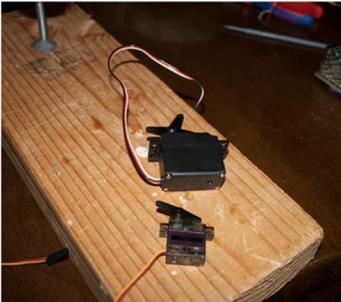


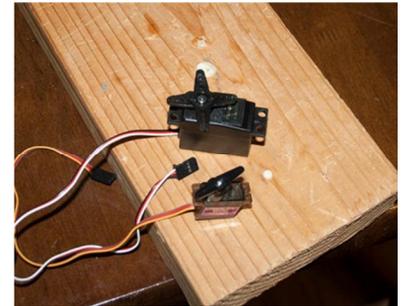


OK today I'm going to do write up about the three axis skull I built. The concept with this project was to make a three axis skull using only basic hand tools, an angle grinder, jigsaw and drill. While I have access to machinery like a lathe and mill I wanted to make this project without machinery so that with simple tools this skull could be reproduced by anyone. First of all the skull I used was the head of a full size "Pose n Stay" skeleton from Costco. First I removed the head of the skeleton, it simply popped off. I then cut a small hole in the bottom which I later

enlarged to accommodate the workings of the skull. Then I cut the top of cranium off with a utility knife, the plastic was very soft and rather thin. After that, I did some work on the jaw. The jaw was tight in its joints and required some whittling to loosen it up. Now that I had a skull that was opened up and had loosened the jaw I was ready to create a new design for the mechanics of the head. It seems to me that most people waaaaay over engineer their props, by using hardware and servos that can support the weight of a VW bug, not really, but you get what I am saying. First of all I chose to use micro servos instead of full size servos. Part of this choice



was because small servos were cheaper, and the "Pose n Stay" skulls are a little bit smaller than a full size skull. The micro servos are probably strong enough to move around a heavier skull, but they definitely have no problem with this "Pose n Stay" skull. The servo's I used however were quite noisy and poor quality. On my next skull I think I'll use better quality servos. Most of the designs that I



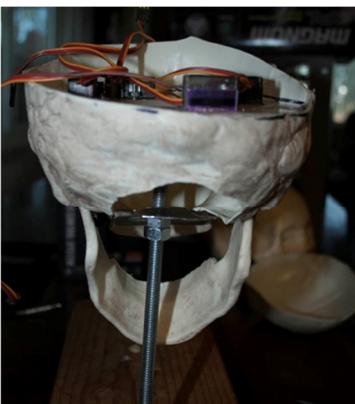
looked at in researching this project required machining and fabricating the hardware in a way that I was capable of, but not everyone has access to machines that can do this kind of fabrication. What I decided to do was use a piece of 5/16 zip bolt, and fabricate a washer and a collar to hold up the head. As you can see in the picture, the washer and collar were domed out. I did this to assist the skull in centering itself. I



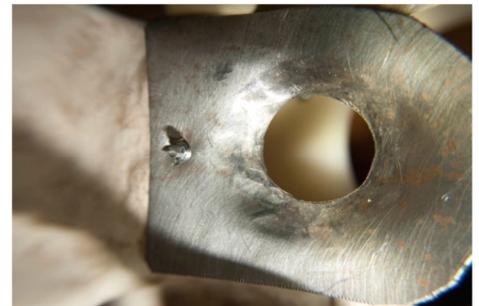
accomplished this with the ball peen hammer. I placed the washer on a sandbag and pounded it which domed it out. I did the same for the collar. Another way to dome out the washer is to pound it while resting on the end of a 1 inch iron pipe. The domed washer was a 5/16 fender washer and the metal used for the collar is 14 gauge mild steel sheet. The collar was made by drilling a 3/4 inch hole and cutting it out with snips. Since this is a



lightweight skull the 14 gauge steel has more than enough strength to support it.



While I haven't tested it, (I plan to soon though) I think the 14 gauge steel will be strong enough to support a heavier skull such as the ones used by others (i.e. A Bucky or Lindbergh skull). Although this method of creating a neck joint does not offer as precise positioning of the skull it works quite well and does not require expensive hardware or custom



fabrication of the bolt. As you can see in the picture the top of the 5/16 bolt has a piece of 4-40 threaded rod on top. The reason why I chose to use a piece of

threaded rod instead of tapping a 4-40 thread was because I tried it! After breaking two taps and wrecking the 5/16 zip bolt, I decided it would be much easier to drill a hole in the end of the zip bolt and glue in a piece of 4-40 rod. I used Steel epoxy to glue it in. The type I used is the kind that comes in a clear cylinder and is rather like dough. You knead it up and that mixes the two parts together. You have about 5 minutes or less to get it positioned the way you want it and it then hardens rather quickly and sticks to just about anything. It can supposedly be machined because it's so strong. I've used it a lot in various projects and crafts and have liked



it very much for its quick curing and easy handling properties. I also used it to glue the 5/16 rod into the board and to glue some of the hardware into the skull. I don't have a picture of the package but you can find it at any of the big box hardware stores (Home Depot, Lowe's, etc.). You can also find all of the hardware and materials I used to build this project with the exception of the servos, their associated hardware and the skull, there as well. I used the angle grinder to round off the edge of a nut pictured here. While this is not necessary it did make the washer sit

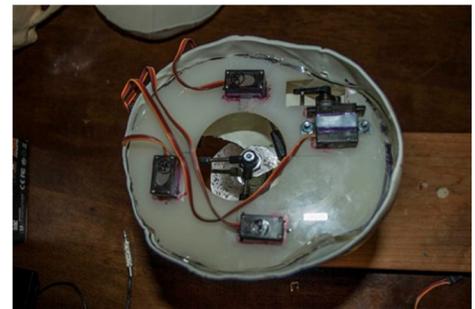
better. The nice thing about this neck assembly is that it's fully adjustable, as far as height is concerned, along the 5/16 rod which makes measurements not as critical. I used another small piece of 14 gauge steel to make a bracket that bolts directly to the 5/16 rod as pictured here. The servo that



turns the head side to side attaches to this bracket. I made this bracket by first drilling a 5/16 hole and then trimming down the piece of metal to make the bracket the size I wanted that way I had something to clamp onto so that I could drill a hole without getting hurt. After I cut the bracket to the shape I wanted I then drilled the small hole. Again measurements here are not critical. I think the hardest



piece to make, at least the piece that took me the longest to make was the Plexiglas plate that the servo's are mounted to. I used a piece of Plexiglas that I had kicking around I would definitely recommend using clear Plexiglas as it would have made this task easier. Using the angle grinder with a sanding pad on it I ground the shape of the inside of the skull I didn't try to get precise, well actually it did try, but it didn't turn out as good as I wanted. By trade I'm a carpenter, and so scribing this plastic to the inside of the skull is something I should be good at. I probably spent way too much time shaping the plastic because



ultimately I glued it in with hot glue which does a great job filling in gaps and cracks. I used a jigsaw to cut out the square holes that the servos go through and to rough cut the outside shape of the Plexiglas before grinding it to fit inside the skull. When I was cutting one of the holes for a servo I cracked the Plexiglas plate and had to glue it which worked fine, but make sure you have some special Plexiglas glue because regular glues don't



bond Plexiglas very well. I used the hole saw to cut out the circle in the center of the plate. Because I know somebody's going to ask the hole I drilled out is 2 inches in diameter. To mount the jaw servo to the plate I used a small piece of plumbers strap that a cut in half lengthwise and drilled the two holes in it.

The most difficult thing to fabricate was the threaded rod pieces that tie the servo's to the connection points on the threaded rod. The 4-40 rod I used was stainless steel and very hard. I used a hand file to clean up the places where I cut it and a used some heavy duty cutting pliers to cut the rod. I got all fancy on the jaw servo



linkage and Bent an "S" bend in the end of it mostly because I was too cheap to use additional hardware ends. Overall I think everything turned out quite well and as far as cost is concerned the hardware was only a couple of dollars, and easy to fabricate. I actually spend more on the linkage for the servos than anything else including the



servos and skull. I actually have posted a video of this skull in action on my YouTube channel; you can check it out [here](#). Here are some extra pictures.

