DeX: A 5DOF Manipulator

Abstract: Manipulator is a compact, low-cost, and user-friendly robotic arm designed with accessibility and creativity in mind. The goal of the project was to build a robotic arm that is affordable, simple to control, and easy to replicate using common prototyping tools and components. Initially planned to use control approach using a scaled physical model paired with potentiometers to mirror movements, it pivoted to using gesture control with the help of a flakes sensor. Through iterative design, prototyping, and troubleshooting, DeX successfully demonstrates a novel control method while maintaining a low production cost of around 5-6k INR.

Objective: To design and build a compact, low-cost robotic arm controlled intuitively through a scaled physical model using potentiometers.

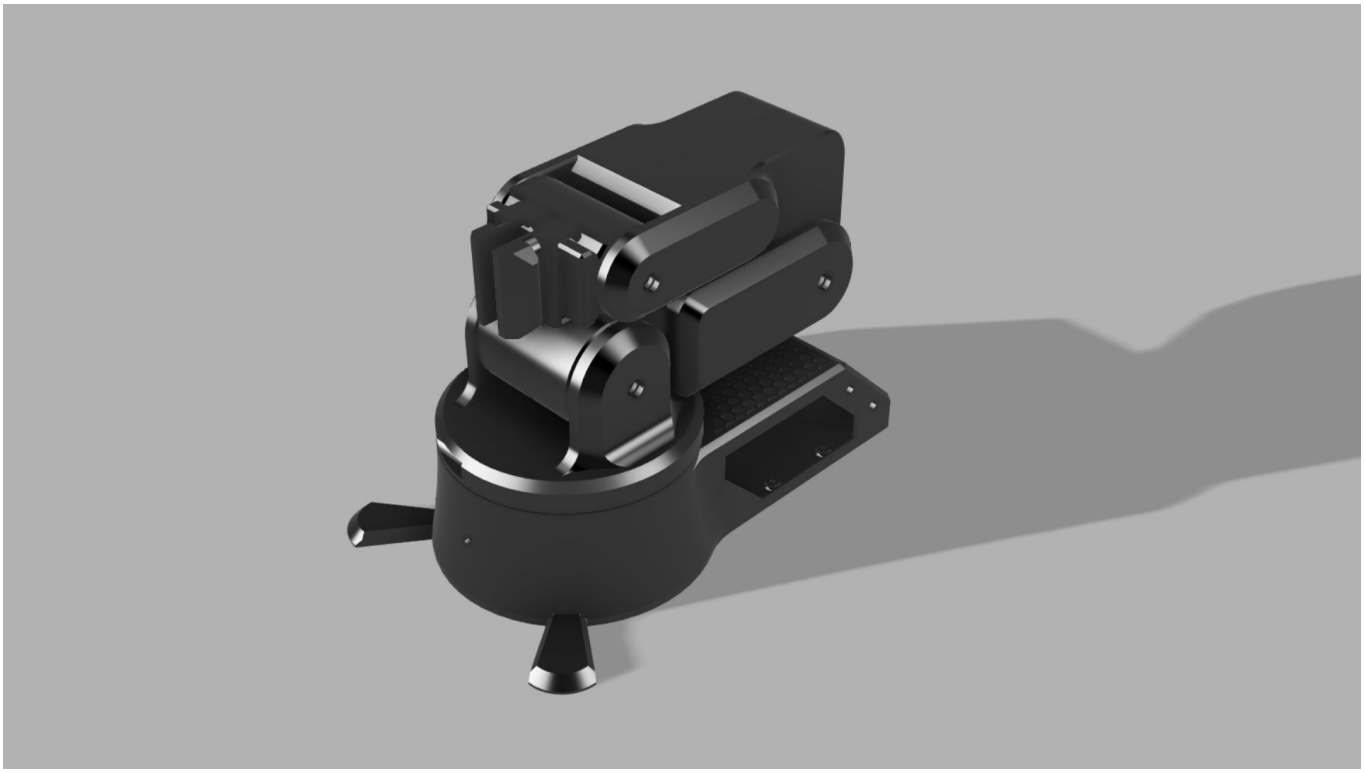

Figure 1: Model of Ceres. Designed using Fusion360.

Key Functions

1. **Robotic Arm Movement:** 5 degrees of freedom using standard servo motors.
2. **Gripper Operation:** A micro servo controls the opening and closing of the gripper.rmine optimal seed placement.
3. **Manual Controller:** A custom-designed, scaled-down physical controller equipped with potentiometers directly maps joint angles to the actual arm.
4. **Push-button Gripper Control:** A tactile push-button on the controller allows for easy actuation of the gripper mechanism.

Core Components & Technologies

Hardware:

– 4x Standard Servo Motors – for the base and arm joints.

– 1x Micro Servo Motor – for gripper control.

– Arduino Uno – the primary microcontroller.

– PCA9685 Servo Driver Board – for controlling multiple servos efficiently.

– LEDs and Switches – for feedback and control.

– 3D Printed Parts – all mechanical parts were custom-designed and printed.

– Screws and Connectors – standard hardware for assembly.

Software:

– Fusion 360 – used for 3D modeling and mechanical design.

– Arduino IDE – used to write and upload code to the Arduino.

– Servo Library – to interface with and control servo motors.

Frameworks & Libraries Used

– **Arduino Servo Library:** To control servo motors easily.

– **Basic Arduino Functions:** analogRead(), digitalRead(), map(), etc., for interpreting user input and controlling outputs.

Real life Render of DeX