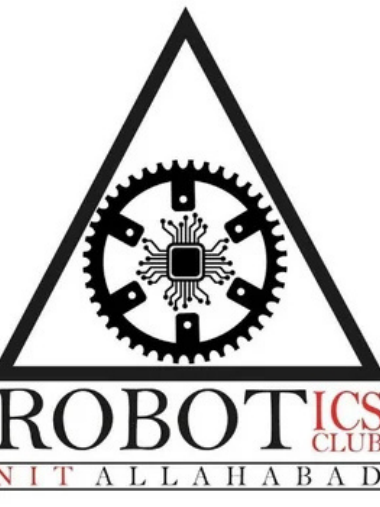# Motilal Nehru National Institute Of Technology Allahabad

6-Degree of Freedom Robotic Arm: Design and Development

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Abstract-:

This project designs a 6 Degrees of Freedom (DOF) robotic arm using MG995/MG958 servo motors and Arduino UNO for precise industrial automation tasks. Key features include inverse kinematics-based trajectory planning, PID control for stability, and a modular gripper system. The arm achieves ±2mm accuracy with a 0.5 kg payload, validated through pick-and-place and object-sorting demo

Tools Used-:

Design softwares:-
- Solidworks For designing
- Ultimaker for mass analysis
- 3D printing

Hardware:-
- Arduino Uno

Coding softwares:-
- Arduino IDE software
- Python

Components of Arm-:

- Base
- Holding part attached to base
- Arduino Microcontroller
- Gripper Assembly
- MG 958 motors with Servo horns
- Ball bearing
- Wooden stand
- Breadboard
- Jumper Wires

Principles-:
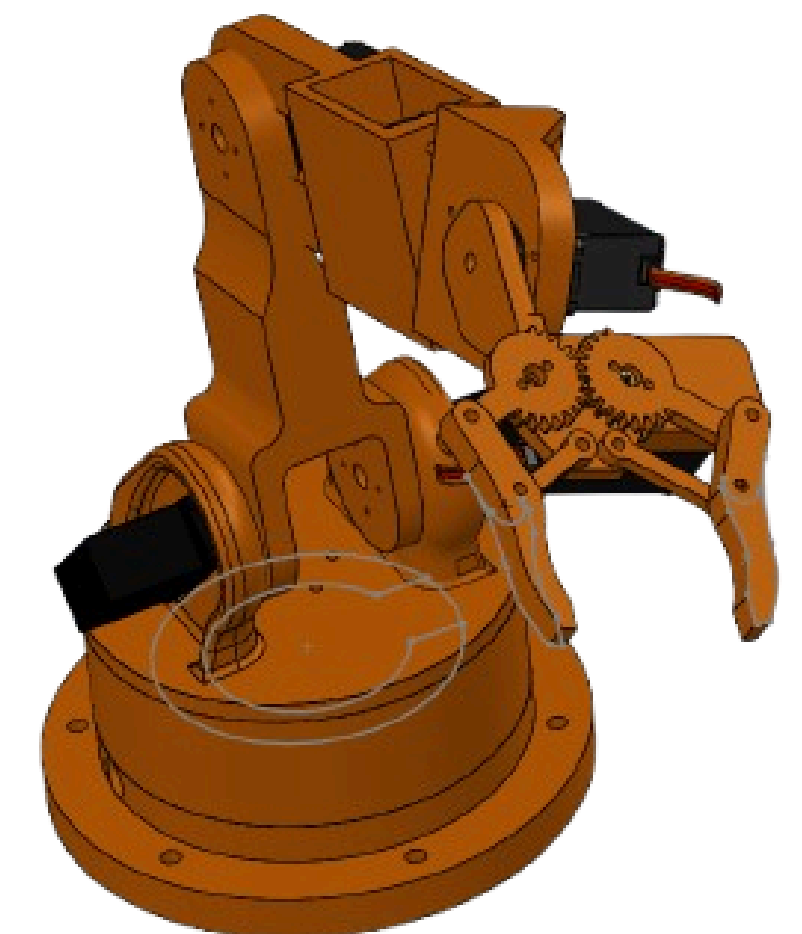
- Inverse,Forward Kinematics
- D-HParameters

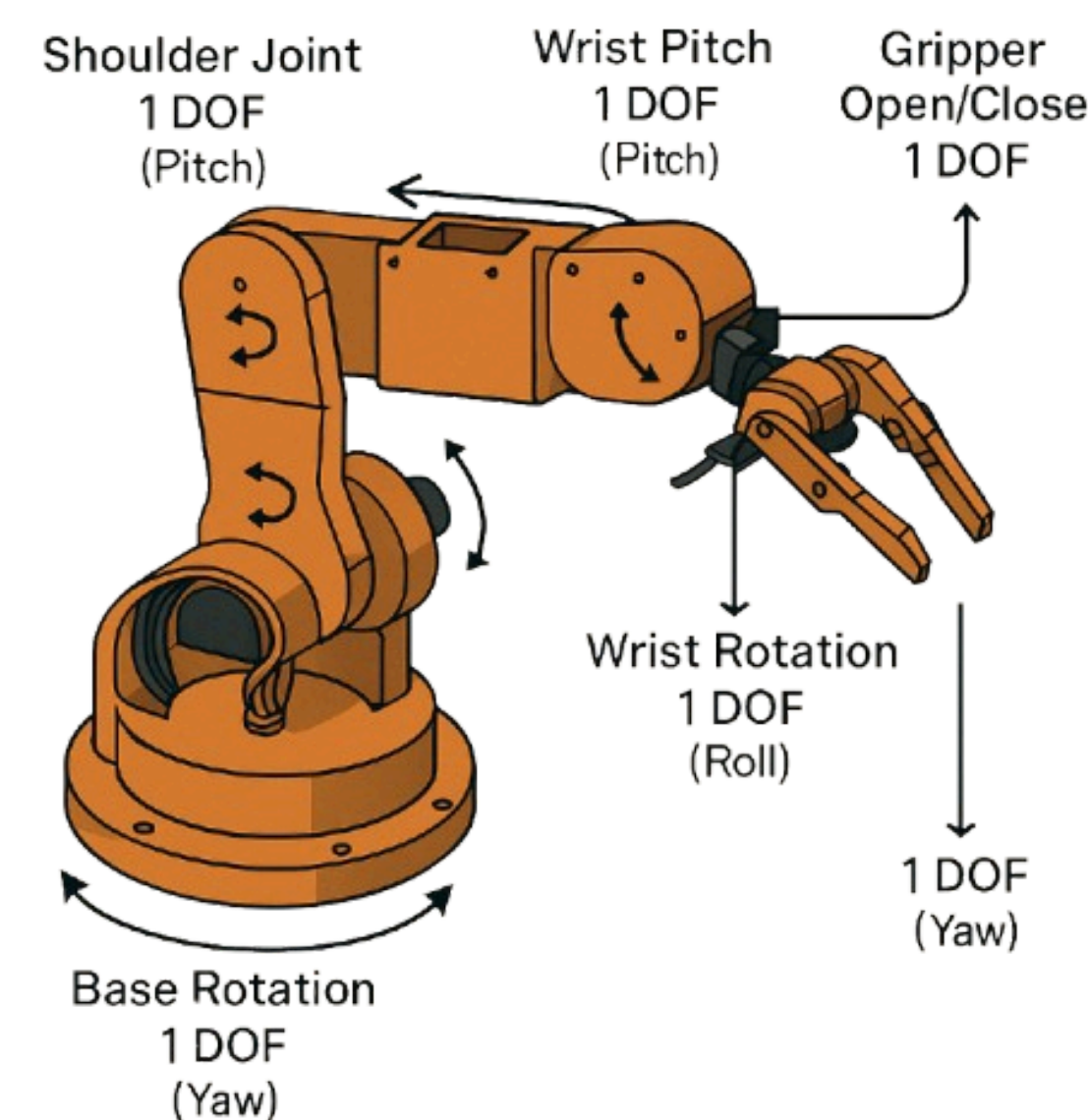Figure: CAD Model of Robotic Arm

METHODOLOGY

Research and Planning → Designing parts in solidworks → 3D Printing of designed parts → Assembly of parts with servo → Applying Inverse kinematics and coding → Path Planning & Final Testing

Shoulder Joint 1 DOF (Pitch)
Wrist Pitch 1 DOF (Pitch)
Gripper Open/Close 1 DOF
Wrist Rotation 1 DOF (Roll)
1 DOF (Yaw)
Base Rotation 1 DOF (Yaw)

Applications-:

- Precision assembly in manufacturing.
- Surgical procedures in medical fields.
- Welding and painting in automotive industries.
- Pick-and-place tasks in logistics and warehousing.
- Laboratory automation for sample handling.
- Film and photography for camera movement control.
- Space exploration for remote manipulation.
- Hazardous material handling and disposal.

Conclusion-:

This project successfully integrated SolidWorks design, Arduino programming, Python control, and inverse kinematics to demonstrate the 6-DOF robotic arm's versatility. We achieved precise spatial manipulation, advancing automation through this combined approach. This work lays the foundation for future robotic control improvements, particularly in complex kinematic solutions. Ultimately, it highlights the 6-DOF arm's vital role in automation, driven by robust software and design integration