Discover Mechanical Engineering
Project Instructions

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1 Safety

1. Watch the following safety video on how to properly use a utility knife
2. Review the guidelines in the following document

2 Cardboard Cut-outs

1. Go to the Github repository and download and extract the .zip file into any folder in your computer

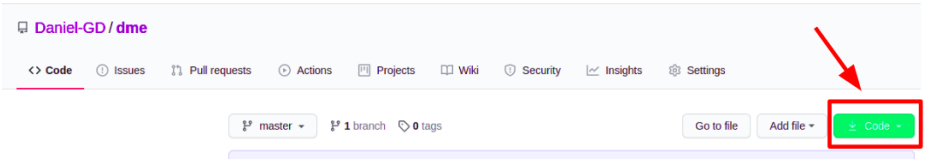

Figure 1: Click the download zip button

2. Go into the extracted `dme-master/Cardboard_Cutouts` folder. You can either print out the template .pdfs which are 1:1 scaled to directly cut out the parts. If you do not have access to a printer you can open the part drawings on your computer to manually create the dimensions on your cardboard.
   (a) (Printer method): Place your printed cardboard cutout templates over the 10"x10" cardboard sheets. (This simplifies the dimensioning/cutting process) Secure paper templates over cardboard with tape. Use the recommended part arrangements pictured below. Be sure to pay attention to the direction of the corrugated cardboard grain direction when laying out the components. This is very important to the structural integrity of your housing.

(b) (Dimension drawings method): Open the .pdf part drawing files in the "Drawings" folder inside the "Sanitizer Dispenser" folder. Trace out each part onto the cardboard using the dimensions provided in the drawings. Use the recommended part arrangements pictured below for efficiently packing your pieces onto the cardboard. Be sure to pay attention to the direction of the corrugated cardboard grain direction when laying out the components. This is very important to the structural integrity of your housing.

Number/Label your parts as you are cutting and tracing them

3. Cardboard Sheet 1: Parts 1,9 and 10

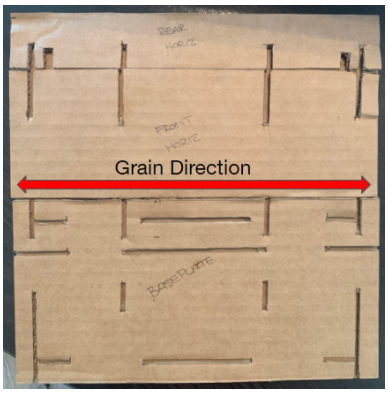

Figure 2: Sheet 1

4. Cardboard Sheet 2: Parts 2,3 and 4

Figure 3: Sheet 2

5. Cardboard Cutout 3: Parts 5,6,7 and 8

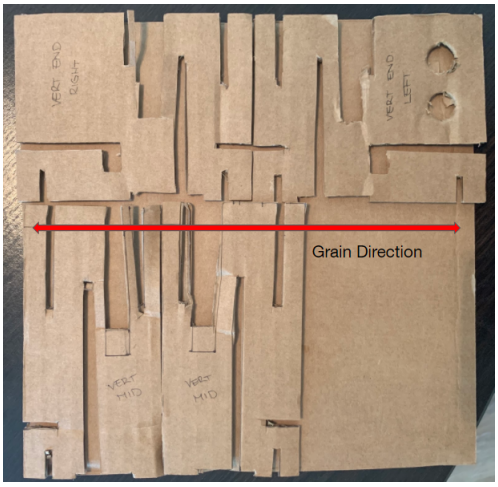

Figure 4: Sheet 3
Note: Use the grain dictated by the arrow, not the cardboard.

6. Cardboard Sheet 4: Parts 11 and 12

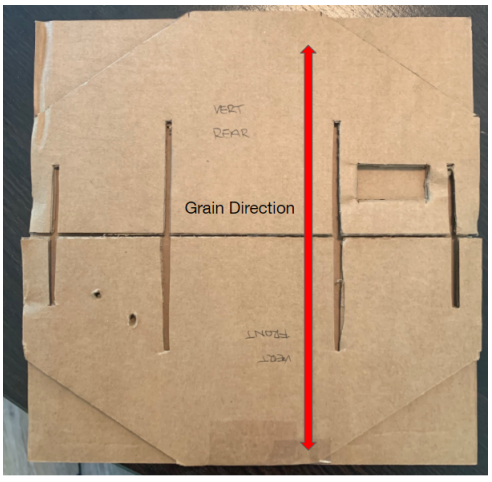

Figure 5: Sheet 4

3 Connecting the electronics

1. For this section, you're going to need the following components:
   - Arduino Uno
   - Ultrasonic Sensor
   - Arduino usb cable
   - Breadboard wires
   - 9V Battery and adapter

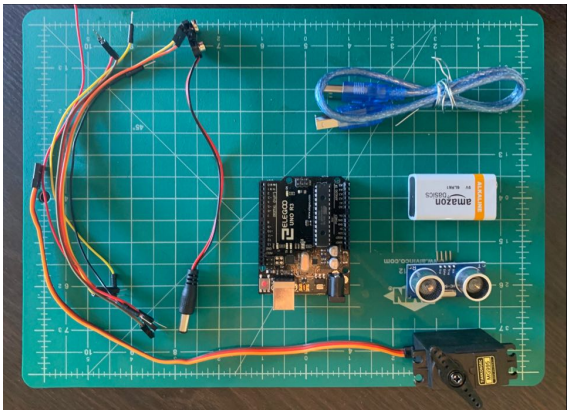

Figure 6: Electronics needed for the project

2. Connect the following components according to the following diagram. *Note: Don't connect the 9v battery or Arduino usb cable yet. Use the black servo in the separate plastic packaging.*

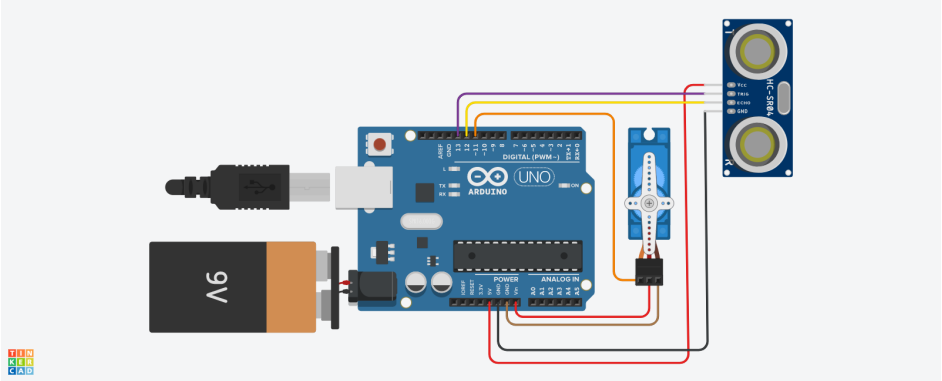

Figure 7: Arduino Circuit Diagram

4 Testing the Hardware

1. Download and Install Arduino IDE in your respective OS if you haven't done so already.

2. Go into `dme-master/HandSanitizer` and open `HandSanitizer.ino` with the Arduino IDE

3. Connect the Arduino Uno to your computer using the usb cable

4. Go to `Tools/Board` in Arduino IDE and select Arduino Uno or Genuino Uno.

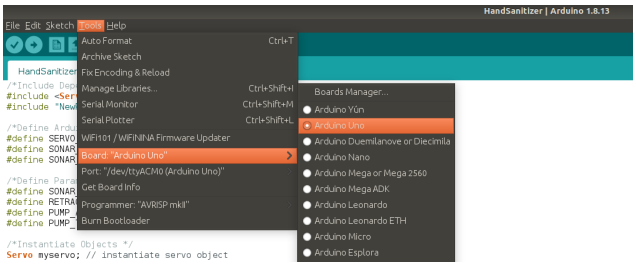

Figure 8: Select Arduino Uno Board

5. Go to `Tools/Port` in Arduino IDE and select Arduino Uno, COM Port X, or other Mac option

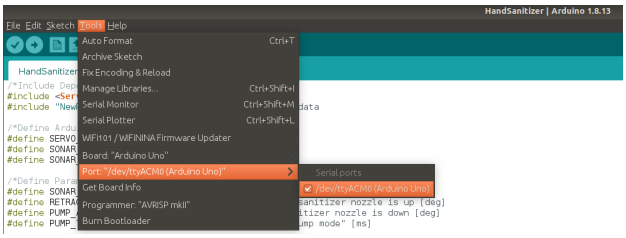

Figure 9: Select appropriate Port

6. Press `Ctrl+u` or click the upload button on the top left to send the code to the arduino. You may get some initial errors, most of the time this should be fixed by pressing upload again.

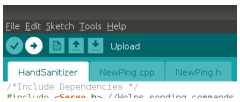

Figure 10: Click the upload button.

7. Verify that when you place an object near the ultrasonic, the servo is actuated. You can verify what the ultrasonic is reading by clicking on the serial monitor button on the top right or pressing `Shift+Ctrl+M`

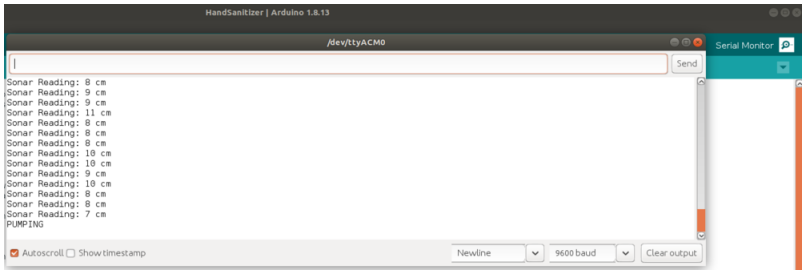

Figure 11: Serial Monitor Output for debugging

5 Assembly

1. You will begin assembling the cardboard components. No fasteners are required, everything is held together via friction fits.

2. Locate your baseplate[Part 1] and insert the two vertical supports [Parts 2 3] as shown in the following image

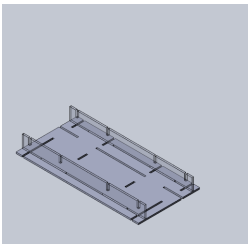

Figure 12: Insert the vertical supports to the baseplate

3. Insert "Vert Mid Thru" [Part 4] into the baseplate[Part 1]

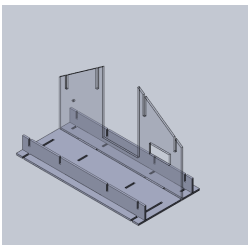

Figure 13: Insert Vert Mid Thru into the baseplate

4. Verify that the ultrasonic sensor press fits nicely into "Vert End Left" [Part 5]. You might need to make the hole slightly bigger

5. Insert "Vert End Left" [Part 5] into the baseplate

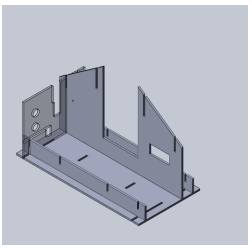

Figure 14: Insert Vert End Left into the baseplate

6. Insert "Vert End Right" [Part 6] into the baseplate

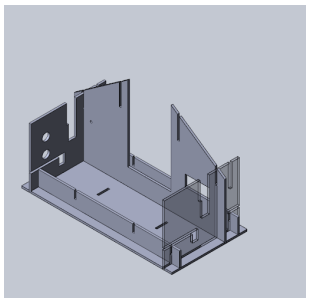

Figure 15: Insert Vert End Right into the baseplate

7. Insert the "Vert Inboards" [Part 78] into the baseplate

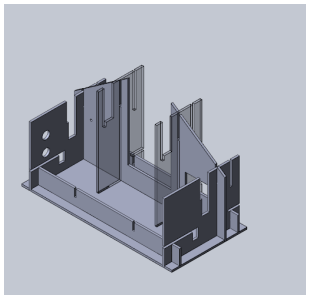

Figure 16: Insert both Vert Inboards into the baseplate

8. Place the arduino in center front, between Vert Inboard pieces. Route the cables from the ultrasonic (orange), servo (red) and battery adapter(blue) as shown in the picture

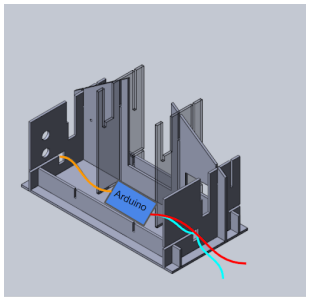

Figure 17: Place the arduino and route the cables appropiately

9. Gently cover all the electronics with the "Horiz Front"[Part 9]. Ensure all the wires are connected and tucked below

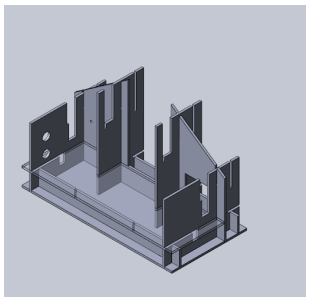

Figure 18: Cover all the electronics with the Horiz Front part

10. Insert "Horiz Rear"[Part 10] on the back of the assembly.

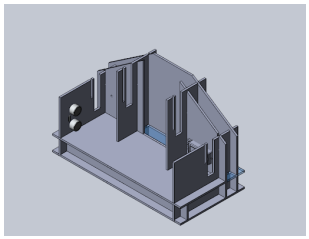

Figure 19: Insert Horiz Rear on the back of the assembly

11. Insert "Vert Rear"[Part 11] on the back of the assembly.

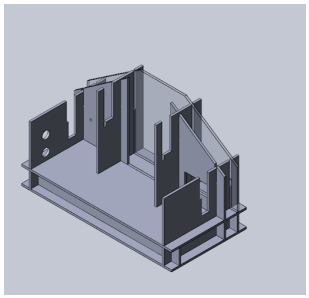

Figure 20: Insert Vert Rear on the back of the assembly

12. Attach servo horn to servo. Rotate servo counterclockwise until servo stops. Remove and replace servo horn to match the orientation of the image below. (About 45 degree left of vertical) When the servo horn is in the proper position, use multitool to screw it down

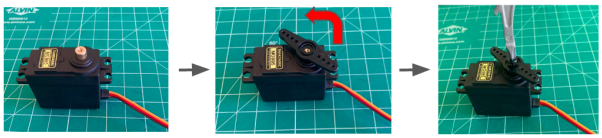

Figure 21: Attach the servo horn and screw it down as shown in the image

13. Attach the steel wire to the most vertical hole on the servo horn. Be sure to wrap the wire securely and tightly so it will not detach. See below:

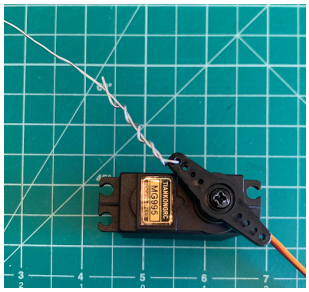

Figure 22: Attach the wire to the servo horn

14. Push Servo through "Vert Mid-Thru" and "Vert Rear" [Part 4 11]. Make sure the servo wire in the back of the servo clears the Vert Rear cardboard and exits out of the back of the assembly.(You may have to insert the servo at a slight angle to clear the wire.)

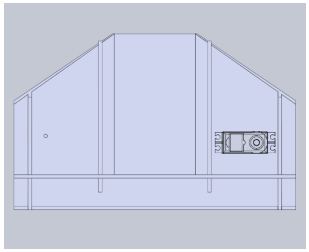

Figure 23: Push servo into the assembly

15. Route the servo wire through the back opening of "Vert Rear" [Part 11], then pull wire through lower cutout on Vert Mid Thru [Part 4] to connect wires in arduino area.

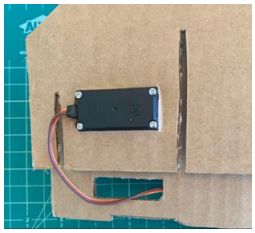

Figure 24: Route the servo wires

16. Push the 4 small servo mounting screws (located in the bag with Servo horns) through Vert Mid Thru cardboard piece.

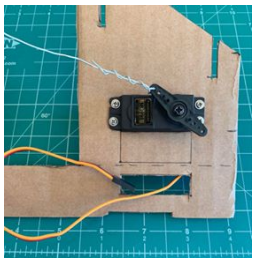

Figure 25: Push the servo mounting screws into the cardboard

17. Slide "Vert Front" [Part 12] into the assembly.

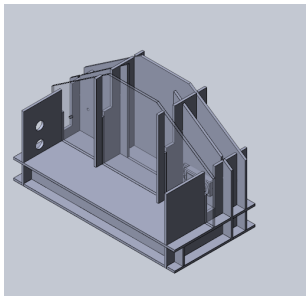

Figure 26: Slide Vert Front into the assembly

18. Push the wood screw through "Vert Front" and "Vert Mid Thru" [Parts 12 4] in approximate location shown below.

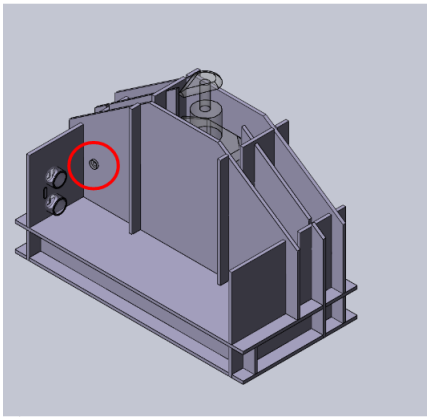

Figure 27: Push the wood screw at the indicated approximate location

19. Notch the top of the hand sanitizer using your large snap blade. Make sure the pump top is fully depressed and screw into the base. Slowly and very carefully notch pump top while it is upside as shown above. Make your notches in line with the pump– do this incrementally, gradually removing more material with your blade.
Note: Be careful not to extend the notches too far inward or you will cause a leak in the hand sanitizer!

Figure 28: Notch the hand sanitizer bottle to route wire

20. Insert the hand sanitizer pump. Pull wire from servo over the top of the sanitizer pump, fitting in the slots on the hand sanitizer cut in the previous step. Pull wire down, ensuring tautness and wrap around the tension screw. (When you secure the wire around the screw, the tension should be enough to just start pushing the sanitizer pump down with any extra force)

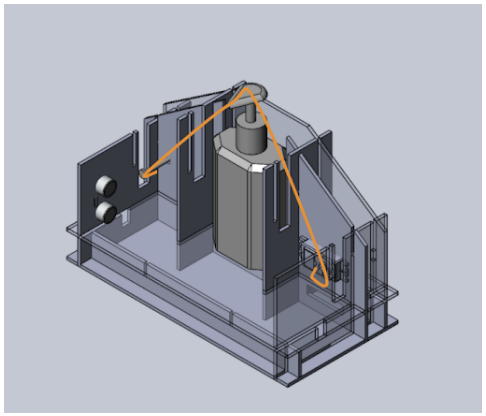

Figure 29: Route wire through hand sanitizer pump and wrap it around the screw

21. Voila! Now off to troubleshooting with the mentors