



INDIAN INSTITUTE OF TECHNOLOGY

THE KATHPUTLI SHOW

ES 408 PROJECT REPORT

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AUTHORS

HARSH MANDALIA 19110186

PANKAJ KHATTI 22210027

UNDER THE GUIDANCE OF:

PROF. MADHU VADALI

Introduction

Puppeteers from different regions conduct their shows in their colloquial languages, limiting communication effectiveness to the audience who know the language. Our objective is to make an automatic puppet dance show which a different perspective of mechatronics.

There are different types of puppets in the market. We chose hand puppets (marionettes), having different degrees of freedom like the movement of hands, legs, head etc., but we chose the puppet having DOF on their hands and the head.

We watched different videos of puppets and observed the movement of hands and head, and with the help of programming, we choreographed puppets with a traditional song.

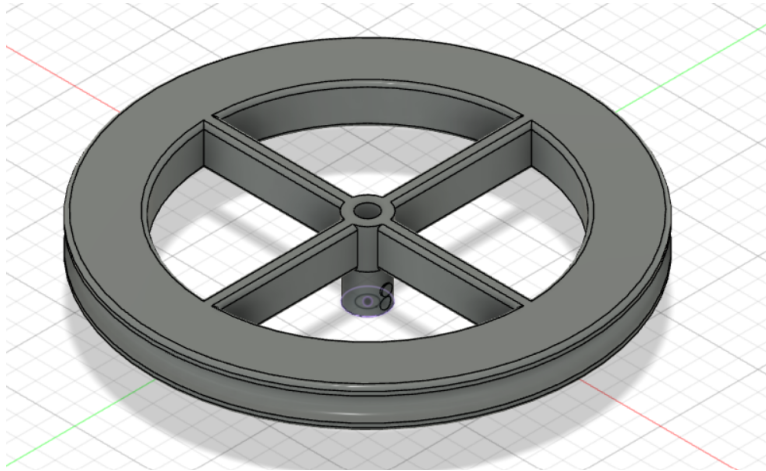
Puppet pictures

We ordered puppets from Amazon. Here are some pictures of the puppets.



Construction

We decided to use servo motors to provide hand movement to the puppet. With the MG90 servo motor, the hand movement is very less, so we decided to use the pulley having an outer diameter equal to the total displacement of the hand.

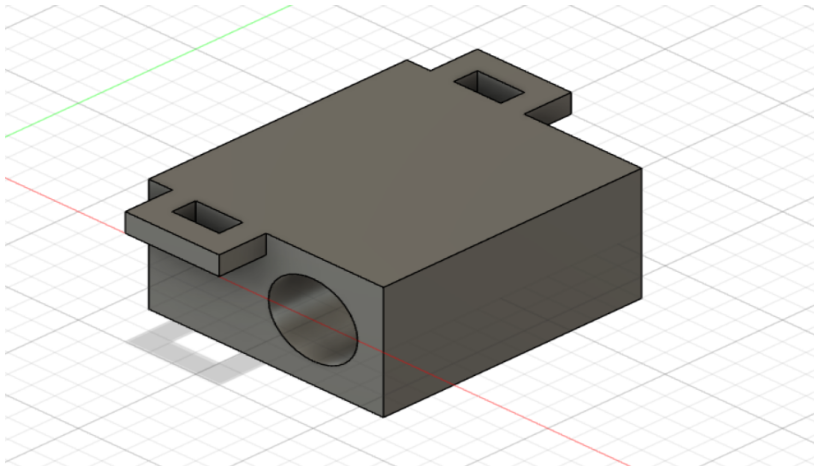


We used screws to connect the servo motor with the pulley with the help of the servo horn. For the high strength of the thread, we used a fishing rope.

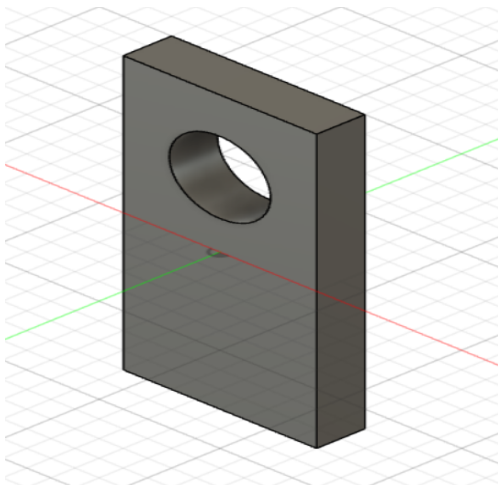
For the transverse motion of the puppet, we use a linear actuator setup. Where we used the stepper motor with the belt and the pulley drive.



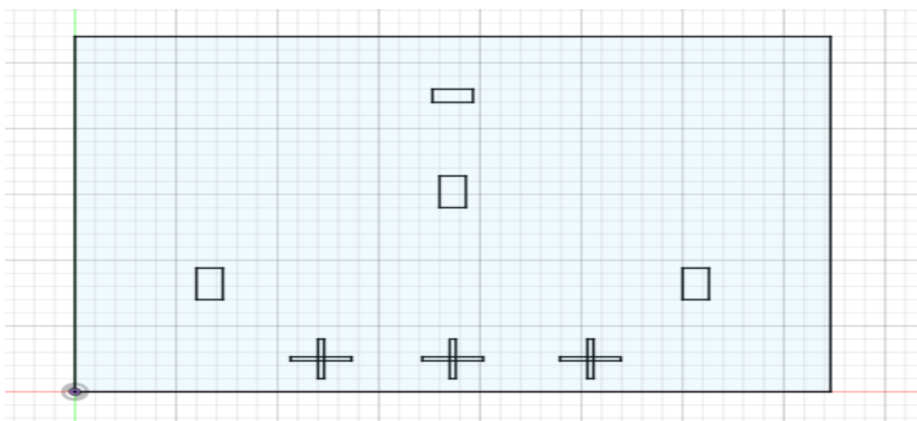
As you can see, we have made a frame out of aluminium extrusion and used M5 bolts to connect the 10mm rod.



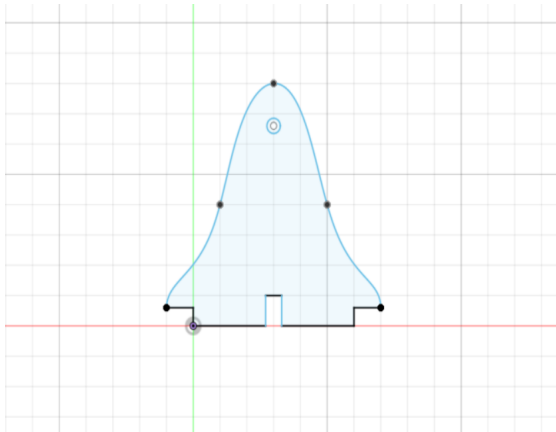
We 3D-printed two of these parts to mount the linear bearing and belts.



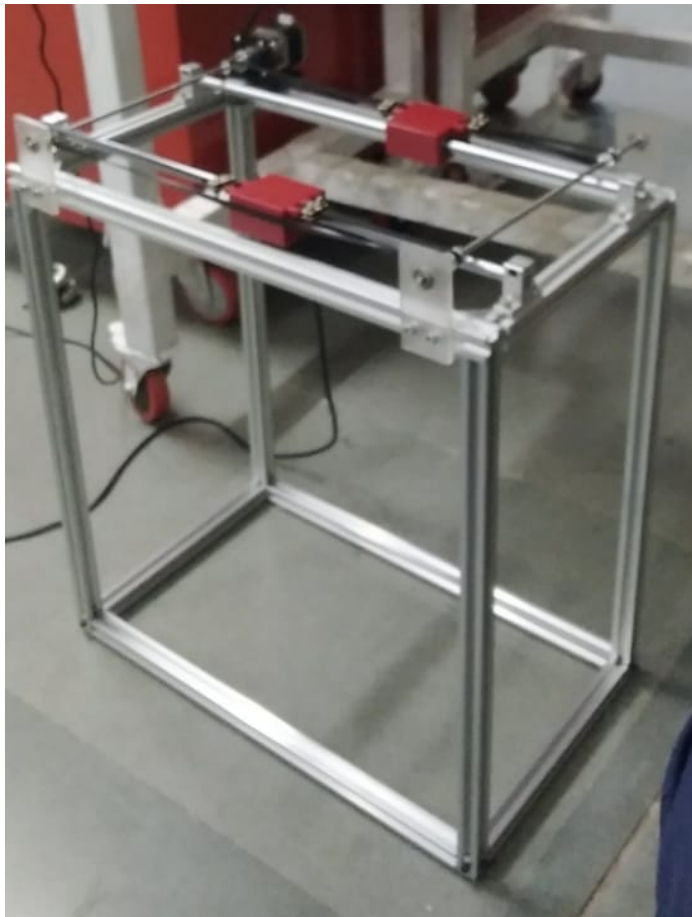
To support the belt pulley system, we 3d-printed 3 of these parts such that the ball bearing can fit inside.



We created a base platform with space for three servo motors and a gap for the jumper wires.



We created three stands as shown above to direct the fishing rope and give it height the same as the pulley.



We used the aluminum extrusion to provide the height for the complete setup.

Part list

Sr. No.	Name	Specs	Quantity
1	Puppet		1
2	MG90		3
3	20 teeth pulley belt	5mm ID pully	1
4	Stepper motor	dia 5mm (NEMA 17)	1
5	Stepper motor driver	TB6600	1
6	Rod	10mm ID, 1m	1
7	10MM linear bearing rail support		4
8	linear bearing	10mm	2
9	ball bearing	5mm ID	3
10	coupler	5mm-5mm	1
11	Aluminum Extrusion	1m, 20x20	3
12	Corner Bracket	4 pieces, 20x20	3
13	Rod	5mm, 1m	1
14	4 bearing	5mm ID	1
15	Sliding T Nut	10 pcs	3
16	bolts	M5 (5mm)	
17		M5 (8mm)	
18	SMPS	12V	1
19	Arduino UNO		1
20	Buck Converter		1
21	breadboard		1
22	Fishing rope	2m	1

Control for the Puppet

We use the Arduino UNO for providing the command to stepper and servo motor. Stepper motor controller is powered by SMPS which converts 220v to 12v power supply. We used a buck converter to get 6v from a 12v power supply, and used this 6v to power Arduino and servo motors. 12v is used to power the stepper motor driver.

We hardcoded the moves of the puppet according to the video timings. For this, we created a function that takes initial and final angles as input and moves the puppet smoothly from the initial to the final position. We also added a parameter that defines the delay between two movements. We tuned the delay to make the movement look smoother.

For the stepper motor, the input was distance in cm and delay between the step signal from Arduino. The distance was used to calculate the number of steps required to move by using the pulley's outer diameter (1.15cm).

```
void moveall(int a1, int a2, int a3, int dist, int dely)
{
    s1.write(a1);
    s2.write(a2);
    s3.write(a3);

    int steps = dist*6400/(PI*1.15);

    if (dist>0)
    {
        digitalWrite(dirPin, 1);
    }
    else
    {
        digitalWrite(dirPin, 0);
    }
    for (int i=0;i<abs(steps);i++)
    {
        digitalWrite(stepPin, HIGH);
        delayMicroseconds(dely);
        digitalWrite(stepPin, LOW);
        delayMicroseconds(dely);
    }
}
```

Here is the link to the Arduino code:

<https://github.com/harsh-mandalia/Mechatronics/blob/main/puppet3/puppet3.ino>

Final setup

We used acrylic sheets to cover the electronics and pulleys. Here is a picture of the final setup with the puppet.



Here is the link for the explanation video:

https://drive.google.com/file/d/1ujat9-2xOdU_S9Xvi0iYzldCHsljffzr/view?usp=share_link

Performance video:

https://drive.google.com/file/d/1XBsubsGmuSw5hHYAO561Me4tYIRN36nE/view?usp=share_link