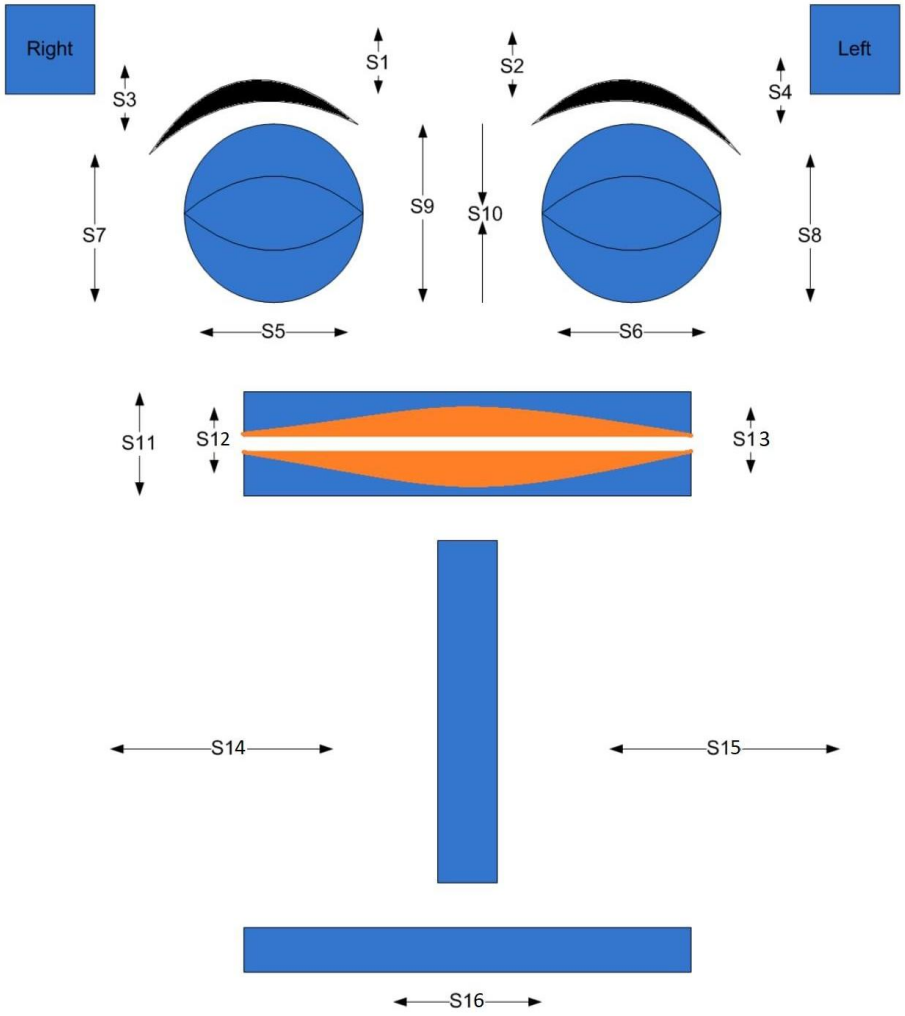
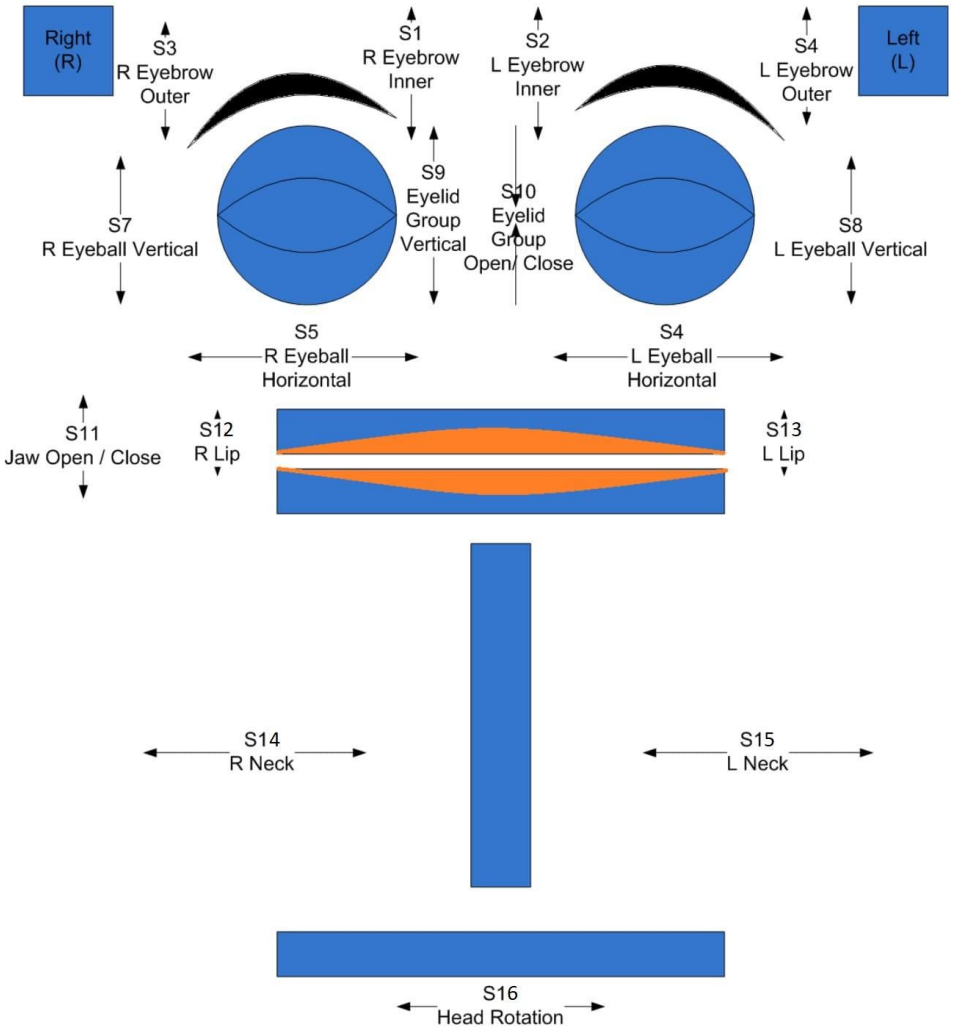
Robot Report

Team 6 - CSE 564

1. Design



2. Movements


Right (R)
S3 R Eyebrow Outer
S1 R Eyebrow Inner
S2 L Eyebrow Inner
S4 L Eyebrow Outer
Left (L)
S7 R Eyeball Vertical
S9 Eyelid Group Vertical
S10 Eyelid Group Open/ Close
S8 L Eyeball Vertical
S5 R Eyeball Horizontal
S4 L Eyeball Horizontal
S11 Jaw Open / Close
S12 R Lip
S13 L Lip
S14 R Neck
S15 L Neck
S16 Head Rotation

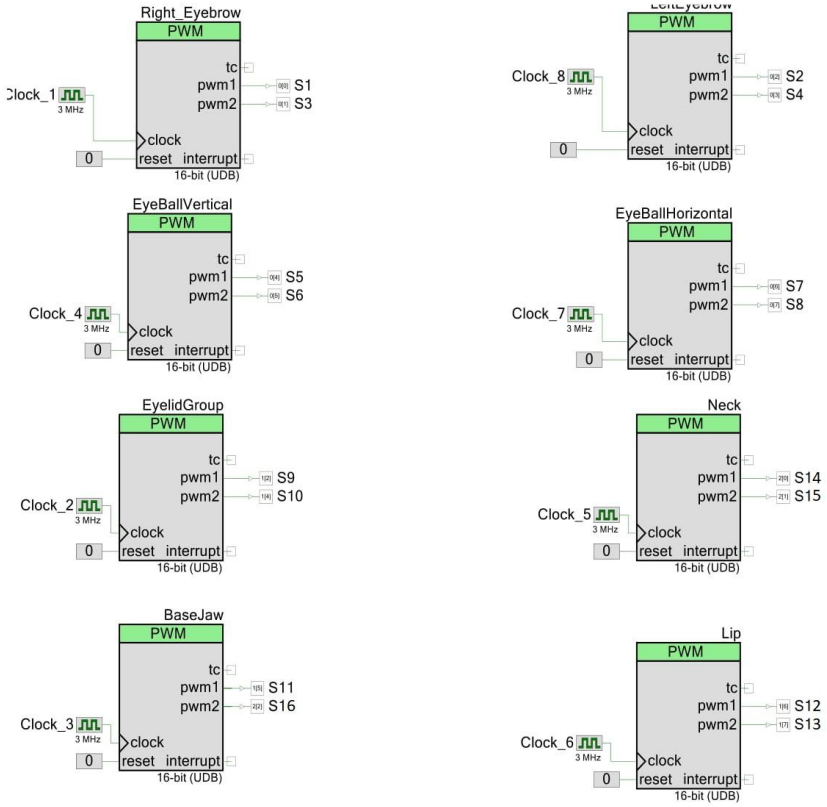
3. Servo Motors and Wires Nomenclature

↓Wires (Brown, Red, Yellow)	Servo Motors →															
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16
B	1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46
R	2	5	8	11	14	17	20	23	26	29	32	35	38	41	44	47
Y	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48

Servo Motor Description AND Mapping of Servo Motors

Description	Servo Motor Number	Port
Right Eyebrow Inner	S1	0.0
Left Eyebrow Inner	S2	0.2
Right Eyebrow Outer	S3	0.1
Left Eyebrow Outer	S4	0.3
Right Eye Ball Horizontal	S5	0.4
Left Eye Ball Horizontal	S6	0.5
Right Eye Ball Vertical	S7	0.6
Left Eye Ball Vertical	S8	0.7
Eyelid Group Vertical	S9	1.2
Eyelid Group Open Close	S10	1.4
Jaw Open Close	S11	1.5
Right Lip	S12	1.6
Left Lip	S13	1.7
Right Neck	S14	2.0
Left Neck	S15	2.1
Base – Head Rotation	S16	2.2

4. Pulse Width Modulation (PWM) Layout (with their Unified Names)



Team Experience

Building this social robot as part of this class helped us gain valuable technical expertise as we developed problem solving abilities along with teamwork. Throughout this experience we learned the value of collaboration. Not only within our own team, but with every other team. This is important because we have been taught software design is not a competition between groups instead it is all a team effort in the improve everyone's design.

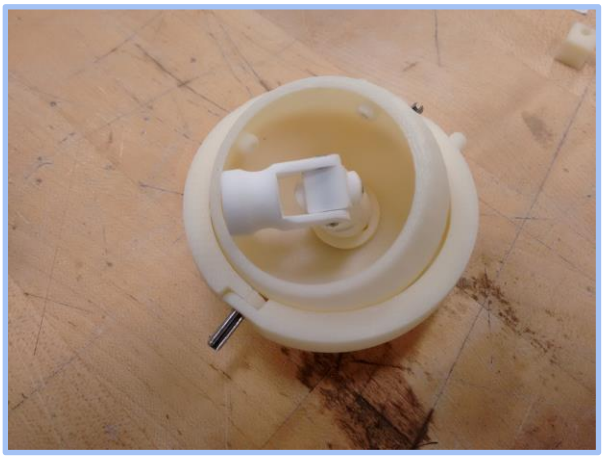
The robot was printed using 3D printers available to us in the Startup lab. Other pieces, such as brass rod, servos motors, and wire were ordered from online vendors. This itself proved to be a challenge because some of the parts were coming from China with shipping rate more expensive than the parts. Team collaboration was used here to be able to order multiple parts so that we could all get everything we need for a cheaper price than getting everything separately. The Servos motors had a shipping time from Amazon that was a very long wait, over a month. I was able to find similar motors on ebay, and shared with the rest of the class.

When we finally got everything printed and shipped we got to work on the robot a few Saturdays throughout the semester. We all were there every Saturday, and worked very well together solving all disagreements without too much trouble. Although we faced several challenges we were able to successfully complete the robot.

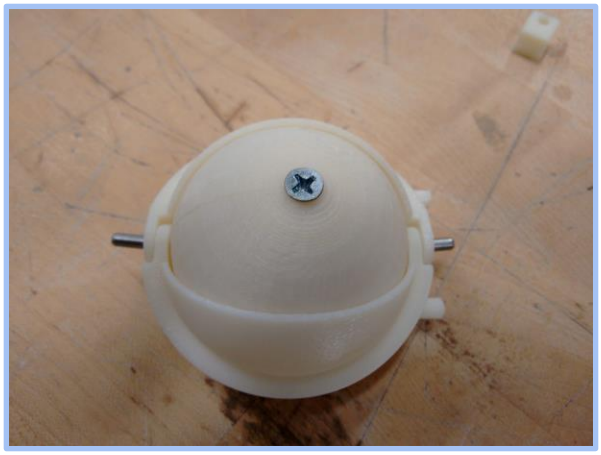
Challenges faced and their Solutions:

While building the robot we were faced with issues before the robot even took his first "breath". The first issues we ran into were the first three listed regarding the eyes:

1. ***Universal joint for eye ball*** – The original universal joins printed using PLA material were very delicate. For several teams, including us, parts of this universal joint broke while assembling the eye together. This happened because too much pressure was required to screwing the pupil into the universal joint that mounted the eyeballs to the rest of the skeleton. These pieces were then replaced for every team, by the more durable material Nylon. These universal joints were not as fragile but they also contained a design flaw, they were slightly too long causing the eyeballs to push up against the eyelids when mounted onto the skeleton. Luckily, this flaw was brought to the professor's attention and the issue was quickly resolved by shaving off part of the end of the universal joint such that the eyelids easily cleared the eyeball. Below is an image of the new, Nylon, universal joint used:



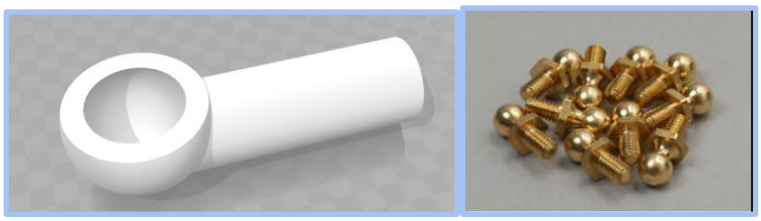
2. ***Eyelids*** – The eyelids were to be attached to the robot skeleton by adding a pin through holes making sure to go through both the skeleton and both of the eyelids. This pin ensured the eyelids were held in an upright position so that the eyelids were able to freely move up and down. The issue with this was that the pinholes on all four of the eyelids was too small, the pin could not fit. This was easily fixed by finding an appropriate drill bit sized to make the hole larger so that the pins can fit through it. Shown below is an image of the pin fitting the eyelids as described:



3. ***Pupils for the eye*** – The pupils for the eyeball was simply a screw attached to the center of the eyeball. This screw was also used to attach the eyeball to the universal join. The issue we faced with the screw was that it was protruding in such a way that it was scraping up against the eyelids when they would open and close. Again, we were lucky other teams brought this to everyone's attention before everything was glued in place. To fix this issue the hole for the screw was made larger using a drill bit so that the screw could go all the way in and the end of the screw was flush with the rest of the eyeball. Below is an image that shows the screws slightly projected outward causing eyelids to run into the screws.

After assembly the robot these were issues we ran into due to moving parts:

4. ***Ball socket*** – The ball connector had to be assembled with the PLA printed part to facilitate the ball movement with the rod. The brass rods used for the eye and eyelid movements had to be glued multiple times to the ball socket.



5. ***Motor Overheating*** – We had to replace 3 motors as the motors failed due to overheating and power supply fluctuations. This was due to movement beyond the rotation angles for the motor. We rectified this by adjusting the values of the movement.

6. ***Left eyeball movement*** – We faced issues while moving the left eyeball horizontally and had to file the universal joint to get the proper movement.

7. ***Numeric values for Motors***- Every motor has a certain numeric value which describes its range of motion and had to be adjusted accordingly for different movements.

8. ***Getting the facial expressions in sync***. As the motors were symmetric so if we tell the left eyebrow and the right eyebrow to go up with the same value, one goes up and the other comes down.