In additions, as the focuses or viewing angles towards the same object could be coming from diverse perspectives, that object could be deconstructed and reconstructed in many different ways. For example, a bird is a simple object, but it is unlikely to provide one model for all as a bird can stand still or fly; it could be viewed from the bottom, the side or from the top. Unlike 3D modelling, it is necessary to build various 2D models to anticipate different conceptions or situations. Carlier, Leonard, Hahmann, Morin, and Collins [42] have done a study to collect information about how people decompose the structure of shapes. Their study covers 1200 shapes in 70 shape classes, and 2861 participants with 41,953 annotations have been collected in which at least 24 annotations per shape. The result clearly reflects that there are many ways to decompose shapes into diverse configurations according to different perceptions. Therefore, many compounds could be created to represent different perceptual models of the same object.

IV. METAPHORICAL RELATIONS, RELATIONAL OPERATIONS AND METAPHORICAL EXPRESSIONS

Unlike the other models, the MPM only provides placeholders for assembling objects together according to specific relations. Although many researchers have made tremendous efforts on the study of mereotopological relations, the focuses are mostly on the studies of physical conditions or spatial relations for engineering, mathematical or scientific purpose. In order to build a model to signify metaphorical expressions, metaphorical relations (MR) is proposed to facilitate the significations of metaphorical expressions with the MPM. For constructing the specific spatial relations to signify the MR as identified in the corpus analysis as described above, a number of relational operations (RO) are encoded in the MPM. The detailed discussion of the features and functionality of MR and RO will be discussed in the following sections.

A. Relational Operation (RO)

Relational operation (RO) is the operation which arranges the position of objects according to the specific spatial or visual relations. These relational operations could arrange the objects according to the concepts of different MRs and then signifying different metaphorical expressions.

Currently, fourteen ROs which are essential for the arrangement of the components are defined in the MPM. These relations include: alignTo, topOf, bottomOf, rightOf, leftOf, rotateAroundPoint, parallelTo, perpendicularTo, scaleBy, matchOneSide, matchExactSize, inside, meetAt and tipOf.

B. Metaphorical Relations and Metaphorical Expressions

A large proportion of conceptual metaphors belong to the orientational metaphor type is associated with spatial relations. While mathematicians and researchers have been investigating the related theories for many years [43, 44, 45], their efforts have seldom come across the notice of visual communication designers. Nonetheless, the diagrammatic renditions of their mathematics concepts provide great resources to signify meanings and make a wide range of metaphorical expressions for different types of visual communication designs. In fact, these spatial relations which could be considered as a kind of visual schema have been used to signify different meanings in the pictogram of Chinese oracle-bone inscriptions in ancient. Two distinctive examples in Fig. 6 showcased the principle of orientational metaphor by positioning the shorter strokes in various relative positions and suggest different semantics.

Figure 6. Ancient Chinese characters based on pictogram for “up” (left group) and “down” (right group) and their modern counterparts

The RO developed for the MPM is originally created for the synthesis of the visual composition; it is mainly aimed at managing the mereotopological relations between different components in the MPM with geometric transformations. However, in the later stage of the development of the MPM, it has been found that these merotopological relations could be constructed according to the principle of image schema to signify specific information and expression metaphorically. Therefore, other than simply arranging the composition of the design with the synthetic operations such as RO, another layer of meaning can be suggested by constructing the Metaphorical Relations (MRs) through the ROs as well.

TABLE III. PERCEPTUAL RELATIONS BETWEEN TWO OBJECTS AND THEIR POSSIBLE METAPHORICAL EXPRESSIONS

Relation	Description	Logo Examples				Possible Metaphorical Expressions		
Positional								
Top of	A is on top of B					authority climax dominant	high rank important hierarchy	superior good influential
Bottom of	A is under B					foundation earthy lower rank	base basic support	endorse subordinate inferior
Left of	A is on the left side of B					accompany assist backward	extend lead liberal	member past peer
Right of	A is on the right side of B					active advance assist	extend forward follow	future companion lateral
Front of	A is in front of B, hiding part of B					apparent credible dominant	exposed forward important	inviting noticeable open
Back of	A is behind B, hiding part of A					backing back up concealed	emerge hidden introverted	obscure dependant disguised
Proportional								
Larger than	Size of A is larger than size of B					authoritative dominant established	expending full generous	influential plentiful powerful
Smaller than	Size of A is smaller than size of B					delicate fine gentle	humble insignificant minor	modest progeny subdominant
Same Size as	A and B are of same size					accompany balance equality	even matching partner	symmetric competitor fair
Part-Whole Relational								
Inside	A is inside B without touching its boundaries					bounded protected secure	sheltered surrounded attention	cherished child comforting
Covered By	A is a component of B					belong to component included	incorporated integral involved	member combined dependent
Covers	B is a component of A					basis central contextual	embracing progenitor cooperation	dynamic essential functioning
Contains	A includes B without touching its boundaries					background backing environment	inclusive protection safeguard	take care of approve assistance
Meet	A and B shares boundaries at one point					agreement contact equality	touch associate closeness	gentle intimate link
Overlap	A and B are partially overlapping each other					affiliated associated bond	consensus equality friendly	harmonious linked share

In TABLE III a number of spatial relations are listed with brand mark examples to illustrate how specific arrangement of visual objects can potentially signify different expressions. TABLE III only indicated one-to-one relations; however, these relations could be applied to one-to-many or many-to-many situations while the expressions may show some minor variations. Based on these spatial relations, the MPM could suggest a kind of relations which may be called as metaphorical relations (MR). Through the MR, different kinds of metaphorical expressions (ME) could be signified through the process of symmetrical object alignment (SOA). Through the process of SOA, the abstract qualities will be represented as concrete images. By choosing a source object with specific metaphorical properties and combined with the relevant MR, the metaphorical properties could be mapped to the target object. Thus, not only the literal meanings but also the metaphorical expressions could be delivered to the receivers.

C. Setting the parameters based on semantics

As the whole idea of the MPM is dealing with semantic, especially those related to expression and emotion, the principle of semantic differential could be utilised to control the parameters. By mapping the value of a semantic differential scale relevant to a specific parameter of a metaphorical relation, the form of the model could be modified and express such meaning respectively. For example, the weight of “authority” can be mapped to the relation “top of” whereas the distance between the top and bottom objects indicates the level of the “authority”. The position of the top object could be placed at either a higher or lower position to signify different degrees of authority as shown in Fig. 7. At the same token, we may enhance the effect by concatenating the “larger than” relation to enhance the effect by mapping the ratio of large to the size of an object.

Other than passing the semantic value to the parameters based on the principle of symmetrical object alignment and semantic differential, it is expected that different types of machine learning methods could be applied to drive the model if the proper interface is provided. However, the experimentation of these ideas are out of the scope of this paper and future development should be done in future.

Figure 7. (a) Original brand mark, (b) increase value of parameter “yOffset” in TopOf and (c) increase value of parameter “xScale” of ScaleBy

D. Resolving problems of contradicting relations

As some of the samples such as TopOf/BottomOf, LeftOf/RightOf shown in TABLE III are contrary pairs, some relations will signify divergent meanings depends on which object is under attention. For example, the object “A” may carry meanings of “authority”, “high rank” or “good” while the object “B” may show the ideas of “support”, “low rank” or “inferior”. In some sense, the expressions of “authority” vs. “support”, “high rank” vs. “low rank” are complementary pairs. However, the expression of “good” and “bad” could be contradictive when a unified brand personality is preferable. In general, this type of conflict could be avoided if the MPM is assembling according

to the theory of visual rhetorics as only the appropriate object will be selected. Although the detail discussion of visual rhetoric is out of the scope of the current discussion, a brief description could elucidate how the MPM would work with semantic issues. In general, if a unified concept is required, the choice of the nature of both object “A” and “B” should complement each other as the samples show in the top row of TABLE III. So, the expression of the complementary pair such as “authority/support”, “high rank/low rank”, and “good” will be dominant while the contradicted meaning “bad” will be submerged. In fact, the metaphorical expressions of a design are affected by the nature of the objects as well as the relations between the objects found in the design.

When a visual rhetorical figure is applied to a brand mark design, if the objects appearing in the design carry distinctive meanings, the metaphorical expressions suggested by the metaphorical relations between the objects could be dominated by the properties of the objects. For example, the construction of the brand mark in Fig. 8, is based on the principle of the rhetorical figure “Antithesis”. The object “A” and “B”, which carry the “opposition of content” as defined by Durand [46], are combined together as a single compound. The composition of this design can be constructed by at least two different metaphorical relations namely, “LeftOf/ RightOf” and “Cover/ CoverBy”. In this case, metaphorical relations suggested by the “LeftOf/RightOf” or “Cover/ CoverBy” will become minor. Here the contradictive expressions suggested by the “happy face” object and “sad face” object on both sides are showing in parallel and suggested the expression of “Antithesis” of two emotions to represent a theatre group.

Figure 8. Brand mark based on the principle of rhetorical figure “Antithesis”

V. AN EXAMPLE OF THE PROCEDURE OF MAKING BRAND MARK DESIGN WITH MPM

In this section, a formal procedure of making brand mark design with MPM is described so that users can acquire a better understanding of how to utilize the model in real life applications.

- A designer or user should get the design specifications with information such as the nature of the business, the target group, the brand personalities or specific requirement collected in advance. Here, for the purpose of demonstration and explanation, an existing brand mark of Swiss Airline is chosen so that we can show how to create the same result with the MPM.
- In general, visual communication designers will seek visual metaphor to represent the design concept. The choice of the metaphor could come from analytical processes such as a visual inventory of the other existing work created for a similar business or lateral thinking such as brainstorming. As the current task is based on an existing design, the first thing to do is analysing and find out the metaphor used in the original design. Through the deconstruction of the original brand mark, two visual metaphors representing the concepts “Swiss” and “airline” are identified.

- Depends on the design requirements, a brand mark design can be created by either an element, a compound or different combinations of both. As the Swiss Airline consists of two metaphorical concepts, creating a compound with two components will be a logical approach to initiate the design. To create a compound to represent these two concepts with visual objects, the MPM consists of one placeholder to contain the concept “Swiss” and another placeholder for the concept “airline”. Then these two placeholders are connected by one relational operation “inside”.
- Then the metaphorical concepts are encoded as a compound as shown in TABLE IV. To recreate the form of the original design, two elements, including a trapezium and a cross have been assigned to the placeholders of the compound. By setting the relevant parameters, a replicate can be created.
- By modifying the parameters or element of the compound, design alternatives could be generated as shown in TABLE V. With different elements in the back, the concept of “airline” will be omitted and signify different semantics according to the metaphorical properties of the replaced element. Similarly, changing the front element will signify different meaning as well.

By using the RO to create different MRs between the elements of the original composition, new metaphorical expressions could be suggested. By referring to the relations shown in TABLE III, each of these new relations could signify a manifold of meaning diverged from the original meaning.

As MPM and its related operations are still under development currently, the use of the coding library is yet not released to public usage. However, a prototype built with FileMaker, which is a relational database supporting HTML and Javascript and convenient for rapid prototyping, is available for designers with no programming experience to do design or experimentation. Through the GUI (Fig. 9), users can enter the ROs to assemble different elements as compounds or more complex compound combined with the other compounds. By selecting different objects for the placeholder and modifying the parameters of the objects or the relations operations, users could create a wide range of design with the prototype.

Figure 9. Screenshot of Prototype with GUI Interface

TABLE IV. CODED SIMULATION OF EXISTING BRAND MARK DESIGN

Swiss Air Brand Mark Example	
Original Brand Mark	Simulated Result

Code Sample (Javascript)	
<pre>//create trapezium to signify airline var tail = Trapezium.createComposed({ length: 190, height: 170, angleLeft: 60, angleRight: 90.5 }) tail.gt("skew", "x", -13, "CM", "g") tail.style("fill", "red") //create cross to signify Switzerland var cross = CrossShape.createComposed({ width:200, height:200, thicknessX: 60, thicknessY: 60 }) cross.style("fill", "white") //establish MR between the tail and the cross cross.addRelation("alignTo",tail,"CR","CR",[15,0]) cross.addRelation("inside", tail, 0.85) //plot resulting brand mark onto screen var logo = Compo.createComposed({}) logo.addItem(tail, cross) logo.plot()</pre>	

TABLE V. VARIATIONS OF THE SIMULATED RESULT

Simulated Result	Description
Change of Object
By changing the shape of the back element, different designs are created. These shapes are not the visual metaphors to represent the concept “airline”; however, they could represent the other brands from the Swiss.
Change of Relation
By changing the shape in the front element, another group of design are created. As the visual metaphor of “Swiss” is replaced, this design could signify an airline associated with different places or institutions.

VI. DISCUSSION

In order to create a universal model to facilitate visual communication design, building a model for expressing emotion is as important as showing information. The MPM proposed in this paper is an initial attempt to develop a new type of computational model for visual communication design based on the conceptual metaphor theory and visual rhetoric. The model is a representation of the semantic and metaphorical structure rather than any specific physical structure of a target object. Unlike some conventional architectural models which represent the physical structures of architectural forms, it only represents the most dominant conceptual structure perceived by the target groups or the designers. Why utilize such configuration instead of using a more definite structure as most of the other models? The major reason is the component of this model is not limited to a definite ontological structure but depending on different levels of metaphorical concepts. These concepts are affected by our embodied experience, our knowledge prevailing in a specific group, society or culture as well as the practice enforced by institutions.

Based on the theory of symmetrical object alignment, we can map the metaphorical properties from a source object to the target object and signifying the intended metaphorical expressions. However, choosing the relevant components to construct a computational model requires specific domain knowledge. Other than the knowledge of computing and coding, defining an MPM for making professional grade design requires the understanding of the brand mark design as well as the understanding of the culture of the target audience.

When a visual form is displayed, its meaning not only affected by the objects perceived by the viewers but the effect of visual rhetorical treatments is also crucial. For the same object, the choice of colour, line quality, texture or particular style could affect the expressions of the outcome. Graphic attributes always carry another layer of metaphorical properties which could affect the expressions signified in the design. A detail discussion of the visual rhetorical effect of graphic attributes is out of the scope of this paper, however, the current MPM have already incorporated the concept that all graphics attributes can be used to signify metaphorical expressions as the examples shown in TABLE VI.

TABLE VI. VARIATIONS OF THE SIMULATED RESULT OF THE CBS BRAND MARK

<i>Change of Attribute</i>
Changes in actual vector point location
Changes in styling methods (vector points are not changed)

VII. CONCLUSION AND FUTURE DEVELOPMENT

It is obvious that the current MPM is created with vector graphics and could not represent photographic or raster images in the design. However, with the relevant adjustments, the MPM could incorporate the raster image processing functions to generate both vector and raster graphics at once.

This paper mainly focuses on how the conceptual metaphor theory is employed in establishing the structures of MPM. It explains the assembling of visual objects as conceptual metaphors for making metaphorical expressions through the manipulations of metaphorical relations. Though it has explained the concept of symmetric object alignment, there is no discussion on how to choose which object as the source object and how it is mapped to the target object. Also, there is only a brief description on how to arrange the objects to compose the final design based on the theory of visual rhetoric in section IV. D. In order to elucidate the design process such as how to select objects and control their parameters, it will require a more detail introduction and in-depth descriptions of visual rhetorical operation (VRO) which is out of the scope of this paper. Currently, a few of VROs based on the seminal paper of Durand [46] have been implemented to facilitate the construction of the MPM. By using the VRO together with the MPM, plenty of diversified designs could be generated and the results are promising. In future, besides the rhetorical figure listed by Durand, a much wider range of visual rhetoric figures which has been reviewed by Baruchello [47] as well as Huhmann and Albinsson [48] should be implemented as VRO for working with the MPM.

The MPM described in this paper is only the first trial of a new type of model for visual communication design. However, its potentials should not be limited to brand mark design. Based on some experiments conducted before, the same model can be used to simulate various types of pattern design or generative art as shown in Fig. 10. This model is flexible and the users can modify the components and relations based on the theory of conceptual metaphor or visual rhetoric for an instant. Furthermore, though this model is initially developed for visual communication designers dealing with two-dimensional works, it could be adapted in different design disciplines immediately. For example, this model could be an ideal creative supporting tool (CST) for architects who need to design the floor plans or facade layouts with symbolic meanings. As all the objects and relations in the MPM are encoded with the conceptual metaphor and visual rhetoric, it will be quite convenient for architects to explore and create new floor plans which is hard to be done with conventional CAD systems.

Figure 10. Three different patterns based on the same element “Regular Star Shape”

Last but not least, as Lakoff and Johnson [18] described a common conceptual metaphor found in human beings—ARGUMENT IS WAR. With such a concept, people use the structure of war to see an argument between different parties. People use the word and ideas such as fight, indefensible, weak point, target, demolished, shoot, strategy, opponent to deal with an argument. They suggested that if there is a culture which views argument as a dance, participants as performers, and the objective is to give a pleasing performance, then the result will be more constructive.

Now, consider that if each MPM is a visual vocabulary or means for the visualization of metaphorical concepts. By choosing different visual vocabularies to represent different matters, we may create powerful resources to facilitate different activities related to communication and creative thinking. Thus, whether a user is from engineering, architecture, fashion or communication design background, or even if that person is a musician or a poet, all could find some approaches to use the model to support one's own works—by switching the mind visions through the transformations of visual metaphors. Eventually, through the building of MPM database with the metaphorical concepts of different cultures embedded, we may be able to create a universal visual language to facilitate better communication and creativity for all.

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