Hackathon Problem Statement: Obfuscating the design with security features
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Brainstorming Process:

      After having just gone over the problem statements together in the zoom meeting, we ultimately decided it was problem statement 1 that we were going to mainly focus on completing. Since all of us were new to Hackathon and are still undergraduate students who don't really have that much experience yet in terms of skill set in programming or design, we thought that problem statement 1 was the most understandable to us in that it was just more so like solving a puzzle. Thus, we chose to work on problem statement 1.

      Originally, we opened the STL file with Paint 3D since that was the default software in which our computers used. However, on Paint 3D we are not able to have the option to see inside the cube, so we would have to use some other software to open it. We decided to install Fusion 360 and use Solidworks for our analysis of the cube.

      We then brainstormed different ideas as to where on the given dice in the STL file we could potentially start working on. As a group, we decided it was most logical to start solving for the die face that correlated with the initial hints given to us in the problem in which Face C has a value of 6 in addition to the quote given to us. After solving for C and 6, we thought it was most logical to move on to solving for Face B since a quote was given to us here as well. Because quotes were given to us, we decided to look into them more in conducting our own Google searches to see if we could interpret the clue even more. We found that the quote regarding Face B was a quote stated by Winston Churchill and we thought the second quote was by Sam Keen, but overall nothing much for the quote for Face C.

      In addition to the main task of solving the face values and letters, a bonus problem was given to us, stating that the problem was to be located inside the dice cube. It's stated to be that a QR code would show up inside the dice cube when the viewing orientation is positioned in a certain way for us to be able to scan it with our phones. Not knowing how to go about it initially, we just brainstormed different view orientations of the dice cube to see if a QR code would show up by just slowly rotating the dice in a way where we could potentially see any sort of resemblance of a QR code.

      In the beginning, we were able to notice the bonus task right away and so instead of traditionally working on the faces of die first, we first primarily focused on finding the QR code since we had more of an idea as to where to look for it in contrast to blindly looking for the clues on the die. Therefore, since the bonus task was the first part that we noticed, we assumed that how we approach the problem statement would be through the problem statement first instead.

Summary of Different Attempts:

      Throughout our process of trying to solve for the faces of the die, we had many different attempts in coming up with the answers that we did. As stated in our brainstorming, we stated that we were to first solve for Face C and B due to the initial clues given to us and were able to narrow our answers down pretty confidently in contrast to the other answers we gave for the other faces of the die.
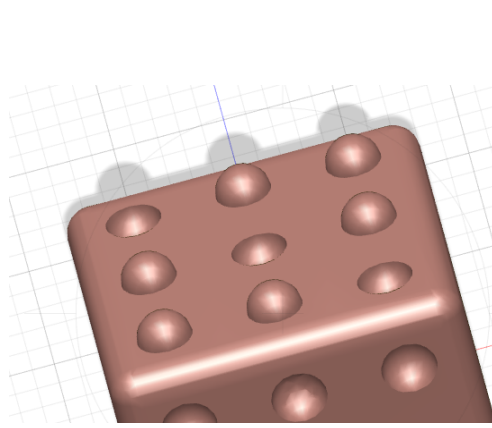
Face B
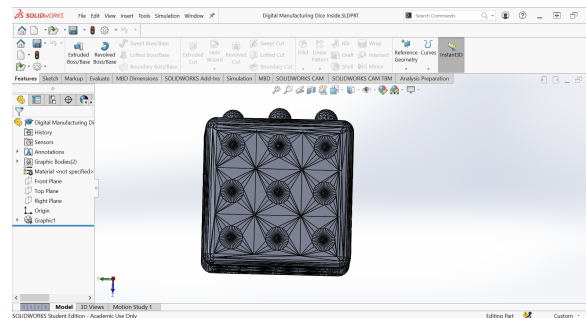
Face C

As shown above, these are the faces we concluded to be Face B and C. We determined that Face C quote was:

> "The best practice is to follow the advice posted on every railroad crossing. Stop to look at both sides."

When reading this quote we noticed that one of the sides of the cubes was flat with two closed semi circles pushed inwards. We believe this quote was the perfect clue for this side, on the surface the side looks flat but taking the advice posed on the railroad crossing we remembered to look at both sides. We originally thought that the side C should be associated with the number 2 due to the fact that there were 2 insides semi circles, but it was already given to us that the side C was associated with the number 6.

After C we thought the best strategy would be to solve puzzle side B because this would start to help us with the orientation of our problem. Originally we saw the side with the 3 imprints of the semicircles on the surface, and 6 semi circles bulging out. The quote given for B was:

> "Mountaintops inspire leaders, but valleys mature them"

The quote was pointing out that there are mountains and valleys, so we hypothesized the bulge could be a reference to the mountains and the craters where the valley. After doing this, we saw that the three valleys can be the reference to the point "valleys" mature, meaning the number of valleys will be a true reference to how many a leader becomes a leader. So we made the conclusion it would make sense for side B to be associated with the number 3.

After figuring out the face values and letters for both B and C, we then moved onto our many attempts in trying to solve for the other sides of the die, including face letters of A, D, E,

and F and face values of 1, 2, 4, and 5 left. From here we faced many challenges in our attempts and in the end we determined our answers by using the process of elimination and educated guessing. We are able to identify the rest of the face letters on the dice due to the dice layout given to us in the problem statement. For instance, since we were able to solve for Face B and C, we know now that Face A will be to the left of Face C and Face E would be to the right of it, etc.
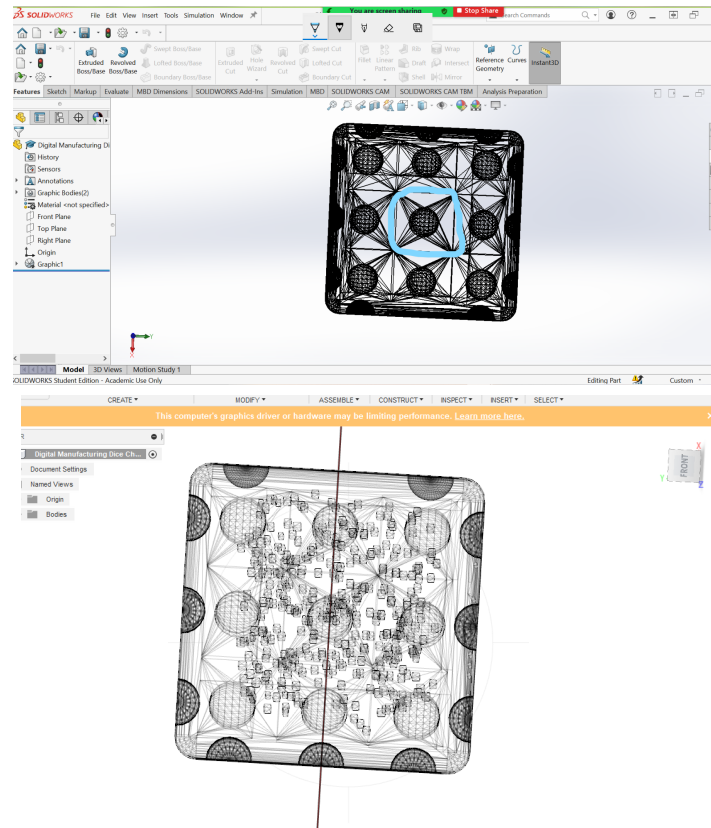

Face D

For Face D, we concluded that the face value for it would be 1. We have two main reasons for coming up with this conclusion. The first reason is that we are able to see that when we display the dice in which the hidden lines are made visible, we are able to see the overlapping lines of Face D with the opposite side of Face B. There, since the middle square is the only square that overlaps perfectly with the contrasting side of the dice, we assume that the Face D is to only have a value of 1. We assume that the other squares that are not overlapping correctly with the other side and the lines don't match up correctly, we consider those squares to be extraneous.
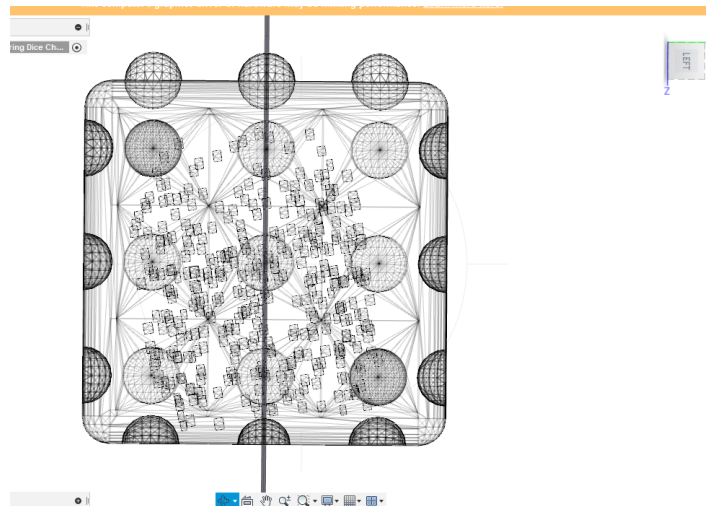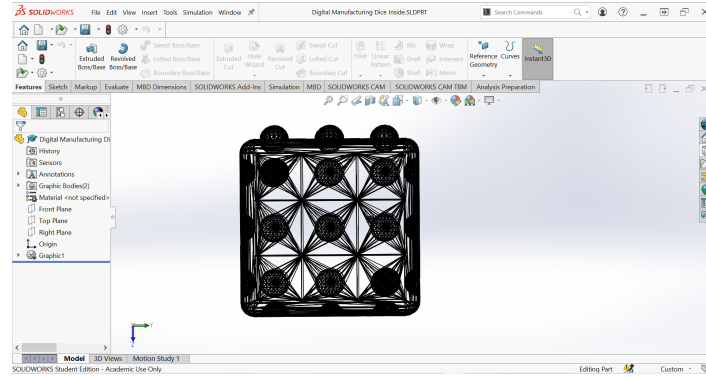
Face F

For problem F we looked at the drawing and saw it was very similar to the side of C, that a similar pattern of dark emphasis on the 2 inner circles appeared again. The rest of the side remains the exact same from side C. One of the things we noticed was the prominence of the 2 internal indentations. Similarly to our reasoning for Face D, we concluded that Face F would have a value of 2 because of the overlapping lines it has with Face C.
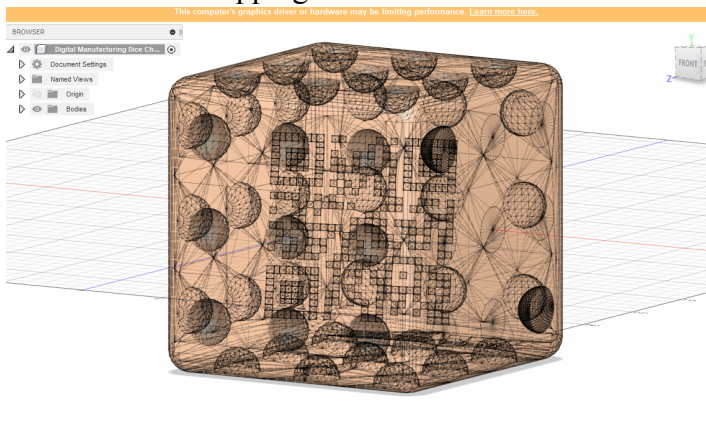
QR Code with Background Noise
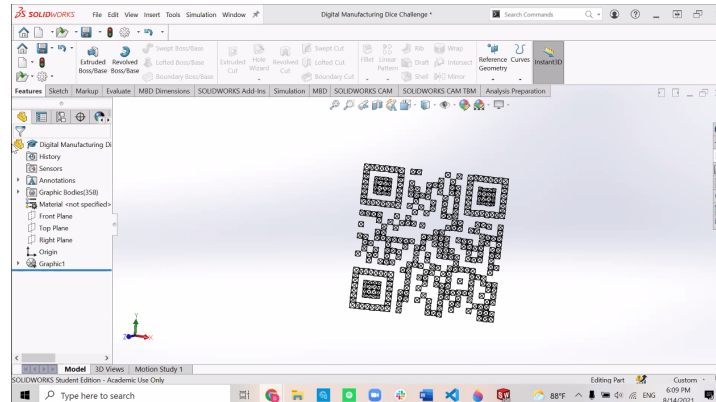
Bonus QR Code Task
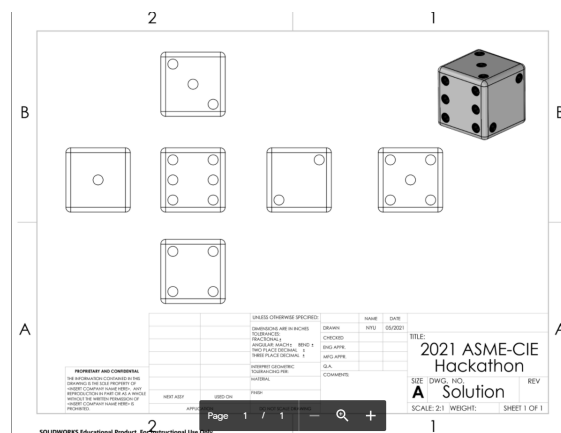
PDF File Unlocked

For the bonus task of this problem statement, we were able to figure out the view orientation and found the correct way to orient the figure in order to display the QR code. We found the correct orientation by slowly rotating the dice and seeing any sort of resemblance of the QR code show up. We know a QR code is a square shape with four corners and having three squares on the top left, right, and bottom left, so when we rotate the dice with the hidden lines visible, we were able to see the resemblance of the QR code. We then took the outside layer of the dice faces away in which we can then scan the QR code which brought us to a Google Drive with a PDF file inside. The PDF file requires a password to unlock it and we managed to figure out the password to it by figuring out an algorithm that helps us unlock the PDF file. We then had the coded program run all night for us in which the next day (Sunday) we were able to get the password and unlock it. The password to the PDF file is "meiche" in which we were able to see the answer key of all the die faces as shown above.

As described above, since we were able to solve the bonus task, the PDF opened up to the solution key for all the dice faces and therefore we corrected the errors we had in our previous attempts.

Challenges We Faced:

Throughout our long journey of solving this Hackathon problem, we faced many challenges along the way. Firstly, the main problem that caused most of our problems was our

lack of experience and also our lack of knowledge in the topic areas prevalent in this Hackathon. None of us were too familiar with CAD, and we initially had to ask Gary for help in opening the STL file because we weren't sure what software we needed to use it for. Our lack of experience and knowledge can also be attributed to the difficulty we faced in approaching the problems because a lot of the times we just had no idea or basic understanding as to where we could look for any of the clues on the surfaces of the die. For the most part throughout the Hackathon, we would notice some things on the surface of the cube that appeared to be different and we would try our best in coming up with a decision towards what Face letter or number it is. However, we wouldn't necessarily have a solidified scientific reason as to why we came up with our answer, but would only point it out. An example of this would be that we would notice a minor difference between the sides of the cube such as on Face F where there appears to be a tiny scratch on the surface. Another example is that with the cubes located inside of the die, there appears to be a cube that was labeled as "open" instead of closed, and we had no way of knowing if it was a clue or not. Another challenge we faced was the time differences each of us had with each other. Since Daniel is from Texas, Bhairav being from India, and Gursharan being from Arizona, the time differences were difficult to compromise. Since Bhairav is all the way across the planet, when we are to work on the Hackathon together he would have to stay up very late in order to work on it with us.

Table of Die Face Values:

Die Face Letter	Die Face Value/Number
A	1
B	3
C	6
D	4
E	2
F	5

Conclusion:

All in all, this Hackathon experience has been really fun and was definitely a learning experience that we would never forget. Despite the struggles we had and the confusion we had with the problem statement, we were really able to learn so much not only about cybersecurity and the prevalence it has in our world, but this Hackathon overall has benefited our problem solving skills when we approach difficult problems. Even though our methodology in coming up with the answers were a bit unorthodox and not necessarily the correct way in determining those answers, I believe that the way we approached the we eventually solved it was unique.