

The Lam Research Challenge

A Nationwide Systems Engineering Competition

Round 3

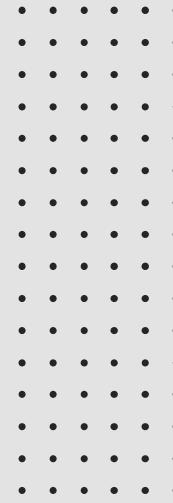
PROBLEM STATEMENT

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- Each team is provided with a **disassembled prefabricated multi-axes robotic manipulator** in a kit form. The kit allows variability in terms of choice of the host controller (ESP32, Arduino Nano, Pi Pico, STM32 based). Also, the **multi-axes movements** can be facilitated by both servos (serial servos or ordinary regular hobby servos or stepper motors). A universal motor controller board is also provided, which can be comfortably interfaced with any of the provided controller boards.

Statement of work

Assemble a multi-axes robotic manipulator with a choice of end effectors that provide means of handling Disks. The robotic manipulator must move disks between two towers that can hold 4 disks in a vertical column configuration.

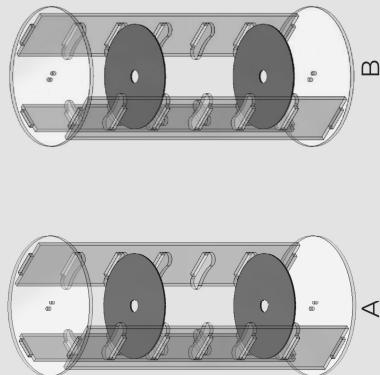
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- The team that is able to replicate the shuffling order in the shortest time without dropping or damaging the disks will receive marks as per the performance criteria.
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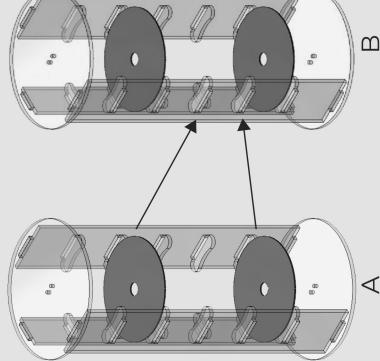
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Place the Contraption and Disc Towers as per the Layout. The Contraption's Home Position should be centered between the two Disc Towers. Tower-A holds Red Discs in positions 1 and 4, while Tower-B holds Black Discs in positions 1 and 4.

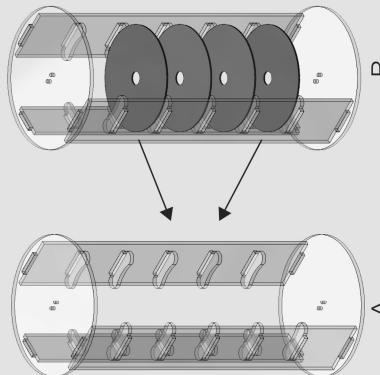
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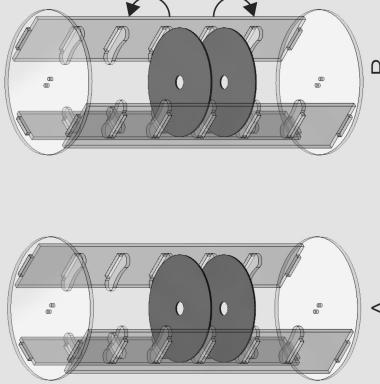
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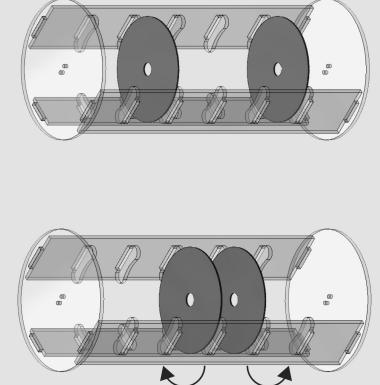
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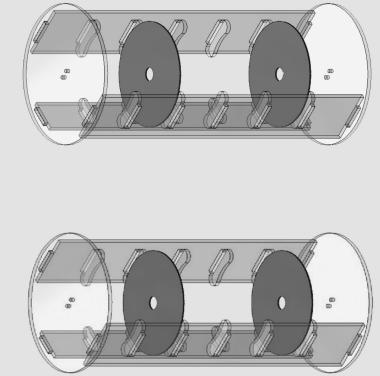
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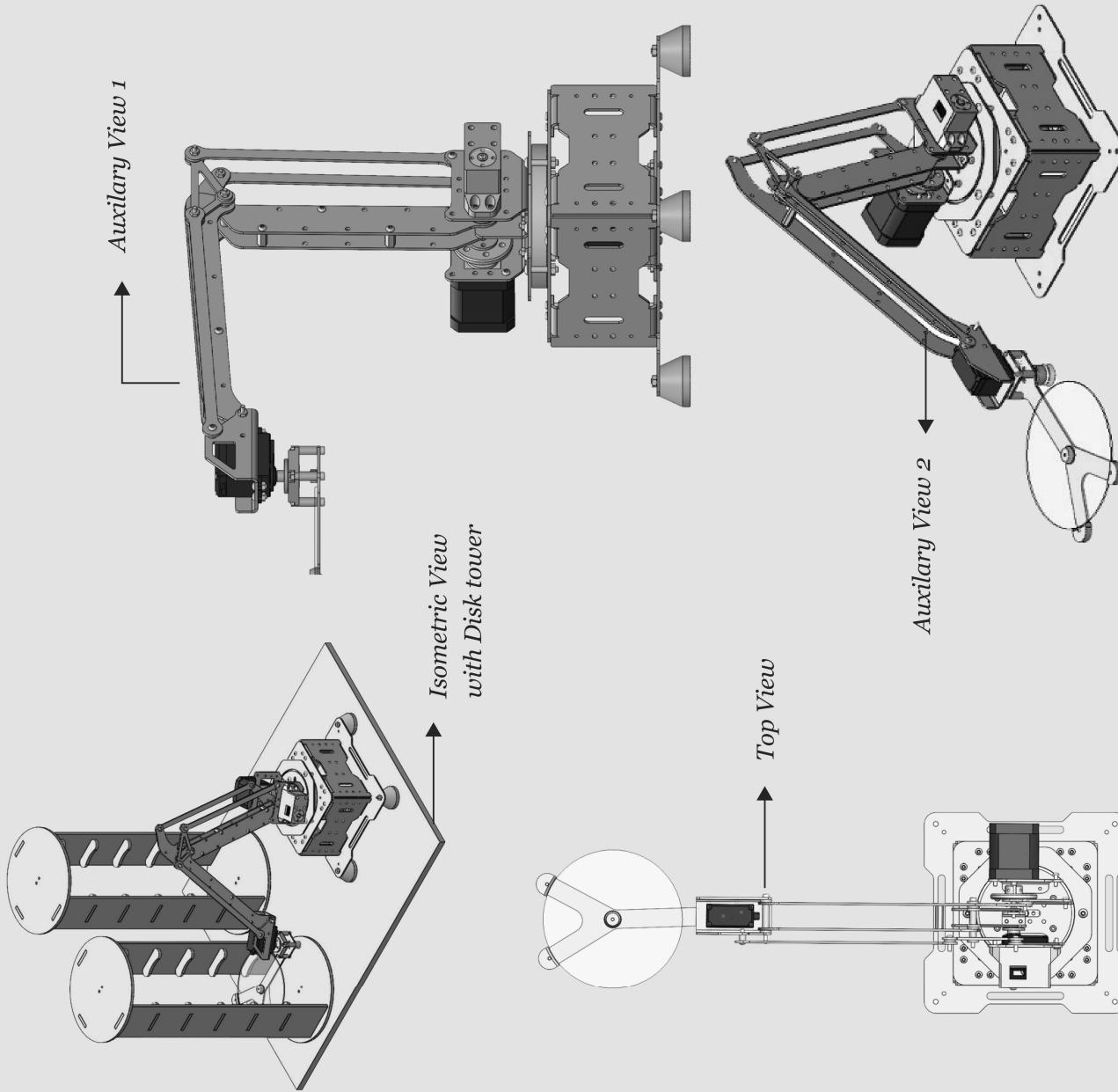
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Note:

Interactive Mechanical Instruction Session: Our Tech Rescue team will visit each zone to explain the contraption's mechanics. Participants will receive a digital file with assembly images for reference.

Marking Structure

Total : 200 Marks

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Handling of all the defined axes, end effector functioning, and task execution downloaded from the PC application –

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Preparation of documentation: Total 60 Marks

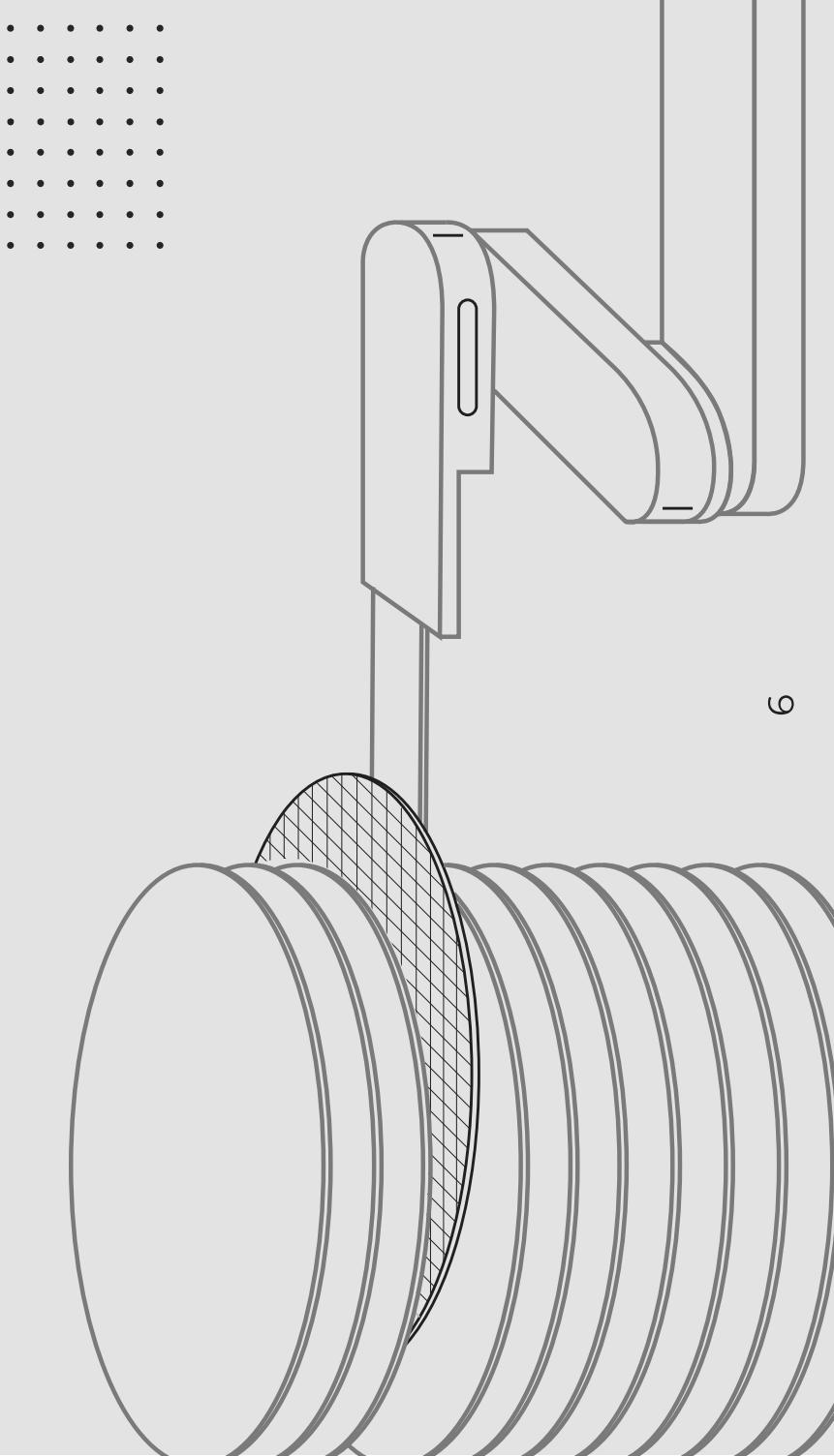
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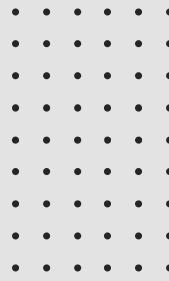
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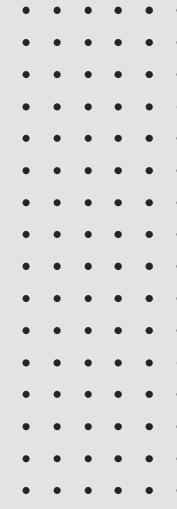
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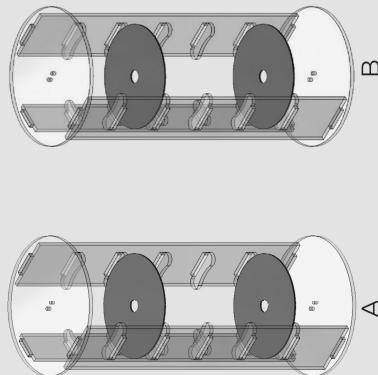
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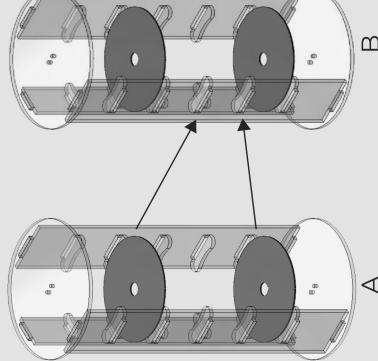
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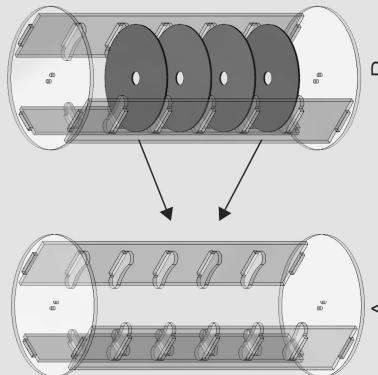
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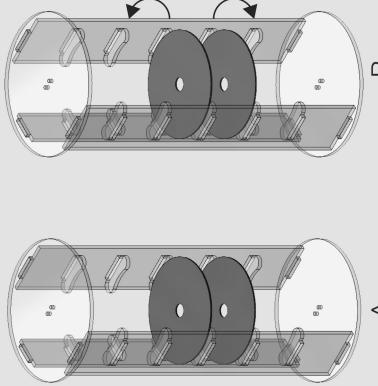
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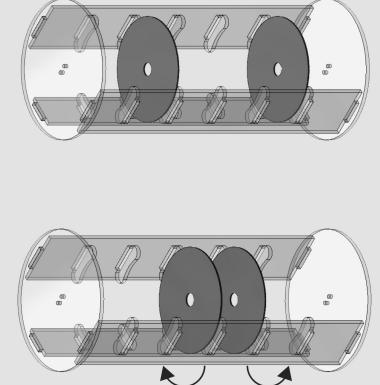
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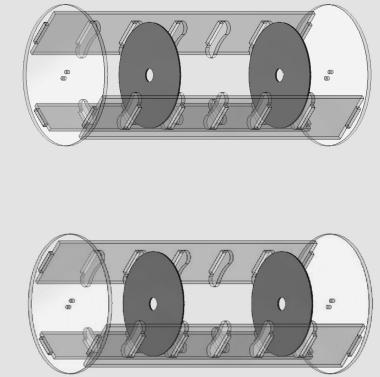
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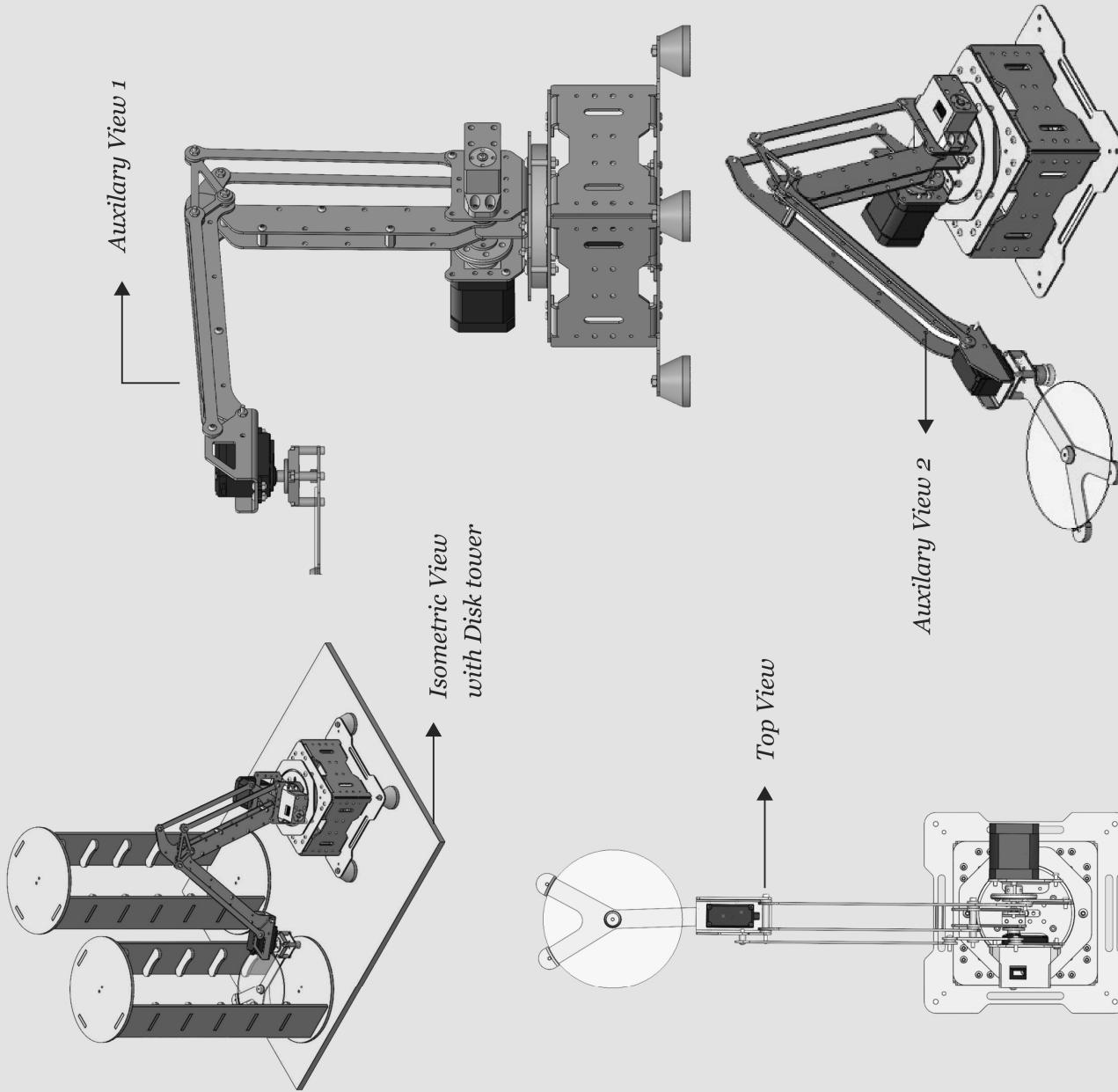
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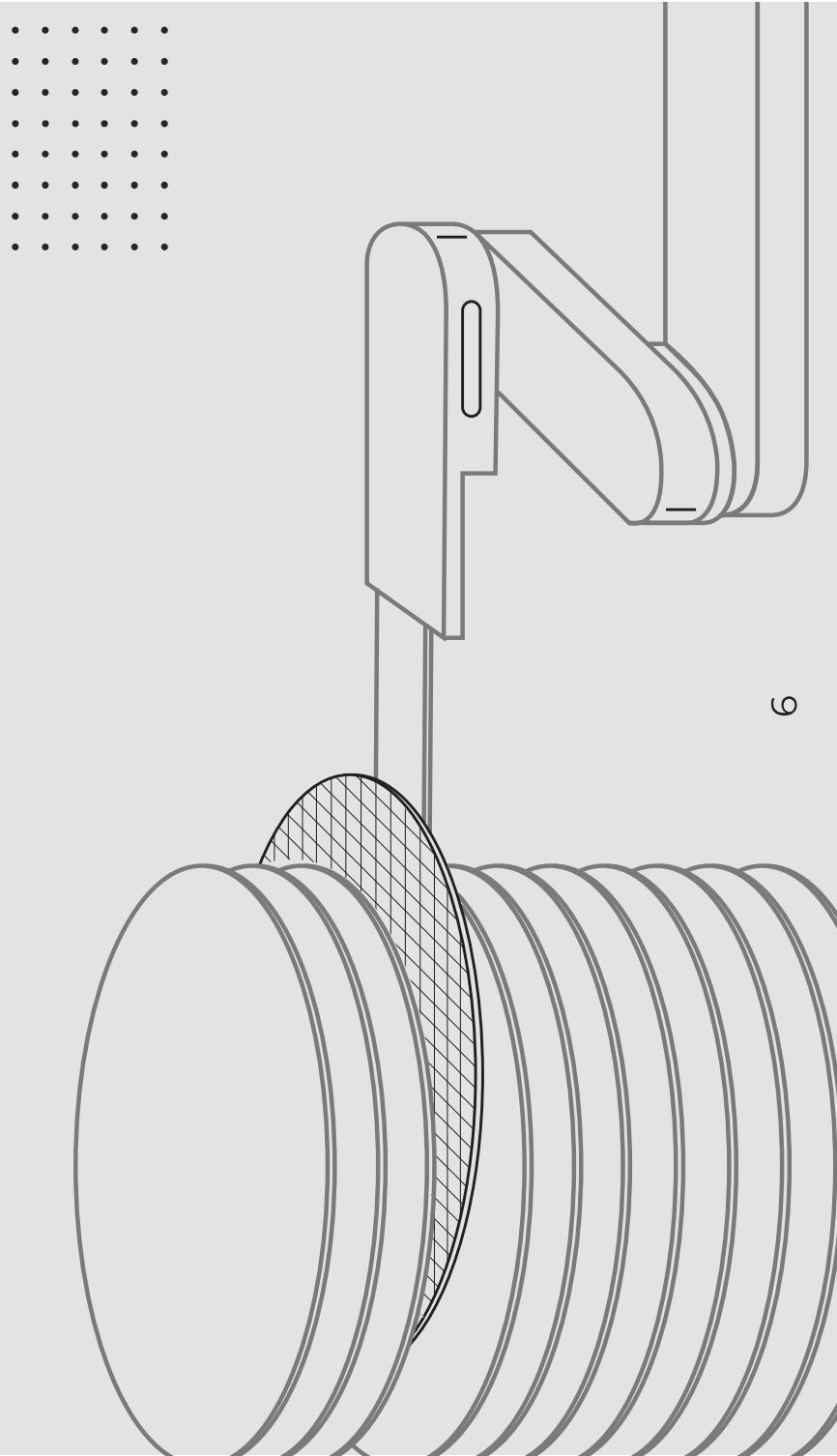
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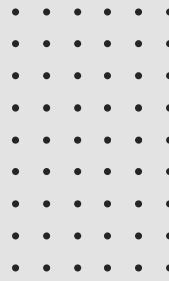
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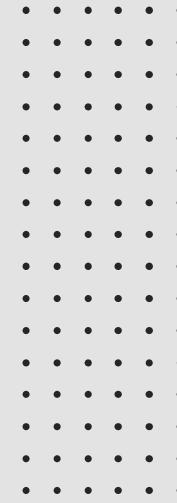
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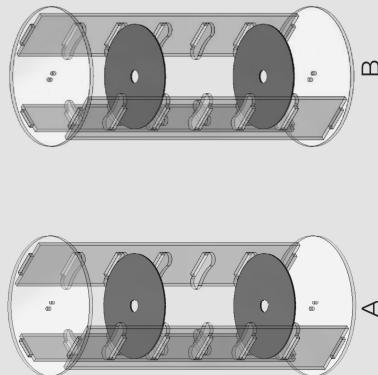
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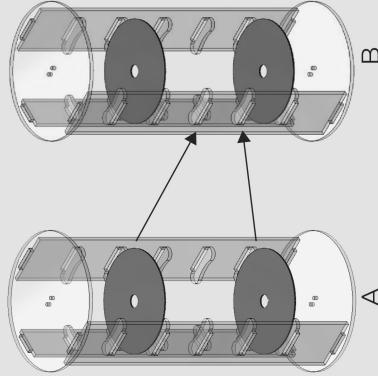
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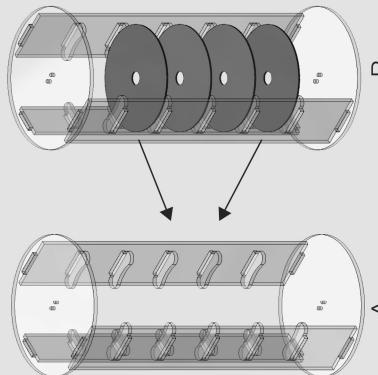
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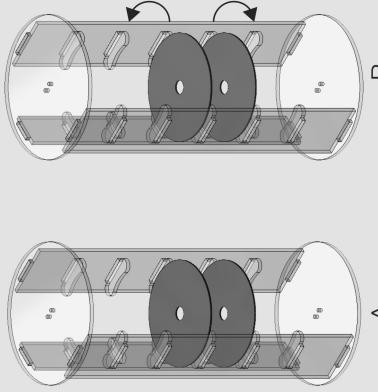
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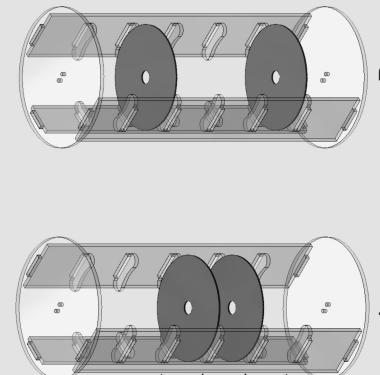
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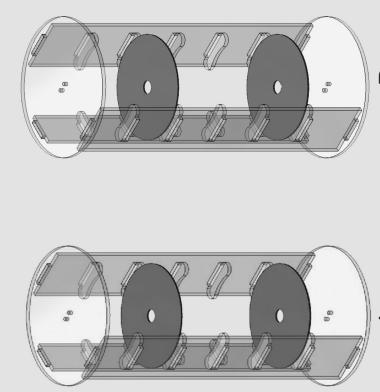
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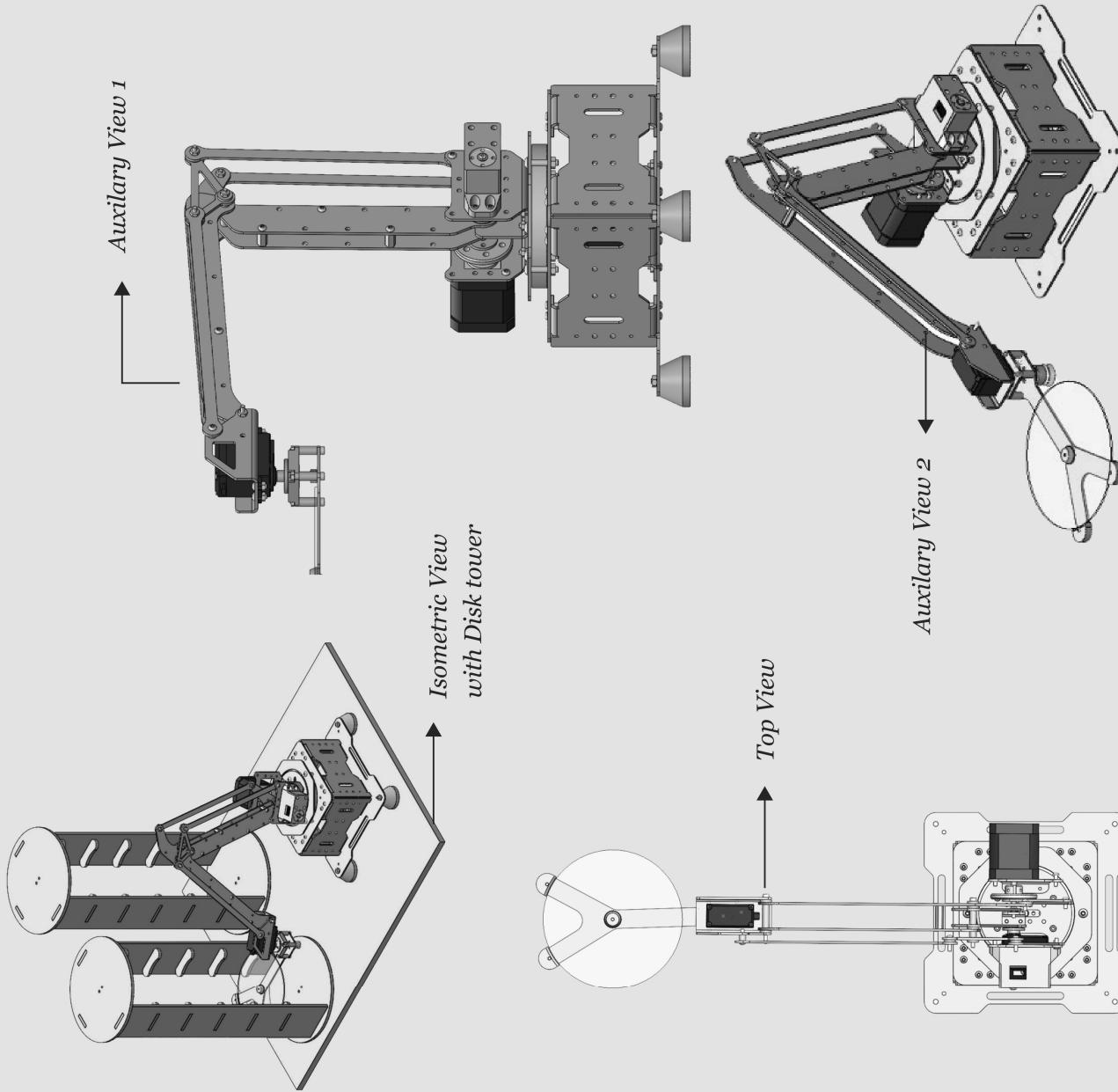
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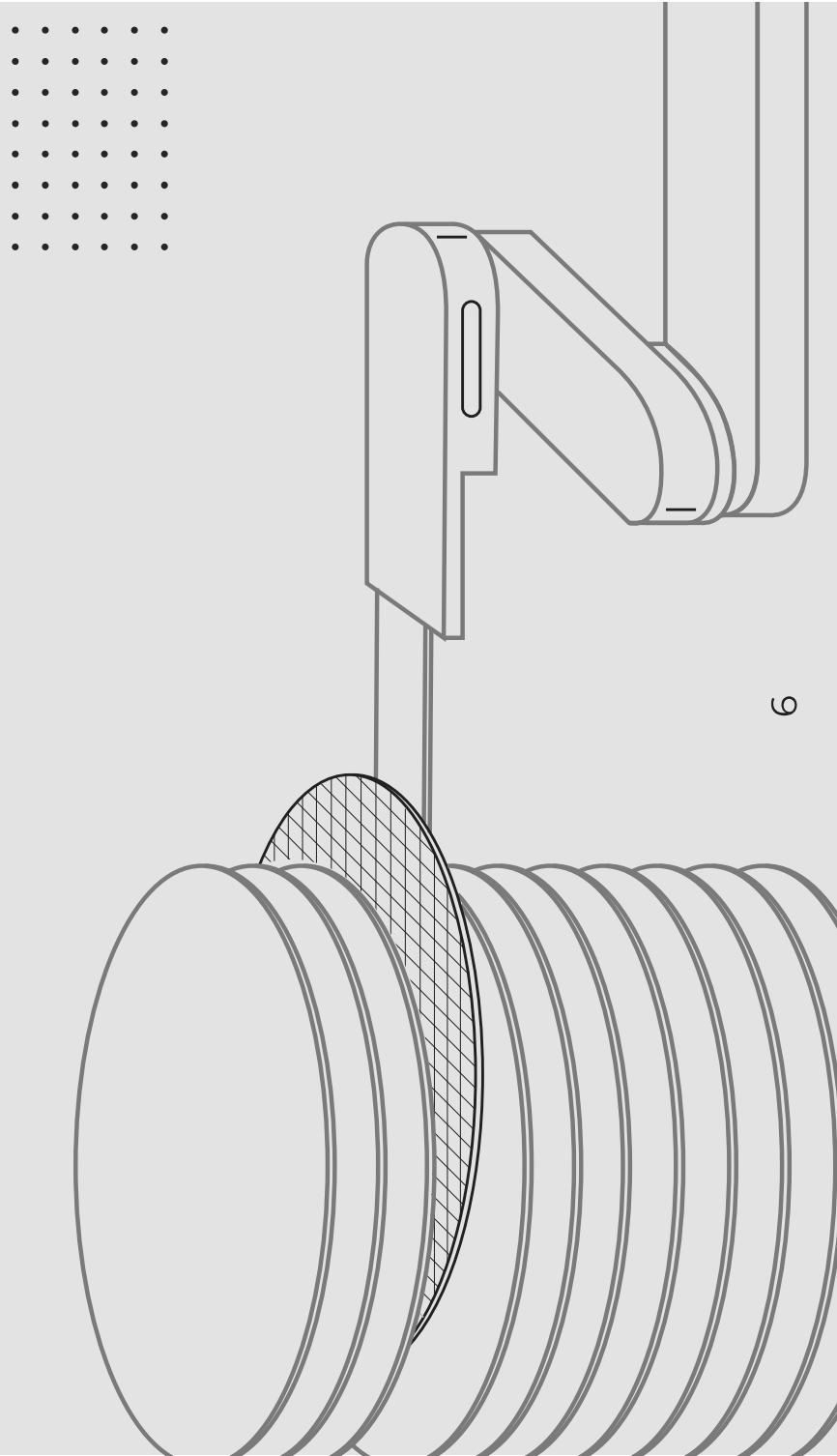
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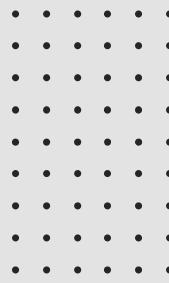
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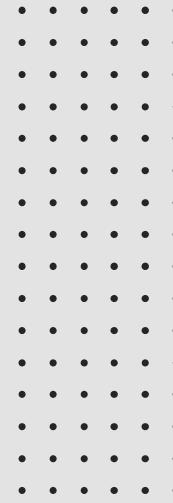
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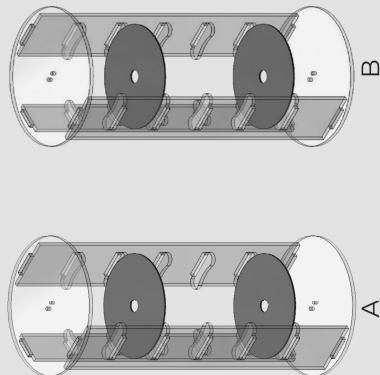
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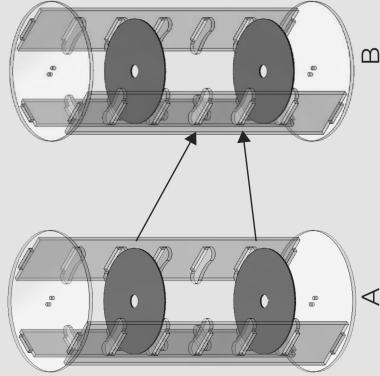
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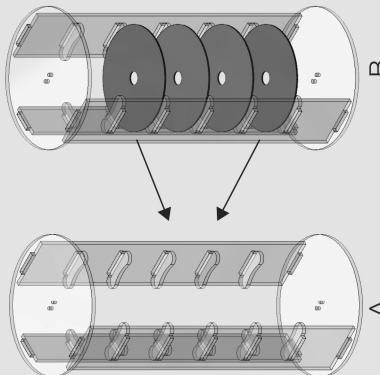
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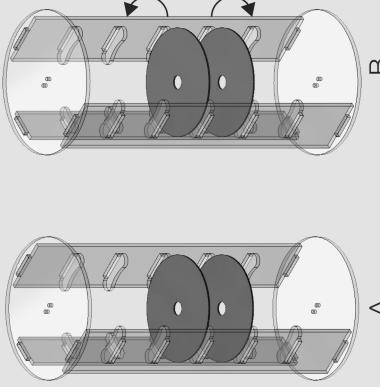
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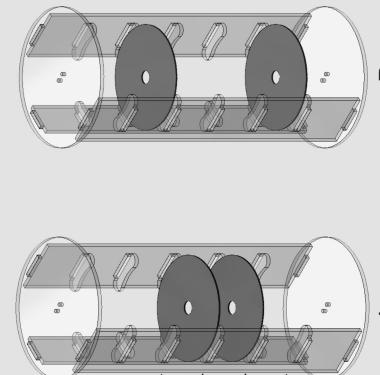
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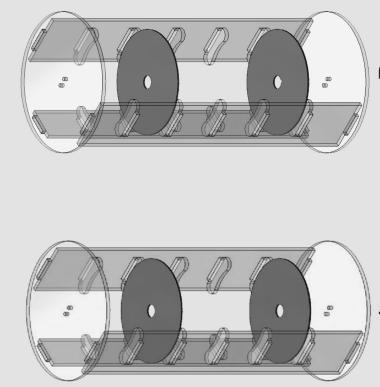
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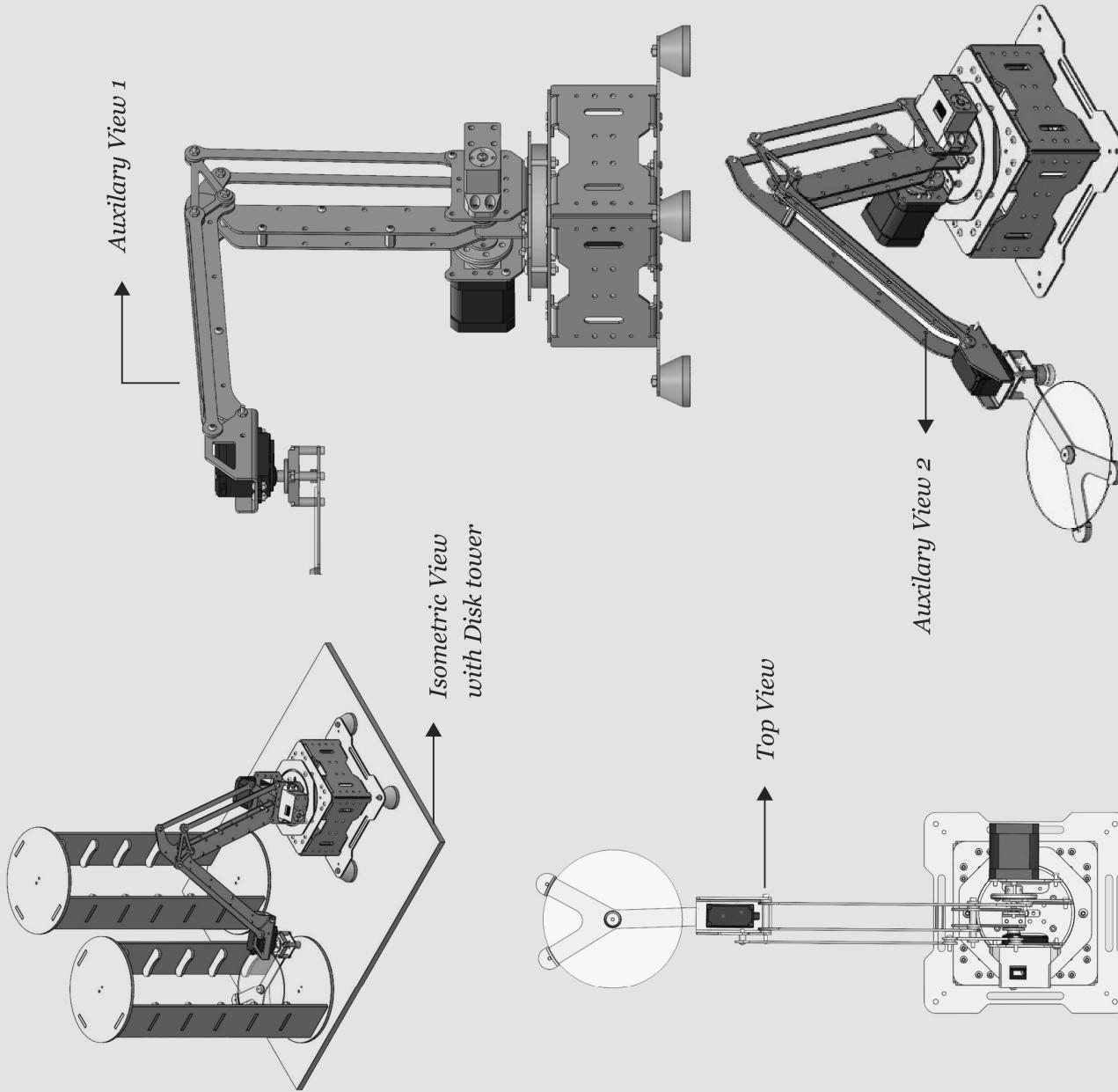
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ContrapTION images



Note:

Interactive Mechanical Instruction Session: Our Tech Rescue team will visit each zone to explain the contraption's mechanics. Participants will receive a digital file with assembly images for reference.

Marking Structure

Total : 200 Marks

The marking structure for Round 3 has been revised from the experience of evaluating Round 2. This is as follows:

1

Total system functioning, utilization of the most appropriate components, and sub-systems for the best performance : Total 60 Marks

Handling of all the defined axes, end effector functioning, and task execution downloaded from the PC application –

- Smooth XYZ axis motion with ability to home and sense end of travel and move to a specified position - *30 marks (10 marks each axis)*
- Dropper operation of end effector to hold and release the disks without dropping or damaging - *10 marks*
- Ability to receive and execute the shuffling commands from the host PC application application - *10 marks*
- Developing the host PC application - *10 marks*

2

Preparation of documentation: Total 60 Marks

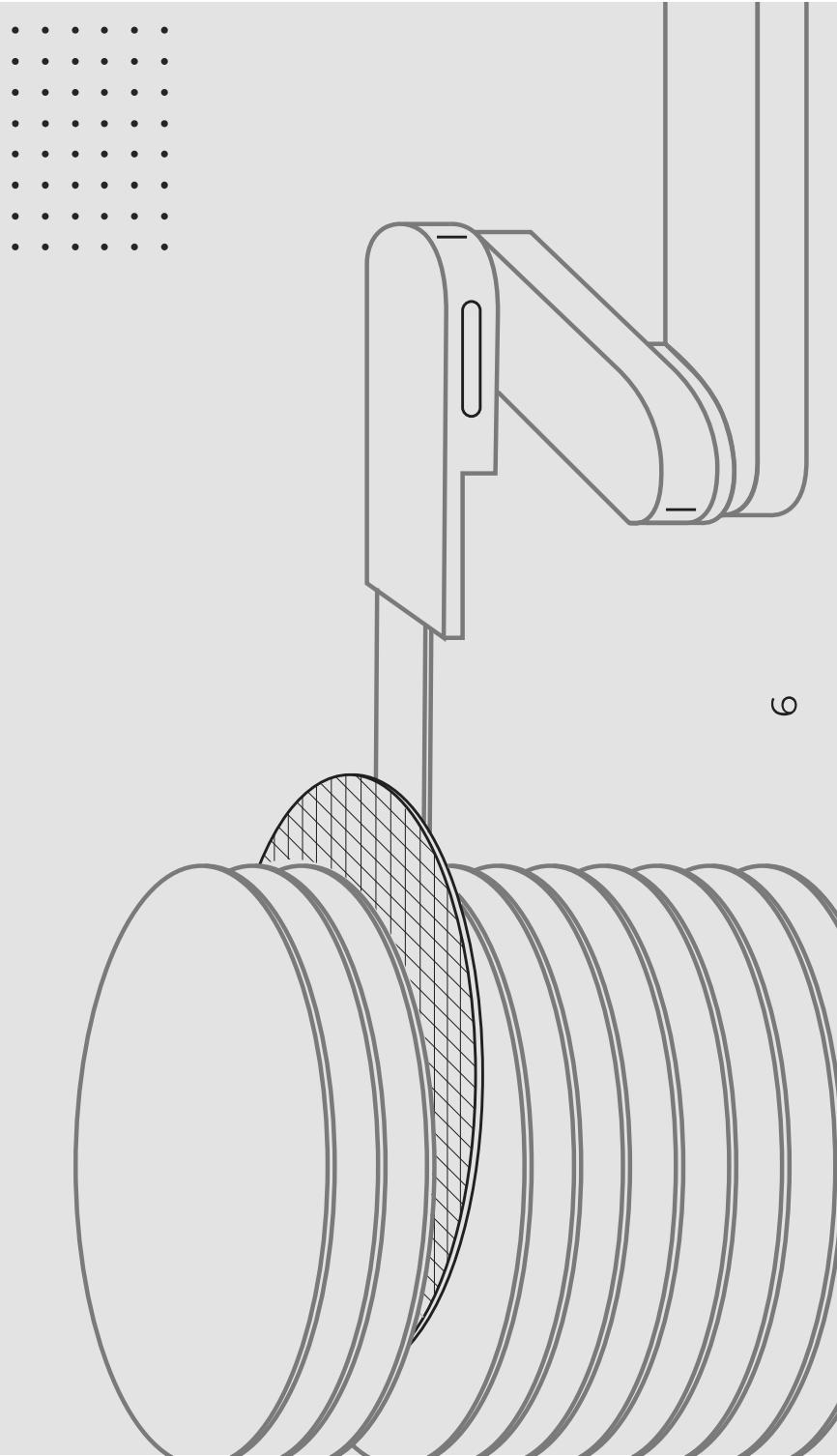
- Operation flow chart using proper flow chart drawing conventions *10 marks (5 marks for firmware flow + 5 marks for PC App flow.)*
- Generation of BOM with proper part number for mass manufacturing, approximate BOM cost and ability to estimate cost of manufacturing 100 similar units - *10 marks.*

- A clear, well-captured video of the complete operation process of the assigned task - *10 marks*. Port map in a tabular form clearly mentioning the controller port pin (GP10), whether it is an input or an output, and functional name assigned in the firmware code - *10 marks*
- A proper system wiring diagram following standard electronics/electrical system wiring convention norms, generated neatly - *10 marks*
- Future improvements and lessons learned - *10 marks*

3

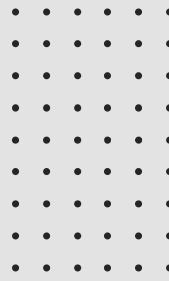
Firmware: Total 80 Marks

- Proper use of functions, code reusability - *10 marks*
- Variables naming convention and scope - *10 marks*
- Appropriate remarks for code readability - *10 marks*
- Proper pseudocode (Plain English shouldn't contain language syntax explaining global variables functions, and main routine - *10 marks*
- Bare-metal code without the use of special libraries like stepper, serial servo, or regular hobby servo - *40 marks*



Terms & Conditions

- There are **six custom rapid prototyping boards** available for you in this challenge to choose from. These include:
 - Arduino Nano Microcontroller Board
 - ESP32 Microcontroller Board
 - RP2040 Development Board
 - RP2040 Robot Controller Board
 - STM32-Based Development Board
- You can select one development board from this list. Please note that you are required to use the **Universal Motor Control Board as a standard component** alongside your selected development board, exception can be universal robot control board.
- If a team **damages the development board or requires a replacement** during the challenge, a deduction of **25 marks** will be applied.
- For **damaged peripherals** (e.g., sensors, motors, etc.), a deduction of **5 marks** will be applied.
- Each team is **allowed only one replacement of each item** during the challenge, **except for the TMC2209**, which can be replaced a maximum of two times.
- If you have any **questions or require assistance at any point** during the challenge, please don't hesitate to **approach the volunteers assigned to your workstations**. They are there to provide immediate support and guidance to help you navigate any difficulties you may encounter.
- For more complex or technical issues that require additional expertise, the volunteers will promptly escalate your query to the help desk. Our **Tech Rescue team is fully equipped to address more intricate challenges** and ensure your experience during the challenge is smooth and productive.



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