

ECE 480 - Application Note

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Executive Summary

A 3D tactile display has been constructed to display pictures by raising pins to different heights. This application note demonstrates how to create the enclosure for the display which will be supporting and holding together all the parts of the device. The 3D tactile display targets research groups such as the Resource Center for Persons with Disabilities (RCPD) at Michigan state university as well as teachers working with people in need of special assistance.

Introduction

The 3D Refreshable Tactile Display is a technology not yet found in the market, therefore, Design Team 5 decided to come up with such technology. It will display 3D images to assist the blinds in learning graphical shapes found in science books. This Display is intended to be built with a budget of \$500 and be more affordable compared to the refreshable braille technologies available. To create the complete design, each team member worked on different parts of it concurrently. Creating a schematic of a design often times allows one to manufacture a part more precisely. Therefore, the enclosure for this project has been designed using Siemens NX 8.5 software. It will then be manufactured by using the resources of the Machining Engineering labs at Michigan State University.

Technical information

The manufacturing portion of the 3D tactile display enclosure will be based on the various sizes its components. The modeling of the enclosure itself was designed using Siemens NX 8.5. This software allows one to create 3D designs either for 3D printing or illustration purposes. The pin support and locking system of the display will be mounted of top of the box since they are the parts that will mainly be in contact with the end-user. The width and length of the box will accommodate the X-Y movable axis that is used to move the different servo motors under each pin. Additionally, the height will be based on

the height of the X-Y axis which are stacked on top of each other, as well as the Z axis that will directly push the pins up. Lastly, there will be slots to hold the Arduino microcontroller and well as the connecting wires. Note that the 3D design modeled in NX does not have accurate sizes as it is used only for illustration purposes. The figures shown below are images of the 3D modeled enclosure.

Procedure

1. **Open** Siemens NX 8.5 located at: Start > All Programs > Siemens NX 8.5 > NX 8.5
2. **Click** on New and **Select** Model.
3. **Name** your part and **Select** the folder path you want to save your part in.
4. **Click** Ok to go to the new blank file you just created.

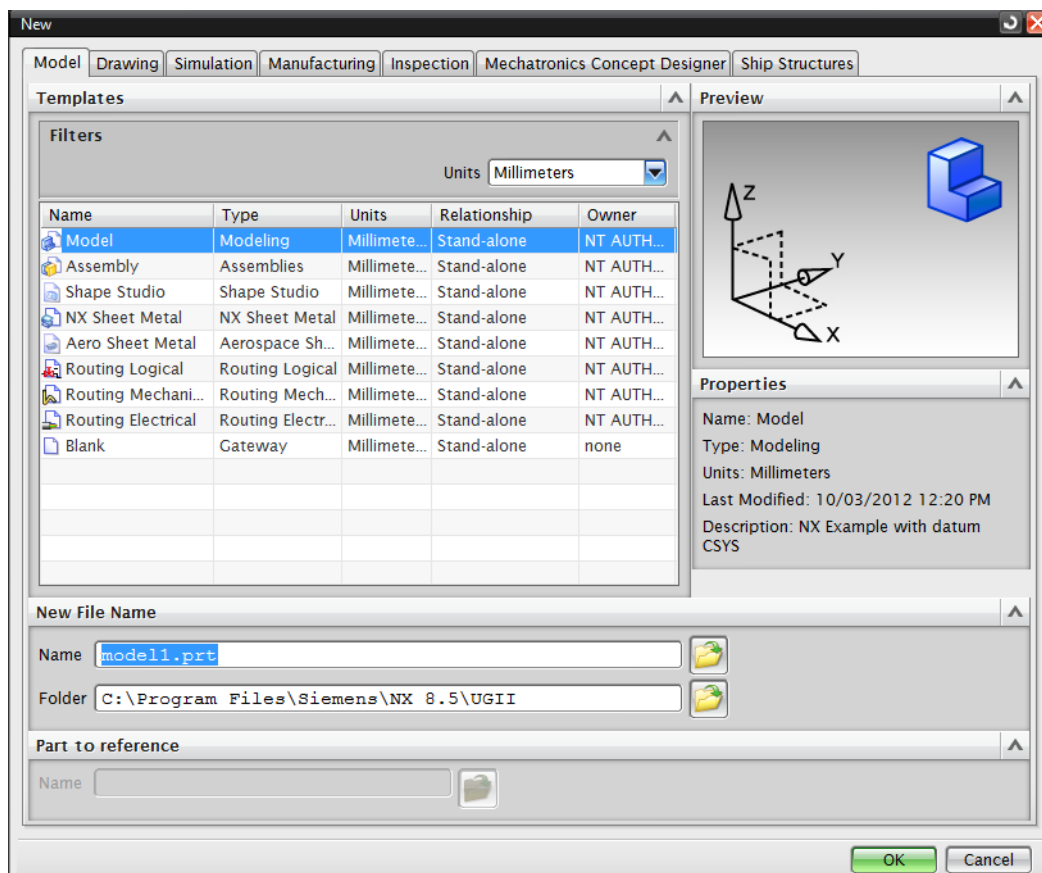


Figure 1: Siemens NX 8.5

- On the quick toolbar button at the top of the window, **Select** Extrude to start designing a shape. **Select** your plane coordinates and **Click** on the shape desired, in this case, a rectangle. **Click** on Finish Sketch to add depth in on the design.

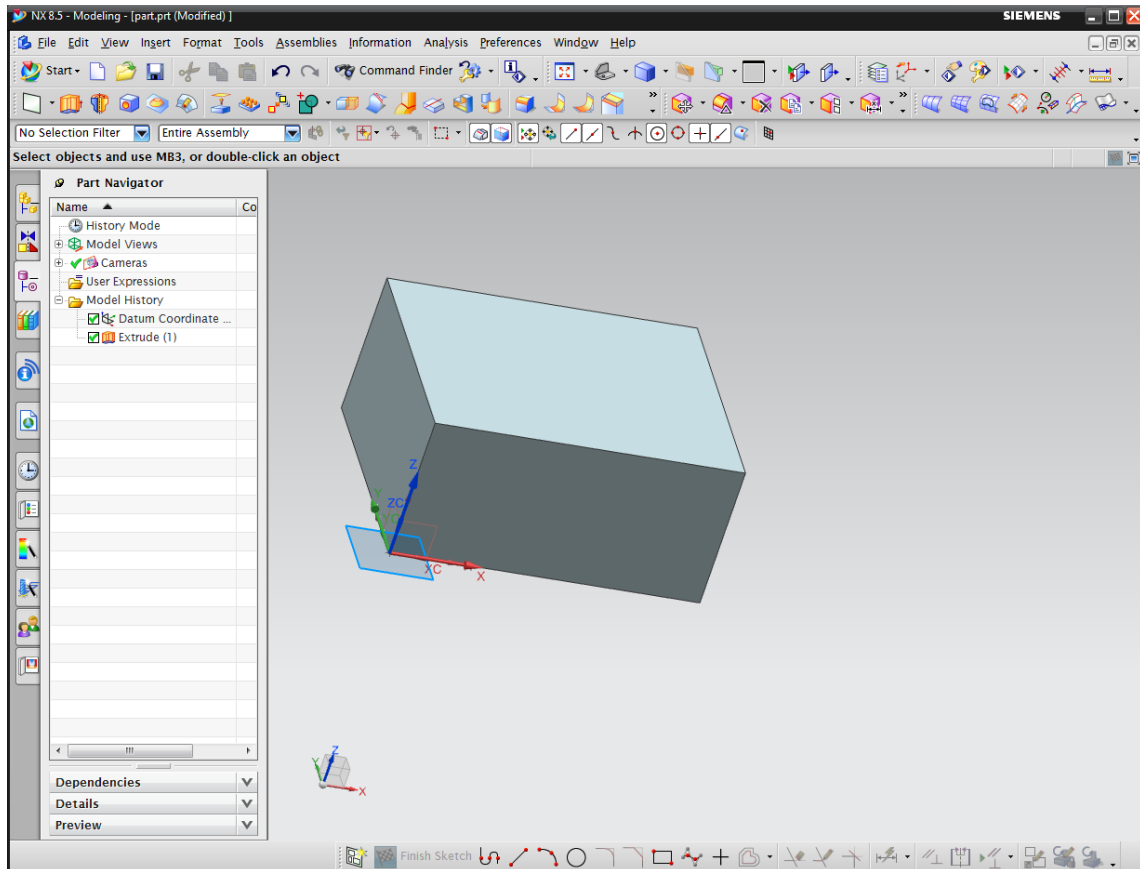


Figure 2: Siemens NX 8.5 (Step 5)

- To make the edges round, **Click** on Face Blend, **Select** the edge desired. Under edge to Blend, input the radius of the bending and **Click** OK to apply the changes. Repeat this process for all other edges you wish to bend.
- To create a shell from the box by getting rid of the extra volume, **Click** on Shell and enter the thickness of your shell. In this case, the thickness will be around 2 mm to replicate a sheet of metal.

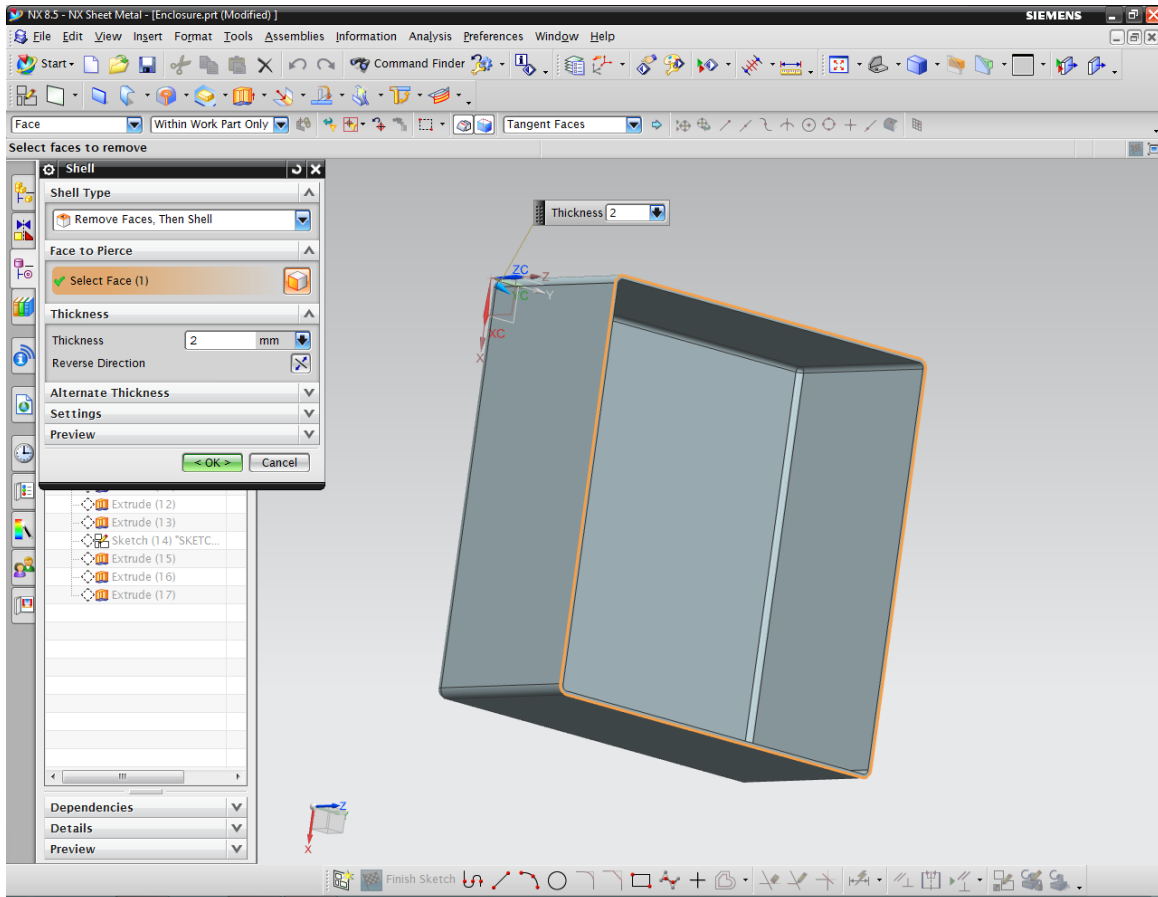


Figure 2: Siemens NX 8.5 (Step 6 and 7)

8. To create a rectangular gap, **Click** Extrude, **Select** the side of the rectangle you wish to add it on. In our case, the rectangle is added on the top of the box. This space will be used as an opening for the pin support and locking mechanism. It is important to make the thickness of the rectangle being added, greater than the shell to create that gap. To do so, under limits, **Input** thickness in the distance text box. Under Boolean, on the dropdown, **Select** Subtract. That will subtract the shape from the plane it was placed on. **Click** Ok to apply changes.

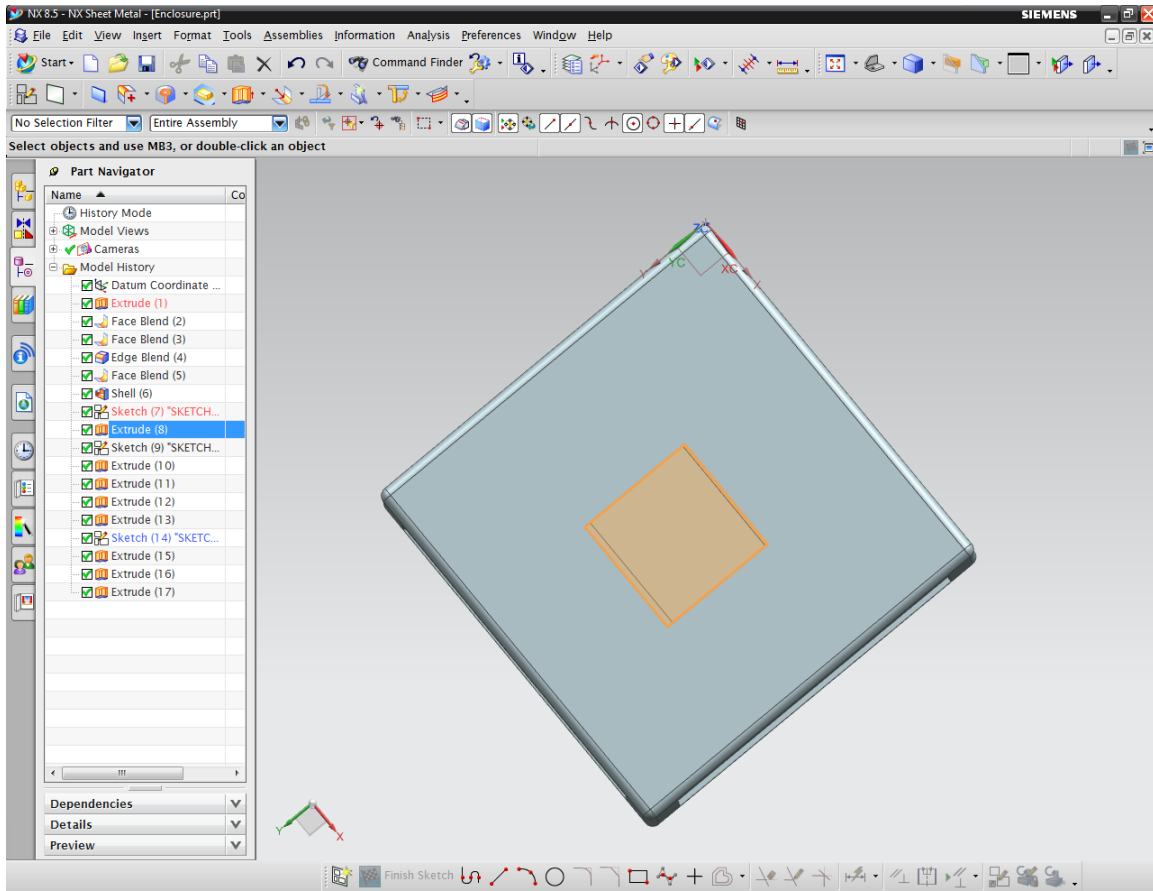


Figure 3: Siemens NX 8.5 (Step 8)

9. Moreover, the other 4 symmetrical sides will be transparent plastic to show what is happening inside of the device. **Repeat** Step 8 to create the rectangular gaps. Note that the dimensions of the gaps are larger than Step 8. Ideally, the distance between the corners bordering the gaps, and the gaps should be one inch to be able to screw the plastic to the box. Make sure everything is properly centered.

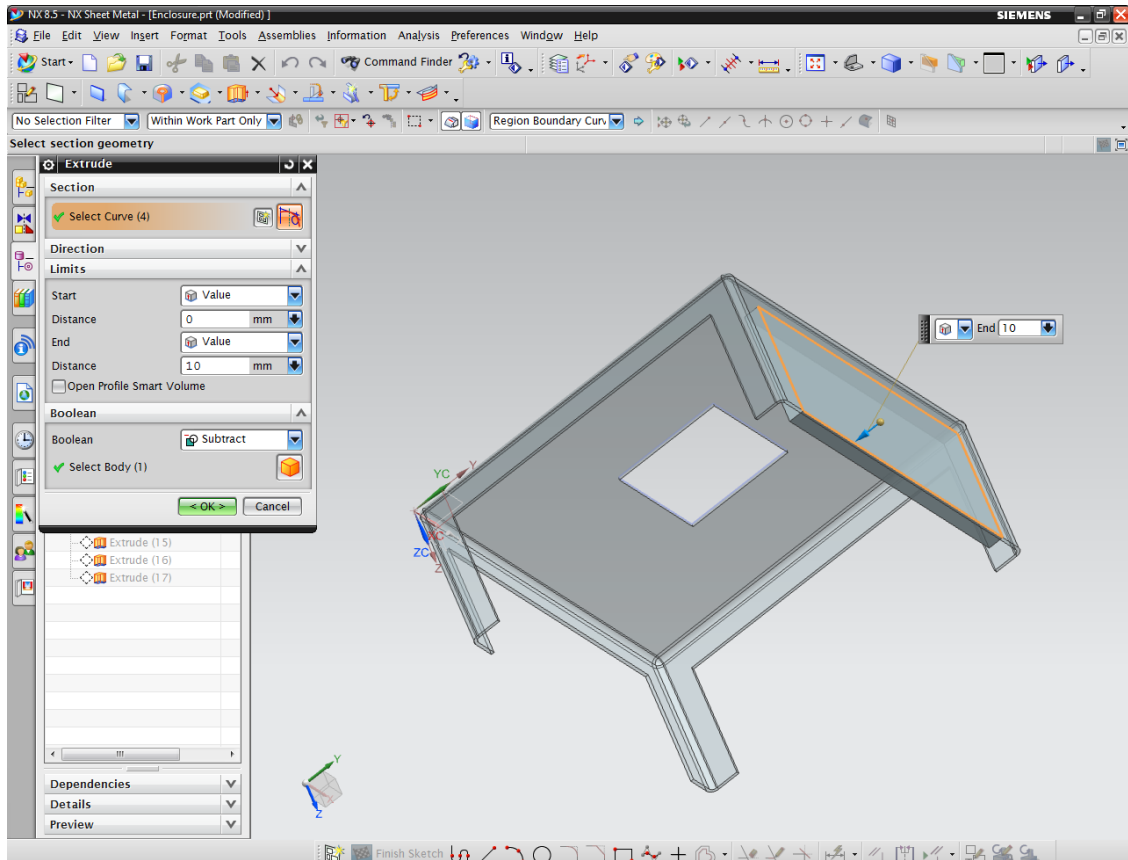


Figure 4: Siemens NX 8.5 (Step 9)

10. To create the base, **Click** Extrude and **Click** the Line feature. It is difficult to create a plane when the sides are blended. In this case, **Select** a straight side on the bottom of the bended comers and draw lines that connect the neighboring blended side. For the round edge of the blended side, **Select** the Arc feature and align the arc you are creating with the round edge of the corner. It should automatically set the radiuses equal to each other. Now that the frame of the base is created, **Click** Finish Sketch to add depth to the base. Lastly, make sure that the thickness of the base is consistent with the rest of the box (2 mm).

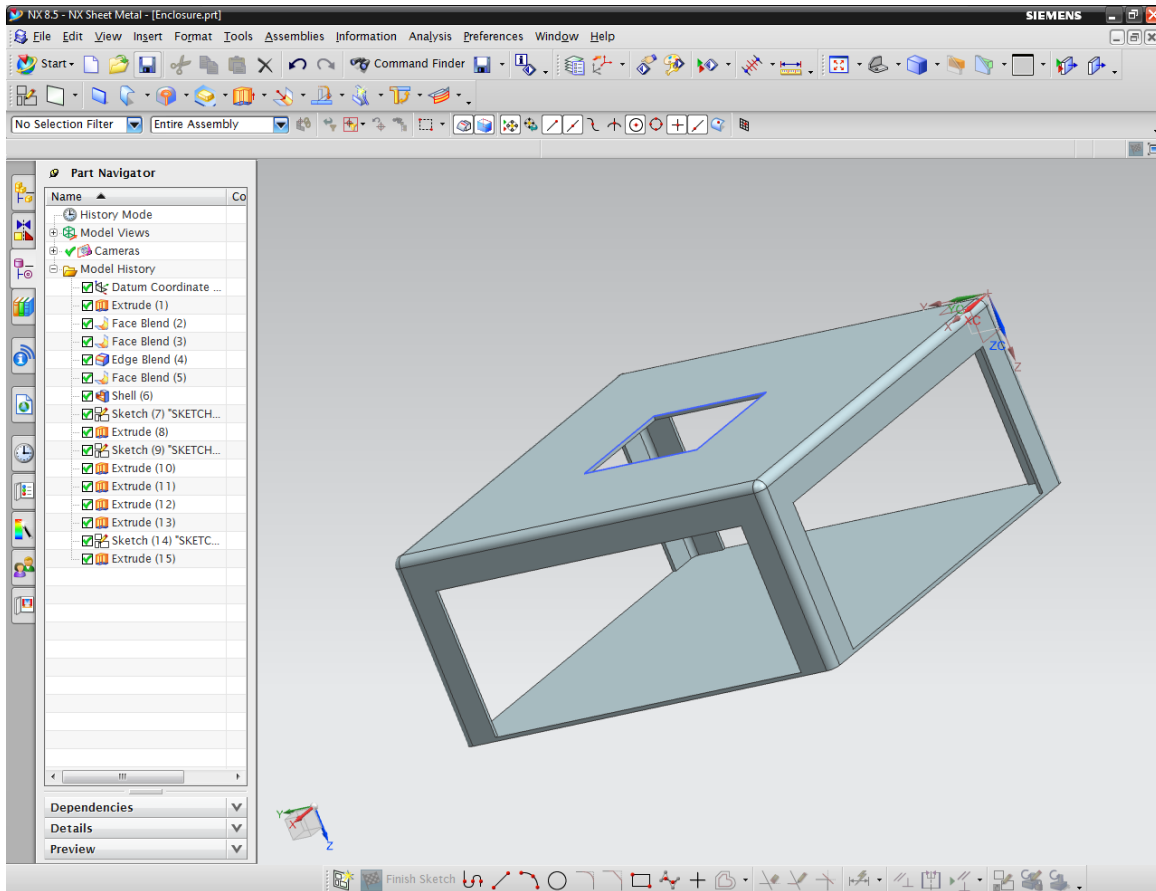


Figure 5: Picture of the enclosure with base (Step 10)

Michael Wang and I jointly worked on this part of the project as we came up with the concept of the support and locking mechanism. One of the most important part of working in a team is that the knowledge team members have were shared, therefore I was able to learn how to use NX as some of us took courses related to 3D designing. Additionally, making sure that the concepts suggested are actually feasible and implementable strongly made in impact in choosing the right design.

Conclusion

This application note shows how to design several parts of the 3D Tactile Display using the Siemens NX 8.5 design tool. The pin support and locking mechanism are 3D printed using the resources of the College of Engineering at Michigan State University. The enclosure for the whole design was modeled using Siemens NX 8.5, however, will be built from scratch in the Machining Engineering labs. It is important to mention that this display technology is not currently commercialized.

References

- ECE 480 - Team 5 Proposal presentation
- ECE 480 - Progress Report
- <http://nxtutorials.com/>
- youtube.com