1. Miniature Robotic Arm for Sample Collection

Project Statement: Build a small-scale robotic arm capable of picking up and storing samples.

Goal: To develop a 3-DOF robotic arm that can autonomously collect and store up to 5 different samples.

Difficulty Level:

Explanation: The project involves mechanical design, electrical components, and software, making it moderately challenging but achievable for a beginner.

Mechanical Sub-System:

- Tools: SolidWorks, CNC Machining
- Concepts: Mechanical Design, Kinematics
- Requirements: Aluminum or steel parts, screws, and bolts

Electrical/Electronics Sub-System:

- Tools: LabVIEW, Oscilloscope
- Concepts: Servo Control, Sensor Fusion
- Requirements: Industrial-grade servo motors, distance sensors, wires

Software/AI Sub-System:

- Tools: ROS, C/C++
- Concepts: Inverse Kinematics, Object Recognition
- Requirements: Computer with ROS and C++ compiler

2. Planetary Drill Simulator

Project Statement: Create a drilling system that can penetrate different layers of simulated planetary surfaces.

Goal: To develop a drilling system capable of penetrating at least three different types of materials and provide real-time feedback.

Difficulty Level:

Explanation: The project is complex due to the integration of mechanical, electrical, and software components but is achievable with dedicated effort.

Mechanical Sub-System:

- Tools: SolidWorks, CNC Machining
- Concepts: Mechanical Design, Material Science
- Requirements: Drill bits, mounting frame

Electrical/Electronics Sub-System:

- Tools: LabVIEW, Oscilloscope
- Concepts: Stepper Motor Control, Sensor Feedback
- Requirements: Industrial-grade stepper motors, force sensors, wires

Software/AI Sub-System:

- Tools: ROS, C/C++
- Concepts: Feedback Control, Data Processing
- Requirements: Computer with ROS and C++ compiler

4. Autonomous Lunar Rover

Project Statement: Build a small-scale autonomous rover capable of navigating a simulated lunar surface.

Goal: To develop a rover that can autonomously navigate a 1m x 1m area, avoiding obstacles and reaching specified waypoints.

Difficulty Level:

Explanation: This project is highly interdisciplinary, involving mechanical design, sensor integration, and advanced software algorithms.

Mechanical Sub-System:

- Tools: SolidWorks, CNC Machining
- Concepts: Mechanical Design, Kinematics
- Requirements: Aluminum or steel parts, screws, and bolts

Electrical/Electronics Sub-System:

- Tools: LabVIEW, Oscilloscope
- Concepts: Sensor Fusion, Circuit Design
- Requirements: GPS module, ultrasonic sensors, control board

Software/AI Sub-System:

- Tools: ROS, C/C++
- Concepts: Path Planning, Sensor Fusion
- Requirements: Computer with ROS and C++ compiler

5. Satellite Docking Simulator

Project Statement: Simulate the docking of a satellite for servicing or refueling.

Goal: To develop a low-cost, home-based simulator that can accurately mimic the docking procedures of a satellite.

Difficulty Level:

Explanation: The project involves multiple disciplines, including mechanical design, electrical circuitry, and software development. It is complex but doable for an absolute beginner who is willing to invest time in learning and implementation.

Mechanical Sub-System:

- Tools: SolidWorks, CNC Machining
- Concepts: Mechanical Design, Kinematics
- Requirements: Aluminum or steel parts, screws, and bolts

Electrical/Electronics Sub-System:

- Tools: LabVIEW, Oscilloscope
- Concepts: Electromagnetism, Circuit Design
- Requirements: Magnetic locks, power supply, wires

Software/AI Sub-System:

- Tools: ROS, C/C++
- Concepts: Control Systems, Magnetism
- Requirements: Computer with ROS and C++ compiler

6. Space Debris Collector

Project Statement: Design a small-scale model of a device that can collect space debris in a controlled environment.

Goal: To develop a device that can autonomously collect at least three different sizes of simulated space debris.

Difficulty Level:

Explanation: This project is complex due to the need for precise mechanical design, sensor integration, and advanced control algorithms.