Digital Prototyping of Candi Kidal Relief on Interior Accessories

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Abstract. Candi Kidal is one of the most important cultural heritages especially in Malang Raya. Candi Kidal is a relic of Singasari Kingdom that has uniqueness in its relief characteristics, namely the emblem of medallion ornaments and Garudeya reliefs. In fact, not everyone, especially the people of Malang Raya, knows the uniqueness of the relief of Candi Kidal. There are many ways to preserve cultural heritage, one of which is to apply this relief ornament on interior accessories products. In the process of making a product, it is necessary to make a prototype product manufacturing process to find out the advantages and disadvantages of the design. The research method used in making designs is with design thinking. The main purpose of choosing this method is to find out the initial problem, create ideas, and make prototypes. In the manufacturing process it is done by visually optimizing the design with 3D software and is made with precision with 3D printing. The results of this research are a study of the process of making prototypes of interior accessories products with Malang locality, namely ornaments from Kidal Temple.

1 Introduction

Candi Kidal is the oldest temple built during the kingdom of Singosari. Its existence still stands strong until now. The uniqueness of this temple has ornaments that are not only decorative ornaments, even story ornaments that have a high philosophical meaning [1]. One of the uniqueness of Candi Kidal is the presence of typical ornaments, namely medallion and Garudeya ornaments. This ornament can only be found in Candi Kidal. Reliefs on the Temple fall into the category of local wisdom. Local wisdom is a form of attitude, views and ability of the community in managing its spiritual and physical environment to the geographical- political, historical, and situational situational situations of a local nature (Kartawinata, 2011) [2].

Along with the development of technology today the younger generation has begun to forget and abandon this very rich Indonesian culture. Globalization also has a strong influence on the decreasing level of public concern to maintain and preserve Indonesian culture. Preservation of cultural heritage can be done in a variety of ways, one of which is to apply the characteristics of cultural heritage to a product such as home décor products.

The development of technology and art tradition is an inverted period of time. Technology thinks far ahead, there are innovations and new things all the time. This innovation can be in the form of material and material innovation, planning and implementation methods, and innovation in terms of supporting tools [3].

Home décor products in the form of accessories are important components in the interior in addition to floor components, walls, ceilings and furniture. Of the searches on instagram, hastags about home décor are 84.8 million posts. Regarding interior interest in Indonesia in general, the data www.trends.google.com showed a steady and upward graph and East Java was in 7th position. This indicates that home décor products as part of the interior still have a fairly high interest.

Today Indonesia is entering the era of Industrial Revolution 4.0. The 4th generation Industrial Revolution is different from the previous industrial revolution. The industry is characterized by technological advances, among others: (1) artificial intelligence robotics, (2) nanotechnology, (3) biotechnology, and (4) quantum computer technology, (5) blockchain (such as bitcoin), (6) internet-based technology, and (7) 3D printers.

In the manufacturing process it is done by visually optimizing the design with 3D software, and is made with precision with 3D printing. Prototyping is an activity and a tool that has received considerable attention in the product development research communities in recent times. With the increasing interest in adopting Design Thinking (DT) in various business and product development domains, early-stage prototyping has become an important activity [4].

1.1 Objectives

Therefore, the purpose of this paper is threefold:
- To give an overview of the shape and meaning of the relief of Kidal Temple
- To provide researchers and practitioners with a brief overview of prototyping research on new interior accessories product development and shows promise for future research.

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- To provide an overview of interior accessories products by applying reliefs from Candi Kidal

2 Literature Review

Literature in the form of opinions used to strengthen the arguments of writing this article [5].

2.1 History of Kidal Temple

Kidal Temple is located in Rejokidal Village, Tumpang District, Malang Regency, precisely about 20 km to the east of Malang city. This temple can be said to be the oldest worship temple in East Java, because the reign of Airlangga (11-12 AD) from the Kingdom of Kahuripan and the kings of the Kingdom of Kediri (12-13 AD) only left the Temple of Belahan and Jalatunda which is a lightning or bath.

Kidal Temple was built in 1248 AD, after the funeral ceremony of 'Cradha' for King Anusapati of singasari kingdom. The purpose of the construction of this temple is to revive King Anusapati, so that the king can get glory as Shiva Mahadewa. Built during the transition from the golden age of central Java kingdoms to the kingdoms of East Java, at Kidal Temple can be found a combination of Central Java temple patterns and East Java temples. Some experts even call Kidal Temple as a prototype of East Java temple.

In ancient Javanese literature, there is a well-known myth among the people, namely the myth of Garudheya, a garuda who managed to free his mother from slavery with a ransom of amerta holy water (water of life). It is said that garudheya's mythical relief was made to fulfill the mandate of Anusapati who wanted to be Ken Dedes, the mother he loved so much. The myth of Garudheya is fully contained in the relief around the foot of the temple. To read it is used prasawiya technique (opposite to the clockwise direction), starting from the south side.[6]

2.2 Prototyping

Digital prototyping is an innovative design method. With digital engineering Product prototyping designed with the concept of generative design and topology optimization designers can visualize and simulate the product to be made starting from its design, strength analysis to the product manufacturing process [7].

The research on prototyping branches out into a wide variety of research domains. From engineering design [1, 6, 8] to human-computer interaction (HCI) [5, 9-13], Design Thinking [2, 14, 15] and software development [16-18]. To illustrate the diversity and give the readers an overview of the various roles that prototyping takes on, brief descriptions are given below.

In DT, prototyping take on quite a different role. Here the main purpose is commonly to facilitate the development and transform novel ideas into preliminary models that can be evaluated [2]. Prototyping—in the very early phases—can also be used as a tool to "get going" by building to think [4]. In this sense, DT is a prototype-driven development process or philosophy. It

is common for development teams to build and test prototypes from the very beginning in a project. This means that the speed is crucial. How fast the team is able to build prototypes, test prototypes and implement lessons learned in the next iteration is a critical factor for progress [4].

2.3 3D Printing

The 3D printing method has many tunings on the printer to make components with good results in terms of shape and size. To get good results, it must be tested in advance against some 3-dimensional printer printing conditions [3]. Printing conditions that can be used as parameters are the density of the structure inside the printed object (infill), the printing temperature is the temperature on the nozzle (print temperature), the height between layers (layer heigh), and the speed of printing (print speed). Each of these parameters can be set inside the Ultimaker Cura application before printing begins. The setting of these parameters can be varied according to the desired target with consequences such as printing time and print form [7].

3 Methods

Research Analysis of The Application of Digital Prototyping of Candi Kidal temple Relief on Interior Accessories Products using Design Thinking research method. Design thinking is a method of problem solving that focuses on the user. The stages in design thinking are Emphatize, Define, Ideate, Prototype, and Test (Ford, 2010) [8]. Design thinking method is done during the process of extracting ideas to design prototypes. Here are the stages of his research.

Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success. Design thinking methodology is "scalable and can be applied incre-mentally to improve existing ideas or it can be applied radically to cre- ate disruptive solutions that meet the needs of people in entirely new ways " [6]. Design thinking methodology can integrate technologies, in- novative thinking, design process, and available resources into human's desire to build up a new and innovative product [9].
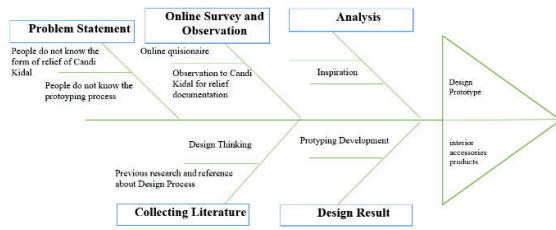

Fig.1. Design Thinking Diagram

Fig.2. Fishbone Diagram

4 Data Collection

The data collected consists of two types :

- Primary Data
  The primary data that will be collected here is survey data, interviews and observations to get detailed photos of the reliefs in Candi Kidal as the basis for applying ornaments on interior accessories to be planned.

- Secondary Data
  Secondary data is data to support research in the form of previous researches relevant to the research made.

5 Results and Discussion

5.1 ANALYSIS

a. Inspiration

Research The ornaments chosen are 2 ornaments that are only found in Candi Kidal namely Medalion and Garudeya. This ornament will then be the data source for the next development. Medalion was chosen because this shape has its own characteristics. Garudeya was chosen because this figure has a very distinctive story that is about the devotion of a child to his parents and is a depiction of King Anusapati who is loyal and devoted to the country. Relief Garudeya is divided into three rounds, consisting of a garuda round carrying a snake, which is a symbol when Garuda's mother still lost to the goddess of snakes. The second half is to carry tirta amerta, a symbol of a child's struggle to free his mother. The third act is garuda carrying a goddess, who is none other than her mother, a symbol of freedom and success of a child.
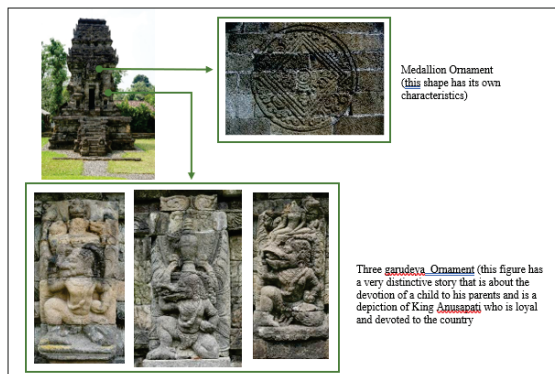

Fig.3. Relief On Candi Kidal Temple

b. Prototyping development

In DT, prototyping take on quite a different role. Here the main purpose is commonly to facilitate the development and transform novel ideas into preliminary models that can be evaluated. Prototyping—in the very early phases can also be used as a tool to "get going" by building to think [4].

The process of making prototypes is carried out by the design thinking method and consists of:

1. Emphatize

In this process, researchers want to know the cause of the problem, namely the lack of knowledge of malang people specifically about ornaments in Candi Kidal. From the questionnaire results showed the results in the form of most of the community has heard, but never come to the Candi Kidal temple. Regarding interest, most people have a considerable interest about Candi Kidal (89,7%). The questionnaire results also show that it is necessary to add Candi Kidal temple ornaments to interior accessories with the aim of cultural preservation (71,6%). With these results the researchers concluded it was necessary to apply ornaments from Candi Kidal on interior accessories.

Fig.4. Empathize Data Support

2. Define

At this stage, the researcher conducted a questionnaire study related to various kinds of interior accessories, including flower pot, lamps and paintings. The top three results of the questionnaire were wall clocks 24.3%, potted plants 23% and paintings 21.6%. Regarding the requirements for good interior accessories, 66.2% chose interior accessories that have functions such as timekeeping, planting media and lighting. From this data, the researchers determined that the objects made were wall clocks with medallion and garudeya relief ornaments.
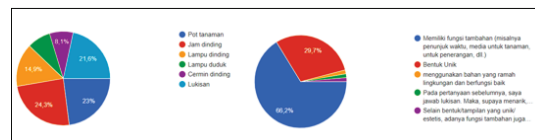

Fig.5. Define Data Support

3. Ideate

In the process of making an ideate, the initial step taken is making a 2D image which is then made a 3D object. The process of making 2d images is carried out by tracing techniques using Autocad software. At this stage, the researcher takes the silhouette of the original ornament. After the 2D tracing process is complete, the file d export to 3d software to create 3d objects and save it in .stl format. After that, 3d printing is done for molding the traced ornament results.

The shape concept of the design made is to apply the form of relief ornaments on interior accessories products with a simpler shape. For Garudeya ornaments, the main form taken is the anatomy of the Garudeya bird (Beak and wings) as well as the main feature above Garudeya's head. For medallion ornaments, the main shapes taken are geometric circles and floral motifs as well as square geometry within them.
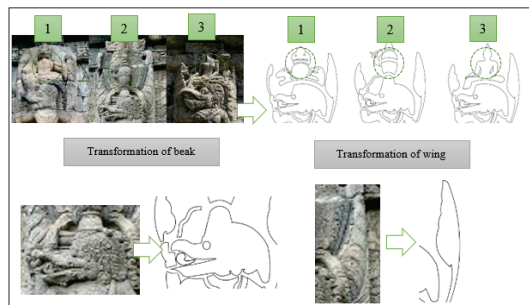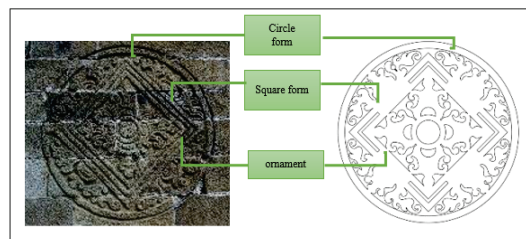

Fig.6. Shape Concept Of Garudeya Relief

Fig.7. Shape Concept Of Medallion Relief

4. Prototype

In the process of making a prototype, the initial step taken is making a 2D image which is then made a 3D object. The process of making 2d images is carried out by tracing techniques using Autocad software. At this stage, the researcher takes the silhouette of the original ornament. After the 2D tracing process is complete, the file d export to 3d software to create 3d objects and save it in .stl format. After that, 3d printing is done for molding the traced ornament results. After the mold is finished, the next step is to do the printing with cement and assemble it with other equipment in the form of a clock machine.
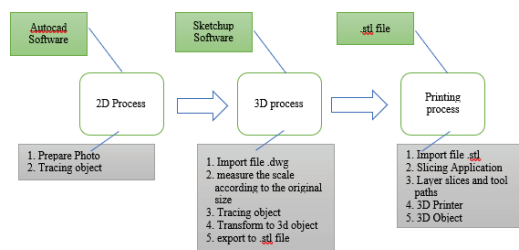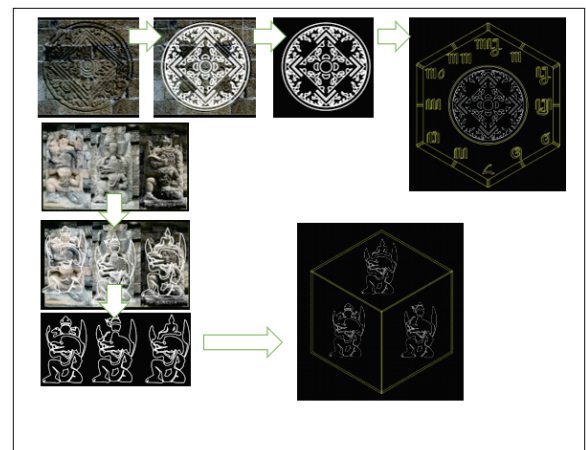

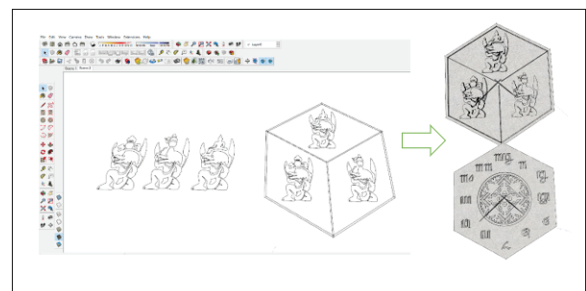**Fig.8.** Prototype diagram

Fig.9. 2D Process

Fig.10. 3D Process

5. Test

In the last stage, the testing process is carried out by operating a 3d printing machine to make prototypes. The position of the object is made horizontally so that the position of the relief faces upwards. This process is done to find out the advantages and disadvantages of using 3d printing in blinding carving prototypes with small dimensions.
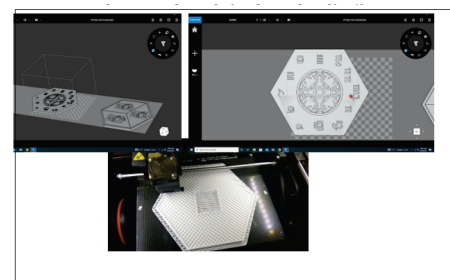

Figure 11. Garudeya Ornament

5.2 Result

The end result of 3d printing is a prototype of an interior accessories product. With the same image field, the shape of the motif is made according to the planned one. The smallest size of the carving made is 2 mm. The carving field is perpendicular to the direction of its fillament spray. With this condition allows carvings to be made without additional support so that the result is smoother.
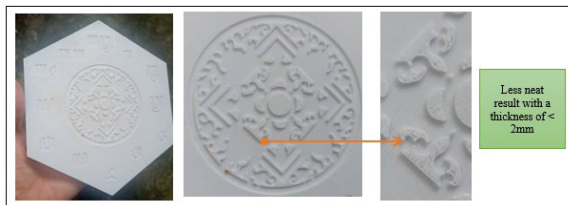
a. Medallion Ornament

Fig.12. Medallion Ornament

b. Garudeya Ornament

Fig.13. Garudeya Ornament

6 Conclusion

There are many ways to preserve culture, one of which is by making prototypes of interior accessories with the theme of carving Left-handed Temple. After research with the Design Thinking method, the results in the form of stages of the design process began from empathize to find out the problems that exist. The problem is that most of the people do not know the relief of Kidal Temple. After that, the determination of the results of the analysis of existing problems can be determined that the interior accessories made are in the form of clocks. In the ideate process, the results are obtained in the form of medallion and garudeya ornaments. The next process is to make the prototype with 3d Printing. The final result obtained is a less neat result on objects with a size of < 2 mm. With the existing results, it needs to be taken into account further in making prototypes that require high detail precision with a small size.

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