“Final Project: Microcar Interior”

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Report

Project Objective:

The objective of this project was to design a full scale mock up of a microcar interior using solidworks taking into account the principles of human factors, anthropometric measurements, and ergonomic design. Overall the dimensions of the car cabin were to be a maximum of 2100 mm long, 1225 mm wide, and 1150mm tall. The car to be designed had to have an engine located in the front end of the car. The location of the engine resulted in several limitations such as the windscreen not being able to be lower than 575mm from the top of the passenger compartment so that the room needed for the engine could be accounted for. Furthermore, it was necessary that the design fit a minimum of 4 people as comfortably as possible while including all controls and indicators necessary for operating the car. In order to accomplish this goal, it was necessary to have a firm understanding of human factors so that factors such as control/display selection, placement, and feel could be determined. It was also necessary to take human factors principles into account to understand how to use sounds, warnings, text, and visibility.

Specifications of Car Parts and the Principles of Human Factors Applied:

- **Center Console Display:**
    - **Center Console Design:** It was decided that the center console display should combine the use of an LCD display as well as buttons underneath it to control the radio, AC, and hazard lights. This was done so that there was a clean display to view information such as the time, the present radio station, and the settings of the AC controls. Rather than opting for a fully functional touch screen, the buttons underneath were designed so that the driver still had tactile feedback when adjusting the settings of the radio or the AC without the necessity of looking at the screen to gain a spatial awareness of the controls. This provides a safer situation for the driver and the passengers. The center console's screen is located 35 degrees below the operator's direct line of sight making it within the viewing range of the operator. Furthermore, the screen has the dimensions 896.1mm x 515.4 mm and can be powered off by the button labeled “Screen” with the power symbol on it (Appendix 4.3, figure 12). It was created this large so the driver could easily see the time, radio station playing, GPS map, and backup camera view.
    - **Clock:** The clock is consistent with the font on the gauges in order to maintain the same form of visual. The clock may be observed on the home screen of the LCD display, and should the display be in use for another function then the time is clearly located in the top right corner of the display. In order to maintain a large degree of visual contrast the font of the text is white while the background

surrounding it is a dark blue; this allows the time to be easily seen and quickly read to minimize the driver's distraction. The height of the text is 120 mm when it is displayed on the home screen in the center. This text height is larger than the minimum text height of 6mm which may be observed when the screen is used and the time is displayed in the right hand corner.

- **Radio:** The radio is controlled by two knobs, one on each side of the display. The volume is on the left side and is controlled by knob that when rotated clockwise increases the volume and when rotated counterclockwise, decreases the volume. This knob also acts as a power button controlling whether the radio is on or off. To turn on or off, the driver just needs to push down on this knob. On the right side of the screen is the tune knob. As it is used less frequently, this knob was put farther away from the driver. There is one FM/AM button that allows the driver to quickly switch from one to the other. There are also 8 preset buttons available for the driver to use to control the radio. They simply just have to hold down the button for a few seconds while on a specific radio station and that station will be programmed to come on when the same preset button is pushed again in the future. This allows the driver to quickly change the radio station to one of their preferences and do so while maintaining their eyes on the road, due to the tactile feedback of the buttons.
- **AC/ Heater Vents and Environmental Controls:**The environmental controls of the air conditioning are controlled by two knobs and 6 buttons. One knob is on the left side of the buttons and the other is on the rights side of the buttons. Both are labeled “A/C” with 21mm text. The air flow knob, controlling the amount of air moving throughout the vehicle, is on the left side of the buttons. The air flow knob has four settings labeled, off, low, med, and high with 21mm text (Appendix 4.3, Figure 16). As the air flow knob is turned clockwise the airflow in the car increases. The temperature control knob, located on the right side of the buttons has 12 settings. As it is turned counterclockwise, the temperature becomes colder and as it is turned clockwise the temperature increases becoming hotter. The cool air is designated by blue dots and the hot air is designated by red dots in accordance with the population stereotype that red represents a hot object and blue represents a cold object (Appendix 4.3, Figure 16). The buttons between the two knobs give the operator options to direct the airflow between the different vents such as towards the passenger's feet or face. These buttons also give the operator the option to turn on the defrost so that the windshield does not become blurry insuring that the operator can maintain visibility of the road in less than optimal conditions.
- **AC/ Heater Vents:** The front facing vents of this car are not in the stereotypical position in the center console as is associated with many cars. The design team

decided that by putting the vents on top of the dash there would be a better ability to direct airflow to the back passengers.

- **Hazard Controls:** The hazard control is a triangular button because there is a cognitive stereotype that the triangular shape should trigger alarm and caution. The exclamation point in its center is placed there to symbolize triggering a distress signal. The button is located underneath the center console display so that it is out of the way of reach unless purposely meant to be pushed, but also so that it is visible to the occupants, and its location is familiar to the occupants of the car because they interact with the center console so frequently.

- **Steering Wheel:**
  - **Steering Wheel Design:** The steering wheel, was designed to be adjustable so that the neutral position could be attained regardless of the height of the passenger (Appendix 4.3, Figure 1). Therefore, depending on the preference of the driver, the steering wheel may be pulled to a more upward angle or downward angle to ensure comfort. In order to turn the steering wheel it should be rotated to either the left or the right turning it in the direction which the wheels are desired to face. This method of movement was based off of the population stereotype that the wheel should be rotated in the direction of desired movement.
  - **Steering Wheel Radio Controls:** Buttons for controlling the volume of the radio are on the the steering wheel (Appendix 4.3, Figure 16). They allow the driver to alter the volume of the radio as well as the radio channel without looking away from the road to increase safety. Due to user stereotype, the buttons for volume control should be pushed on the upper edge to increase the volume and on the bottom end to decrease volume. This same convention is applied to the tuner button where pushing up increases the number of the radio station and pushing down results in a decrease of the number of the radio station. These buttons are located 2.46 cm on the inside edge of the steering wheel so that they may be easily accessed by the thumbs of the driver.
  - **Steering Wheel Horn:** A horn is located in the center of the steering wheel, so that it is not accidentally triggered by the driver while driving, but it is easily accessible should the driver need to alert another driver on the road (Appendix 4.3, Figure 1). When the center of the steering wheel is hit, a loud “beep” is sounded to warn other drivers. The close proximity to the driver allows them to quickly alert another driver without searching for the horn. The steering wheel is within less than 45 degrees from the operator's line of sight putting it within the operator's range of sight.
  - **Steering Wheel Stock:** There is one stock which branches off of the steering column (Appendix 4.3, Figure 19). This stock is present so that the driver has close proximity and easy control of the car's headlights, turn signal, and

windshield wipers while taking up minimal space so as not to crowd the driver. The stock is located 10 cm behind the steering wheel so that the driver does not accidentally hit the stock.

- **Turn Signal:** In order to control the car's turn signal the stock should be pushed upwards to signal a right turn and downwards to signal a left turn (Appendix 4.3, Figure 19). This method of control has the driver pushing the stock in the direction which they intend to turn making the movement more intuitive requiring little thought for operation.
- **Windshield Wipers:** In order to control the windshield wipers the head of the stock is a small knob which rotates forwards and backwards (Appendix 4.3, Figure 19). To turn the speed of the wipers up the knob should be rotated in the direction moving towards the front of the car. To decrease the speed of the wipers the knob should be turned in the direction of the operator. There four settings denoted: “Hi”, “Low”, “Auto”, and “Off” with a text height of 6 mm. The word “Push” is also denoted on the part that needs to be moved to change the setting of the windshield wipers. Each time the knob reaches a new setting a small tick may be felt so that the driver may gauge the position of the knob without visual confirmation. These ticks are also marked with a small white tick mark for a visual confirmation should it be desired.
- **Headlights:** To control the headlights the stock should be pushed backwards to to turn the high beams on (Appendix 4.3, Figure 18). The low beams for the lights will turn on automatically due to a sensor which turns the low beams on once the light outside becomes less than optimal. HID headlights were used for the microcar. These headlights cast a light blue color rather than the traditional yellow-white light. This was done because HID lights are brighter than the traditional halogen headlights. By using these lights the driver is at a greater advantage because the headlights are more effective at cutting through unideal situations such as rain and fog so that the driver may be able to see clearly.

- **Car Doors:**
  - **Door Design:** It was decided that suicide doors should be used on the car due to its small size. This means that the front door is opened revealing a small latch on the second door which then opens out towards the back of the car rather than the front of the car. This allows the front and back seats to be easily accessible to all passengers rather than having passengers sitting in the back need to move the front seat up to slide out of the car.
  - **Side mirror adjustment controls:** On the side panel of the driver's door, is a toggle button which may be used to adjust the side mirrors of the car (Appendix 4.3, Figure 24). It is important to be able to move the left and right mirror separately, so there is a small switch below the toggle button to select the left mirror, denoted “L”, or the right mirror, denoted “R” with a text height of 18mm.

The mirrors may then be adjusted, after one is selected, by depressing the toggle button below the switch. By depressing the toggle button to the left the mirrors will be turned to the left, by depressing the button to the right the mirror moves in the right direction. This same principle of movement may be applied to the up and down directions of the button. If the toggle button is depressed in the center the mirror will not change position. This toggle control was chosen so that the tactile movement of the operator's fingers were moving in conjunction with the mirrors to allow the operator the ability to spatially perceive the movement of the mirrors.

- **Door Window Controls:** The window controls for the doors are located on the side panel of the door towards the front of the door so that the forearm does not need to be extended to access the controls (Appendix 4.3, Figure 20). The controls are placed vertically on the X-plane of the car and are located on both the drivers side door and on the passenger side door. To roll the window down the button should be depressed at the back end of the seesaw button and held until the window reached the desired position. To be rolled up, the button should be depressed at the top of the button and held until the window reaches the desired position.
- **Door latch and handle:** The door latch of this car is unique due to the size of the car. It was decided that by adding a latch to the car the passengers would be forced into an uncomfortable position to open the door as the latch would essentially be pulled into the passenger's lap causing the need to twist the arm in an uncomfortable position to grasp the handle; this would be especially uncomfortable for larger passengers. As a result it was decided that the door handle should be located on the side panel of the door and be depressed inwards using only the fingers in the natural movement used to make a fist (Appendix 4.3, Figure 21). To open the door it should then be pushed forwards extending the arm in a natural motion to open the door towards the front of the car. This method was applied to the front drivers door and the front passenger door. For the back doors the handle may be accessed on the inside between the two doors featuring the same handle, but in this case it is vertically oriented again to naturally accommodate the position of the hand. The door is then pulled towards the operator to open it and access the back seats.
- **Door lock control:** The door lock is on the side of the door and they are running horizontal behind the handle which opens the door (Appendix 4.3, Figure 22). The button closest to the handle is the unlock button and the button furthest from the handle is the lock button. There is a small cylinder like pen on the top of the door which is extended to show that the door is unlocked and depressed to show that the door is locked. This was designed to give the driver a visual cue as to whether the doors were locked or unlocked without having to try the handle. The

position of these buttons were decided because it allows the user to cognitively group the door handle and the controls which unlock and lock it.

- **Car Seats:**
    - **Front Seat Design:** The seats were designed to have an adjustable backrest so that the occupant may manipulate the angle according to the degree which they would like to be reclined. The seat was designed to support the natural curvature of the spine resulting in a thicker base and a thinner top to accommodate for the curvature of the small of the back (Appendix 4.3, Figure 30). The ideal angle for the backrest, though it is adjustable, is 21 degrees because it is the ideal seated angle to limit the pressure of the trunk on the occupant's pelvis. Therefore the angle of the headrest was angled in 21 degrees from the vertical of the backrest. Ideally the angle of this will result in the passenger having their heads facing forwards while still supporting the base of the neck. The length of the seat is designed to go to the knees of the 5th percentile woman. This allows the thigh of the occupant to be supported. The width of the 95th percentile man's hips were used to determine the width of the seat making it slightly larger than his hip span to make seating comfortable for all occupants. The base of the seat is angled slightly upwards at 10 degrees to position the leg for comfortable extension so that the pedals of the car may be utilized.
    - **Back Seat Design:** The dimensions of the backseats are the same as the dimensions of the front seat, however these seats are not adjustable and have an angle of roughly 10 degrees rather than the ideal 21 degrees because space limitations had to be accounted for. This angle still allows for a relief of pressure and the cushioning is still present to follow the curvature of the spine. These seats are located along the back wall of the car and the compromise in reclining angle allows the back seat passengers to have ample leg room which was decided to be a stronger factor in supporting overall comfort.
    - **Seat adjustment controls (up, down, forward, backward, back angle adjust):** The controls to adjust the seats are located on the side of the seat which is facing the door (Appendix 4.3, Figure 23). The button is a four way toggle which should be pressed forwards to move the seat towards the dash, backwards to move the seat away from the dash, up to move the seat towards the ceiling of the car, down to move the seat towards the floor. To adjust the angle of the seat the corner corresponding to the angle desired to be changed should be depressed and held until the desired is achieved.
- **Dash Controls:**
    - **Speedometer:** This car utilizes a digital speedometer as well as a traditional analog speedometer. The digital speedometer was designed for the convenience and safety of the driver. It is located in the middle circular display and displays the exact speed of the car in mph (Appendix 4.3, Figure 6). As this is the most

viewed gauge, it is the largest with a text size of 90mm.This will save the driver time when checking the speed, thus optimizing safety. There is also a traditional, analog, speedometer to the left of the digital speedometer in the left circular display also measuring the speed of the car in mph. This is provided in case the digital fails as well as for drivers who are conditioned to using this type of speedometer and prefer it.

- **RPM gauge:**The RPM gauge is located along the circumference of the middle circular display, that also encompasses the speedometer (Appendix 4.3, Figure 7). The text height is smaller with a height of 21mm, as it is less important than the speedometer located in the middle circular display. The color of the RPM numbers are white as it contrasts with the gray color of the background, yet as the the RPM increases to a dangerous level the colors are red to easily notify the driver.
- **Gas gauge:** The gas gauge is in the upper right circumference of the right circular display. As seen in Appendix 4.3, figure 8 the 1 represents a full tank, the ½ represents a half full tank, and the 0 represents almost no gas left in the tank and the height is 15mm. The gaspump represent that this range of numbers is referring to the amount of gas in the car's tank. The gas pump is initially white but, will come on and turn red when only 1 gallon of gas is left in the tank.
- **Odometer:** The odometer is placed under the speedometer in the middle circular display (Appendix 4.3, Figure 9). It is smaller, with a text height of 7.5mm. It is also a digital display with white numbers on a gray color background.
- **Oil pressure:** The oil pressure gauge is on the bottom of the left circular display (Appendix 4.3, Figure 10). It has white text with numbers ranging from 0 to 80, with a text height 7.5mm. The oil pressure symbol is also white but will come on and turn red when the oil pressure is too low.
- **Engine Temperature Gauge:** The engine temperature gauge is on the bottom of the right circular display. Its function is to notify the driver when the engine gets to high temperatures. The text is white except for the highest temperature values which then turn red to notify the driver of the unsafe temperatures, with a text height of 15mm.

- **Ignition:**
  - This car utilizes a push to start ignition (Appendix 4.3, Figure 2). This type of ignition was designed for the convenience of the driver. By moving away from the traditional key ignition the driver may start the car faster with a simpler movement. There is no need for coordination which is required to insert the key into a thin key cut out and twist it to turn over the ignition. Instead the driver may simply extend their arm and press down on the button. This will result in the engine turning over and starting. The small light on the button will light up green to show that the car has been successfully started. By using a keyless ignition the

issue of locking one's keys in the car is also avoided because the car will not manually lock while the keys are within the car. The issue of someone forgetting to turn off the engine once they are done using the car is also addressed by a short high pitched alarm sounding when the driver attempts to leave the car if the engine is still engaged. This button is located to the right of the steering column to allow for easy access and proximity to the driver. It is 3.8cm in diameter making it much larger than the tip of the drivers index finger which is used to depress the button. This large size allows the ignition button to be easily seen by the driver so that it is not difficult to find. The size of the button also allows it to stand out from any other buttons in its proximity so that its importance is cognitively implied.

- **Seat belts for 4 occupants:**
    - Shoulder belts for each of the 4 occupants were included (Appendix 4.3, Figure 28). For this portion of the design it was important that the height of the passenger was heavily considered. In order to make the angle at which the belt came across the occupant's lap comfortable to all individual occupants the height of where the belt begins was made to be adjustable. This was done so that a shorter person may use the seat belt across their torso rather than cutting up close to their neck and so that a taller person may adjust it to a higher setting so that it is not in the way of their arm closest to the door. To adjust the height of the head of the seat belt the top portion should be pushed down on and slid to the desired height. As a safety precaution, a seat belt warning light was added to the dash controls. When the driver is not wearing the seat belt there is an audio cue to the driver to remind the driver to put on the seat belt and the symbol on the right circular display with light up red.
- **Glove Compartment:**
    - The glove compartment was designed with is use in mind. Generally the glove box is used to store small pamphlets such as the owner's manual and titles of insurance. It was found that people also use these small compartments to store items such as tissues and napkins. Because of its use, it was decided that it should be located in front of the passenger seat (Appendix 4.3, Figure 14). This was done because it is a preconception that this is where the glove box should be located, but also because this is the only place in the car where it may be accessed easily by a passenger while not being distracting or interfering with the operator of the car. Since it is largely applicable to storage it was decided that the glove box should be as large as possible without compromising the comfort of the passenger. The glove box has a button in the top left corner which is depressed and allows the box to open outwards at an angle and stops before hitting the legs of the passenger. By the box stopping at a 45 degree angle the contents may be accessed and it also prevents any of the contents of the glove compartment from sliding out while the car is moving.

- **Internal map light and control:**
    - The map light consists of two lights 8.31cm wide and 6.38cm long making the lights larger than the operator's hands for easy access and usability. These are located near the windshield close to the sunroof controls (Appendix 4.3, Figure 15). Rather than cluttering the area with buttons, it was opted that push lights should be utilized. This keeps the user from fumbling to find the button in the dark and it also eliminates the possibility of them accidentally opening the sunroof while they were trying to turn on the light. Therefore in order to turn the light on is should be lightly pressed by the user, and in order to turn it off it should be lightly pressed once more. The large surface area of the light ensures that the user will be able to easily locate the light to activate it. These lights will automatically turn on when the user enters the car being triggered by an opened door. This serves two functions; it alerts the user if one of the car doors has been left ajar, and it allows the user to see when entering the car if it is dark it will enable them to see the ignition button without having to completely rely on touch alone.
- **Sunroof controls:**
    - The controls for the sunroof are located between the two map lights (Appendix 4.3, Figure 27). the seesaw button should be depressed forwards and held to close the sunroof the desired. Likewise, the button should be depressed towards the back of the car to move the sunroof back to open it. The sunroof also has a felt cover which may be pulled out over top of the sunroof to prevent light from coming in through the top of the car when the sunroof is not in use.
- **Cigarette lighter and ash bin:**
    - The cigarette lighter and ashbin are located on the passenger side door above the control for the window (Appendix 4.3, Figure 26). Though this is not the expected placement of this feature, the design team decided that placing it next to the window control would encourage the person smoking to roll down the window of the car to limit the other passengers exposure to secondhand smoke. This use of suggestive placement is mildly inconvenient for the smoker, but it was decided that this may limit the amount that they smoke, as well as, increase the safety of the other passengers in the vehicle.
- **Cup holder accessible to each potential occupant:**
    - In this microcar each occupant has easy access to a cupholder. The cup holder for the two front seats is located in the center between the two seats (Appendix 4.3, Figure 29). The same concept is applied for the backseats of the car have a cup holder located between the two seats. The cupholders were designed to hold an average sized beverage container and are deep enough so that the beverage will not spill under normal circumstances and that enough of the cup is still exposed so that the occupant can easily grip the container to remove it. The cupholders were

purposely placed in a position separate from other controls so that they would not become an obstacle that the occupants needed to avoid when attempting to alter any controls. This eliminates the possibility that the cups will be spilled because they were pushed over by an elbow when another control was being altered.

- **Automatic Transmission**
    - An automatic transmission was opted for rather than a manual transmission. This decision was reached as a result of the limited space and the concentration of the driver. From the perspective of space, the automatic transmission was selected because it does not require a pedal for the clutch. Because we made the choice to make the parking break a pedal located on the far left side underneath the steering wheel it was decided that the addition of the clutch in this location as well would put the occupants of the car in a potentially dangerous situation (Appendix 4.3, Figure 11). By placing 4 pedals underneath the steering wheel a dangerous situation is created because they will all be very close to one another due to space constraints making it possible for the operator to depress the wrong pedal. By selecting the automatic transmission there is only need to have three pedals beneath the wheel allowing ample space between one another so as to prevent the driver from accidentally pressing the wrong pedal. This played hand in hand with the safety of the driver; it was decided that the use of an automatic transmission requires less concentration and physical requirements from the driver. This allows them to devote all of their concentration to the road rather than focusing on simply operating the car.
- **Car Pedals:**
    - **Parking Brake control:** The parking brake is a rectangular pedal which is purposely located as far to the left of the floor board and positioned higher up than both the accelerator and the brake (Appendix 4.3, Figure 5). This mildly inconvenient position was chosen so that the operator would not hit the parking brake on accident; this allowed the possibility of putting the operator and the passengers in a potentially dangerous situation. To operate the parking brake the brake should be depressed until it stops and sticks to apply it. To take the parking brake of the pedal should be lightly depressed and the operator's foot should then be removed allowing the pedal to resume its elevated off position.
    - **Accelerator:** The Accelerator is the pedal furthest to the right of the floor board and is 8.4cm so that it is comparable to the width of the foot (Appendix 4.3, Figure 3). The gas is also slightly right of the natural sitting position of the driver. This shift in position is to ensure that the driver has made the conscious decision to accelerate the vehicle. To operate the acceleration pedal it should be gradually depressed to cause the car to accelerate at faster rates. To stop accelerating the car further the operator's foot should be removed from the pedal.

- **Brake:** The brake of the car is 15 cm wide making it wider than the foot of the driver (Appendix 4.3, Figure 4). The brake is also located directly in front of the driver's foot while their legs are positioned in the natural sitting position. The brake is made to be wider and closer to the foot of the operator so that the brake may be triggered quickly without worry that the pedal will be missed. To operate the brake it should be depressed gradually until the vehicle comes to a stop.

Project Conclusion:

Ultimately, the microcar designed accommodates for a multitude of human factors including but not limited to cognitive grouping, design functionality, the usage of colored signals, and several other factors detailed above. The car has been proportioned so that it may comfortably accommodate occupants ranging from the size of a 5th percentile female to a larger 95th percentile male. Small design details have been considered alongside their functionality so that an educated and usable placement of controls could be discerned. Therefore, considering all design and usability aspects the design team believes that an aesthetically appealing and functional car has been proposed.

Appendix:

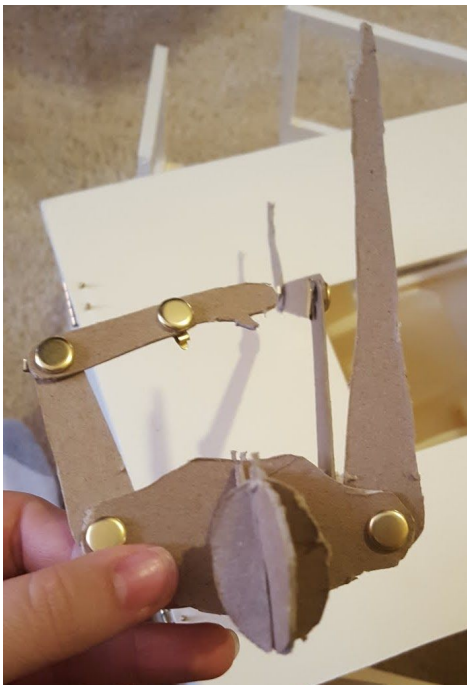
1.1 Anthropometric Measurements for a 95th Percentile Male:

95th Percentile Man Height: 184.9 cm	**Front View**			
	Actual length of segment (cm)	**Actual location of the center of mass**	**1/6th Scale for length (cm)**	**1/6th Scale Center of Mass**

Head and neck	**33.652**	**33.652**	**5.609**	**5.609**
Trunk	**53.251**	**26.626**	**8.875**	**4.438**
Upper Arms (2)	**34.391**	**14.995**	**5.732**	**2.499**
Forearms (2)	**26.995**	**11.608**	**4.499**	**1.935**
Hands (2)	**19.969**	**10.104**	**3.328**	**1.684**
Thighs (2)	**45.301**	**19.615**	**7.550**	**3.269**
Shanks (2)	**45.485**	**19.695**	**7.581**	**3.283**
Feet (2)	**7.211**	**3.606**	**1.202**	**0.601**
Sitting Height (from info)	**90.700**		**15.117**	

1.2 1/6th Scale Anthropometric Model for a 95th Percentile Male:

Top View	**Side View**

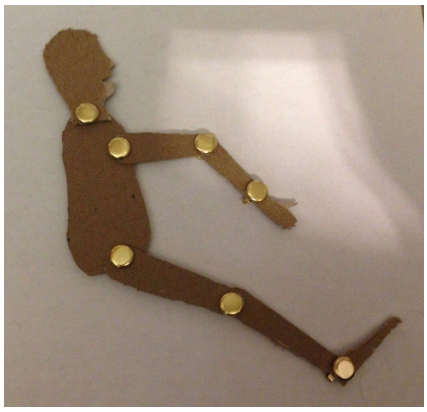


2.1 Anthropometric Measurements for a 5th Percentile Woman:

5th Percentile Woman Height: 149.9 cm	Front View			
	Actual length of segment (cm)	Actual location of the center of mass (proximal)	1/6th Scale for length (cm)	1/6th Scale Center of mass
Head and neck	27.2818	27.2818	4.546966667	4.546966667
Trunk	43.1712	21.5856	7.1952	3.5976
Upper Arms (2)	27.8814	12.1562904	4.6469	2.0260484
Forearms (2)	21.8854	9.410722	3.647566667	1.568453667
Hands (2)	16.1892	8.1917352	2.6982	1.3652892
Thighs (2)	36.7255	15.9021415	6.120916667	2.650356917
Shanks (2)	36.8754	15.9670482	6.1459	2.6611747
Feet (2)	5.8461	2.92305	0.97435	0.487175

Sitting Height (From data)	**78.5**		**13.08333333**	

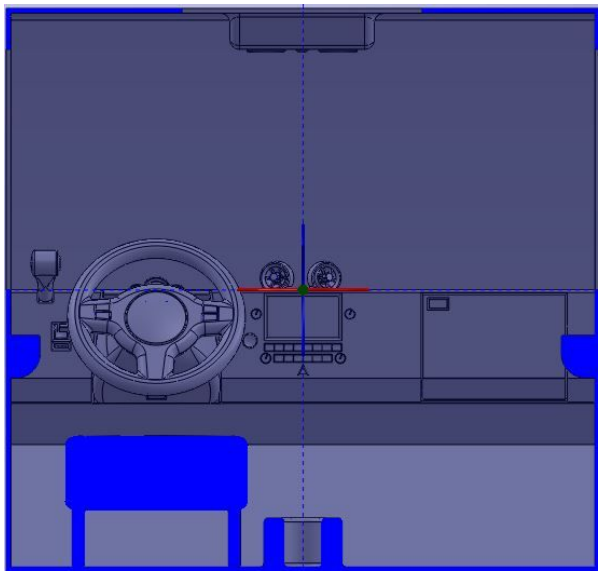
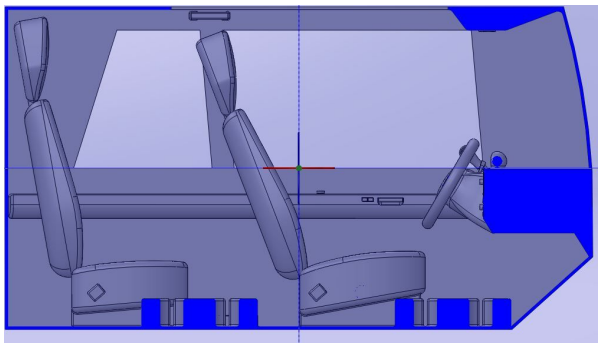
2.2 1/6th Scale Anthropometric Model for a 5th Percentile Woman:

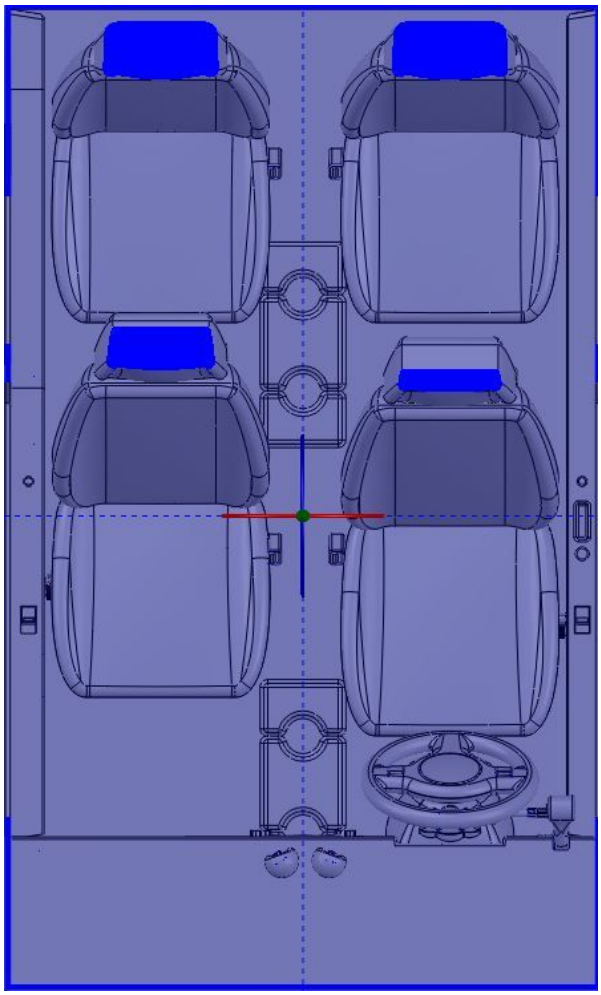
Top View	**Side View**
	

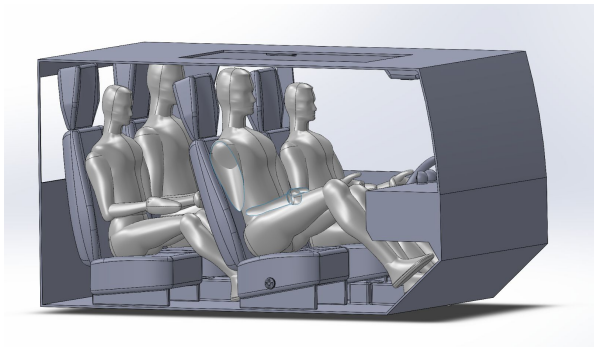
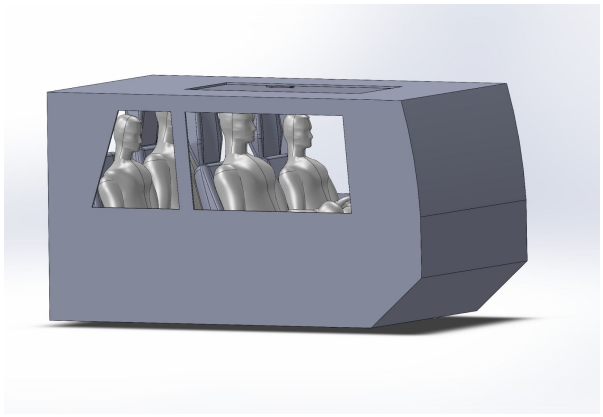
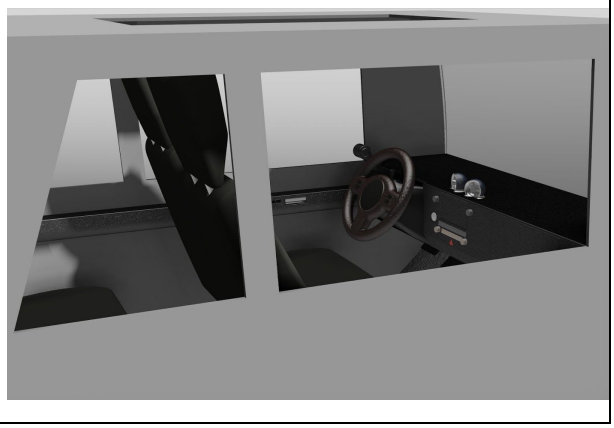
3.1 Formulas and Calculations Utilized:

- Minimum Height of Text Formula: 2*distance*tan(radians/2)
  - Height= 2*800mm*tan(.430/2)
  - Height = 6mm
  - Minimum height for all text is 6mm

4.1 Solidworks Design:

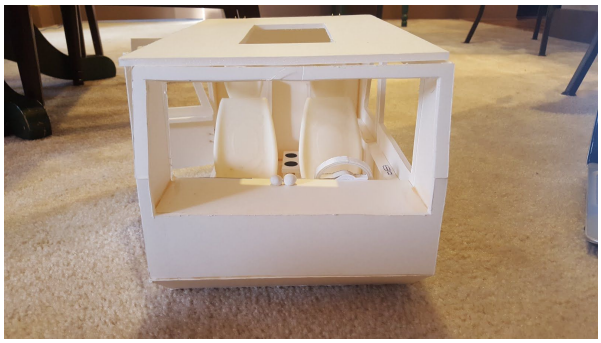
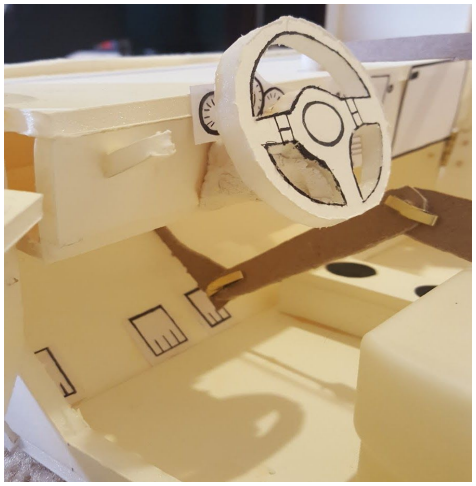
Interior View: Dash	
Side View: Interior	

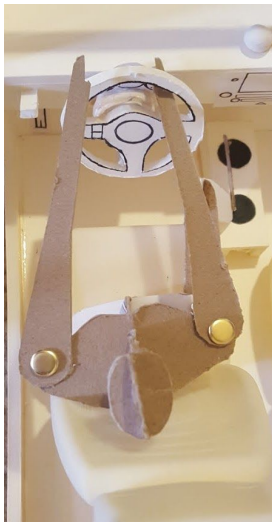
Top View: Interior	
Side View: Human Models Included	

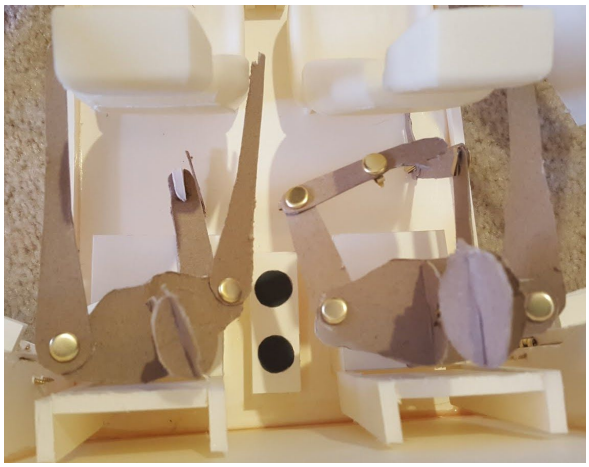
	 
Render with Materials	

4.2 1/6 th Scale Mockup of the final Design:

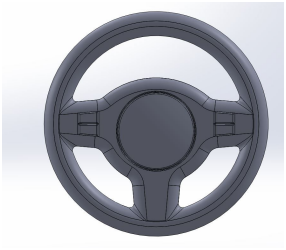
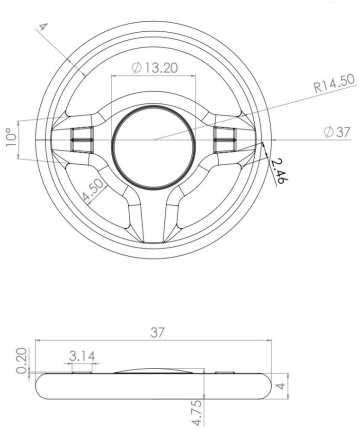
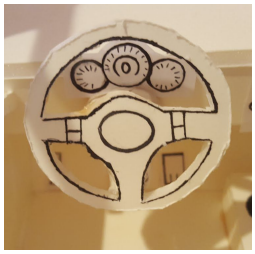
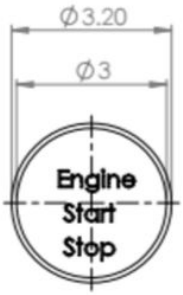
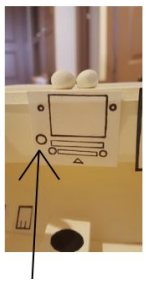
Top view (without roof)	
Side View (closed doors)	
Side View (open doors)	

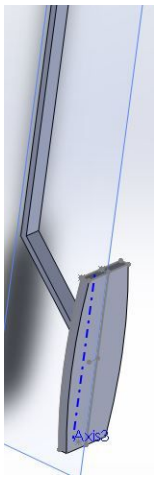
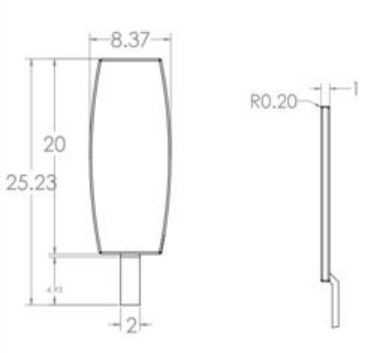
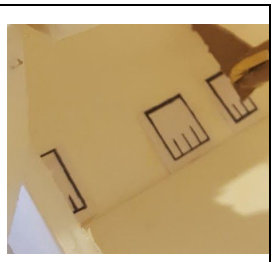
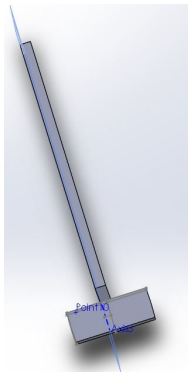
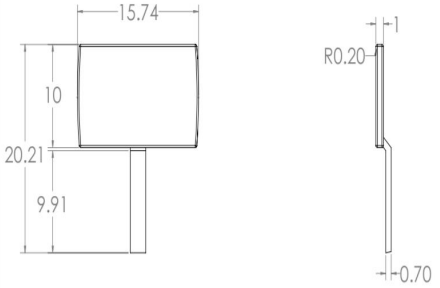
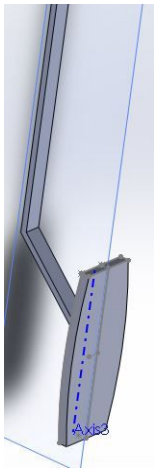
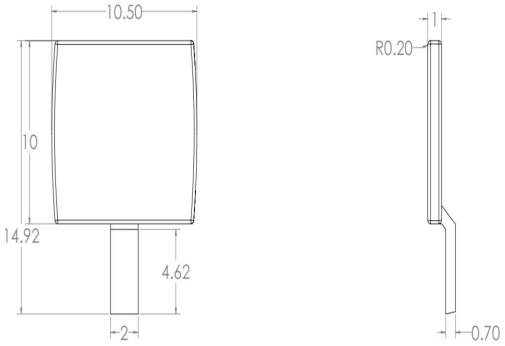
Front View	
Side View- showing how 95th Percentile male fits in the Vehicle	
Side View-showing where the foot of the Model hits the Pedals of the Car	

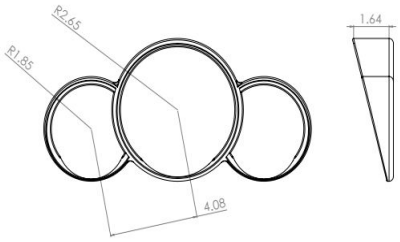
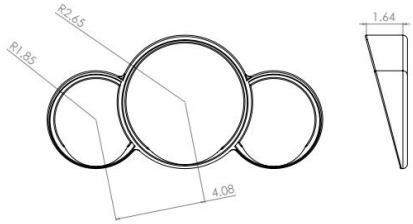
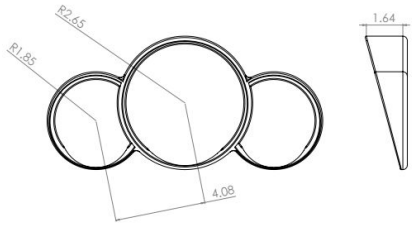
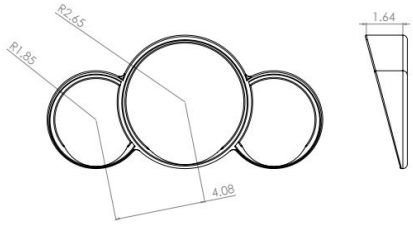
Side View- Showing how the 5th Percentile Female fits in the Car	
Top View- of 5th Percentile Female in the Car	 
Top View- 95th Percentile Male in the Car Seat	

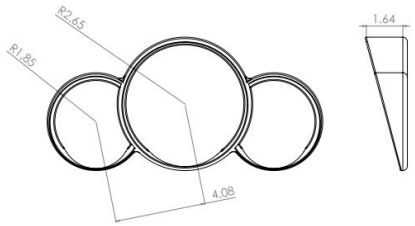
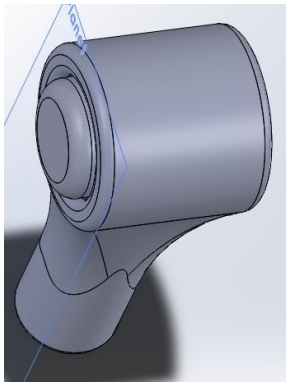
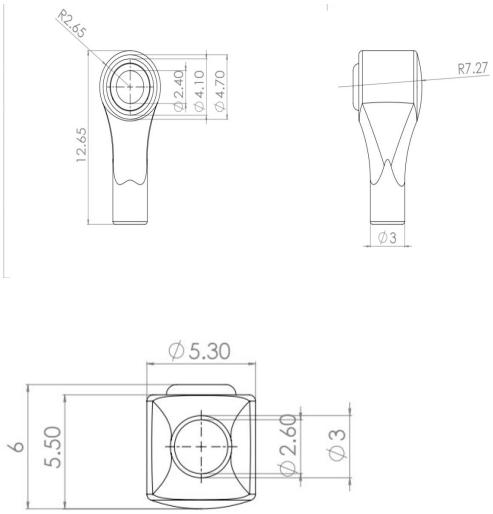
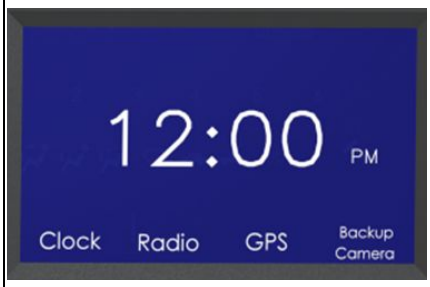
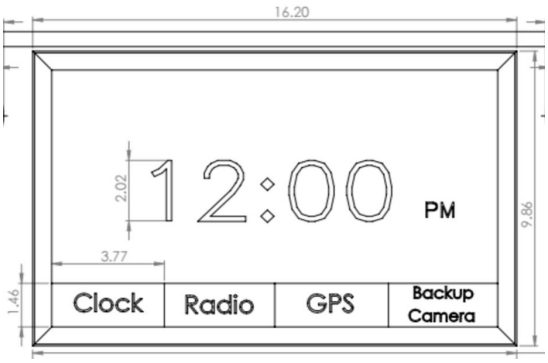
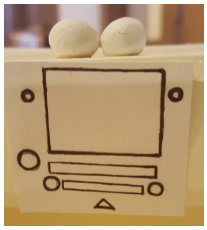
Top View- 95th Percentile Male and 5th Percentile Female in the back seat of the car	

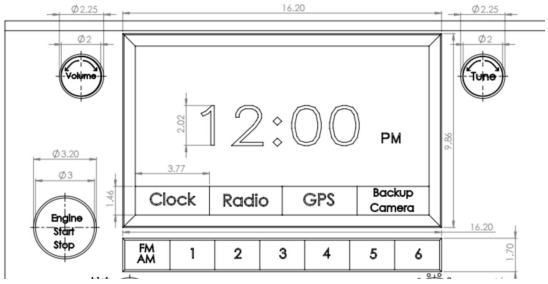
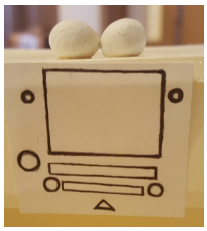
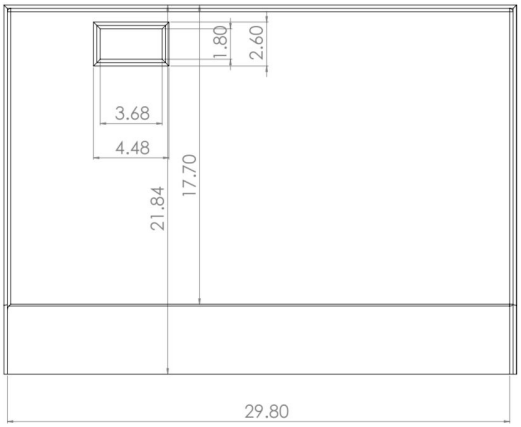
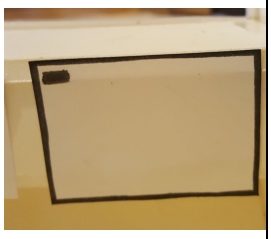
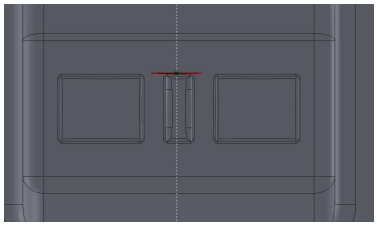
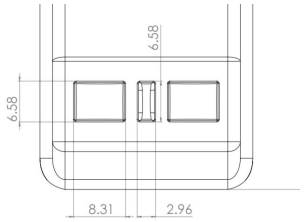
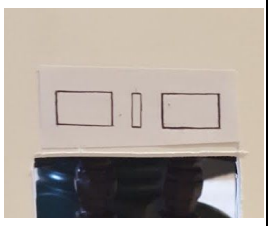
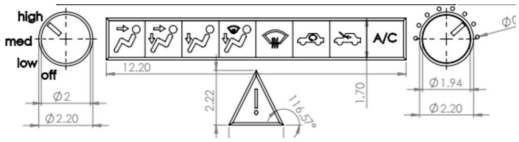
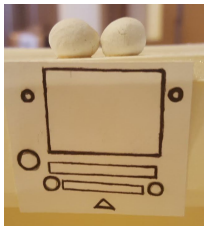
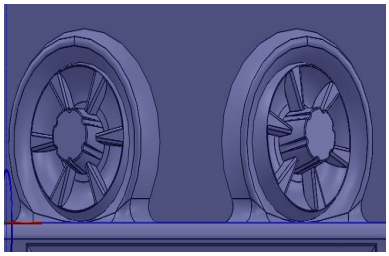
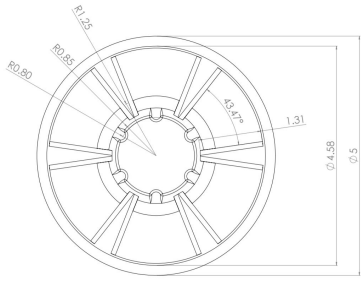
4.3 Parts to reference from the 3D Model and Physical Model:

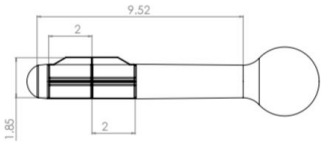
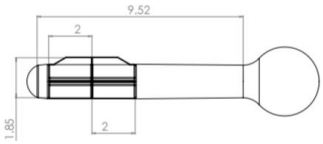
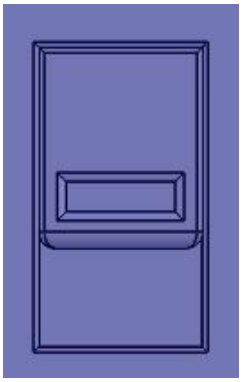
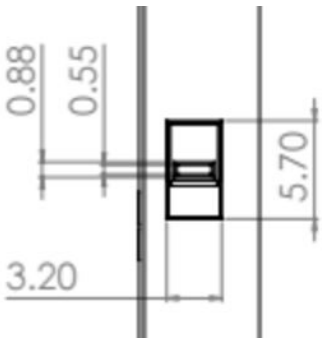
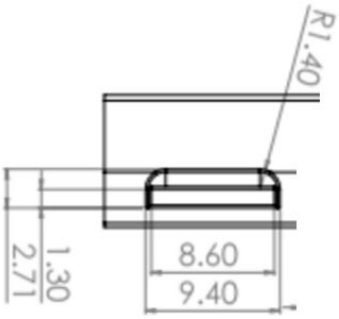
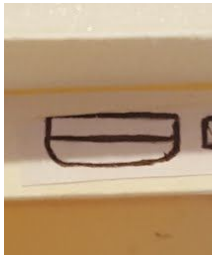
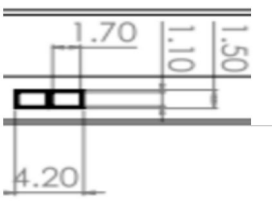
	Solidworks Model	**Dimensioned Part**	**Physical Model**
1. Steering Wheel			
2. Ignition Button			

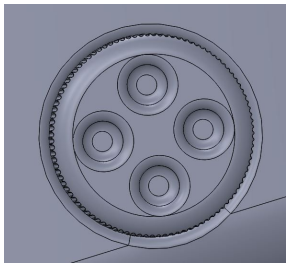
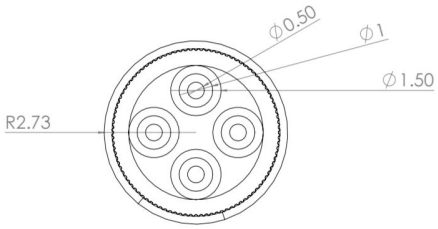
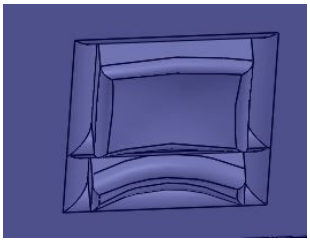
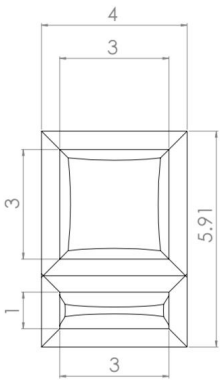
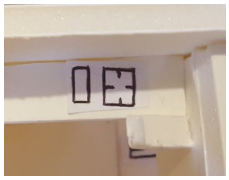
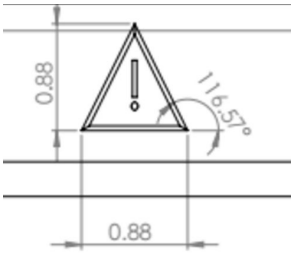
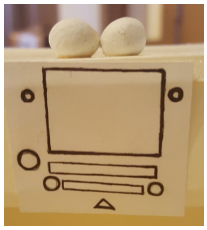
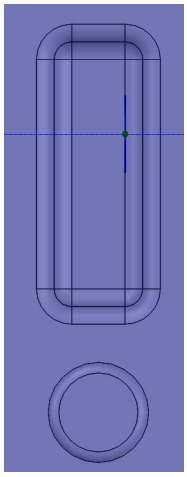
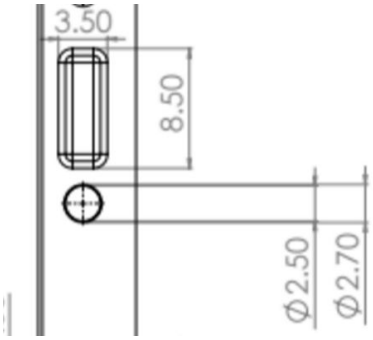
3. Accelerator			
4. Brake			***Same as figure 3**
5. Parking Brake Control			***Same as figure 3**

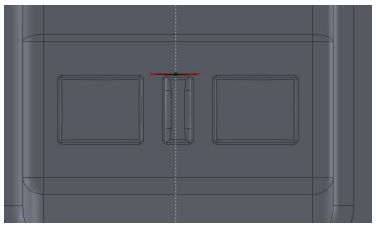
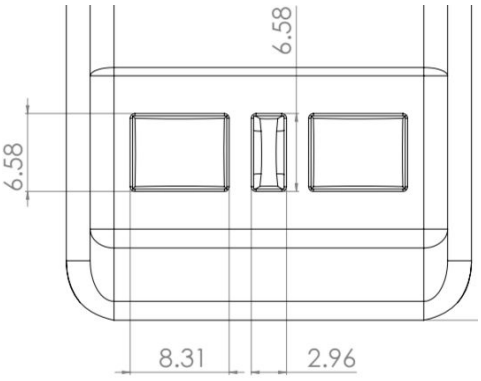
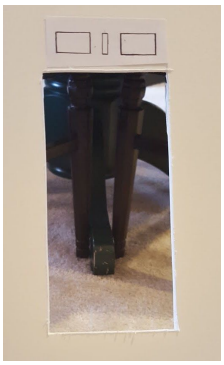
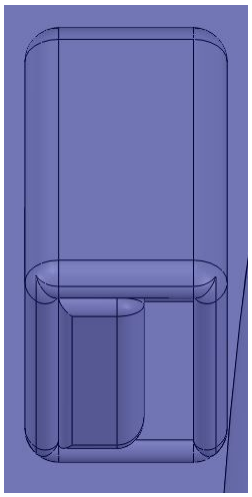
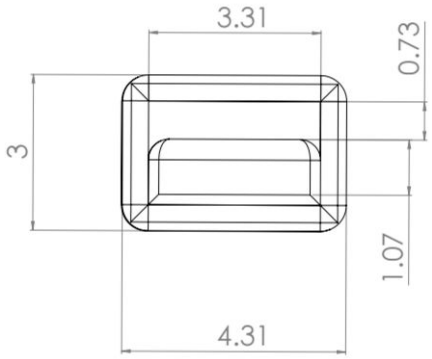
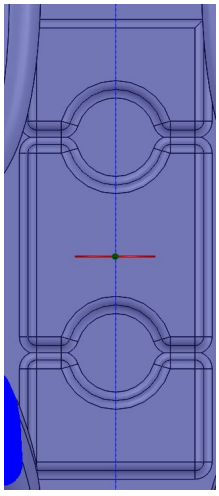
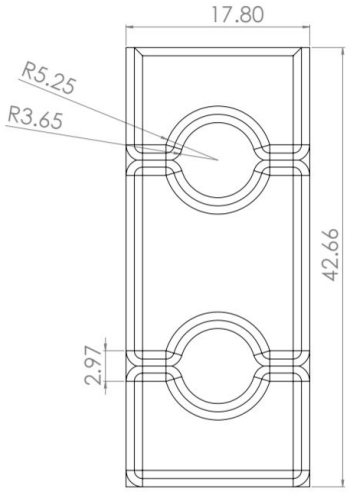
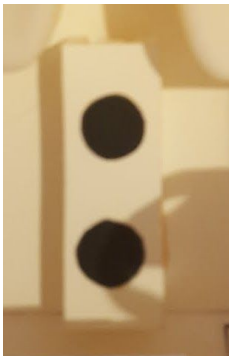
6. Speedometer			
7. RPM Gauge			
8. Gas Gauge			
9. Odometer			

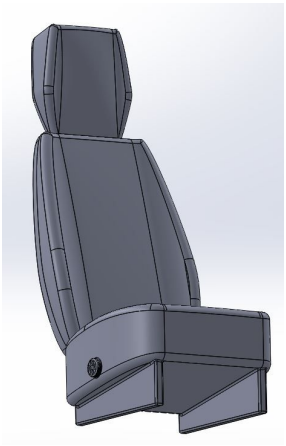
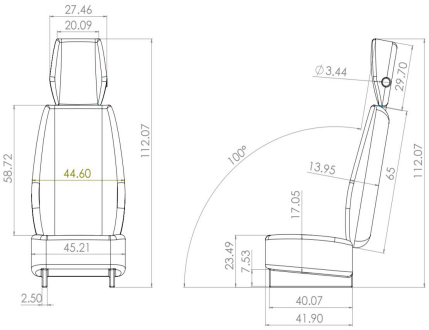
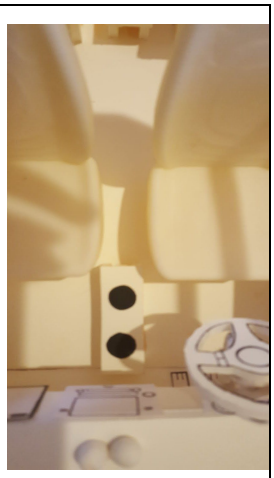
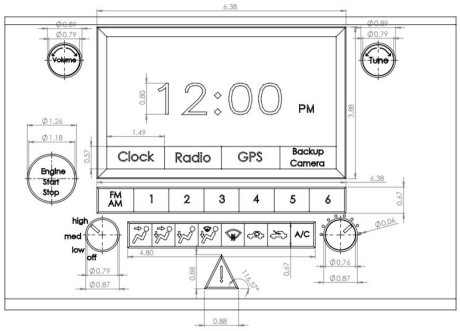
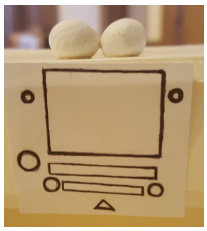
10. Oil Pressure Gauge			
11. Gear Shift			
12. Clock			

13. Radio			
14. Glove Compartment			
15. Internal Map Light and Control			
16. Environmental Controls			
17. AC/ Heater Vents			

18. Headlight Control			--
19. Wiper Control			--
20. Door Window Controls			
21. Door Latch			
22. Door Lock Control			

23. Seat adjustment Control			
24. Side Mirror Controls			
25. Hazard Lights			
26. Cigarette Lighter and Ashtray			--

27. Sunroof Control			
28. Shoulder belts			--
29. Cup Holders			

30.Seat			
31. Dash Display			

References:

Macey, Stuart., Geoff. Wardle, and Art Center College of Design. *H-Point : The Fundamentals of Car Design and Packaging.*Culver City: Design Studio Press, 2009. Print.

Panero, Julius. *Human Dimension and Interior Space : A Source of Design Reference Standards.*New York: Whitney Library of Design., 1979. Print.