Appendix B

B-1. Assembly Instructions

B-1.1. Electronic Assembly

On the PC controller board there are 18 rows and 14 columns which are utilized for wiring components. The rows are numbered starting from the bottom from P0 to P15. The row above row P15 will be referred to as row 16 and the row above that will be referred to as row 17. The columns are not numbered on the PC board. They will be referred to as columns 1 through 14 with column 1 starting at the left side of the board. The side of the board closest to row P0 will be referred to as the bottom of the board. The side of the board closest to row 17 will be referred to as the top of the board. The holes in the board will be identified by a row, column coordinate system notated by parenthesis containing first the row identifier then the column identifier as such, (row, column). Wire size used to wire the controller board is 24 AWG.

1. Place the 16 pin H-bridge socket onto the board with the socket straddling the Vdd and Vss traces running down the middle of the board. Place the bottom left pin of the socket into (P0,5). Be sure the notched side of the socket is facing toward the top of the board. Solder the pins. Insert the 16 pin H-bridge into the socket.

2. Place a 100KΩ resistor into (P9,4) and (P12,4). Solder and cut off excess leads.

3. Place a 100pF ceramic capacitor into (P13,3) and (P15,3). Solder and cut excess leads.

4. Place a 50KΩ resistor into (17,1) and (17,3). Solder and cut excess leads.

5. Place a 2 pin plug into (P15,10) and (P14,10). Solder to board.

6. Place a 3 pin plug into (P13,10), (P12,10) and (P11,10). Solder.

7. Wire (P1,1) to (P1,3).
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8. Wire (P2,1) to (16,1).

9. Wire (P6,1) to (P6,3).

10. Wire (P7,1) to (P9,3).

11. Wire (P7,2) to (P11,8).

12. Wire (P2,3) to (P14,8).

13. Wire (P3,3) to (P9,7).

14. Wire (P4,3) to (P8,7).

15. Wire (P5,3) to (P15,8).

16. Wire (P7,3) to (P9,6).

17. Wire (P12,3) to (16,6).

18. Turn the board over and wire (P0,3) to Vss, running the wire along the underside of the board.

19. Wire (16,4) to (P13,8).

20. Wire (P13,5) to (P12,8).

21. Wire (P15,5) to (P15,7).

22. Wire (P10,6) to (P7,10).
23. Connect the positive and negative solenoid leads into the 2 pin socket that plugs into the 2 pin plug at (P15,10) and (P14,10). Be sure that the lead corresponding to the positive voltage polarity when the solenoid is opened is the lead that corresponds to (P15,10) when the socket is plugged into the board. If this is not so the solenoid will not operate properly.

24. Connect the two leads from the potentiometer into the 3 pin socket that plugs into the 3 pin plug at (P13,10), (P12,10) and (P11,10). Be sure that the potentiometer leads correspond to (P13,10) and (P12,10) when the socket is plugged into the board. The orientation of the two potentiometer leads into the socket holes corresponding to (P13,10) and (P12,10) does not matter, however, be sure that the leads are connected to the potentiometer such the when the potentiometer dial is turned all the way counter-clockwise the resistance between the two leads is zero. If this is not so the system will not operate properly.

25. Connect the output labeled ‘0’ on the output bank on the receiver board to the 3 pin socket that plugs into the 3 pin plug at (P13,10), (P12,10) and (P11,10). Be sure that this leads corresponds to (P11,10) when the socket is plugged into the board.

26. Connect wires from the 12V input on the controller board to the 12V input on the receiver board. Connect and run these wires along the underside of the board.

27. Connect a battery plug to the voltage input at the top left side of the board. This input is labeled Vss and Vin and is located left of the 9V battery plug. Be sure the ground wire is connected to the hole labeled Vss and the positive wire is connected to the hole labeled Vin.

28. Ground the metal housing by connecting a ring connector to any of the four screws on the board and connecting that screw to the metal housing with the nut that fastens the antenna into place.
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B-1.2. Mechanical Assembly

To begin this phase of the assembly process, it is assumed that the builder has moderate machining skills. Each of the prototype assemblies was constructed using only a drill press and the band saw. Figures 12 and 13 depict the final product.

B-1.2.1. Receiver Assembly

Figure 12. Sensor Assembly.

1. Each of the tapped holes (4 supporting the PCB and 4 supporting the battery tray) must be drilled and tapped to a 4-40.
2. Use 4-40x1.25” screws to support the PCB standoffs.
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3. Use 4-40x.75” female to female standoffs to support the PCB.
4. Use 4-40x.25” button head screws to support the battery tray. Insert the screws from inside of the enclosure.
5. Drill the .25” hole for the antenna mast.
6. Drill the 1” hole on the door using a sheet metal bit for the lens.
7. Cut a piece of Plexiglas to the inside dimensions of the door seal. Align the Plexiglas to the door and drill holes to align with the grounding stud and the 1” lens opening.
8. Apply silicone to the lens and mount the Plexiglas.
9. Apply pressure to the Plexiglas for several hours and place a nut and washer on the grounding stud.
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B-1.2.1. Receiver Assembly:

1. Cut a 5.2”x5.2” piece of aluminum.
2. Drill and countersink the 4 large holes to mount the tray.
3. Drill the 4 holes for each PCB.
4. Use any length female to female standoff to mount the PCBs.
5. Drill the .25” hole in the housing for the antenna mast.
6. Drill the .25” hole in the housing for the trimpot.

Figure 13. Controller Assembly.
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7. Drill the two holes for the valve.
8. Mount the tray inside of the housing and install the valve.
9. Align the solenoid such that the valve fully closes and opens.
10. Mark the solenoid position.
11. Drill and tap 4-40 holes into the tray.
13. Install the solenoid.