010107

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Junior / Discovery

Golden Ratio: How to Be Beautiful

This project describes the application of the Golden Ratio to designs around the world. If the Golden Ratio design is applied to any consumer product, it will produce an aesthetic appealing result to the consumers. This project analyzes the design of many consumer products (automobiles) from different countries and their appealing effect to the public, and the correlation between the prices and the Golden Ratio.

Project Forms

Project #010107 – The Golden Ratio: How to Be Beautiful

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Background

The first instance of the Golden Ratio appears in nature; roses, the layout of the sun flower seeds, petals, shells, etc. After carefully studying the Golden Ratio, artists applied it in their creations of popular art such as sculptures, paintings, architecture and, surprisingly, music, as well as literary works. There were numerous iconic figures that believed in the power of the Golden Ratio. It even dated back to 450 BC with Phidias being one of the leading individuals that had used it in the statues of Parthenon, although it was not clear if he understood the concept of it. Instead, Euclid had been aware of the idea of the Golden Ratio and defined it in his book “Elements”. It had been discovered by a Duke University Engineer (Ref.[7]) that the Golden Ratio was captivating to the eye due to the fact that we humans scan the horizontal axis with more focus than the vertical axis. So if there is an image using the Golden Ratio proportion, the eye can interpret it with effectiveness. Even Leonardo DaVinci applied it to many of his pieces. The way the Golden Ratio is incorporated into music is by means of the Fibonacci sequence. The relationship between the Fibonacci sequence is often found in the timing of musical compositions. For instance, the climax of songs is often found at roughly 61.8% of the song, as opposed to the middle or end of the song. (Ref.[2]) Since this “seems” to be the way to integrate beauty, advertisers, architects, artists and really anyone who wishes to create a visual impact, uses this strategy to allure their customers. Using only rectan-

gles can become quite tedious, which is why it is used in other polygons such as the pentagon.

Ever since I was ten years old I have been hearing about the Golden Ratio, and have became fascinated with it. It was my decision to do a science fair project on Golden Ratio to learn more about it and its application.

Theory

The Golden Ratio is a mathematical constant and an irrational number. (Ref[1]).
If a straight line 'A' is divided into two segments as 'B' and 'C', and 'B' being the longer segment, then the Golden Ratio is defined as the ratio:

$$\frac{A}{B}=\frac{B+C}{B}=\frac{1+\sqrt{5}}{2}=1.6180339\ldots$$

Purpose

This report describes the application of the Golden Ratio to the design of consumer products such as cars that are part of our lives. It studies how the Golden Ratio design of the car front, side and back panel affects their attractiveness to the consumers.

Hypothesis

Since all the automobiles are designed for beauty and performance, are the automobile designers following the Golden Ratio principle to appeal to the consumers? I think the designers strictly follow the Golden Ratio to apply to the side, front and rear panels to get the looks needed for appeal and higher sales.

Procedure

The idea was to find the most sold cars in North America and search if they had the Golden Ratio applied in their design. The list of car sales from (Ref[3]) led me to a list of cars by maker. I chose fourteen of the 2016 models of cars (as samples) from various countries having high and low prices. I collected the pictures of the chosen cars, and four rectangles were drawn on the side, front and rear panels on the pictures. For each rectangle the ratio of the longest to the shortest length (Golden Ratio of the rectangle) was calculated, and their average of four readings were calculated. Results are tabulated as shown in the Result section. The same steps were repeated for all the other thirteen sample cars, and their Mean and the Standard Deviation of all the cars were tabulated as shown in the Results section. The graphs were drawn to understand the spread of the ratios and their frequency distribution.

Results

The following are the results of the average ratios on the fourteen samples of cars:

Ford Fusion	1.3442	Ford Taurus	1.4712
Buick Lacrosse	1.509	Nissan Altima	1.736
Mazda 3	1.7625	Kia Optima	1.665
Hyundai Elantra	1.465	Kia Soul	1.517
Hyundai Sonata	1.479	BMW M4	1.735
BMW 3 Series	1.693	Volkswagen Jetta	1.675
Mercedes AMG	1.700	Audi R8	1.563

Mean Ratio for all the sample cars = 1.594

Standard Deviation of all measured ratios = 0.099

Deviation of the average ratios from the Golden Ratio = 1.618-1.594 = 0.024

Percentage of Deviation of average ratios from the Golden Ratio = (0.024/1.618)*100 =1.48%

There were many factors that could have affected the results such as:

- Legibility of the profiles on the pictures
- Rectangles on pictures drawn may be inaccurate rectangles
- Measuring errors using the simple ruler and its accuracy
- The choice of rectangles considering infinite number of rectangles can be drawn on a single panel
- The cars of low price, high safety, perfect interior space, powerful performance and even without the Golden Ratio can be extremely successful

Conclusion

By looking at the graphs and the readings from my measurements of the ratios, it appears that the ones for many foreign cars are within the range 1.65 to 1.71, whereas the North American automobiles showed poorly. Perhaps the aesthetics are not as important as I thought they would be. Still, almost all the sampled cars are within the 1.48% of the true Golden Ratio (1.618) measurements. The true information about the Golden Ratio design can be assessed only if the measurements are done on the automobiles using the measuring tape, and this may give better results than those of the pictures, but there will always be errors in the results. Because of the limitations mentioned, it is very difficult to correlate the price of the car against the Golden Ratio

design as you may see in the results. It appears the automobile sales may not accurately follow the Golden Ratio design but is compensated for the other features. From my fourteen sample measurements (in the Results section), I can ascertain almost every manufacturer is considering the Golden Ratio concept in the design of the cars. Although the Golden Ratio is not necessarily an absolute rule to be followed in order to be appealing, it is a way on “How To Be Beautiful”.

Improvements

One of the problems of working with cars is that people might be looking at other attributes such as fuel efficiency, colour, price, interior space, performance etc. Although being subjective, a survey can provide a glimpse of what shapes appeal to people. In such case, surveying different ages, gender, cultural backgrounds, low priced and expensive cars etc. Not all cars have the same features, so it would be hard to measure the cars with the same criteria, since I get to know the cars ans their features. I could obtain measurements from the cars with and without the wheels to observe if they are a key feature in the beauty. Research different objects other than cars and see if the designers incorporate the Golden Ratio. Research objects in nature and man-made structures, like buildings, towers and even natural creations like great coral reef or ant hills.

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