Token for the School’s Guest of Honour

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Abstract

A token is defined as an item to be presented at a special occasion. Hwa Chong Institution presents tokens at different events, as do many other associations. However, this group has taken note of the fact that tokens presented at Hwa Chong's events are reused. This causes these tokens to become boring and dull. This project served to create an innovative and original token to be presented to a guest of honour. It was decided that a wooden box will be created, with laser cut details on the cover. This will be accompanied by an engraving of the school's Chinese name on the front of the box. The box will also be opened in a similar fashion to a toolbox. Such a box fills the place of an original token, such that more variety in tokens presented to guests of honour is achieved.

After further group meetings, it was pointed out to the group that the lasercut details could replace the front piece of the box. This change was reflected in the most recent prototype. In addition, due to restrictions in skill, the group was unable to follow the original idea to have a layered design for the front cover. As a result, the box was restricted to one layer, the clock tower.

Introduction

Although Hwa Chong distributes numerous tokens of appreciation to guests of honour, this group has discovered that those tokens are repetitive. After this group interviewed staff at the Kong Chian Administrative Centre, it has been found that tokens presented over the past few years have included crystal plaques, artworks and calligraphy pieces made by students. Although they may be considered suitable gifts, this group viewed such tokens as unrepresentative of the school values, such as Win-Win or 自强不息. A target was set to incorporate school values and special features of the school into the design, to make it more memorable for the guest in question.

Aims of the Project

This Project Aims To

1. Discover the problem of repetitive tokens for guests of honour
    a. The problem is relatively hidden from the students
2. Build a token that is unique
    a. Token should incorporate school values and special features
    b. Examples of special features include the clock tower and Tan Kah Kee statue
    c. Token should be made by hand

Proposed Solution

For our solution, this group proposes to have a box. This box will be similar to a jewellery box in size and shape. Prominent features include the hinges, the laser-cut details and the plaque, which will now be further explained.

The Hinges

Firstly, the hinges will be made up of wood, as inspired by Cryptic Woodworks, a design house specialising in unique woodworking designs. We are using linkage hinges, based on a mathematical and engineering concept known as four-bar linkages, used in certain specialized mechanism designs. Members of the linkage assembly move in prescribed paths constrained by the size of the members and the locations of the joints, and can be expressed mathematically. This design concept can be creatively applied to mechanisms that involve moving parts in two or three-dimensional spaces, to achieve practical or simply “cool” effects. The challenge in four-bar linkage design lies in the determination of the desired spatial movements of the individual members, sizing the members as well as locating the joints, so that the resulting mechanism would not end up in some unexpected awkward configuration if one or more members are inadvertently disturbed.

Laser-cut Details

Next, laser-cut details have been added as a part of this group’s box design. Originally, before mid-term evaluations, this group was planning to implement both 3D printing and laser-cut details into the token. However, the group came to a conclusion that 3D printing could ruin the classy look of the token after a number of trials where the 3D printed resin details could not be integrated with the solid wood box structure to achieve a visually pleasant appearance. and has thus decided to remove it. The laser-cut details this group has experimented with feature a scaled portrait of the HCI Clock Tower, as well as the two symbolic trees beside it. After further evaluation, this group also determined that vector cut would produce superior results if the required details emphasize sharp outlines, while raster cut can be added to

achieve a more intricate “layered” or 3D effect. For the sample token produced, no raster cut effect was required.

Plaque

Lastly, this group proposes to have a miniature plaque at the top of the box with the wordings “Hwa Chong Institution” and “华侨中学“ imprinted on it. This group has also decided to include the wording “饮水思源” onto the top of the box to convey the school’s value. The group understands that it is the school who knows who the guest of honour will be is for a certain event, and has thus left the space empty for the school to put its own plaque when needed. This group hopes that this token can be well appreciated by the guest of honour to whom we are giving it to.

Results and Discussion

After two paper prototypes and three stages of prototyping proper, the group has arrived at a final product. Each of the five stages will now be described in detail.

First Paper Prototype

Our original idea for the box was based on the concept of origami applied to mechanical engineering. We were informed by a 2016 article in the Journal of Mechanical Engineering Science entitled “A review of origami applications in mechanical engineering” by Nicholas Turner, Bill Goodwine and Mihir Sen which gave a lot of information on the subject. We felt that it would be a good idea to produce a collapsible box for easy storage and transportability of the box when not in use. Our first paper prototype is shown below (Fig. A and Fig. B).

Fig A. Origami-inspired box when opened.

Fig B. Origami-inspired box when compressed.

Figures A and B show a box folded using origami principles so that it can compress into a flat state for easy storage and transportation when not in use. The lid is standalone and completely detachable. We had intended to make grooves in one side of the lid into which decorative details - either lasercut or 3D printed - would be inserted. We later scrapped the idea of a compressible box because we wanted to focus on lasercutting and/or 3D printing. We were also not sure if the box would be rigid enough to function without collapsing.

Second Paper Prototype

Our second paper prototype is shown below (Fig. C).

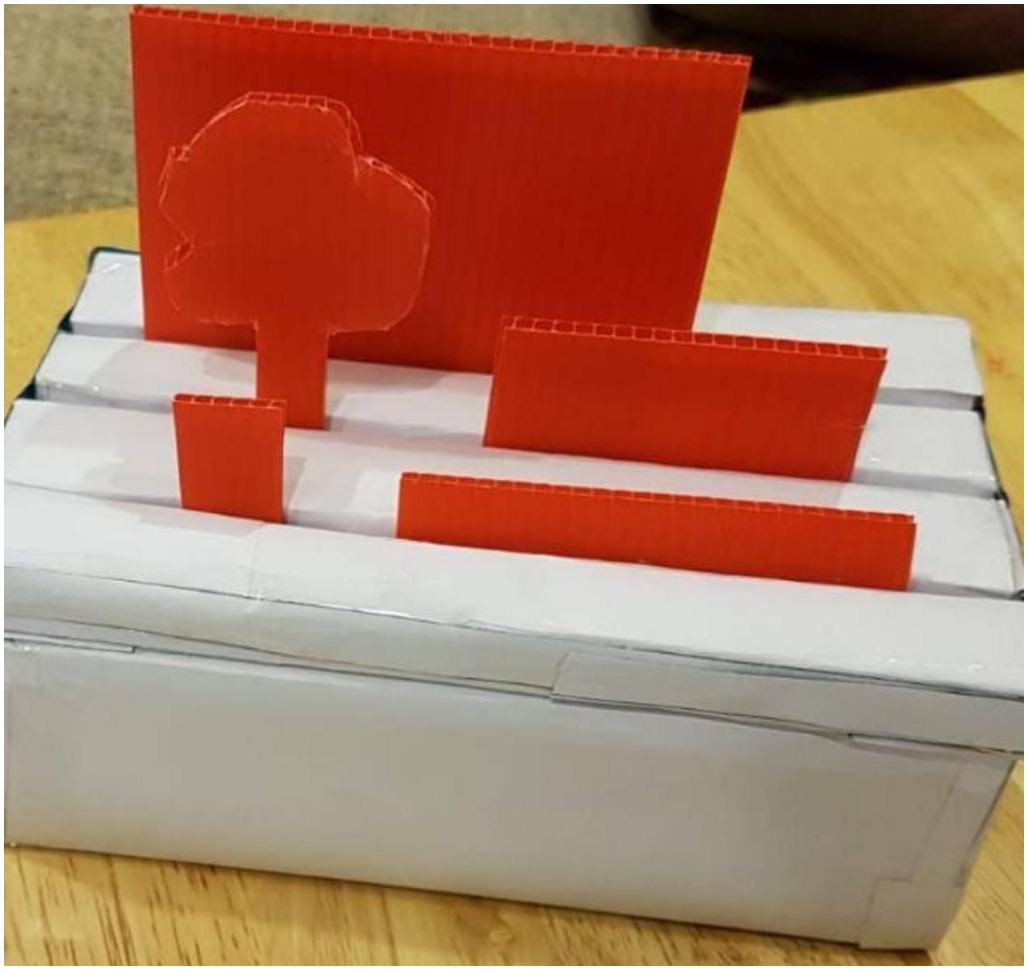

Fig C. Second paper prototype.

The lid of the box is still standalone and completely detachable but the box is now rigid and non-collapsible. The lid is grooved in order to accomodate HCI-themed decorative details. Due to concerns that the decorative details could become detached when the box is in used, we modified our design to incorporate the decorative details onto the sides of the box and to consider other decorative features such as Arduino-powered LED lighting.

First Prototype

The first prototype is shown below (Fig. 1).

Figure 1.1: Cardboard box

This prototype is a cardboard scale model that comes without the envisioned hinges. It was later used as a guide as to the size of the box as the group built later models. The group had many ideas for the first box. It was planned for the laser-cut details to be attached to the top of the box at first, as well as having the Hwa Chong school name engraved on a transparent acrylic that was to be illuminated by red LED lights powered by Arduino. Also, the hinges were meant to be acrylic and the group had the intention of engraving a set of school values on each hinge. However, after some thought, the group decided to abolish the idea. It was also planned to have three panels for the laser-cut or 3D printed details, the clock tower, the trees and the Tan Kah Kee statue. However, after realising that laser-cutting the Kah Kee statue would marr it’s features and that permission was needed from respective parties, we decided to replace it

with some terraces. Lastly, we initially decided to incorporate an actual clock into the box but after receiving negative feedback that it meant sending people to death, we decided against it.

Second Prototype

The second prototype is shown below. (Fig. 2.1)

This prototype was the first one to be made out of wood. It has fully-functioning hinges that have been made out of clear acrylic. (Fig. 2.2 and 2.3)

Fig. 2.2: Opened box

Fig. 2.3: Closed box

The front of the box initially held an LED light. However, this was since removed from the front design as the wiring took up too much space inside the box. (Fig. 2.4)

Fig. 2.4: The LED

Realising that an Arduino board would take up too much space in a compact box, we decided to get rid of it.It was proposed to replace the front of the box with the laser cut or 3D printed details instead, which did not happen as the group decided to build a new box. This change is reflected in the third box. However, we worked on the first prototypes of a laser cut HCI clock tower and 3D printed HCI clock tower. These are shown below (Fig. 2.5).

Fig. 2.5: Our first prototype of the laser cut HCI clock tower appears at the top of the photograph and the first prototypes of the 3D printed HCI clock tower appear at the left and bottom of the photograph.

We used the software TinkerCad and Cura to make the 3D printouts and Inkscape to make the lasercut detail. Design-wise, we had come up with a stylised version of the HCI clock tower. For the lasercut item we confined ourselves to vector cut.

After placing our prototypes against the prototype of the box, we decided that wood on wood looked better. Furthermore, since we were looking to paste the details onto the side of the box, we would not be fully utilizing the potential of TinkerCad, which allows us to build different features into each layer of the computer design.

Based on feedback from our teacher-mentor, we also re-worked our design of the clocktower to make it more life-like. Inkscape permitted the merging of different layers of shapes. However, fundamentally, we found it to be more suitable for producing 2D images unlike TinkerCad, which could make fully 3D models. We decided to stick to a 2D laser cut but experimented with raster

engraving to complement the vector cuts. We had hoped that a combination of vector cuts and raster engraving would add some different dimensions to our decorative feature. We experimented with printing speed and laser strength to get the desired depth of lines and grooves. Our finished product is shown in Fig 2.6 below.

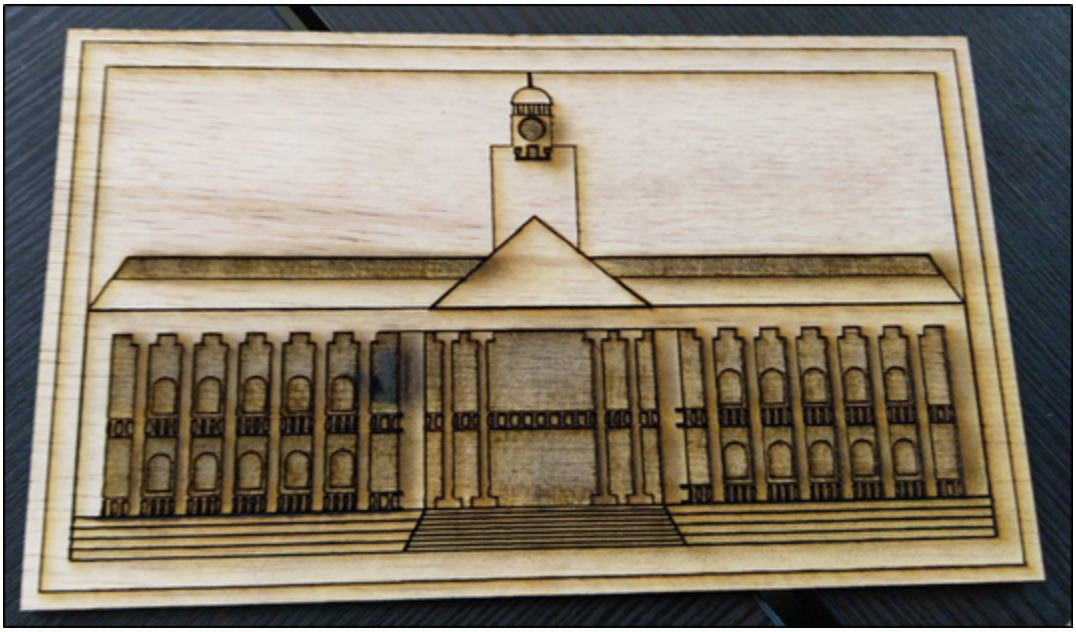

Fig 2.6: Our final laser cut of the HCI clock tower.

Despite working with a printing speed and laser strength which was overall suitable, the wood singed more in some parts than others. We are still reflecting on the course and will experiment further. For now, we hypothesize that wood, being a natural material, has properties which may vary from section to section and some parts are softer /less dense than others, hence the different degrees of singeing.

Third Prototype

This is our third prototype. (Fig. 3.1)

Fig. 3.1: The final box

This prototype is similar to the second prototype. However, finishing works have been done, such as the application of lacquer to the box to make it appear shinier. (Fig. 3.2)

Fig. 3.2: Lacquer applied

The lasercut detail was pasted by the group onto the front of the box. (Fig. 3.3). We had not been sure if it was possible for us to add the HCI logo into our softcopy of the HCI

clocktower due to copyright issues, hence we did not do so. We used a sticker of the logo obtained from the school to adhere to our lasercut detail.

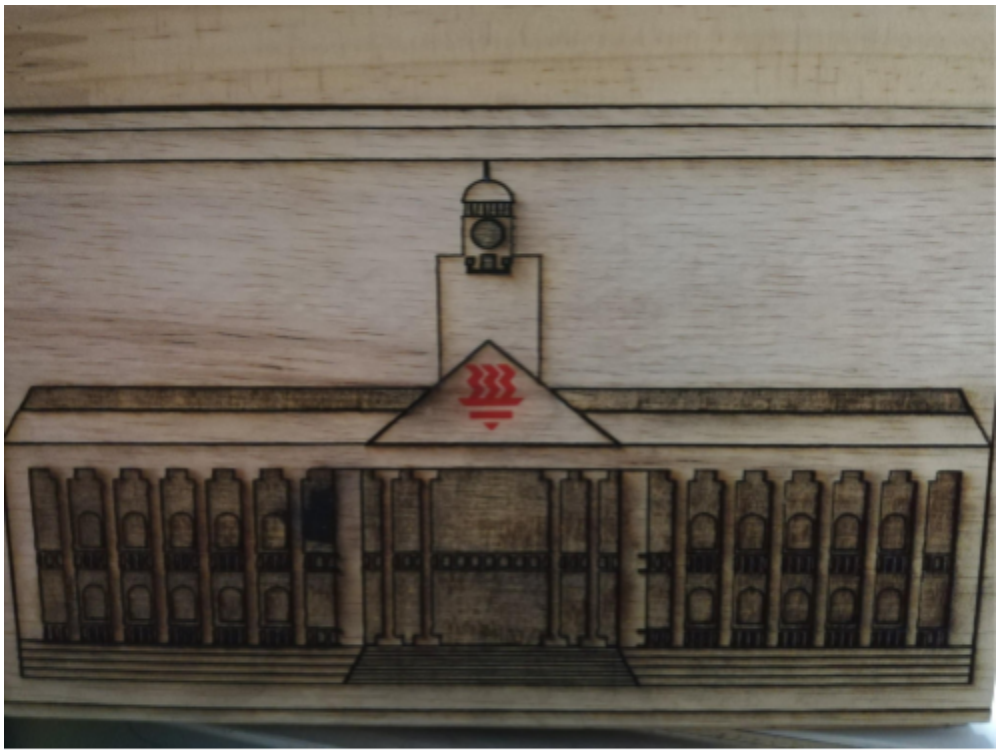

Fig. 3.3: Lasercut design

As for the hinges, it was agreed amongst the group that the previous type of hinge was to be unchanged. The group still used the type of hinge as mentioned under “Proposed solution”, except that the measurements have been made more accurate such that the box would be easier to use. Also, the group decided to change the material to wood as it found out that acrylic could crack easily, especially with the strain the cover exerted on it.

Conclusion

This project has successfully created a unique token for a guest of honour, which incorporates two of the envisioned features, namely the lasercut and the hinges. It has also been made to be presentable to the guest of honour through lacquering.

However, some limitations were the lack of skill on the group members' part, namely in woodworking and lasercut design. This resulted in poor measurement and cutting of the wood, which in turn caused the box to have some gaps in between the wood pieces. In addition, the group was not experienced in lasercut designing. Hence, we may not have selected the appropriate software (or, in the alternative, did not know how to fully utilize our chosen software) to produce a multi-layered or multi-dimensional rendition of the HCI clock tower.

Some future improvements would include looking for more information on lasercut designing or consulting any seniors who have experience in designing lasercut designs. This would allow us to create a box with two or even three layers of lasercut designs.

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