

# Ideas

- For each step that requires electrical assembly, provide an electrical schematic.
- For each step that requires electrical fabrication, provide high quality photos.
- Create a page that lists the tools you need.
- Put 'caution' dialogues when the user is doing something dangerous, like handling a soldering iron.
- Make sure to include steps to wait for a solder joint to cool down or to turn off the soldering iron.
- Order of booklet contents:
  1. Title Page
  2. Table of contents
  3. Tools needed
  4. Exploded view of vehicle
  5. Steps on how to assemble vehicle
  6. Engineering drawings of each part
  7. Electrical schematic of whole car

# Draft

1. Fasten the rearShellToBottomChassisBracket part onto the bottomChassis part using four M2.5 x 12 mm hex socket cap screws and M2.5 nuts.
2. Obtain two HC-SR04 ultrasonic distance sensors and eight female-female jumper wires and connect them to each of their pins.
3. Install the two HC-SR04 ultrasonic distance sensors onto the rearShell part and install this assembly onto the rearShellToBottomChassisBracket using two M2.5 x 18 mm hex socket cap screws and M2.5 nuts.
4. Fasten ten M2.5x10mm female-female standoff screws onto the bottomChassis part using ten M2.5 x 12 mm hex socket cap screws.
5. Cut 1.25" of red 22 AWG wire from its spool.
6. Obtain wire strippers and strip a ¼" of the wire's insulation on both sides.
7. Grab and twist both stripped ends until they are no longer frayed.
8. Repeat steps 4-6 for four wires.
9. Obtain a soldering jig and mount a DAGU DC motor on one of the clips by its tab and a wire from steps 4-7 on the other.
10. Obtain the coil of solder and straighten its free end to a length of 2".
11. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
12. Route one of the stripped ends of a wire from steps 4-7 through the specified lead of the DAGU DC motor.
13. Carefully place the tip of the soldering iron on the routed lead of the DAGU DC motor and quickly apply solder before its components begin to melt.
14. If needed, obtain flush cutter pliers and trim excess solder.

15. First, unmount the wire from steps 4-7 and then the DAGU DC motor from the soldering jig and place them on the workspace.
16. Repeat steps 8-14 for each DAGU DC motor.
17. Cut two 3" of red 22 AWG wire from its spool.
18. Obtain wire strippers and strip a ¼" of the wire's insulation on both sides.
19. Obtain a 2.5x45mm heat shrink tube and cut it in half using flush cutter pliers.
20. Route the red DAGU DC motor wires through the cut heat shrink tube.
21. Coil the free ends of the red DAGU DC Motor wires and one of the wires from steps 16-17 together.
22. Obtain the free wire of the daisy chained wires and mount it on one of the clips of the soldering jig.
23. Carefully place the tip of the soldering iron on the coiled joint and quickly apply solder.
24. After the joint and its surrounding wires cool down, position the cut heat shrink to cover the joint.
25. Obtain a BBQ lighter and apply heat onto the cut heat shrink until it has shrunk to capacity.
26. Repeat steps 4-24 for black 22 AWG wire.
27. Inspect coupling and fasten the black set screws so that interference is prevented during couplingCollarBracket insertion.
28. Insert the couplingCollarBracket part through the coupling.
29. Mount the coupling-couplingCollarBracket assembly onto the plastic noncircular shaft of the DAGU DC motor and fasten the black set screws.
30. Fasten the daguDCmotorBracketPiece1 part onto the coupling-couplingCollarBracket assembly using two M2.5 x 25 mm hex socket cap screws and M2.5 nuts.
31. Repeat steps 26-29 for a second DAGU DC motor.
32. Fasten the daguDCmotorBracketPiece1- coupling-couplingCollarBracket assemblies onto the bottomChassis part using seven M2.5 x 12 mm hex socket cap screws and M2.5 nuts.
33. Repeat steps 26-31 using daguDCmotorBracketPiece2 for the remaining DAGU DC motors.
34. Fasten the L298N motor driver onto the bottomChassis part using four M2.5 x 6 mm cross head screws.
35. Loosen the terminal blocks corresponding to OUT1, OUT2, OUT3, and OUT4.
36. When viewing the car from the rear, insert the red wire of the right-side motor's free end into the OUT1 terminal block and tighten it.
37. When viewing the car from the rear, insert the black wire of the right-side motor's free end into the OUT2 terminal block and tighten it.
38. When viewing the car from the rear, insert the red wire of the left-side motor's free end into the OUT3 terminal block and tighten it.
39. When viewing the car from the rear, insert the black wire of the left-side motor's free end into the OUT4 terminal block and tighten it.
40. Connect a female-female jumper wire from the pin above the ENA pin on the L298N motor driver to the pin located on row V, column 22 on the Arduino Mega Sensor Shield.
41. Connect a female-female jumper wire from the ENA pin on the L298N motor driver to the pin located on row S, column 22 on the Arduino Mega Sensor Shield.
42. Connect a female-female jumper wire from the IN1 pin on the L298N motor driver to the pin located on row S, column 23 on the Arduino Mega Sensor Shield.

43. Connect a female-female jumper wire from the IN2 pin on the L298N motor driver to the pin located on row S, column 24 on the Arduino Mega Sensor Shield.
44. Connect a female-female jumper wire from the IN4 pin on the L298N motor driver to the pin located on row S, column 25 on the Arduino Mega Sensor Shield.
45. Connect a female-female jumper wire from the IN3 pin on the L298N motor driver to the pin located on row S, column 26 on the Arduino Mega Sensor Shield.
46. Connect a female-female jumper wire from the ENB pin on the L298N motor driver to the pin located on row S, column 27 on the Arduino Mega Sensor Shield.
47. Connect a female-female jumper wire from the pin above the ENB pin on the L298N motor driver to the pin located on row V, column 23 on the Arduino Mega Sensor Shield.
48. Connect a male-male jumper wire from the VCC terminal block of the Arduino Mega Sensor Shield to the 5V terminal block of the L298N motor driver.
49. Connect a male-male jumper wire from the GND terminal block of the Arduino Mega Sensor Shield to the GND terminal block of the L298N motor driver.
50. When viewing the car from the rear, connect the female jumper wire that's already connected to the Gnd pin of the left HC-SR04 ultrasonic distance sensor to the pin located on row G, column AREF on the Arduino Mega Sensor Shield.
51. When viewing the car from the rear, connect the female jumper wire that's already connected to the Echo pin of the left HC-SR04 ultrasonic distance sensor to the pin located on row S, column 13 on the Arduino Mega Sensor Shield.
52. When viewing the car from the rear, connect the female jumper wire that's already connected to the Trig pin of the left HC-SR04 ultrasonic distance sensor to the pin located on row S, column 12 on the Arduino Mega Sensor Shield.
53. When viewing the car from the rear, connect the female jumper wire that's already connected to the Vcc pin of the left HC-SR04 ultrasonic distance sensor to the pin located on row V, column AREF on the Arduino Mega Sensor Shield.
54. When viewing the car from the rear, connect the female jumper wire that's already connected to the Gnd pin of the right HC-SR04 ultrasonic distance sensor to the pin located on row G, column 46 on the Arduino Mega Sensor Shield.
55. When viewing the car from the rear, connect the female jumper wire that's already connected to the Echo pin of the right HC-SR04 ultrasonic distance sensor to the pin located on row S, column 49 on the Arduino Mega Sensor Shield.
56. When viewing the car from the rear, connect the female jumper wire that's already connected to the Trig pin of the right HC-SR04 ultrasonic distance sensor to the pin located on row S, column 48 on the Arduino Mega Sensor Shield.
57. When viewing the car from the rear, connect the female jumper wire that's already connected to the Vcc pin of the right HC-SR04 ultrasonic distance sensor to the pin located on row V, column 46 on the Arduino Mega Sensor Shield.
58. Obtain one tailLightsRearBracket part, seven red LEDs, and seven yellow LEDs.
59. Insert the red and yellow LEDs through the holes of the tailLightsRearBracket with the anode leads inserted through the inner holes and the cathode leads inserted through the outer holes.
60. Make room for heat shrink installation of the anode leads by bending the cathode leads upwards.

61. Obtain a soldering jig and mount the tailLightsRearBracket-LED assembly by its mounting tab using one of the clips where the LED heads are pointing towards the workspace.
62. Obtain a 10k  $\Omega$  resistor and mount it to the remaining clip.
63. Orient both clips so that the resistor lead contacts the lead of an LED that is part of one of the anode rows.
64. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
65. Carefully place the tip of the soldering iron on the resistor lead-LED anode lead contact point and quickly apply solder before its surrounding components begin to melt.
66. Repeat steps 62-65 for the remaining LEDs of the anode row.
67. Repeat steps 62-66 for the two cathode rows and remaining anode row.
68. Obtain seven 2.5x45mm heat shrink insulation and cut them in half using flush cutter pliers.
69. Route all fourteen of the cut halves of the heat shrink insulation into the anode leads.
70. Obtain a BBQ lighter and apply heat to the heat shrink insulation until it has sufficiently shrunk.
71. Cut 2" of red or black 22 AWG wire from its spool.
72. Obtain wire cutters and cut into the insulation of the wire in  $\frac{1}{2}$ " increments starting from one of its free ends in preparation of stripping its insulation completely. There will be four cut increments total.
73. Starting from any cut point nearest to the wire's free end, carefully pull out the insulation toward the free end and repeat this for every  $\frac{1}{2}$ " cut increment until the wire is completely stripped of its insulation.
74. Grab the stripped wire  $\frac{1}{2}$ " from the free end and twist the free end until the section between the free end and the grab point until it is no longer frayed.
75. Grab the stripped wire  $\frac{1}{2}$ " away from the previous grab point but toward the frayed end and use the other hand to twist the wire at the same point until this section is no longer frayed and repeat this process until the wire is no longer frayed.
76. Repeat steps 71-75 for three more stripped wires.
77. Coil the stripped wire along each cathode lead once in its respective row until it's daisy chained completely.
78. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
79. Carefully place the tip of the soldering iron on each coil-lead joint and quickly apply solder before its surrounding components begin to melt.
80. After the coil-lead joints and its surrounding components cool down, trim excess stripped wire from the ends of this assembly.
81. Repeat steps 77-80 for the two anode lead rows and the remaining cathode lead row.
82. Obtain two black female-female and two red female-female jumper wires.
83. Using flush cutter pliers, cut each of the wires in half.
84. For each of the cut wires, strip  $\frac{1}{4}$ " of its insulation from the cut end.
85. For each modified wire, grab them by its insulation closest to the stripped end and use the other hand to twist the stripped end until it's no longer frayed.
86. For one of the cathode rows, coil the end of the partially stripped black wires onto the completely stripped wire that is coiled onto the cathode leads of the LEDs closest to the center.

87. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
88. Carefully place the tip of the soldering iron on the coil joint and quickly apply solder before its surrounding components melt.
89. Repeat steps 86-88 for the two anode lead rows with the red wires and the remaining cathode lead row with the black wire.
90. Obtain a roll of electrical tape with a width of  $\frac{7}{10}$ " and cut two pieces that are 1  $\frac{1}{2}$ " inches in length.
91. Sandwich these cut pieces of electrical tape onto one of the cathode rows so that the leads are completely covered.
92. Repeat steps 84 and 85 for the two anode lead rows and the remaining cathode lead row.
93. Repeat steps 58-92 to create a second set of taillights for the vehicle.
94. Obtain two tailLightsFrontBracket parts, eight M2.5 x 12 mm hex socket cap screws, eight M2.5 nuts, four tailLightSpacer parts, and the two fabricated taillights from steps 58-93.
95. Fasten the two tailLightsFrontBracket parts onto the exterior of the rearShellPart as shown in the figure below.
96. Fasten the four tailLightSpacer parts and the two fabricated taillights onto the interior of the rearShellPart as shown in the figure below.
97. When viewing the car from the rear, connect the red female jumper wire of the red LEDs of the right taillight to the pin located on row V, column 47 on the Arduino Mega Sensor Shield.
98. When viewing the car from the rear, connect the black female jumper wire of the red LEDs of the of the right taillight to the pin located on row G, column 47 on the Arduino Mega Sensor Shield.
99. When viewing the car from the rear, connect the black female jumper wire of the yellow LEDs of the of the right taillight to the pin located on row G, column 48 on the Arduino Mega Sensor Shield.
100. When viewing the car from the rear, connect the red female jumper wire of the yellow LEDs of the of the right taillight to the pin located on row S, column 47 on the Arduino Mega Sensor Shield.
101. When viewing the car from the rear, connect the red female jumper wire of the red LEDs of the left taillight to the pin located on row V, column 48 on the Arduino Mega Sensor Shield.
102. When viewing the car from the rear, connect the black female jumper wire of the red LEDs of the of the left taillight to the pin located on row G, column 49 on the Arduino Mega Sensor Shield.
103. When viewing the car from the rear, connect the black female jumper wire of the yellow LEDs of the of the left taillight to the pin located on row G, column 50 on the Arduino Mega Sensor Shield.
104. When viewing the car from the rear, connect the red female jumper wire of the yellow LEDs of the of the left taillight to the pin located on row S, column 46 on the Arduino Mega Sensor Shield.
105. Obtain two M4 x 12 mm cross head screws and fasten the male-female USB Type A cable onto the rearShell part.

106. Connect the male-female USB Type A cable into the USB Type A port of the Arduino Mega.
107. Obtain three M2.5x20mm male-female standoff screws and one M2.5x15mm female-female standoff screws and one M2.5x15mm female-female standoff screw and fasten them together in any order.
108. Repeat step 60 until there are four standoff assemblies comprising of three M2.5x20mm male-female standoff screws and one M2.5x15mm female-female standoff screws and one M2.5x15mm female-female standoff screw.
109. Obtain two standoff assemblies and two M2.5 x 12 mm hex socket cap screws and fasten them to the bottomChassis part using the mounting holes near the rear of the vehicle shown below.
110. Obtain one HC-SR04 ultrasonic distance sensor and four female-female jumper wires and insert them into the four pins of the sensor.
111. Obtain one sideShellLeft part and insert the sensor-wire assembly from step 110 through the large holes in the figure below from the flat side.
112. Insert four M2.5 x 16 mm hex socket cap screws through the four mounting holes near the sensor holes of the sideShellLeft part from the non-flat face of the sideShellLeft part in the figure below.
113. Insert sideShellToBottomChassisBracket through the threads of the four M2.5 x 16 mm hex socket cap screws from the flat face of the sideShellLeft part so that its mounting tabs mate onto the flat face.
114. Insert sideDistanceSensorBracket through the threads of the four M2.5 x 16 mm hex socket cap screws from the flat face of the sideShellLeft so that it mates with the mounting tabs of the sideShellToBottomChassisBracket part.
115. Fasten the side shell assembly using four M2.5 nuts
116. Repeat steps 110-115 with the sideShellRight part.
117. Obtain one of the side shell assemblies, four M2.5 x 8 mm hex socket cap screws, one rearToTopChassisLeftBracket, and one frontToTopChassisLeftBracket
118. Insert the four M2.5 x 8 mm hex socket cap screws from the side of the side shell assembly where the wheel arches protrude.
119. Insert the rearToTopChassisLeftBracket part through the threads of two M2.5 x 8 mm hex socket cap screws so that its flat side containing the mounting tab is facing outward.
120. Insert the frontToTopChassisLeftBracket part through the threads of the remaining M2.5 x 8 mm hex socket cap screws.
121. Fasten the rearToTopChassisLeftBracket and frontToTopChassisLeftBracket parts using four M2.5 nuts.
122. Repeat steps 117-121 using rearToTopChassisRightBracket and frontToTopChassisRightBracket parts.
123. Obtain two M2.5 x 12 mm hex socket cap screws and M2.5 nuts and fasten the side shell assemblies onto the bottomChassis part so that the mounting tabs of the rearToTopChassisLeftBracket and rearToTopChassisRightBracket are coincident with the rearShell part.
124. Obtain four M2.5 x 12 mm hex socket cap screws and M2.5 nuts and fasten the rearShell part to the side shell assemblies.

125. When viewing the car from the rear, connect the female-female jumper wire that's already connected to the VCC pin of the HC-SR04 ultrasonic distance sensor attached to the left side shell assembly to the pin located on row V, column 11 on the Arduino Mega Sensor Shield.
126. When viewing the car from the rear, connect the female-female jumper wire that's already connected to the Trig pin of the HC-SR04 ultrasonic distance sensor attached to the left side shell assembly to the pin located on row S, column 11 on the Arduino Mega Sensor Shield.
127. When viewing the car from the rear, connect the female-female jumper wire that's already connected to the Echo pin of the HC-SR04 ultrasonic distance sensor attached to the left side shell assembly to the pin located on row S, column 10 on the Arduino Mega Sensor Shield.
128. When viewing the car from the rear, connect the female-female jumper wire that's already connected to the Gnd pin of the HC-SR04 ultrasonic distance sensor attached to the left side shell assembly to the pin located on row G, column 11 on the Arduino Mega Sensor Shield.
129. When viewing the car from the rear, connect the female-female jumper wire that's already connected to the Gnd pin of the HC-SR04 ultrasonic distance sensor attached to the right side shell assembly to the pin located on row G, column 51 on the Arduino Mega Sensor Shield.
130. When viewing the car from the rear, connect the female-female jumper wire that's already connected to the Echo pin of the HC-SR04 ultrasonic distance sensor attached to the right side shell assembly to the pin located on row S, column 51 on the Arduino Mega Sensor Shield.
131. When viewing the car from the rear, connect the female-female jumper wire that's already connected to the Trig pin of the HC-SR04 ultrasonic distance sensor attached to the right side shell assembly to the pin located on row S, column 50 on the Arduino Mega Sensor Shield.
132. When viewing the car from the rear, connect the female-female jumper wire that's already connected to the Vcc pin of the HC-SR04 ultrasonic distance sensor attached to the right side shell assembly to the pin located on row V, column 53 on the Arduino Mega Sensor Shield.
133. Obtain three HC-SR04 ultrasonic distance sensors and twelve female-female jumper wires and connect each wire to the Vcc, Trig, Echo, and Gnd pins of each sensor.
134. Obtain the frontShell part and insert the three sensor-jumper wire assemblies through the holes shown in the figure.
135. Obtain and insert the frontDistanceSensorBracket into the interior of the frontShell part until its mounting holes are aligned with the corresponding mounting holes of the frontShell part. The part should be flush with the frontShell part and firmly pressed against the sensors.
136. Obtain the frontShellToBottomChassisBracket part and place it under the frontShell part and align its mounting holes to the corresponding mounting holes of the frontShell part.
137. While the mounting holes of the frontDistanceSensorBracket and frontShellToBottomChassisBracket parts are aligned with the mounting holes of the frontShell part, insert four M2.5 x 16 mm hex socket cap screws from the frontShellToBottomChassisBracket side and fasten the assembly together using four M2.5 nuts.
138. Obtain the bottomHeadLightRightRear part and four yellow LEDs.
139. Insert the leads of the LEDs through the tab mounting holes of the bottomHeadLightRightRear part with both leads of each LED pointing toward the flat surface, the cathode lead near the free surface of the mounting tab, and the anode lead near the surface of the mounting tab base.

140. Make room for heat shrink installation of the anode leads by bending the cathode leads upwards.
141. Obtain a soldering jig and mount the bottomHeadLightRightRear-LED assembly by the cathode lead of the LED that has both of its leads protruding the most towards the flat surface of the bottomHeadLightRightRear part using one of the clips.
142. Obtain a 10k  $\Omega$  resistor and mount it to the remaining clip.
143. Orient both clips so that a resistor lead contacts the mounted cathode lead.
144. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
145. Carefully place the tip of the soldering iron on the resistor lead-mounted cathode lead interface point and quickly apply solder before its surrounding components begin to melt.
146. Repeat steps 141-144 in a decrements of decreasing lead protrusion length toward the flat surface of the bottomHeadLightRightRear part.
147. Repeat steps 141-145 for the two anode rows and the remaining cathode row.
148. Obtain four 2.5x45mm heat shrink insulation and cut them in half using flush cutter pliers.
149. Route all eight of the cut halves of the heat shrink insulation into the cathode leads.
150. Obtain a BBQ lighter and apply heat to the heat shrink insulation until it has sufficiently shrunk.
151. Cut 2" of red or black 22 AWG wire from its spool.
152. Obtain wire cutters and cut into the insulation of the wire in  $\frac{1}{2}$ " increments starting from one of its free ends in preparation of stripping its insulation completely. There will be four cut increments total.
153. Starting from any cut point nearest to the wire's free end, carefully pull out the insulation toward the free end and repeat this for every  $\frac{1}{2}$ " cut increment until the wire is completely stripped of its insulation.
154. Grab the stripped wire  $\frac{1}{2}$ " from the free end and twist the free end until the section between the free end and the grab point until it is no longer frayed.
155. Grab the stripped wire  $\frac{1}{2}$ " away from the previous grab point but toward the frayed end and use the other hand to twist the wire at the same point until this section is no longer frayed and repeat this process until the wire is no longer frayed.
156. Repeat steps 151-155 for three more stripped wires.
157. Coil the stripped wire along each cathode lead once in its respective row until it's daisy chained completely.
158. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
159. Carefully place the tip of the soldering iron on each coil-lead joint and quickly apply solder before its surrounding components begin to melt.
160. After the coil-lead joints and its surrounding components cool down, trim excess stripped wire from the ends of this assembly.
161. Repeat steps 157-160 for the two anode lead rows and the remaining cathode lead row.
162. Obtain two black female-female and two red female-female jumper wires.
163. Using flush cutter pliers, cut each of the wires in half.
164. For each of the cut wires, strip  $\frac{1}{4}$ " of its insulation from the cut end.



165. For each modified wire, grab them by its insulation closest to the stripped end and use the other hand to twist the stripped end until it's no longer frayed.
166. For one of the cathode rows, coil the end of the partially stripped black wires onto the completely stripped wire that is coiled onto the cathode leads of the LEDs closest to the center.
167. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
168. Carefully place the tip of the soldering iron on the coil joint and quickly apply solder before its surrounding components melt.
169. Repeat steps 166-168 for the two anode lead rows with the red wires and the remaining cathode lead row with the black wire.
170. Obtain a roll of electrical tape with a width of  $\frac{7}{10}$  " and cut two pieces that are 1  $\frac{1}{2}$  " inches in length.
171. Sandwich these cut pieces of electrical tape onto one of the cathode rows so that the leads are completely covered.
172. Repeat steps 164 and 165 for the two anode lead rows and the remaining cathode lead row.
173. Repeat steps 138-172 using the topHeadLightRightRear part and four clear LEDs; the bottomHeadLightLeftRear part with four yellow LEDs; and the topHeadLightLeftRear part using four clear LEDs.
174. Obtain four M2.5 x 16 mm hex socket cap screws and insert them through the mounting holes on the exterior of the frontShell part below.
175. Obtain two topHeadLightSpacer parts and two topHeadLightToFrontBumper parts, insert them through the threads of the four M2.5 x 16 mm hex socket cap screws that were inserted through the frontShell part, and fasten them using four M2.5 nuts.
176. Obtain one M2.5 x 20 mm hex socket cap screw, one topHeadLightRightFront part, and the topHeadLightRightRear-clear LED assembly and mate them together like the figure below by inserting the screw through their center mounting hole.
177. When viewing from the frontShell assembly's interior, obtain one M2.5 nut and fasten this top right headlight subassembly to the right topHeadLightToFrontBumper part's bottom right mounting hole like in the figure below.
178. Obtain one M2.5 x 30 mm hex socket cap screw, insert it through the remaining mounting hole of the top right headlight subassembly and obtain one M2.5 nut and fasten it to the frontShell assembly.
179. Repeat steps 174-178 using the topHeadLightLeftRear-clear LED assembly,
180. Obtain the bottomHeadLightRightFront part, the bottomHeadLightRightRear-yellow LED assembly, one M2.5 nut, and one M2.5 x 25 mm hex socket cap screw and fasten it to the frontShell assembly like in the figure below.
181. Repeat step 180 with the bottomHeadLightLeftFront part and the bottomHeadLightLeftRear-yellow LED assembly.
182. Obtain the frontShellToTopChassisBracketRight part and the frontShellToTopChassisBracketLeft part and fasten it to the frontShell assembly using four M2.5 x 8 mm hex socket cap screws and four M2.5 nuts like the figure below.

183. When viewing the car from the rear, connect the female jumper wire that's already connected to the Echo pin of the right HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row S, column 35 on the Arduino Mega Sensor Shield.
184. When viewing the car from the rear, connect the female jumper wire that's already connected to the Echo pin of the right HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row S, column 34 on the Arduino Mega Sensor Shield.
185. When viewing the car from the rear, connect the female jumper wire that's already connected to the Vcc pin of the right HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row V, column 34 on the Arduino Mega Sensor Shield.
186. When viewing the car from the rear, connect the female jumper wire that's already connected to the Gnd pin of the right HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row G, column 34 on the Arduino Mega Sensor Shield.
187. When viewing the car from the rear, connect the female jumper wire that's already connected to the Echo pin of the center HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row S, column 32 on the Arduino Mega Sensor Shield.
188. When viewing the car from the rear, connect the female jumper wire that's already connected to the Trig pin of the center HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row S, column 31 on the Arduino Mega Sensor Shield.
189. When viewing the car from the rear, connect the female jumper wire that's already connected to the Vcc pin of the center HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row V, column 31 on the Arduino Mega Sensor Shield.
190. When viewing the car from the rear, connect the female jumper wire that's already connected to the Gnd pin of the center HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row G, column 31 on the Arduino Mega Sensor Shield.
191. When viewing the car from the rear, connect the female jumper wire that's already connected to the Trig pin of the left HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row S, column 6 on the Arduino Mega Sensor Shield.
192. When viewing the car from the rear, connect the female jumper wire that's already connected to the Echo pin of the left HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row S, column 5 on the Arduino Mega Sensor Shield.
193. When viewing the car from the rear, connect the female jumper wire that's already connected to the Vcc pin of the left HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row V, column 5 on the Arduino Mega Sensor Shield.
194. When viewing the car from the rear, connect the female jumper wire that's already connected to the Gnd pin of the left HC-SR04 ultrasonic distance sensor mounted on the frontShell part to the pin located on row G, column 5 on the Arduino Mega Sensor Shield.
195. When viewing the car from the rear, connect the red jumper wire routed from the top right head light and connect it to the pin located on row V, column 30 on the Arduino Mega Sensor Shield.
196. When viewing the car from the rear, connect the black jumper wire routed from the top right head light and connect it to the pin located on row G, column 30 on the Arduino Mega Sensor Shield.

197. When viewing the car from the rear, connect the red jumper wire routed from the bottom right head light and connect it to the pin located on row S, column 30 on the Arduino Mega Sensor Shield.
198. When viewing the car from the rear, connect the black jumper wire routed from the bottom right head light and connect it to the pin located on row G, column 29 on the Arduino Mega Sensor Shield.
199. When viewing the car from the rear, connect the red jumper wire routed from the bottom left head light and connect it to the pin located on row S, column 7 on the Arduino Mega Sensor Shield.
200. When viewing the car from the rear, connect the red jumper wire routed from the top left head light and connect it to the pin located on row V, column 7 on the Arduino Mega Sensor Shield.
201. When viewing the car from the rear, connect the black jumper wire routed from the bottom left head light and connect it to the pin located on row G, column 6 on the Arduino Mega Sensor Shield.
202. When viewing the car from the rear, connect the black jumper wire routed from the top left head light and connect it to the pin located on row G, column 7 on the Arduino Mega Sensor Shield.
203. Align the mounting tab holes of the frontShellToTopChassisBracketRight and frontShellToTopChassisBracketLeft parts with the mounting holes of the frontToTopChassisLeftBracket and frontToTopChassisRightBracket parts.
204. Place the vrsLearningKit assembly on its side like the figure below to prepare for standoff assembly installation.
205. Obtain one of the standoff assemblies from step 108 and align their female threads with one the remaining mounting holes of the bottomChassis Part and the remaining mounting holes of the frontToTopChassisLeftBracket and frontToTopChassisRightBracket parts and hold it in place with your hand.
206. While holding the standoff assembly in place, obtain one M2.5 x 12 mm hex socket cap screw and fasten the standoff assembly to the bottomChassis from underneath the vrsLearningKit.
207. Repeat steps 204-206 for the remaining standoff assembly.
208. Obtain the 6X 1.5V AA Battery Storage Case, inspect to see that the toggle switch is set to 'OFF', and remove its compartment cover.
209. Obtain six AA batteries and insert them into the 6X 1.5V AA Battery Storage Case.
210. Reinstall the 6X 1.5V AA Battery Storage Case compartment cover.
211. Trim the length of the red and black wires so that they are 4" in length.
212. Obtain wire cutters and strip  $\frac{1}{2}$ " of insulation from both wires' cut ends.
213. Grab the red wire by its insulation at a point nearest to the stripped end.
214. Using the other hand, grab and twist and the stripped end until it is no longer frayed.
215. Repeat steps 213 and 214 for the red wire.
216. Talk about soldering the black wire to the toggle switch and soldering the red wire to a wire with a male end.
217. Cut 6" of black 22 AWG wire from its spool.
218. Obtain wire cutters and strip  $\frac{1}{2}$ " of insulation from both wires' cut ends.

219. Grab the black wire by its insulation at a point nearest to one of the stripped ends.
220. Using the other hand, grab and twist and the stripped end until it is no longer frayed.
221. Repeat steps 219 and 220 for the remaining stripped end.
222. Obtain a soldering jig and mount the 6" black wire on one of the clips by its insulation 3" from one of the stripped ends.
223. Obtain one 2.5x45mm heat shrink insulation tube and cut it in half using flush cutter pliers.
224. Route one of the halves of the cut 2.5x45mm heat shrink insulation tube and route it through the black wire of the 6X 1.5V AA Battery Storage Case.
225. Obtain the black wire of the 6X 1.5V AA Battery Storage Case and mount it to the remaining soldering jig clip by its insulation 2" from its stripped end with the cut heat shrink insulation tube being able to readily be removed.
226. Coil the stripped end of the 6" black wire onto the stripped end of the 6X 1.5V AA Battery Storage Case black wire.
227. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
228. Carefully place the tip of the soldering iron on the coiled joint and quickly apply solder before its components begin to melt.
229. Move the cut heat shrink insulation tube and cover the soldered coiled joint.
230. Obtain a BBQ lighter and apply heat onto the cut heat shrink until it has shrunk to capacity.
231. Unmount the newly extended black wire of the 6X 1.5V AA Battery Storage Case from the clip closest to the stripped end.
232. Adjust the grab position of the extended black wire of the 6X 1.5V AA Battery Storage Case so that its respective clip mounts it 3" away from its stripped end.
233. Obtain one on-off-on toggle switch and mount it to the remaining soldering jig clip by its handle.
234. Route the stripped end through the common terminal of the on-off-on toggle switch and coil it.
235. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
236. Carefully place the tip of the soldering iron on the common terminal wire joint and quickly apply solder before its components begin to melt.
237. After the joint has cooled down, release the extended black wire of the 6X 1.5V AA Battery Storage Case from its respective clip.
238. Cut 10" of black 22 AWG wire from its spool.
239. Obtain wire cutters and strip ½" of insulation from both wires' cut ends.
240. Grab the black wire by its insulation at a point nearest to one of the stripped ends.
241. Using the other hand, grab and twist and the stripped end until it is no longer frayed.
242. Repeat steps 240 and 241 for the remaining stripped end.
243. Obtain a soldering jig with the on-off-on toggle switch already mounted and mount the 10" black wire on one of the clips by its insulation 3" from one of the stripped ends.
244. Route the stripped end through the on terminal of the on-off-on toggle switch and coil it.

245. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
246. Carefully place the tip of the soldering iron on the on-terminal wire joint and quickly apply solder before its components begin to melt.
247. After the joint cools, unmount the on-off-on toggle switch.
248. Adjust the grab position of the black wire soldered to the on-terminal of the on-off-on toggle switch so that it is mounted 3" from its stripped end.
249. Obtain the remaining half of the 2.5x45mm heat shrink insulation tube and route it through the stripped end of the black wire soldered to the on-terminal of the on-off-on toggle switch.
250. Obtain a male-male or male-female black jumper wire and cut it in half using flush cutter pliers.
251. Obtain wire cutters and strip ½" of insulation from the cut end.
252. Grab the cut male-male or male-female black jumper wire by its insulation at a point nearest to one of the stripped ends.
253. Using the other hand, grab and twist and the stripped end until it is no longer frayed.
254. Using the remaining soldering jig clip, mount the cut male-male or male-female black jumper wire 3" away from its stripped end.
255. Coil the stripped end of the 10" black wire onto the stripped end of the cut male-male or male-female black jumper wire.
256. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
257. Carefully place the tip of the soldering iron on the coiled joint and quickly apply solder before its components begin to melt.
258. Move the cut heat shrink insulation tube and cover the soldered coiled joint.
259. Obtain a BBQ lighter and apply heat onto the cut heat shrink until it has shrunk to capacity.
260. Release all components mounted on the clips of the soldering jig.
261. Obtain a male-male or male-female red jumper wire and cut it in half using flush cutter pliers.
262. Obtain wire cutters and strip ½" of insulation from the cut end.
263. Grab the cut male-male or male-female red jumper wire by its insulation at a point nearest to one of the stripped ends.
264. Using the other hand, grab and twist and the stripped end until it is no longer frayed.
265. Obtain a soldering jig and mount the red wire of the 6X 1.5V AA Battery Storage Case from step 214 3" away from its stripped end using one of the clips.
266. Obtain one 2.5x45mm heat shrink insulation tube and cut it in half using flush cutter pliers.
267. Route one of the halves of the cut 2.5x45mm heat shrink insulation tube and route it through the stripped end of the red wire of the 6X 1.5V AA Battery Storage Case
268. Mount the cut male-male or male-female red jumper wire by its insulation 3" away from its stripped end using the soldering jig's remaining clip.
269. Coil the stripped end of the red wire of the 6X 1.5V AA Battery Storage Case onto the stripped end of the cut male-male or male-female red jumper wire.

270. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
271. Carefully place the tip of the soldering iron on the coiled wire joint and quickly apply solder before its components begin to melt.
272. Move the cut heat shrink insulation tube and cover the soldered coiled joint.
273. Obtain a BBQ lighter and apply heat onto the cut heat shrink until it has shrunk to capacity.
274. Release all components mounted on the clips of the soldering jig.
275. Cut 8" of red 22 AWG wire from its spool using flush cutter pliers.
276. Obtain wire cutters and strip ½" of insulation from both wires' ends.
277. Grab the 8" red wire by its insulation at a point nearest to one of the stripped ends.
278. Using the other hand, grab and twist and the stripped end until it is no longer frayed.
279. Repeat steps 277 and 278 for the remaining stripped end.
280. Obtain a soldering jig and mount the 8" red wire on one of the clips by its insulation 3" from one of the stripped ends.
281. Obtain one on-off-on toggle switch and mount it to the remaining soldering jig clip by its handle.
282. Route the stripped end through the on-terminal of the on-off-on toggle switch and coil it.
283. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
284. Carefully place the tip of the soldering iron on the on-terminal wire joint and quickly apply solder before its surrounding components begin to melt.
285. After the joint cools, unmount all components.
286. Obtain the T Type 9V Battery Clip and trim both wires to a length of 2" using flush cutter pliers.
287. Obtain wire cutters and strip ½" of insulation from both wires' ends.
288. Grab the red wire by its insulation at a point nearest to its stripped end.
289. Using the other hand, grab and twist and the stripped end until it is no longer frayed.
290. Repeat steps 288 and 289 for the black wire.
291. Cut 7" of red 22 AWG wire from its spool using flush cutter pliers.
292. Obtain wire cutters and strip ½" of insulation from both wires' ends.
293. Grab the 7" red wire by its insulation at a point nearest to one of the stripped ends.
294. Using the other hand, grab and twist and the stripped end until it is no longer frayed.
295. Repeat steps 293 and 294 for the remaining stripped end.
296. Obtain a soldering jig and mount the T Type 9V Battery Clip's red wire on one of the clips by its insulation ½" from one of the stripped ends.
297. Using the remaining soldering jig clip, mount the 7" red wire 3" away from one of its stripped ends.
298. Obtain a 2.5x45mm heat shrink tube and cut it in half using flush cutter pliers.
299. Route one of the cut 2.5x45mm heat shrink tube halves through the mounted 7" red wire.
300. Coil the stripped end of the red wire of the T Type 9V Battery Clip onto the stripped end of the 7" red wire.

301. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
302. Carefully place the tip of the soldering iron on the coiled joint and quickly apply solder before its components begin to melt.
303. Move the cut heat shrink insulation tube and cover the soldered coiled joint.
304. Obtain a BBQ lighter and apply heat onto the cut heat shrink until it has shrunk to capacity.
305. Release all components mounted on the clips of the soldering jig.
306. Repeat steps 291-305 using black 22 AWG wire and the T Type 9V Battery Clip's black wire.
307. Obtain a soldering jig and mount the extended red wire of the T Type 9V Battery Clip on one of the clips by its insulation 3" from one of the stripped ends.
308. Obtain the on-off-on toggle switch with the 8" red wire soldered on and mount it to the remaining soldering jig clip by its handle.
309. Route the stripped end of the T Type 9V Battery Clip's red wire through the common terminal of the on-off-on toggle switch and coil it.
310. Obtain a soldering iron, turn it on and adjust its temperature settings to a temperature that is sufficient for the solder being used.
311. Carefully place the tip of the soldering iron on the coiled joint and quickly apply solder before its components begin to melt.
312. Obtain the 9VbatteryBracket part and the T Type 9V Battery Clip with the toggle switch attached and loop its clip through the rectangular hole like the figure below.
313. Obtain a 9 V Battery and attach the T Type 9V Battery Clip with the toggle switch attached to its terminals.
314. Mate the 9 V Battery coincident with the inner face containing the rectangular hole like the figure below.
315. Obtain the male DC barrel jack with screw terminals and loosen its terminals using a cross head screwdriver.
316. Insert the remaining stripped end of the red wire of the T Type 9V Battery Clip with the toggle switch attached into the '+' terminal of the male DC barrel jack with screw terminals.
317. Insert the remaining stripped end of the black wire of the T Type 9V Battery Clip with the toggle switch attached into the '-' terminal of the male DC barrel jack with screw terminals.
318. Using a cross head screwdriver, tighten the screws corresponding to the '+' and '-' terminals of the male DC barrel jack.
319. Obtain the topChassis part and the 9VbatteryBracket containing the 9 V battery and fasten them together using four M2.5 nuts and four M2.5 x 12 mm hex socket cap screws like the figure below.
320. Obtain the 6X 1.5V AA Battery Storage Case and slide the toggle switch to 'ON'.
321. Obtain the AAbatteryPackBracket part and insert the 6X 1.5V AA Battery Storage Case's cavity like the figure below.
322. Fasten the AAbatteryPackBracket containing the 6X 1.5V AA Battery Storage Case to the topChassis part using four M2.5 x 12 mm hex socket cap screws and four M2.5 nuts like the figure below.

323. Fasten the two on-off-on toggle switches to the topChassis part using their included hex nut and washers like the figure below.
324. Loosen the VCC screw terminal of the L298N motor driver using a cross head screwdriver, insert the red male wire from the topChassis assembly and tighten the terminal using the same tool.
325. Loosen the GND screw terminal of the L298N motor driver using a cross head screwdriver, insert the black male wire from the topChassis assembly and tighten the terminal using the same tool.
326. Plug in the male DC barrel jack from the topChassis assembly and plug it into the female DC barrel jack of the Arduino Mega.
327. Fasten the topChassis assembly to the vrsLearningKit using four M2.5 x 12 mm hex socket cap screws like the figure below.
328. Fasten the four wheels to the vrsLearningKit using four M4 x 12 mm cross head screws.