PROJECT ABSTRACT

Six-DOF Stewart Platform Motion Simulator Demo Model

A six-degree-of-freedom Stewart platform: six linear actuators on universal joints drive a top plate under Arduino Mega inverse-kinematics control, with joystick and scripted motions. Delivered built-to-order with platform, firmware, calibration guide, report, PPT and viva kit.

Project type: Hardware

Availability: Built to order

Suitable branches: Mechanical

Technologies: Arduino Mega, 6x linear actuators, 12x universal joints, inverse-kinematics firmware (C++), joystick, calibration routine

Price: Request a quotation

Prepared by Projectech · projectech.in — for academic project reference.

01. Title

Six-DOF Stewart Platform Motion Simulator Demo Model

02. Introduction / Background

Most student robots are serial arms — joints stacked in a chain. The Stewart platform is the opposite: a parallel robot where six actuators work together to position one plate, giving six degrees of freedom (three translations, three rotations) with remarkable stiffness. It is the mechanism behind flight simulators, telescope mounts and precision vibration tables. The mathematics that makes it work — inverse kinematics, converting a desired platform pose into six actuator lengths — has a clean geometric solution the student can genuinely implement. This project builds a tabletop Stewart platform with six servo-driven linear actuators, an Arduino Mega controller, joystick live control and scripted motion sequences, calibrated to the student's own build geometry.

03. Problem Statement

Parallel-robot kinematics is taught as pure mathematics because the hardware looks unbuildable. The project addresses this with a tabletop six-DOF Stewart platform where the student implements the inverse kinematics themselves, calibrates the actuator geometry, and commands real poses — making an advanced mechanism tangible and demonstrable.

04. Objectives

- Build a six-actuator Stewart platform with universal joints and rigid plates.
- Implement inverse kinematics (pose to actuator lengths) on an Arduino Mega.
- Provide a geometry calibration routine for the student's own build.
- Support joystick live control of platform attitude.
- Ship a library of scripted motion sequences (tilt wave, sway, heave).
- Enforce software travel limits and stall protection on the actuators.
- Deliver the complete student kit: platform, firmware, calibration docs, report, PPT and viva Q&A.;

05. Proposed Methodology

The platform is assembled from base and top plates joined by six servo-driven linear actuators on twelve universal joints. The student measures the six base and six platform joint coordinates and enters them through the calibration routine. The inverse-kinematics function converts any desired pose (position + orientation) into six actuator lengths, which the firmware turns into servo commands at approximately 20 Hz. Poses come from the joystick, the preset library or scripted sequences; software limits clamp every command inside the safe actuator range.

06. System Architecture / Working

A commanded pose — from joystick, preset or script — enters the inverse-kinematics function with the calibrated joint geometry, producing six target actuator lengths. The Arduino Mega converts each length to a servo command and drives all six actuators simultaneously, moving the top plate to the pose. At approximately 20 Hz the motion is smooth and continuous; scripted sequences chain poses into tilt waves, circular sways and heave bounces. Travel limits and stall handling protect the mechanism from overdrive on every command.

07. Hardware / Software Requirements

- Arduino Mega 2560
- 6x servo-driven linear actuators (approx. 100 mm stroke)
- 12x universal joints
- Base and top plates (machined/plywood)
- Joystick input module

- Inverse-kinematics firmware (C++)
- Geometry calibration routine
- 6 V high-current actuator supply

08. Expected Outcomes

- A working six-DOF platform executing joystick and scripted motions.
- A student-implemented inverse-kinematics solution matched to their own geometry.
- Measured pose repeatability (approx. ±2 mm expected) documented honestly.
- A complete report, PPT and viva Q&A; on parallel-robot kinematics and calibration.

09. Applications

- Teaching parallel-robot kinematics with real hardware.
- Demonstrating motion-simulator principles at tabletop scale.
- A platform for advanced control experiments (future student work).

10. Future Scope

- Closed-loop pose feedback with an IMU on the top plate.
- Larger actuators for human-scale motion simulation.
- VR-linked motion profiles for simulator demos.
- Vibration-isolation studies using the platform.