Fatima Jinnah Women University

Department of Electronic Engineering

ROBOTIC ARM & MATLAB KINEMATICS INTERFACE

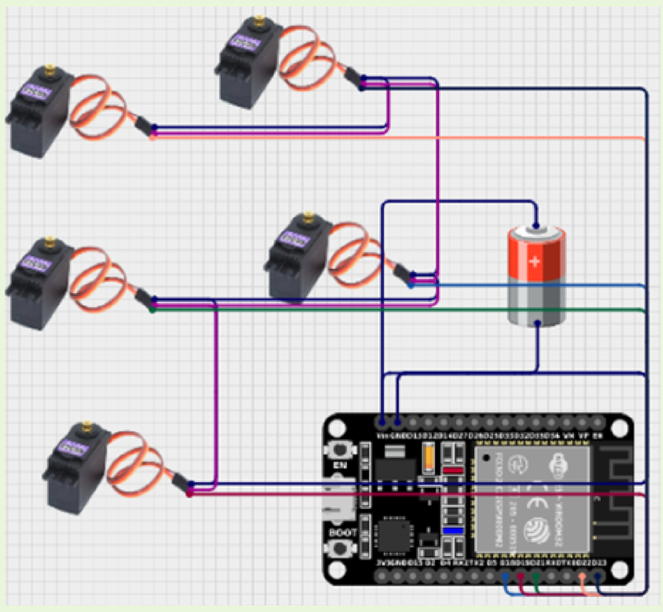
INTRODUCTION

- Growing demand for automation in industry and laboratories
- Development of a 4-DOF robotic arm controlled by ESP32 and MATLAB
- Integrates mechanical CAD design with kinematic algorithms and GUI

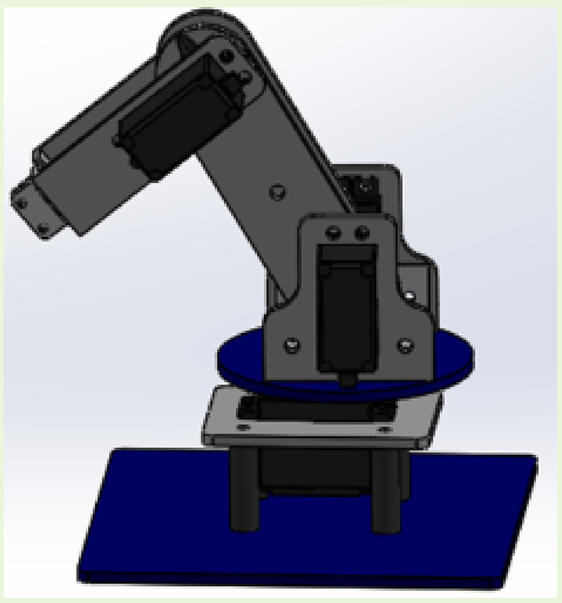
OBJECTIVES

- Design and assemble a 4-DOF robotic arm
- Implement forward & inverse kinematics in MATLAB
- Create a MATLAB App Designer GUI for real-time control
- Integrate ESP32 for serial communication with MATLAB

SCHEMATIC DIAGRAM

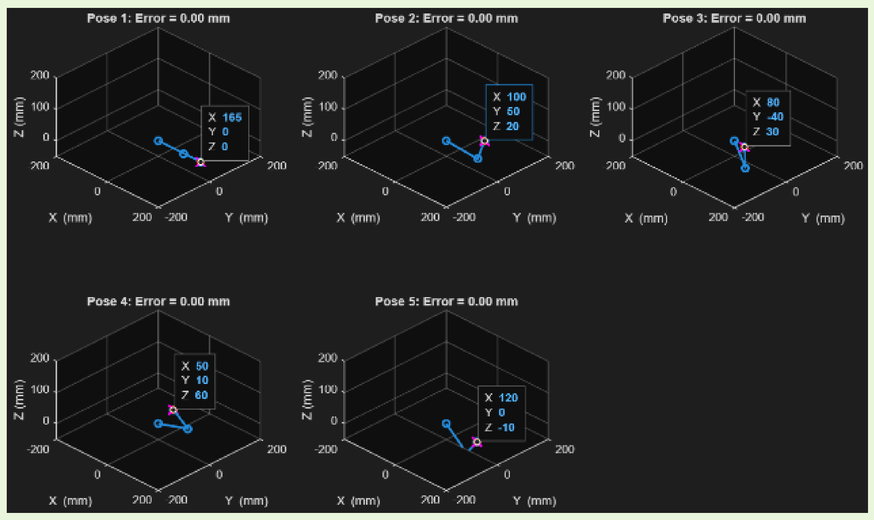


CAD MODELLING



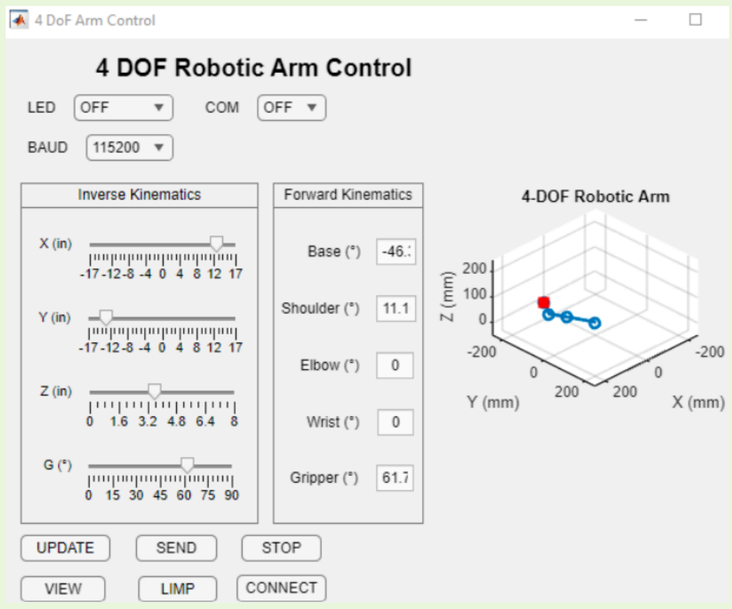
KINEMATICS IMPLEMENTATION

- DH Parameters: Defined for base, shoulder, elbow joints
- Forward Kinematics: FKINE.m multiplies homogeneous transforms
- Inverse Kinematics: IKINE.m solves joint angles via trigonometry
- Validation: test_accuracy.m tests five target poses, <2 mm error



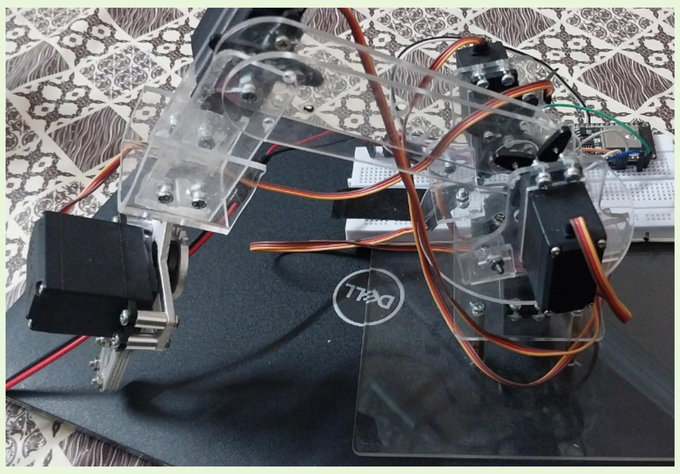
MATLAB GUI

- Interface Panels:
- Forward Kinematics (joint angle sliders)
- Inverse Kinematics (X, Y, Z input fields)
- Controls: CONNECT, SEND, UPDATE, VIEW, STOP buttons
- 3D Visualization: Real-time plotting of arm configuration



RESULTS & DISCUSSION

- Pose Accuracy: Zero error for all five test poses
- GUI Response: Reliable command transmission to ESP32
- Visualization: Clear real-time feedback of movements



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