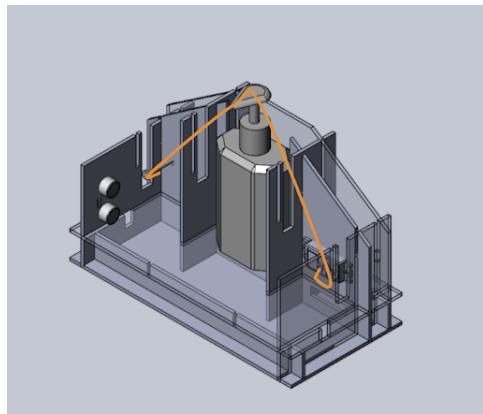


# Discover Mechanical Engineering

## Project Instructions

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## Contents

<b>1 Safety</b>	<b>2</b>
1.1 How to use the utility knife . . . . .	2
1.2 Safety Tips . . . . .	3
1.3 What do do in case of an injury . . . . .	4
1.4 References . . . . .	4
<b>2 Cardboard Cut-outs</b>	<b>5</b>
<b>3 Electronics</b>	<b>8</b>
3.1 Connecting the electronics . . . . .	8
3.2 Testing the Hardware . . . . .	9
<b>4 Assembly</b>	<b>11</b>

# 1 Safety

## 1.1 How to use the utility knife

1. Always inspect the tool before using it. The blade must be sharp.
2. If the blade is dull (it's taking multiple passes to cut the cardboard), snap the blade as show in the following pictures

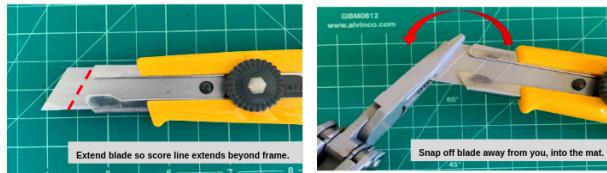


Figure 1: Snapping the blade safely

3. Always cut with the first score line on the blade within the metal rail and with the rotary ratchet locked down.

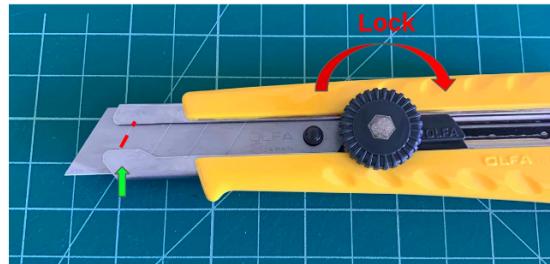


Figure 2: Prepare the utility knife to cut

4. Use the ruling on your cutting mat to align parts and help maintain straight lines marking and cutting.



Figure 3: Align the straight edge with the cutting mat

5. When cutting, track blade down the metal straight edge. Your blade should make a 30-45 degree angle with the material. Apply force evenly on the ruler to prevent movement from the cardboard, and **be mindful of your fingers when cutting!** Cut slowly and firmly, applying even force. You should be able to cut through the cardboard in one pass.



Figure 4: Cut at an 30-45 degree angle and press

## 1.2 Safety Tips

1. Use the knife as it was intended. Don't use it to pry or turn screws.
2. When positioning and using the knife, ensure the cutting path is not in the direction of your body or other hand.
3. Keep the blade covered(retracted) when not in use or when in storage.
4. Discard used blades in an appropriate container.

### 1.3 What do do in case of an injury

1. In case of an injury in your hand/finger:
  - (a) **Clean the wound.** Gently clean the cut by wiping away blood or dirt with little water and diluted antibacterial liquid soap.
  - (b) **Treat with antibiotic ointment.** Carefully apply an over-the-counter (OTC) antibiotic cream, such as bacitracin, to minor cuts. If the cut is deep or wide, go to the ER.
  - (c) **Cover the wound.** Cover the cut with an adhesive dressing or other sterile, compressive dressing. Don't wrap the finger too tightly so that blood flow is completely cut off.
  - (d) **Elevate the finger. Try to keep the injured figure above your heart as much as possible until the bleeding stops.**
  - (e) **Apply pressure.** Hold a clean cloth or bandage securely around the finger. Gentle pressure in addition to elevation may be needed to stop the bleeding.
2. When it's recommended to seek **emergency help**:
  - (a) The cut reveals deep layers of skin, subcutaneous fat, or bone.
  - (b) The edges of the cut can't be gently squeezed together because of swelling or the size of the wound.
  - (c) The cut is across a joint, having possibly injured ligaments, tendons, or nerves.
  - (d) The laceration continues to bleed for more than 20 minutes, or it simply won't stop bleeding with elevation and pressure.

### 1.4 References

1. <https://www.youtube.com/watch?v=zM-w5VPW40Y>
2. <https://ehs.yale.edu/sites/default/files/files/utility-knives.pdf>
3. <http://safety.ucanr.edu/files/235577.pdf>
4. <https://www.healthline.com/health/cut-fingerhome-treatment>

## 2 Cardboard Cut-outs

1. Go to the [Github repository](#) and download and extract the .zip file into any folder in your computer

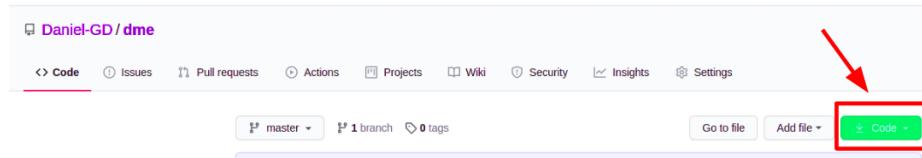


Figure 5: Click the download zip button

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

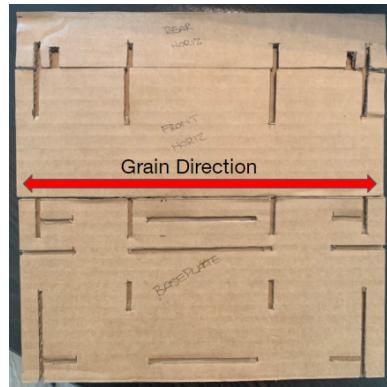


Figure 6: Sheet 1

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

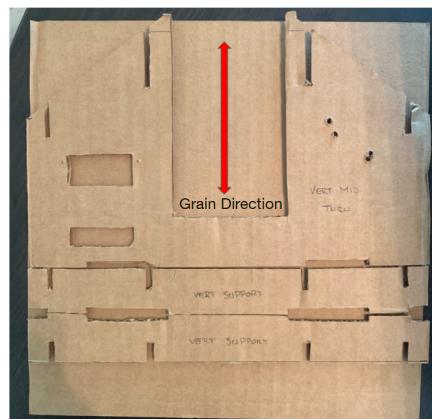


Figure 7: Sheet 2

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

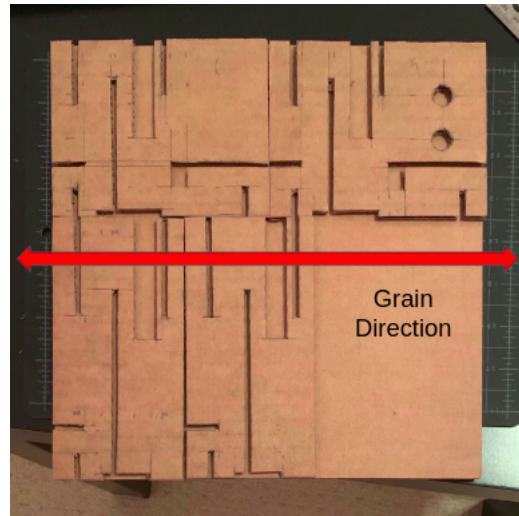


Figure 8: Sheet 3

6. Cardboard Sheet 4: Parts 11 and 12

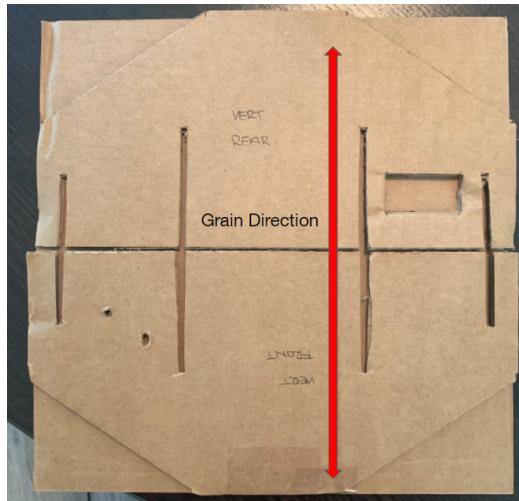


Figure 9: Sheet 4

### 3 Electronics

#### 3.1 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

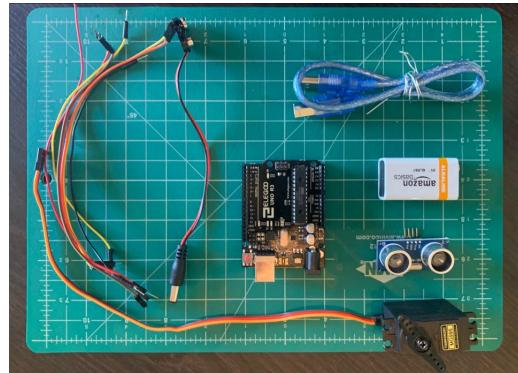


Figure 10: Electronics needed for the project

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.*

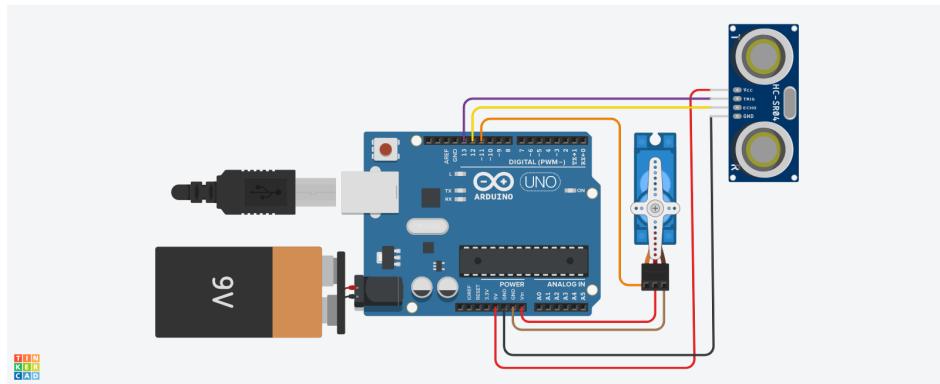


Figure 11: Arduino Circuit Diagram

### 3.2 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.

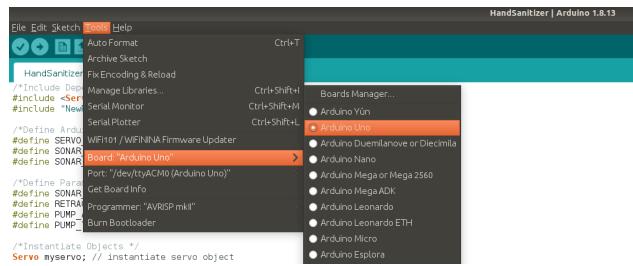


Figure 12: Select Arduino Uno Board

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

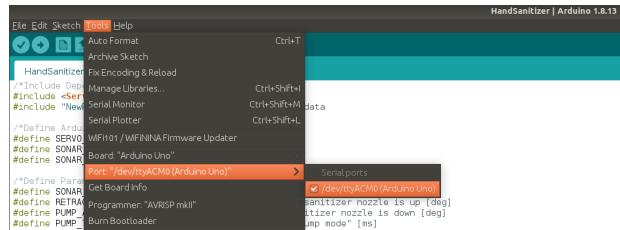


Figure 13: Select appropriate Port

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.

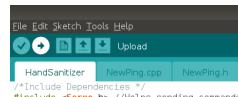
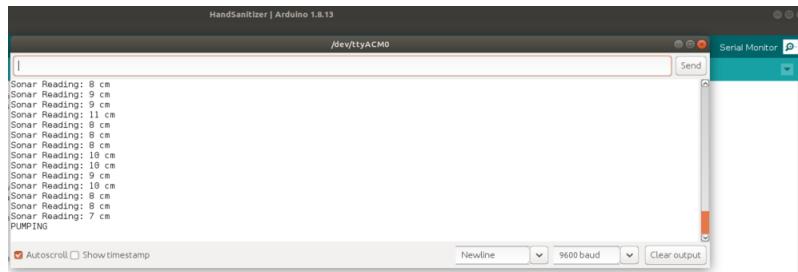


Figure 14: Click the upload button.

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



The screenshot shows the Arduino Serial Monitor window titled "HandSanitizer | Arduino 1.8.13". The port is set to "/dev/ttyACM0". The main text area displays a series of sonar reading messages:

```
Sonar Reading: 8 cm
Sonar Reading: 9 cm
Sonar Reading: 9 cm
Sonar Reading: 11 cm
Sonar Reading: 8 cm
Sonar Reading: 8 cm
Sonar Reading: 8 cm
Sonar Reading: 10 cm
Sonar Reading: 9 cm
Sonar Reading: 9 cm
Sonar Reading: 10 cm
Sonar Reading: 8 cm
Sonar Reading: 8 cm
Sonar Reading: 7 cm
PUMPING
```

At the bottom of the window, there are three buttons: "Autoscroll" (checked), "Show timestamp" (unchecked), "Newline" (dropdown menu), "9600 baud" (dropdown menu), and "Clear output".

Figure 15: Serial Monitor Output for debugging

## 4 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

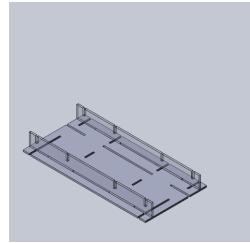


Figure 16: Insert the vertical supports to the baseplate

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

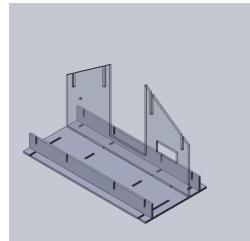


Figure 17: Insert Vert Mid Thru into the baseplate

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

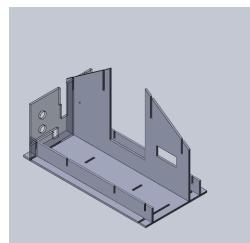


Figure 18: Insert Vert End Left into the baseplate

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

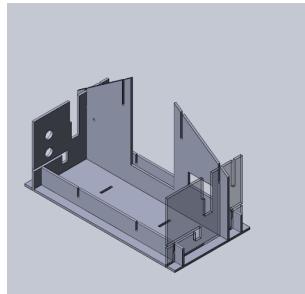


Figure 19: Insert Vert End Right into the baseplate

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

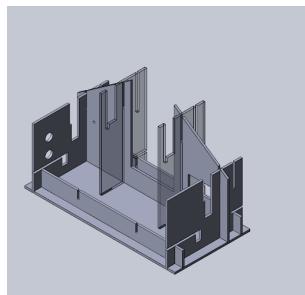


Figure 20: Insert both Vert Inboards into the baseplate

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

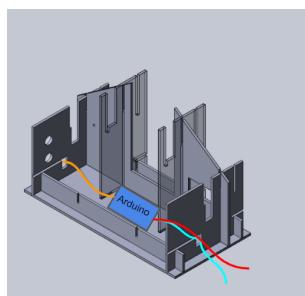


Figure 21: Place the arduino and route the cables appropriately

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

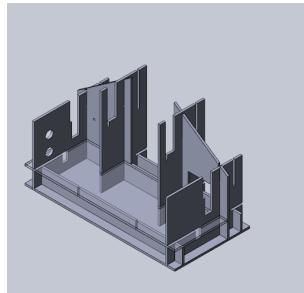


Figure 22: Cover all the electronics with the Horiz Front part

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

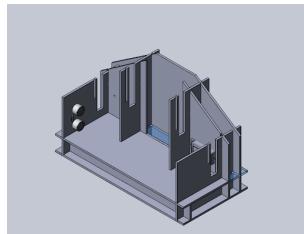


Figure 23: Insert Horiz Rear on the back of the assembly

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

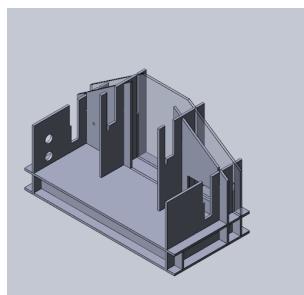


Figure 24: Insert Vert Rear on the back of the assembly

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 25: 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:

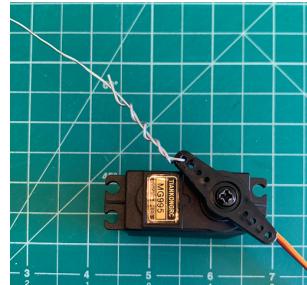


Figure 26: Attach the wire to the servo horn

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.)

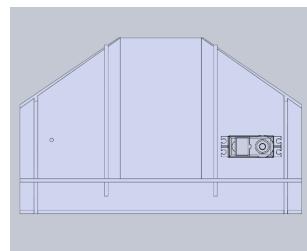


Figure 27: Push servo into the assembly

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.

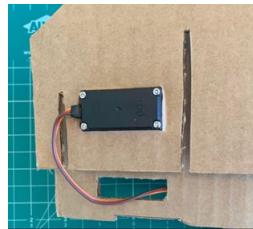


Figure 28: Route the servo wires

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

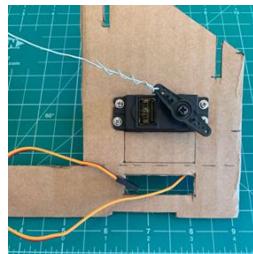


Figure 29: Push the servo mounting screws into the cardboard

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

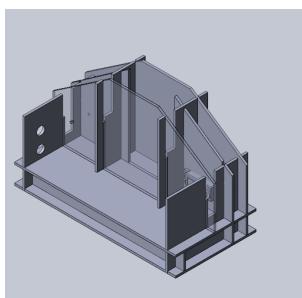


Figure 30: Slide Vert Front into the assembly

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

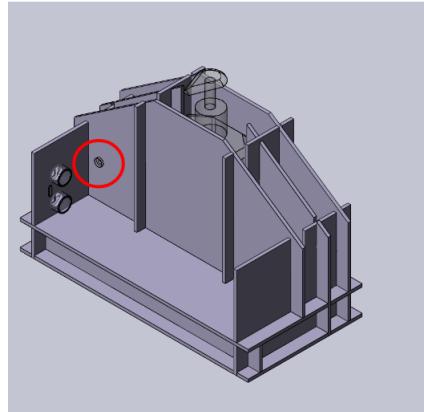


Figure 31: Push the wood screw at the indicated approximate location

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 32: 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)

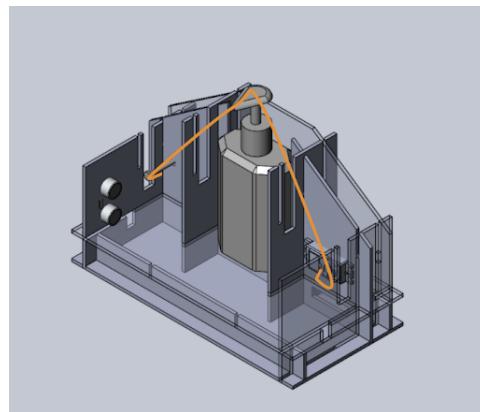


Figure 33: Route wire through hand sanitizer pump and wrap it around the screw

21. Voila! Now off to troubleshooting with the mentors