

# Investigation of Aesthetic Quality of Product by Applying Golden Ratio

Vishvesh Lalji Solanki

**Abstract-** Although industrial and product designers are extremely aware of the importance of aesthetics quality, they make aesthetic design decisions largely on the basis of their intuitive judgments and 'educated guesses'. Despite aesthetic aspect of a functional product be an important reason for customer choice to buy a product. While ergonomics and human factors researchers have made vital contributions to the safety, productivity, ease-of-use, and comfort of human-machine-environment systems, aesthetics is largely ignored as a topic of systematic scientific research in human factors and ergonomics. Aesthetics is a link between a product and the user's emotion contributes to obtaining more desirable products for the user. To develop products with aesthetic benefits, multiple factors must be considered simultaneously. This paper presents the strategic focus on product design, arguing that an aesthetics dimensions may help a product to be a commercial success. To achieve product aesthetically appealing to consumer GOLDEN RATIO is used. The literature shows the ways and how golden ratio has been in existence in the world we live, and some works of art and architecture that asserts the presence of golden ratio. Its impact designer decision making in concept design stage and has a signification impact in success of the product, there for hybrid methodology to be adopted in concept design stage. This method will also utilize a parametric design algorithm, and make product aesthetically appealing. To develop this new methodology thorough, literature review was used. The graphical algorithm editor software is used to modify aesthetics dimensions, after getting the result, this approach can be used in many other area of product designing.

**Index Terms**—Aesthetic, Design, Golden ratio, product.

## I. INTRODUCTION

In the age of competition, product should serve its primary purpose. Consumer nowadays demands are different from older times. The product has become a status symbol in our society. Aesthetic quality is equally important for a product to sustain in market along with the functional quality.

Product can reach to functional quality but how to design for aesthetic; this thesis will explain the importance of aesthetic quality and how to improve product aesthetic quality. But how one can differentiate between two similar categories of product? Answer lies between the comparative study of the product, but from new perspective. From aesthetic point of views, but it's very difficult to evaluate a product as previously define design standards. From the literature survey

it's very difficult to evaluate product beauty, there are lot of constrain like, age, sex, culture, time, and process. Poor and developing country don't have enough resource to spend on design process, so they only consider the functionality and aesthetic quality is largely ignored, and only functionality not satisfied consumer psychological need.

Implementing aesthetic quality and applying in product design is a very blurred and confusing process currently. Design of product is largely done by designer intuitive judgment. There are no fixed ways to apply aesthetic quality like any law of science. Until than golden ratio is used to design a product for aesthetic quality. The industrial design has major impact on the existence of the human race. The work of Leonardo da Vinci's shown in Figure 1, during that time functionality and aesthetic quality was one common thing. Comparing with the old times, this thesis work concludes that the reason for reduction in innovation and its application on product aesthetic quality. Particularly in the developing country and developed country the gap is more. This kind of situation leads to cultural essence in product design and that can result in lack of aesthetic in new product development.

There are different standard available for design. In which aesthetic standard is mostly ignores. And now popular companies are taking consideration of the aesthetic quality. To design for aesthetic quality, many dimension are edited so cad software is used in the process so that designer can edit product dimension, making sketch in 2D and then in 3D. After completion of product design public survey method is used, there are many method of evaluation of design.

First design is made in 3D modeling using cad software, the product is generated in software and then doing public survey method for evolution of the aesthetic quality of the product. This approach is new to check the aesthetic quality of the product in design stage, for that golden ratio is applied to the product in design stage there one can edit it if required, and then product is brought to public survey .companies with skilled designer have more idea, better and more competitive product then other company which have one that aesthetic consideration in the product. Modern design attempts to increase quality of life by designing product that meets consumer requirement combining different concept and focus on shape texture colors, style, price and function, so manufacture should found on the product aesthetic quality so to satisfy consumer need and that product should be aesthetic

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appealing it's a ways of branding but in designedly way .many attempt is made to improve aesthetic quality of the product using ergonomics using computer algorithm (Nayak, August-2015 ).

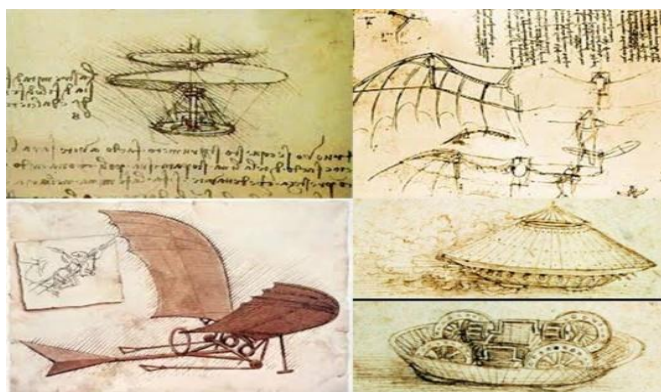


Figure 1 Work of Da Vinci works in engineering design

The irrational number 1.618 , golden ratio (Omotehinwa T. O, July 2013) which is also known as golden section by the ancient Greeks , golden proportion, mean ratio, divine proportion, golden mean or golden number (Koshy, 2001), is widely used in modern sciences particularly in theoretical physics (Markowsky, 1992). The golden ratio has many properties and present in nature's creation. It is a number that is equal to the reciprocal of its own with the addition of 1:  $\Phi = 1/ \Phi + 1$ (Stakhov, 2006). Likewise. This Golden ratio had been used by Egyptians in the construction of their great pyramids. It is denoted by Greek letter called phi ( $\Phi$ , capital letter or, small letter).

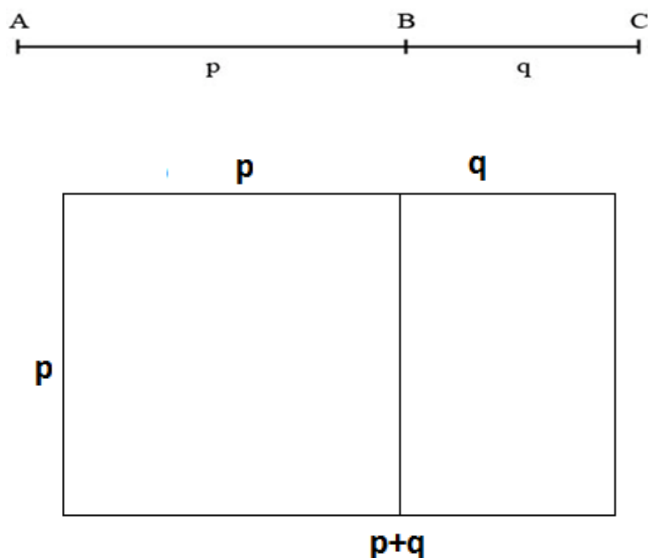


Figure 2 Golden ratio applied to line and rectangle

$$\phi = \frac{p}{q} = \frac{(p+q)}{p} = \frac{1+\sqrt{5}}{2} = 1.6180339887 \quad (1)$$

Above figure 1 shows that ratio of p: q and (p+q): p is equal to 1.618, this how golden ratio is applied to a line segment. Figure 2 shows how golden ratio is applied to rectangle. This ratio has great impact on aesthetic quality of the any object in

which it is applied. In this paper we will try to apply golden to our product to get desire aesthetic quality.

Current designs is done without considering aesthetic quality or if it is consider then there is no method to applied aesthetic quality to product, as a result its fail to reach to consumer. In some case designer considering aesthetic quality to reach the customer need but most of design decision are based on their judgment, experience, observation, inspiration and figment etc. this existing method for using and study aesthetic quality in product evolution. In order to investigate product aesthetic quality golden ratio is applied. This approach will increase aesthetic value of product .

This research works aims to solve the problem and gap between psychological needs and functionality of the product by defining methodology and aesthetic design consideration. In recent time the product are modification of older and existing product for a reason “adaptive design model “are important and famous in field of design Clarkson (Clarkson J.)specified that design process is fixed from beginning .the design process deals with concept design process design and manufacturing phase . Our problem revolves around designing phase where transformation of idea, methodologies and ignore aesthetic value of product.

This approach developed method to increase aesthetic quality by applying golden ratio approach by following basic design rule and anthropometric data is considered. Modifications are easy in this stage and have less time consuming. This thesis try to integrate both usability and aesthetic quality of product in concept design phase with many outcomes in this trial and error method based on Anthropometric data have a vital role in usability of the product which results in success of the product, but aesthetic cannot be ignored because the role of aesthetic is silent but the effective impact on consumer, the main intention for aesthetic success is a way to influence user psychology the success of product depends and influence of functionality, aesthetic usability. Golden ratio approach gives effective way to enhance the aesthetic quality and software generated CAD model which can be edited any time.

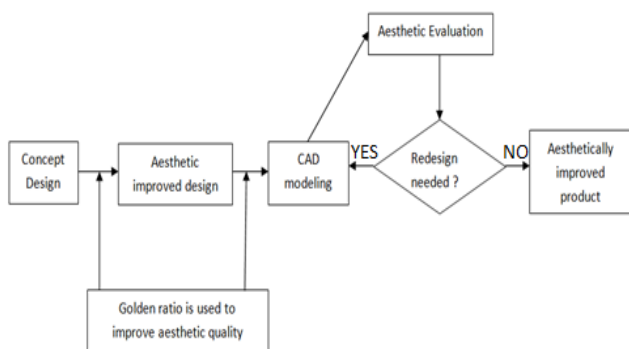
The requirement of today's product performance leads to the creation of solution that Performance factor such as aesthetics ergonomics and usability in which aesthetic quality is taken in attention. Despite the research in history, no single model can be agreed to provide a satisfactory description some modern approach to the design is presented and practical relevance is discussed.

## II. IMPORTANCE OF AESTHETIC QUALITY

Today product design is multidisciplinary job as a result development processes became complicated , there are many approach of product design such as engineering design , industrial design , design for manufacturing, design for usability and design for aesthetic quality etc. it is very difficult to design a product with all the approaches and hence aesthetics is not given enough importance . The adverse effect of this incomplete design process is leads to failure of the product. The product has to be accepted by society both physically and psychology.

Good design is important in new product development as function; visually appealing product can be clearly different from competition. So the aim of designer is to compromise in the race to market. Without aesthetics inclusion .the product will not get market success most of the aesthetic design in most of the case depends upon designer experience. While focusing on artistic value and aesthetic implementation, new product goes through lots of conflicts between commercial and creative. There are several theories to product design some believed that product should strictly lead by customer need. Both physical and psychologically. it is very difficult to apply. Aesthetic quality. And also difficult to control and measure of aesthetic quality. “It’s difficult to quantify beauty”.

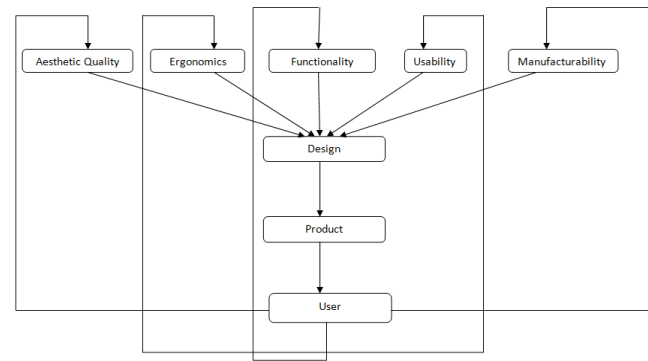
From the above observation, due to knee interest in product design industries and manufacturing are have to consider aesthetic as a strategy design tool in design stage it is very difficult to balance between commercial and creative interests due to multidisciplinary span it’s very challenging to applying aesthetic element to product design.



**Figure 3 Methodology to apply the aesthetic quality by golden ratio.**

Based on above background. This paper aims to explain and investigate the importance of aesthetic quality. The prepared methodology gives brief idea of aesthetic as a new dimension in product design. The reason for selecting this problem is that in product development phase face difficulty in applying aesthetic dimension to product.

From Figure 3, concept design of a product can be modified by golden ratio. After that CAD modeling software is used this is very flexible to edit the dimension of the product. Then aesthetic evolution, from that some idea of designing product can be captured. If product comes out with aesthetic quality then design phase is finished and our job is done.



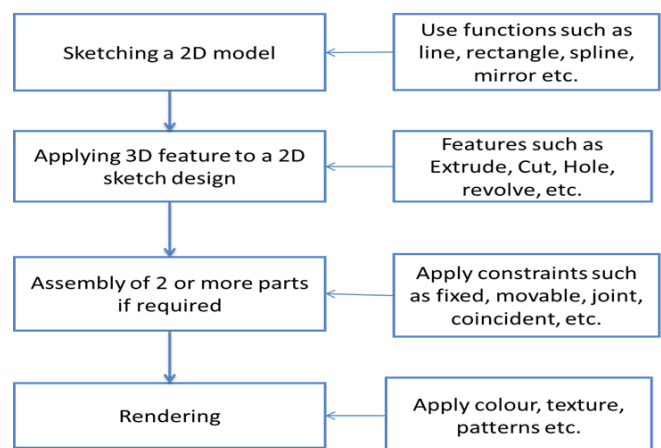
**Figure 4 Hierarchical flows of design data**

From the above literature review, it was found that the current design process have gap in coordination between different aspect of design like aesthetic quality and usability , various design model are available ,they are unable to fulfill the users psychological needs.

The flow chart shows how design input comes from the user and the modification or redesign is done in the field of product design. There is no doubt the evaluation of a product by the user leads to some valuable breakthrough in removing design defects. The design process should consider aesthetical quality as a vital role to consumer to select any product. That means it can’t be ignored, it has to give equal important as ergonomics, functionality, usability and manufacturability.

The design of the product in this research has been carried out using cad software. It is a tool used to create a 2D and 3D CAD (Computer Aided Design) model. Cad software is used to model the product. The design of any product begins with sketching 2D model which is then converted to 3D using different functions. A complex geometry can also be designed within this framework and even it has different design capabilities such as Assembly, creating animations, structural and aerodynamic analysis etc.

In this study, the 2D sketch was drawn first and then 3D model was created within the Part Design module. After finishing the design, rendering was applied to the model. Rendering is the property to apply coloring and textures to the model.



**Figure 5 Methodology of applying aesthetic quality.**

Figure 5 shows the design process using a cad software. Apart from the above, there are several other features incorporated in cad software. The product designed in this study was mainly carried out using the above procedure. The parameters that are required to be changed are applied in the sketch and 3D feature module of the design process. In this research, the first product which was selected to apply the golden ratio was a wooden chair. The initial input geometrical parameters was obtained from a pre-available parameters measured from an already manufactured chair. The geometrical dimensions were calibrated as required to obtain a golden ratio.

**Defining the Product design :**

The initial design parameters are captured from the already manufactured chair. The dimensions are then noted down and then designed using CAD design software. After analyzing, all the available and editable dimensions, the dimensions that fit into a Golden ratio are applied in the sketch design mode of cad software. Dimensions such as height, width, thickness are all considered in analyzing to make it aesthetic appealing. Such a design changes is explained in detail in the following section.

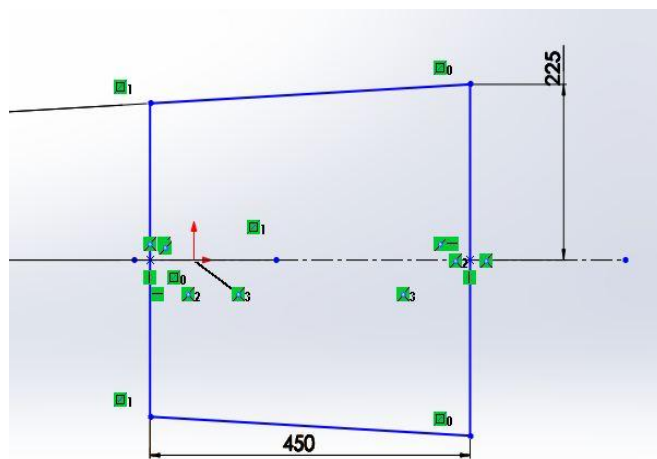
*Modification of aesthetic properties:*

The aesthetic properties of any object is mainly divided into four major properties which include texture, colour, form and proportion. These parameters are based on how the human senses any object. Thus, the aesthetic property of any object is one of the most challenging and appealing task in the design process of any product. To improve the aesthetic property of any product or an object, it is important to enhance and understand how to apply the changes in the four major properties that it looks appealing to a customer. The problem to implement the aesthetic properties varies from person to person and thus it is difficult to quantify beauty and attractiveness.

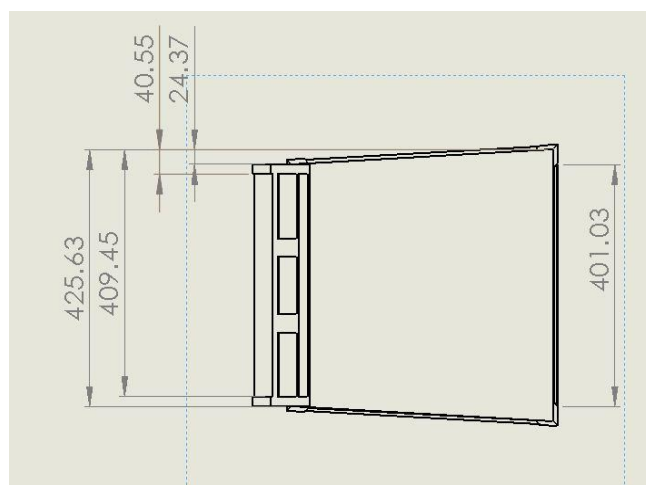
*Generative Design*

This form of design is often represented as a rule based design where various promising design outcomes are applied. Parameters and variables are the rules considered in the generative design process. In order to obtain an acceptable and extensive outcome, parameters are applied in an organised manner.

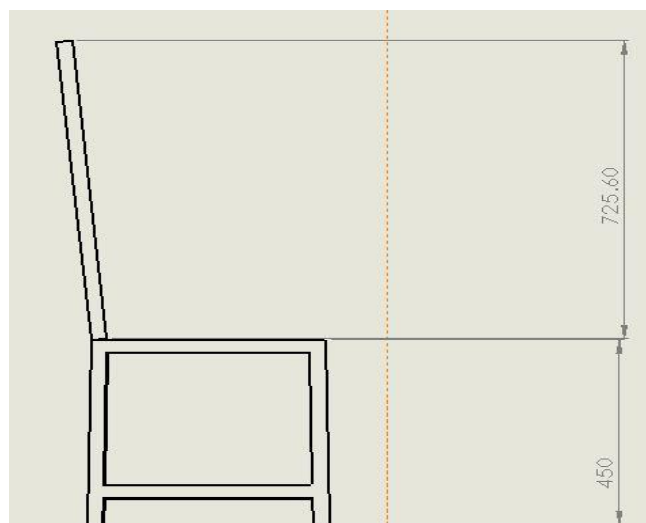
As described earlier, the design of the first product, i.e. wooden chair was started with chair design. The first process in the design using cad software involves the design of a 2D sketch on a specific plane. Thus, the sketch was made using functions such as lines and rectangles made available in the sketch module of the design section. The first sketch that was made on a front plane can be seen in Figure 6. After finishing with this sketch, the sketch was converted to a 3D design using a feature called Extrude. The user can specify the direction and thickness in order apply the thickness to the designed sketch.



**Figure 6 2D Sketch view in Sketch mode (Solidworks)**



**Figure 7 Top View of a Chair**



**Figure 8 Side View of a chair**

After finishing the first sketch on the front plane, the user can exit the sketch module and return to the 3D design mode. After extruding the first sketch, the user can perform the design changes on the extruded design or specify an additional plane to start again the sketching on the different plane. In this design, a 2D sketch was performed in order to make four legs of the chair at an angle of 1 degree moving

outwards. The backrest of the chair was designed by creating a plane at an angle of 3 degree outwards from the left edge of the above figure.

The final designed chair can be viewed from Figure 9. All the necessary dimensions were modified such as to obtain the Golden ratio. For example, consider Figure 8, i.e. the side view of the chair, if considering the ratio of backrest height and that of legs of the chair, it is equal to the Golden ratio (i.e.  $725/450 = 1.61$ ). Similarly, from Figure 7 (i.e. top view, the Golden ratio applies there as well which is  $40.5/24 = 1.61$ ). Similarly, the Golden ratio has been applied at several places such that it inhibits the aesthetic property of the chair.

After the design has been created, the product can be looked more appealing by applying the texture or colour to the product and this was done using the Rendering feature that is available in the cad software. This feature will allow the user check their design in several different forms and at the end of the design process; one can look how appealing the chair looks. This property is highly based on different personnel views. However, in these design the textures and colour are going to be mainly based on the views of the people obtained from the survey.



**Figure 9 3D CAD Model of a Chair**

### **Conclusion**

From this section, it became clear how the aesthetic property was applied to the product to make it more appealing for the customers. The methodology applied in this research was clearly explained using an example of chair designed using cad software package. Similarly, several other products can be designed on this basis keeping the principle in mind of how the golden ratio works. This brings an end to this chapter.

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