DESIGN PORTFOLIO

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Introduction:-

Mechanical Design Engineer with 8+ years and 8,000+ hours in CAD, GD&T, and manufacturing process design. Delivered 25+ end-to-end projects from requirements through build and test. Experienced in FEA, CFD, and heat transfer. Specialize in New Product introduction (NPI) and Special-Purpose Machine (SPM). Drive high-velocity projects, partner cross-functionally, and make rapid, data-driven decisions. Currently pursuing an MS in Mechanical Engineering to deepen expertise in CAE, CFD, and heat transfer.

Design Projects:-

1. IGBT Cold Plate Design & AC-DC Converter Packaging
2. Lithium Iron Phosphate Battery Pack 3KWh
3. Lithium Iron Phosphate Battery Pack 13KWh
4. Digital foiling machine
5. Electrification of Light Commercial Vehicles
6. Electric Motor Test Bench (Client: Bharat Bijlee)
7. Solar Module DML Test Machine (Client: NCPRE IIT Bombay)
8. Portable Electro Luminescence Test Device
9. Drone space frame design (Client: Rapid Manufacturing Lab - IIT Bombay)
10. Pathology Slide Scanner
11. Blood Smear preparation device (Medical Device)
12. Team Eta – (Shell Eco-Marathon 2013, 2014 & 2015)
13. Auto disengagement clutch design
14. Magnetic Gearbox
15. Mars rover Team Mentor (IIT Bombay)
16. Sheet Metal Product design
17. Flare EV 30 charger
18. Jig for Drilling Motor Casting
19. Die Tool for the Paper lid
20. Automated chess (Gaming for the next generation)

IGBT Cold Plate Design & AC-DC Converter Packaging

Objective / Client Requirement:

- Design three converter models of varying lengths and IGBT counts, along with a cold plate for cooling IGBTs that also functions as a structural member.
- Cold plate: Must be manufacturable using conventional methods while avoiding long weld joints (no FSW or bolted/welded plates).
- Each IGBT dissipates 1000 W, with a maximum coolant temperature rise of ≤5 °C per inverter (when connected in series).
- Enclosure: Must be IP69-rated, securely mounting and supporting all converter components.

Approach:

- Proposed multiple design options, including:
  - Extruded cold plate channels with various cross-sections and flow diverters to create a zig-zag coolant path for improved heat transfer.
  - Cold plate with heat pipes, using bent copper tubes press-fitted into the plate.
  - Cold plate with copper coolant tubes directly press-fitted into the plate.
- Engaged with the client to review circuit diagrams, operating currents, and voltages of components to strategically position interconnected components, reduce copper length, minimize EMI, and improve DFA and maintenance access.
- Selected aluminum casting for the enclosure to meet IP69 requirements, ensuring durability and protection against water/dust ingress.

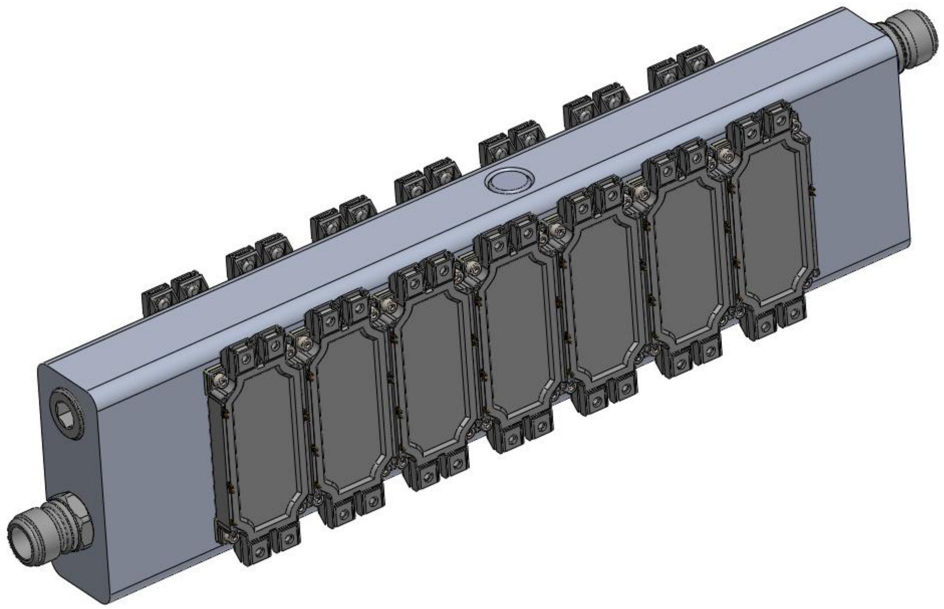
Solution:

- Developed an extrudable cold plate cross-section with machined flow diverters to create a zig-zag coolant path, improving heat transfer, eliminating long FSW welds, reducing weld joints by 60%, and improving leak-prevention and manufacturability.
- Conducted CFD analysis to validate coolant mass flow, Achieved ≤5 °C rise/converter (when connected in series) and 20% lower pressure drop.
- Designed laminated copper busbars, reducing length by 22% through optimized component placement and part commonization across variants. Minimized EMI by separating low and high voltage circuits.
- Lowered tooling cost by ~30% by implementing stackable clip-on plastic components adaptable across all converter models.
- Created an IP69-rated aluminum-cast enclosure to house capacitors, sensors, and other components, and performed modal analysis to ensure structural integrity.

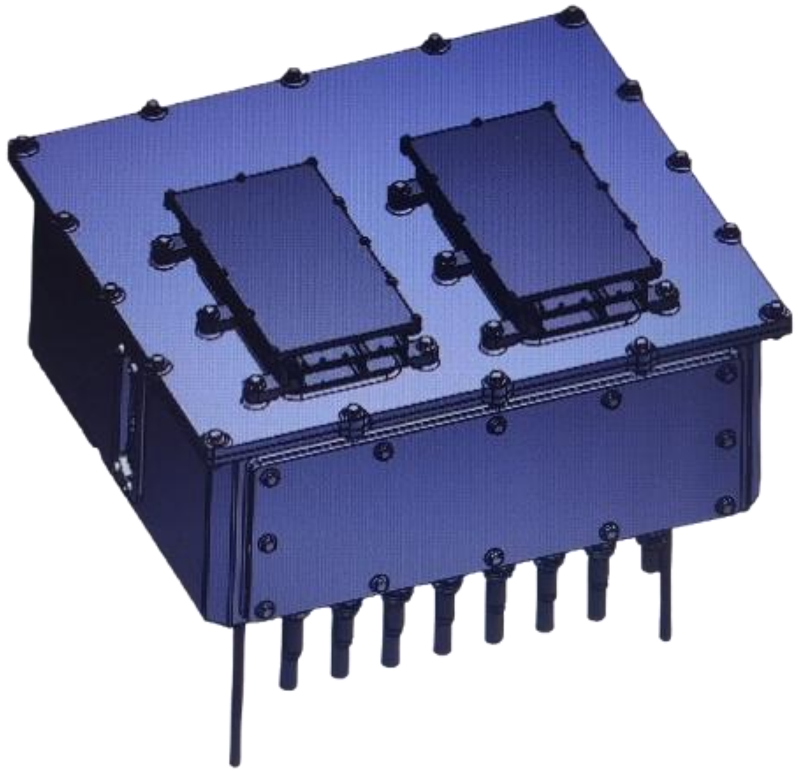
My Role:

- Conceptualized design, created CAD models, and prepared GD&T drawings while collaborating with the client.
- Performed calculations for coolant flow rate, heat transfer, pressure drop, and busbar design.
- Conducted CFD thermal and free-free modal analysis to evaluate thermal and structural performance.
- Applied DFMA principles to streamline manufacturing and assembly.

- **Cold Plate For cooling IGBT :**



- **Ac to DC Converter:**



Lithium Iron Phosphate Battery Pack 3KWh

Objective:

- Design a battery pack according to AIS 038 standards, using 50Ahr Lithium Iron Phosphate prismatic cells. Battery packs should be designed and packaged to fit within the existing space of 3-wheeler vehicles, enabling the retrofit of internal combustion engines to electric drivetrains.

Approach:

- My design strategy focused on developing modules that could be arranged to adapt to various configurations, including variations in size, shape, voltage, and amp-hour capacity. To meet the 48V battery pack voltage and peak current requirements, I opted to design a 24V nominal voltage module. These modules could be connected in series and stacked vertically, maximizing space utilization within the vehicle while providing the required power.

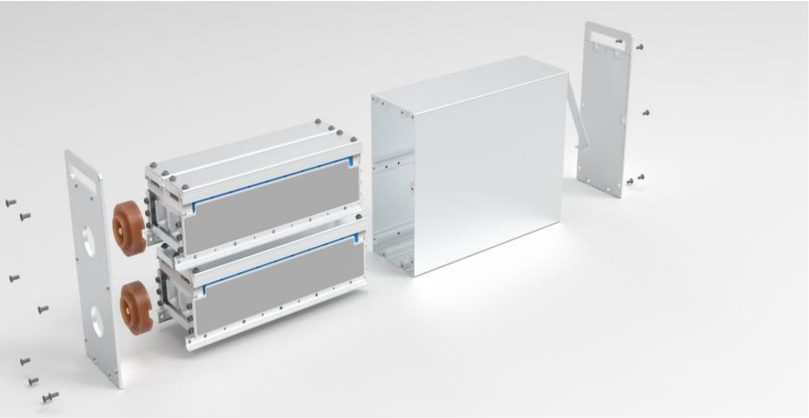
Solution:

- The battery pack was developed using an aluminium extruded body and a door featuring an IP-rated dust and moisture protection seal, fitting optimally within the vehicle's available space.
- Laser-welded aluminum 1060 busbars were designed for electrical connections. To manage the heat generated by the batteries, thermal interface material was applied to enhance heat transfer out of the enclosure.
- Components like the BMS and sensors were efficiently packaged. A modal analysis was also conducted to ensure the design's structural integrity, and a CFD thermal analysis was performed to understand the temperature distribution across the pack, cutting hot-spot temperature by 7 °C.

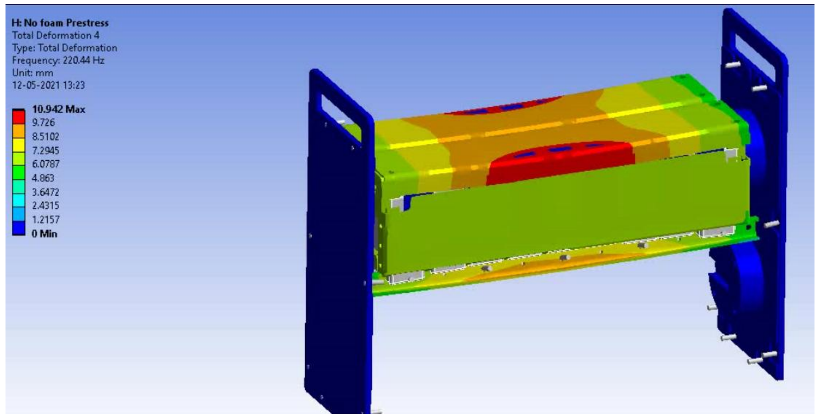
My Role:

- Conceptualized and designed the battery module and pack according to AIS 038 standards. while coordinating closely with the client.
- Developed CAD models and production drawings with GD&T for precise manufacturing.
- Conducted free-free modal and CFD thermal analysis, to determine natural frequencies and thermal performance.
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline production.
- Oversaw prototype manufacturing and procurement of off-the-shelf parts.
- Planned, managed, and participated in testing for validation.

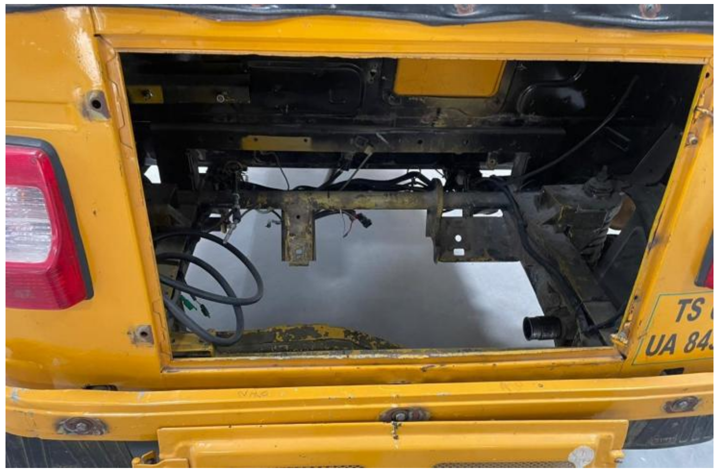
- **Exploded View of battery pack:**



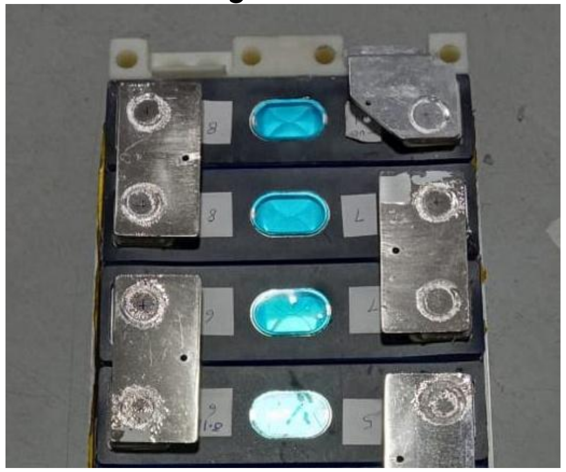
- **Modal Analysis:**



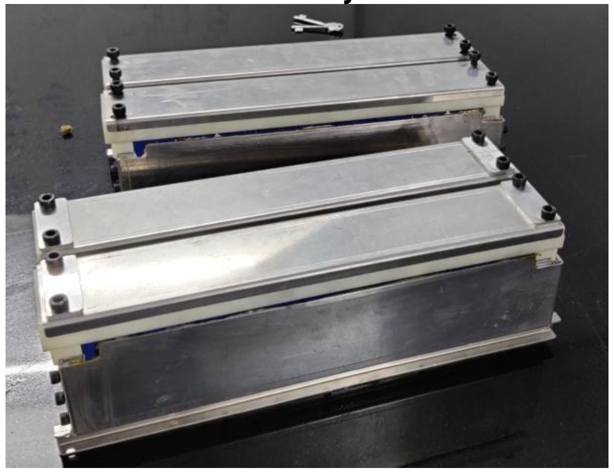
- **Space available in 3-wheeler vehicle:**



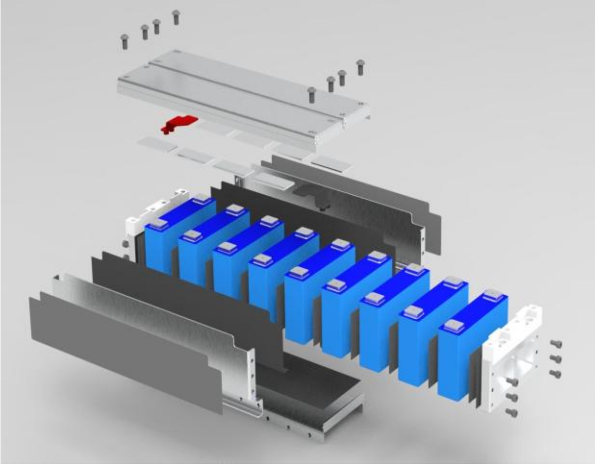
- **Laser Welding of cells:**



- **Manufactured Battery Modules:**



- **Exploded View of 8S1P Module:**



Lithium Iron Phosphate Battery Pack 13KWh

Objective:

- Design a battery pack according to AIS 038 standards, using 135Ahr Lithium Iron Phosphate prismatic cells. Battery packs should be designed and packaged to fit within the existing space of 4-wheeler lightweight commercial vehicles, enabling the retrofit of internal combustion engines to electric drivetrains.

Approach:

- My design strategy focused on developing modules that could be arranged to adapt to various configurations, including variations in size, shape, voltage, and amp-hour capacity. To meet the 98V battery pack voltage and peak current requirements, I chose a 24V nominal voltage module. These modules could be connected in series and mounted side by side, optimizing space utilization within the vehicle while delivering the necessary power.

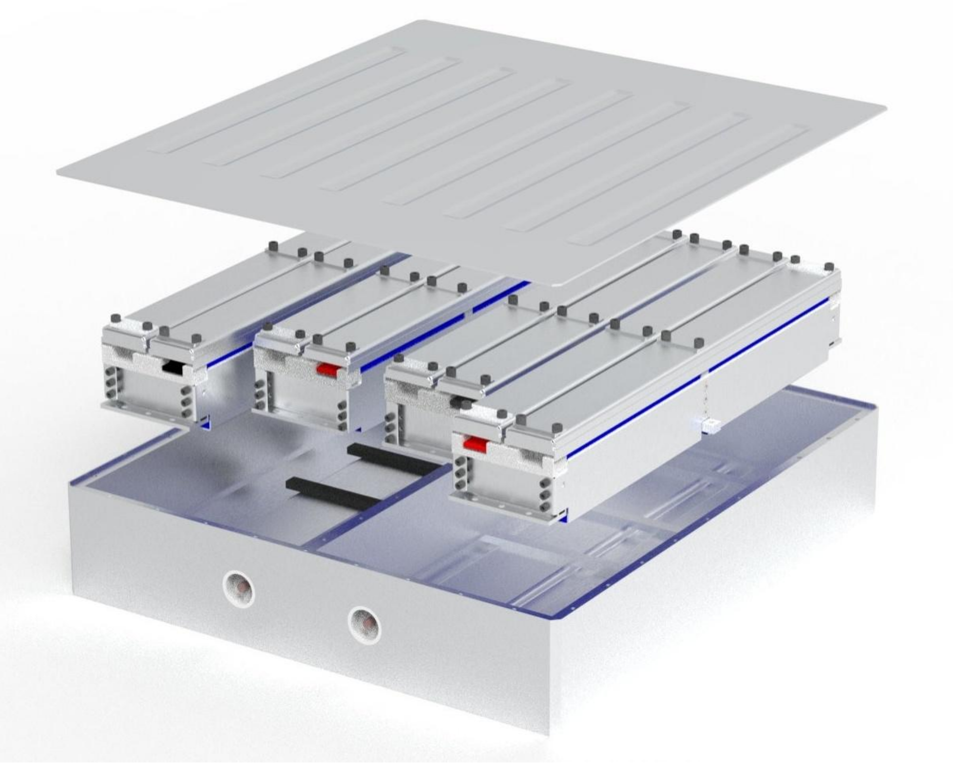
Solution:

- The battery pack was designed from a welded aluminium body and a top lid featuring an IP69-rated dust and moisture protection seal, fitting optimally within the vehicle's available space.
- Laser-welded aluminium busbars were designed for electrical connections. To manage the heat generated by the batteries, thermal interface material was applied to enhance heat transfer out of the enclosure.
- Components like the BMS and sensors were efficiently packaged. A modal analysis was also conducted to ensure the design's structural integrity and CFD thermal analysis was performed to understand the temperature across the pack when used in the vehicle.

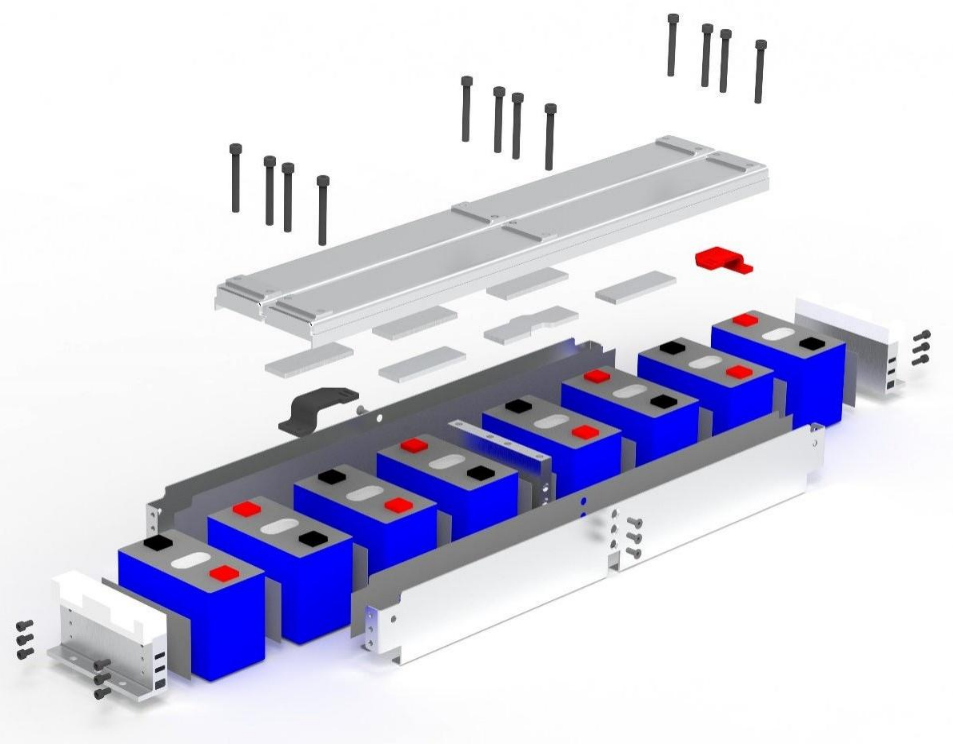
My Role:

- Conceptualized and designed the battery module and pack according to AIS 048 standards. while coordinating closely with the client.
- Developed CAD models and production drawings with GD&T for precise manufacturing.
- Conducted free-free modal analysis, to determine natural frequencies and thermal performance.
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline production.
- Oversaw prototype manufacturing and procurement of off-the-shelf parts.
- Planned, managed and participated in testing for validation.

- **Exploded View of Battery Pack:**



- **Exploded View of 8S1P Module:**



Digital Foiling Machine

What is foiling?

- Foiling is used to create different shiny designs and graphics on various materials.
- Traditional foil printing is a specialized process that involves heat, pressure, metallic foil, and a brass die. In this method, the foil and paper are pressed together using a heated die, resulting in a textured, debossed finish as the foil is transferred onto the card or paper stock.
- Digital foil printing, on the other hand, eliminates the need for brass plates. Instead, varnish is printed directly onto the paper stock using a printer, which means there are no setup costs. The varnish-printed paper is then passed through a heated rubber roller along with the foil, depositing the foil only where the varnish has been applied.

Objective:

- The objective was to design a digital foiling machine that is cost-efficient for small foiling orders and operates on a single-phase power supply, allowing small presses to perform fast and economical foiling.

Approach:

- Planned to develop a prototype to validate heating calculations and evaluate the foiling process. This prototype will also allow the PLC programming team to test their code, ensuring effective integration and performance.
- Conceptualized a timing belt–driven foil tensioner, conveyor, and heating roller system powered by a single motor. To lower motor torque and manufacturing cost decided to use a hollow Hard chrome-plated aluminum roller.
- After conducting thorough testing of the initial proof of concept, the final prototype with automatic paper feeding and collection will be developed.

Solution:

- I developed a robust digital foiling machine that can foil paper up to 2 feet wide and operate on a single-phase power supply.
- Developed a timing belt–driven foil tensioner, conveyor, and heating roller system powered by a single motor, using a hollow Hard chrome-plated aluminum roller that lowered motor torque by 30%, and manufacturing cost by ~15%.
- It features automatic paper feeding and collection, making it suitable for both small and large order quantities. The addition of a pick-and-place system ensures smooth operation and enhances efficiency in the foiling process.

My Role:

- Conceptualized and developed CAD, production drawings with GD&T for precise manufacturing.
- Performed Structural and Heater calculations.
- Performed DFMA to streamline production and reduce assembly time.
- Oversaw prototype manufacturing and procurement of off-the-shelf parts.
- Planned, managed, and participated in testing for validation.

- **Final Product -**

- **Prototype -**

Electrification of Light Commercial Vehicles

Objective:

- Design an electric drivetrain for a light commercial vehicle by replacing the internal combustion (IC) engine with an electric motor while maintaining equivalent performance, achieving minimum retrofit cost.

Approach:

- Selected Tata ACE for retrofitting due to its widespread use in the LCV segment.
- Analyze drive configurations using fixed gear ratios and the existing 4-speed manual gearbox, coupled with an axial flux DC motor. Calculate torque requirements for fully loaded cargo with 14.5° gradeability.
- Reverse-engineer gearbox to map bolting/locating hole coordinates to replicate them in the motor–coupling assembly to ensure shaft concentricity.

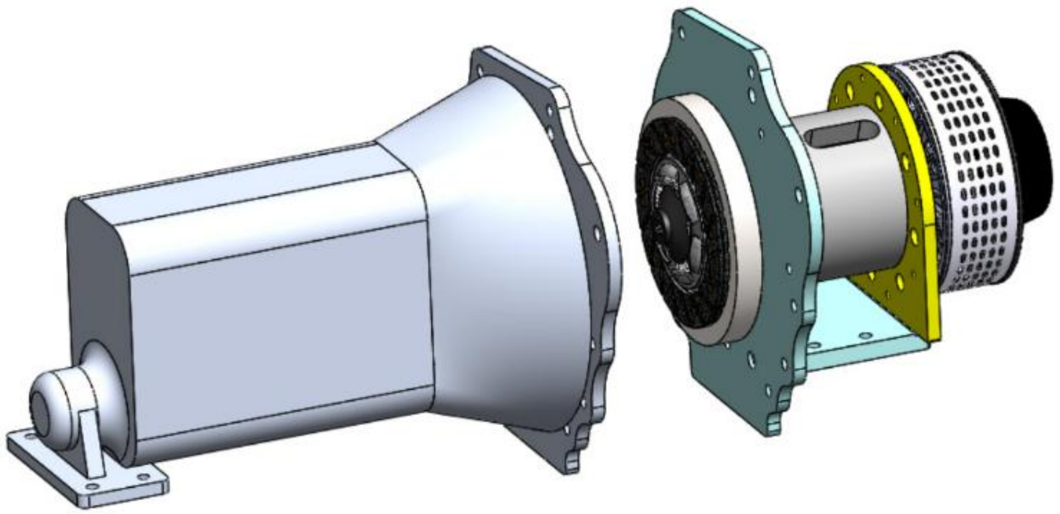
Solution:

- Engineered an electric drivetrain by replacing the IC engine with an axial flux DC motor; validated manual gearbox reuse, achieving target performance with 40% lower motor power and 12% lower retrofit cost.
- Reverse-engineered gearbox to map bolting/locating hole coordinates, and replicate them in motor–coupling assembly, ensuring precise shaft concentricity.
- Designed the motor–gearbox assembly with a flexible coupling to protect the motor during prototype testing.
- Developed mounting points to reuse the existing bracket with minimal chassis modifications, simplifying integration.
- Maintained the post-gearbox drivetrain unchanged, preserving compatibility with the OEM spare supply chain.

My Role:

- Conceptualized and developed CAD, Drawings, GD&T for precise manufacturing.
- Performed Reverse engineering of location points on the gearbox casting.
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline manufacturing and assembly.
- Assembly and Testing of prototype.

- **CAD Model of Drivetrain:**



- **Electrical drivetrain after manufacturing:**

Electric Motor Test Bench

Client - Bharat Bijlee Ltd.

Objective:

- Design and supply a machine to test motors of varying frame sizes, shaft diameters, mounting arrangements, and power ratings at the Bharat Bijlee manufacturing facility. The fixture needed to accommodate multiple configurations on a single platform.

Approach:

- Conceptualized the testbench layout and classified 15 motors based on mounting arrangement: flange mount and base mount.
- Designed a flange to accommodate seven frame sizes of flange-mounted motors.
- Designed a height-adjustable platform for base-mounted motors to align the shaft of the torque sensor with the motor under test.
- Mounted the dynamo motor and torque sensor on a fixed structure for consistent measurement.

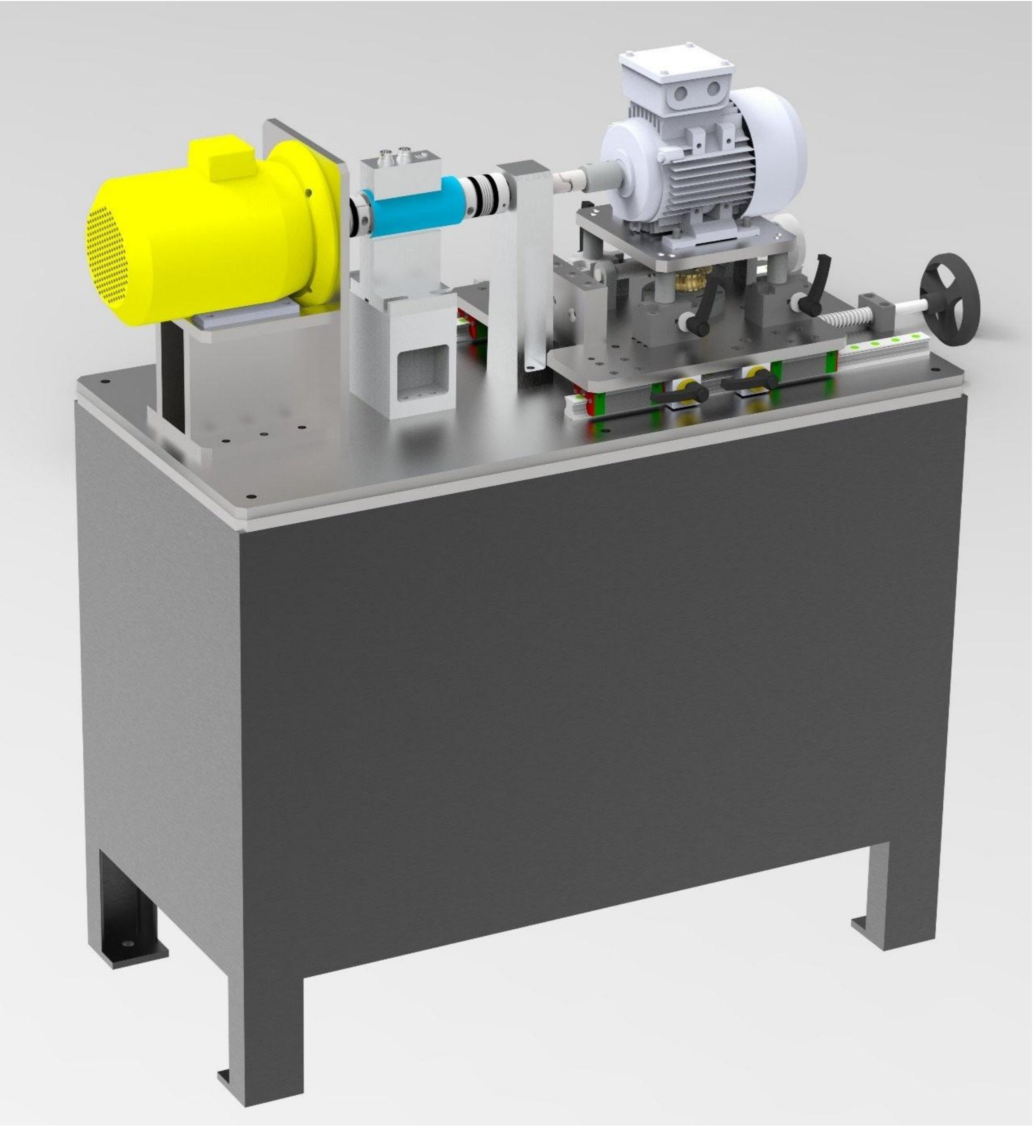
Solution:

- Designed a fixture to test 15 motor types up to 10 HP and 60 N·m torque. Selected a 0–60 N·m torque sensor to cover the full testing range.
- Integrated three-ring locators to align seven flange-mounted motor sizes on a single bracket.
- Developed a height-adjustable platform with T-bolts for base-mounted motors, reducing costs by 30% with adaptable mounts.
- Enabled forward–backward platform motion, reducing motor changeover time to 3 minutes.
- Integrated a double-disc coupling to allow micron-level misalignment tolerance and protect the torque sensor.

My Role (Freelancing Project):

- Conceptualized design, created CAD models, and developed GD&T production drawings in collaboration with the client.
- Applied DFMA principles to streamline manufacturing and assembly.
- Managed vendor manufacturing and procurement of off-the-shelf parts.
- Oversaw prototype assembly and testing at a rented workshop.
- Completed installation at client site.

- **CAD of Motor Test Bench showing an arrangement of base mount motor:**



Solar Module DML Test Machine

Client: NCPRE IIT Bombay

Objective:

- This project aimed to develop a Dynamic Mechanical Loading (DML) machine to simulate the static and dynamic stresses solar panels experience during adverse weather conditions like snowstorms and strong winds, and verify IEC compliance.
- This machine is designed to study the effects of mechanical stresses on solar panel performance and evaluate the resilience of new solar panel designs against snow and wind loads, in line with the latest IEC standards. Additionally, it incorporates capabilities for Electroluminescence (EL) imaging and flash I-V testing of the photovoltaic (PV) module.

Approach:

- Various sizes of solar panels are manufactured for different applications, so decided to design a machine that could test all size variations. Special units with centrifugal pumps will provide both pressurized air and vacuum to apply the required load on the panel.
- A camera setup will be positioned opposite the Dynamic Mechanical Loading (DML) machine to capture Electroluminescence (EL) images of the PV module.

Solution:

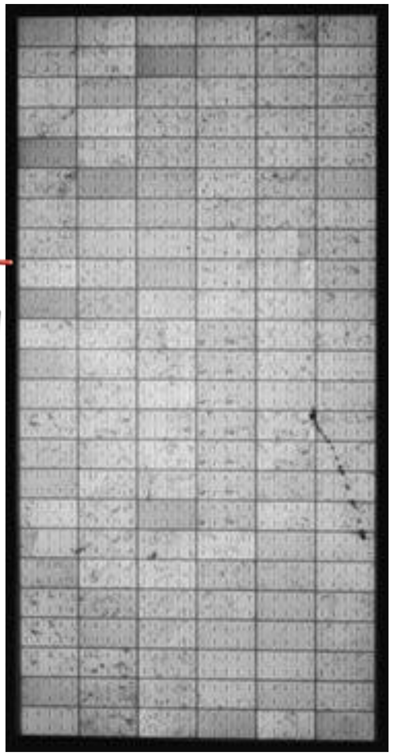
- Engineered an adaptive mechanism for testing module sizes from 0.9×0.7 to 2.1×1.1 m, reducing cost 18% and ensuring 100% adaptability to future variants.
- The pressurized air and vacuum system is designed to apply static loads up to 8000 Pa and dynamic loads up to 2500 Pa, exceeding IEC standards. The tool can administer stress cycles on solar panels as per IEC standards, with full control through a PLC and HMI interface, ensuring precise testing and adjustments.
- The camera setup, positioned opposite the DML tool, is programmed via PLC to capture Electroluminescence (EL) images of the PV module during specified testing phases. These images allow for assessing damages and performance before, during, and after testing. Interconnect ribbons between cells, vulnerable to breakage from mechanical stresses, can be thoroughly evaluated using EL and flash I-V images. This method enables a comprehensive study of damage to the solar panel and its performance, ensuring accurate analysis of stress-induced failures.

My Role (Freelancing Project):

- Conceptualized the design, created CAD models, and developed production drawings with GD&T while coordinating closely with the professor at IIT Bombay.
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline manufacturing and assembly.
- Manufacturing from vendors and procurement of off-the-shelf parts.
- Assembly and Testing of the prototype at a rented workshop.
- Installation at IIT Bombay.

- **DML Tool Installed at IIT Bombay :**

- **Sample of EL Picture :**



- **Deflection of the solar panel due to stress induced by creating a vacuum on the backside of the panel:**

- **Deflection of the solar panel due to stress induced by applying compressed air to the backside of the panel.:**

Portable Electro Luminescence Test Devise

Client: NCPRE IIT Bombay

Objective:

- EL imaging of the PV module installed in the field is essential for studying damages caused by stresses and optimizing power production by replacing damaged panels and claiming warranties.
- The aim was to develop a portable, user-friendly Electroluminescence (EL) testing kit to detect cracks, interconnect failures, bypassed strings, and other defects in solar panels. For use in solar farms, the lightweight kit with a camera should easily transfer between panels, utilizing the solar panel frame as a guide for efficient inspections across multiple panels.

Approach:

- Various sizes of solar panels are manufactured for different applications so the decision was made to design a tool that can be adjusted to test all variations of solar panels.
- The design approach involved mounting the camera on adjustable legs, allowing for effective image capture of both small and large solar panels.

Solution:

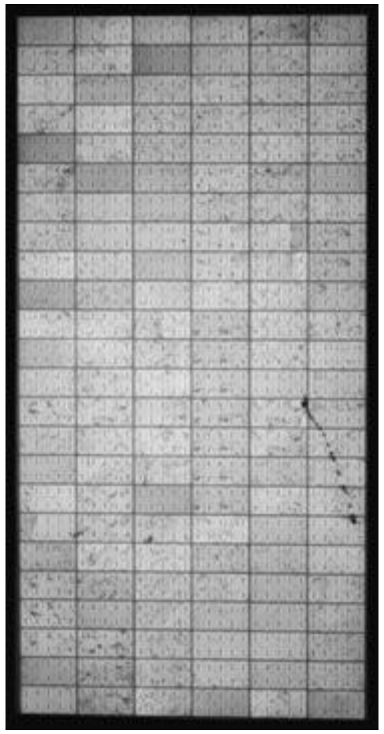
- I developed a modular setup using aluminium telescopic arms that can be quickly assembled, dismantled, and transported for on-site solar panel testing. The telescopic arms in the base structure allow for adaptation to various solar panel sizes, while the adjustable arm for the camera enables flexibility in the field of view, ensuring effective image capture for different testing scenarios.
- A structure equipped with a camera can be easily transferred between solar panels using grooved wheels attached to the base frame. The wheels utilize the solar panel frame as a guide, making it convenient to move the camera from one solar panel to another. Enabled warranty claims on 15,000 modules and improved power output.
- Fig. 1 (a) shows the photo of the setup. Fig. 2 (b) shows the EL image of the PV module captured using this tool.
- The EL image captured using this tool doesn’t require a perspective transformation.

My Role (Freelancing Project):

- Conceptualized the design, created CAD models, and developed production drawings with GD&T while coordinating closely with the professor at IIT Bombay.
- Manufacturing from vendors and procurement of off-the-shelf parts.
- Assembly and Testing of the prototype.
- Supplied to IIT Bombay.

- **Prototype 1, Fig. 1 (a) :**

- **Picture takenusing the Product Fig 2 (b)**



- **Prototype 2:**

Drone Space Frame Design
Client: Rapid Manufacturing Lab - IIT Bombay

Objective:
- The aim was to design a drone for medical emergency services capable of carrying a 90 kg payload. The drone needed a modular structure for easy assembly and transport, enabling rapid deployment in emergencies.

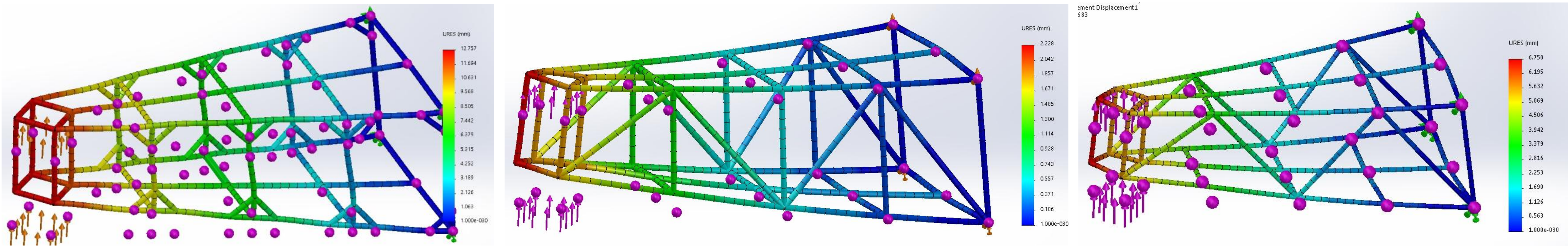
Approach:
- Initially designed a cost-effective space frame using readily available mild steel to validate the concept, acknowledging payload reduction due to higher weight.
- After successful prototype validation, planned a transition to an aluminum frame for the final structure to optimize weight savings while maintaining structural integrity.

Solution:
- Designed a modular space frame housing 8 motors, controls, and battery packs, capable of flying with a 90 kg payload.
- Performed FEA simulations on multiple design iterations to maximize the strength-to-weight ratio, achieving a 12% improvement.
- Developed custom fabrication fixtures to ensure accurate welding, achieving ±1 mm fabrication tolerance.
- Designed drone arms with bolted joints for quick assembly/disassembly, making the system highly portable and cost-effective.

My Role (Freelancing Project):
- Conceptualized the design, created CAD models, and prepared GD&T drawings in coordination with a professor at IIT Bombay.
- Performed structural FEA simulations for optimization.
- Designed fabrication fixtures for precise welding assembly.
- Coordinated vendor manufacturing and delivered the final product to IIT Bombay.

- **Drone at the Expo:**

- **Drone Structure FEA to increase the strength-to-weight ratio:**



Pathology Slide Scanner

Project research engineer - IIT Bombay

Objective:

- The goal was to develop a pathology slide scanner to scan pathology slides and store them in a digital format. The scanned images of pathology slides can be stored and sent to doctors overseas for evaluation and diagnosis of critical diseases like cancer.

Approach:

- To capture the microscopic details, a 20X zoom lens is required. At this level of magnification, the camera's field of view narrows to 1mm x 1mm.
- To capture the entire slide and convert it into a digital format, we decided to develop a 3-axis mechanism.
- The slide will move in the x and y directions to capture a series of images, while the z-axis will be used to adjust the camera's focus.

Solution:

- Phase 1 - Built a digital microscope prototype from scratch using lead screws with 50-micron accuracy. This prototype allowed the coding and electronics teams to test and trial their code.
- Phase 2 - Prototype two was optimized to achieve 20-micron accuracy and autofocus using ball screws. It also included linear encoders to create a closed-loop system. I completed both fully functional prototypes within the specified timelines.

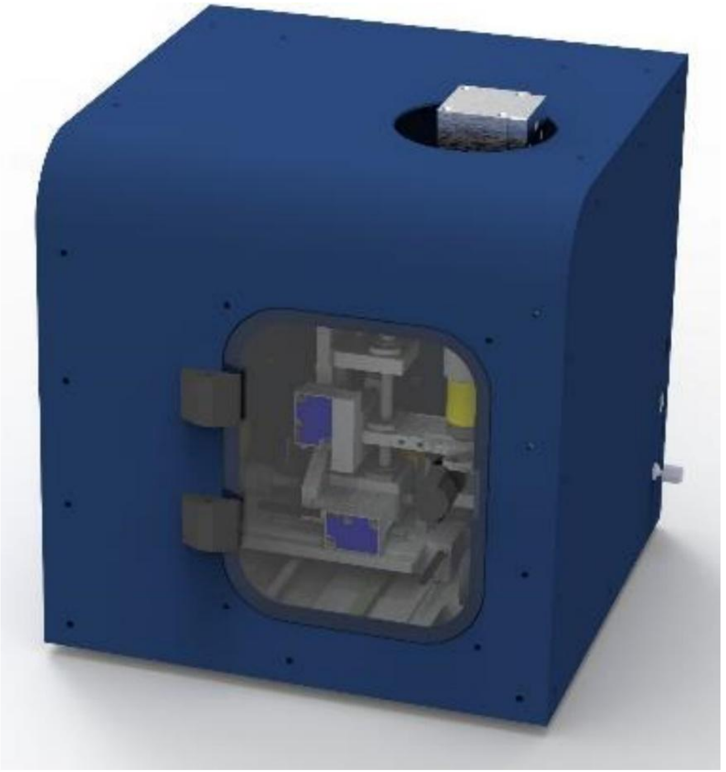
My Role:

- Conceptualized the design, created CAD models, and developed production drawings with GD&T while coordinating closely with the professor at IIT Bombay.
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline manufacturing and assembly.
- Manufacturing from vendors and procurement of off-the-shelf parts.
- Assembly & Testing.

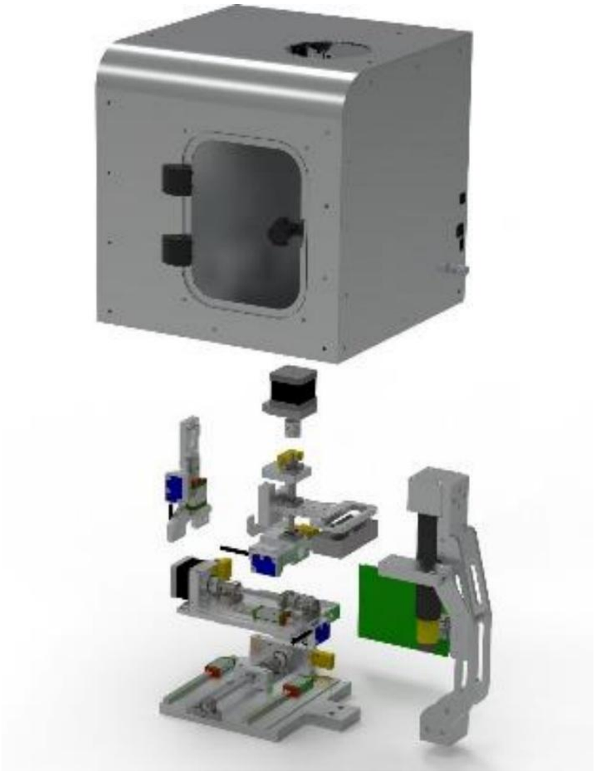
- **Phase 1 prototype:**

- **Phase 1 prototype Inside:**

- **Phase 2 prototype:**



- **Phase 2 prototype Inside:**



Blood Smear preparation device (Medical Device)

Objective:

- The purpose of this project is to design a device capable of creating ideal smears on pathology slides. This device is intended for use in regions affected by malaria outbreaks during the rainy season. In collaboration with a microbiologist, the project aims to develop a power-independent device that produces blood smears of varying thicknesses, which will enhance the accuracy of malaria diagnoses.

Approach:

- The plan was to develop devices that do not require any power source and include speed adjustments. This prototype will facilitate testing and data collection of blood smear shapes at various speeds.
- Once we have data on the optimal speed range for achieving perfect blood smears, two separate devices will be developed: one utilizing a mechanical system and the other featuring electronic control for different applications. The electronic device will be more compact compared to the mechanical system.

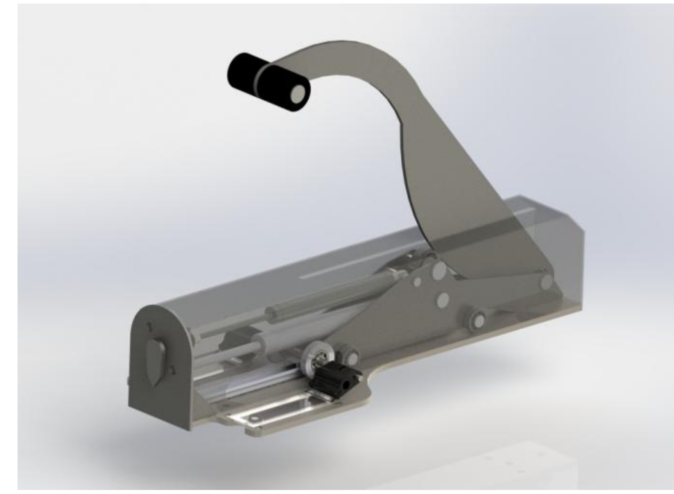
Solution:

- **Phase 1** - The prototype was developed using mechanical components such as a variable damper and nitrogen spring. The variable damper enables different spreading speeds, allowing for the adjustment of smear thickness. This device facilitated testing and data collection on blood smear shapes at various speeds, providing valuable insights for further development.
- **Phase 2 –** A simplified prototype was developed using a nitrogen spring and a fixed damper to reduce costs while achieving the necessary smear quality for malaria diagnostics. This phase focused on optimizing the design for efficiency and effectiveness in creating blood smears, facilitating accurate diagnostic results.
- **Phase 3 –** The third prototype utilized an electro-mechanical platform to enhance precision and provide greater control over smear thickness, making it well-suited for advanced pathology testing laboratories.

My Role (Freelancing Project):

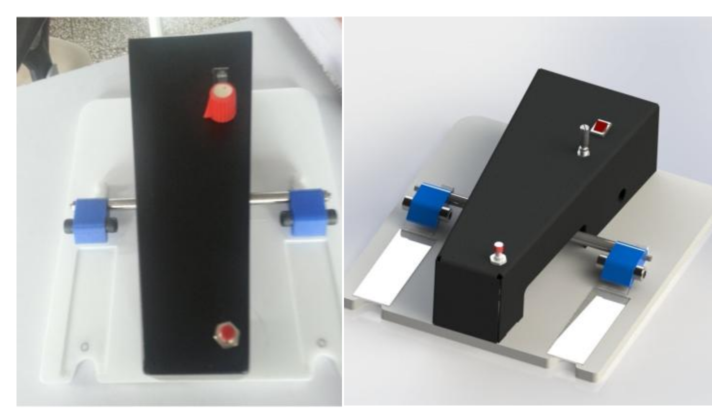
- Conceptualized the design, created CAD models, and developed production drawings with GD&T while coordinating closely with the client(microbiologist).
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline manufacturing and assembly.
- Manufacturing from vendors and procurement of off-the-shelf parts.
- Assembly & Testing.

Phase 1:

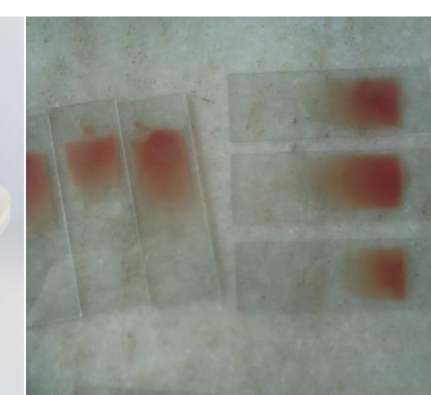


Phase 2:

Phase 3:



Blood Smear:



Team Eta
(Co-curricular activities)

About Team Eta and Shell ECO Marathon competition:

- The Shell ECO Marathon competition's main purpose is to challenge teams from around the world to design, build, and test ultra-energy-efficient vehicles. With annual events initiated in the United States of America, Europe, and Asia, winners are the teams that go the furthest using the least amount of energy. The events inspire young engineers to push the boundaries of fuel efficiency & invent new technology.

Co-founded Team Eta in 2013:

- Co-founded Team Eta with five passionate classmates and led a student team that designed and built ultra-fuel-efficient vehicles; directed subsystem design and system integration across three prototypes. Participated in the Shell Eco-Marathon in 2013, 2014, and 2015.

Achievements:

- 2015: Achieved India's highest mileage of 153 km/L, ranked 1st in India and 5th in Asia among 120 teams from 17 countries.
- 2014: Only Indian team to pass all inspections and complete on-track runs; placed 27th of 80 teams in the design category.

Team Eta Prototype car ARYA,
Shell Eco-Marathon 2015 -

Team Eta Prototype car J-14
Shell Eco-Marathon 2014 -

Team Eta Prototype car JUGAAD 13
Shell Eco-Marathon 2013 -

My contribution to Team Eta
(Co-curricular activities)

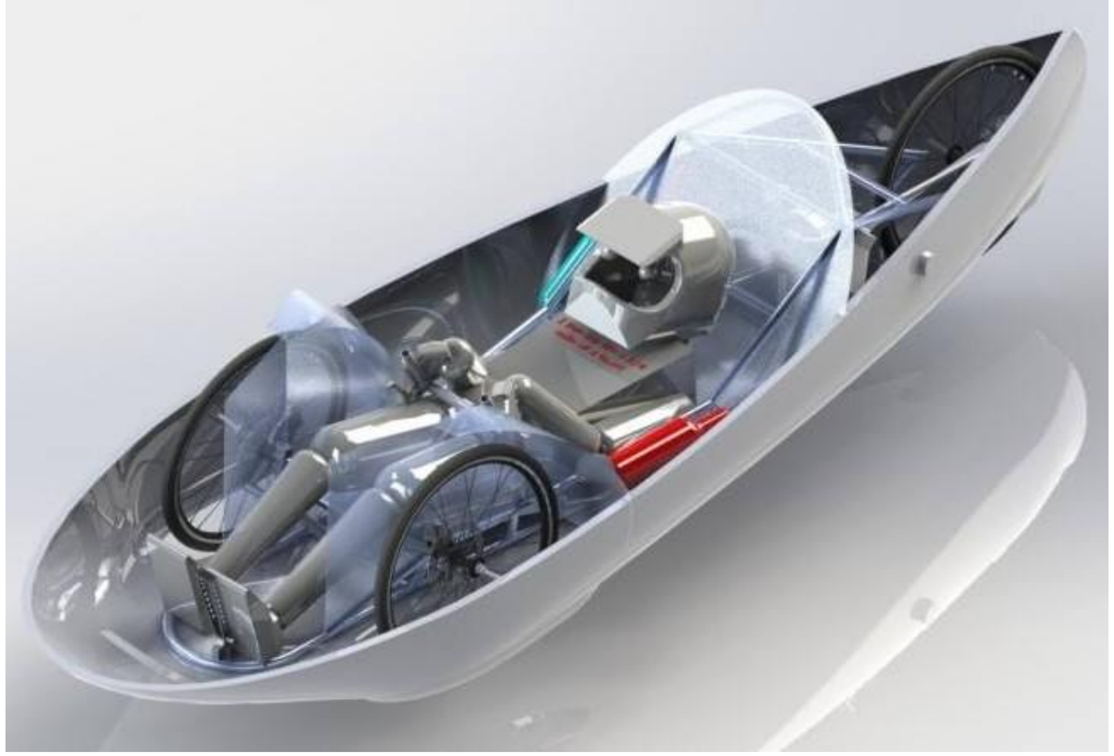
Technical Director & Coordinator (Shell ECO Marathon 2014 & 2015):

- I directed the engineering of a 35cc single-seater fuel-efficient prototype car for the Shell Eco-Marathon.
- My responsibilities included setting technical goals, optimizing designs, and ensuring that all team members' parts were compatible with dependent systems.
- I led a team of 30 students to design, manufacture, and test the prototype within 280 days.
- Collaborated with industries to develop manufacturing strategies in areas of rapid prototyping, Carbon fibre composite manufacturing, frame fixturing, CNC machining and case hardening.
- Created a test plan of 300 Km for vehicle performance tuning and verification of system parameters.
- Competed in the Shell Eco-Marathon Asia 2015, ranking first in India and fifth in Asia among 120 teams from 17 countries, achieving a fuel efficiency of 153 km/L.
- Competed at Shell Eco-Marathon Asia 2014 – (Only Indian team to complete all inspections and run the car on track).

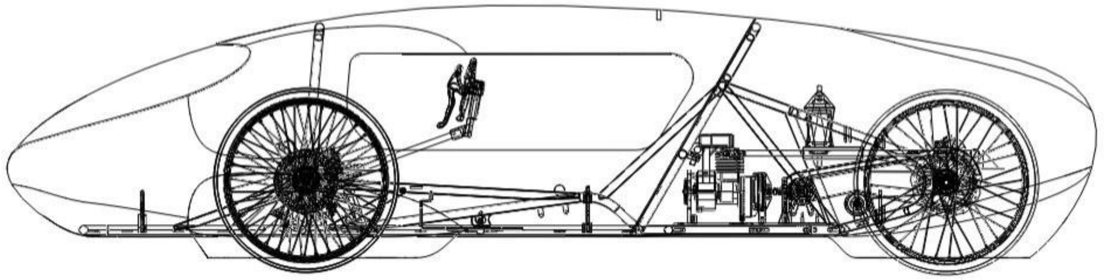
CAD Design & Manufacturing Drawing Manager (Shell ECO Marathon 2013, 2014 & 2015):

- We had a special sub-team for designing car subsystems, such as the chassis, drivetrain, powertrain, steering, suspension, and brakes. The CAD manager's responsibility was to ensure that all parts from the subsystems fit onto the chassis and with each other. I contributed as a CAD manager for three years.
- Responsibility also included making assembly drawings and BOM.

J-14 CAD Design for Shell Eco-Marathon 2014 :



Arya CAD Design for Shell Eco-Marathon 2015 :

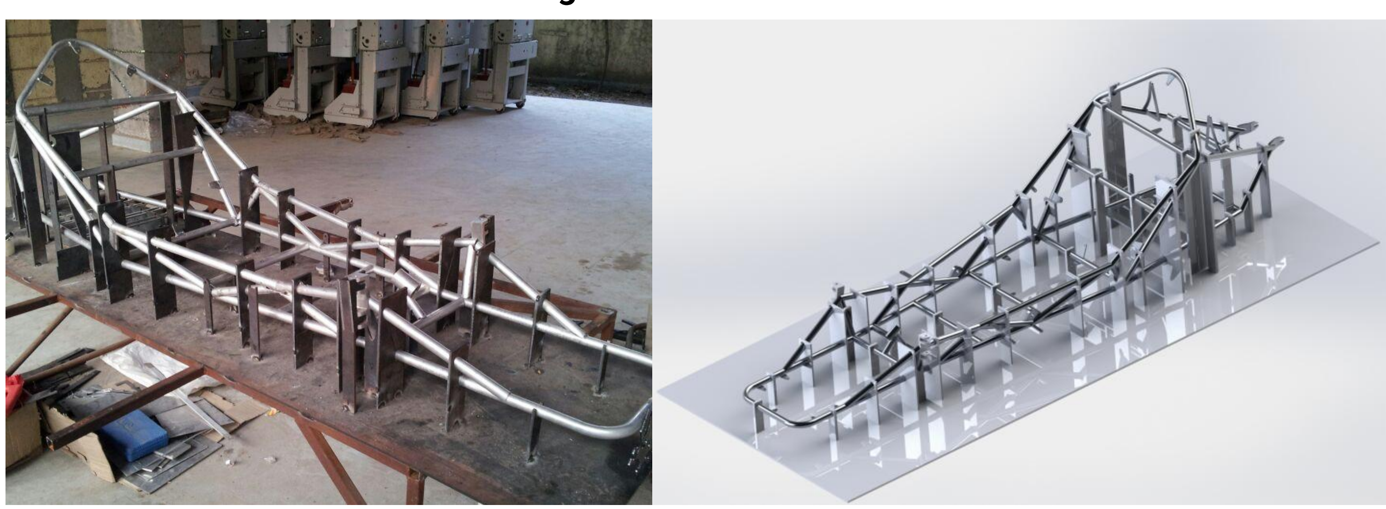


My contribution to Team Eta
(Co-curricular activities)

Chassis Team Lead (Shell ECO Marathon 2014 & 2015):

- Led a team of two students, analysed different aluminium grades (6061-T6, 6063-T6) and incorporated manufacturing technologies such as laser profile cutting, tube bending and fixture design to fabricate a space frame chassis.
- Designed and developed an ergonomic and lightweight space frame chassis using SolidWorks and structural simulations on ANSYS.
- Incorporated a side geometry that enhanced load distribution and reduced material.
- Increased number of Bent pipes to reduce the number of joints, after annealing of aluminium pipes bending was done followed by Tempering (T6) to achieve high strength.
- Lowered the centre of gravity by 5% which allowed lateral accelerations.
- Developed fixture setups that allowed manufacturing pickup points on the frame within an error of 1 mm, verified using a coordinate measuring machine.
- Reduced the frame weight by 20% with a 9% improvement in stiffness in 2014 compared to the 2013 design.
- Reduced the frame weight by 6 kgs with constant stiffness in 2015 compared to the 2014 design.

Chassis & Fabrication Fixture Design Shell Eco-Marathon 2014 :



Chassis & Fabrication Fixture Design Shell Eco-Marathon 2015 :

My contribution to Team Eta
(Co-curricular activities)

Composite team member (Shell Eco-Marathon 2015):

- In 2014, the car's outer shell was made of a glass fiber and epoxy-based resin composite. Played a key role in the Composites Team, achieving a 30% weight reduction in the new prototype by replacing glass fiber with carbon fiber using an in-house vacuum bagging process (Picture 4).
- Worked on manufacturing planning, material selection, and sourcing advanced materials globally.
- We created the pattern by splitting the design into 50mm sections and CNC machining these sections from 50 mm-thick MDF sheets. The pieces were then stacked and assembled using glue and screws to form the final shape, followed by the addition of a finishing touch of PU paint (Pictures 1 & 2).
- Manufactured the mould using glass fiber and polyester resin (Picture 3). The outer shell was made from two layers of 100GSM carbon fiber and ROHACELL foam to ensure stiffness (Picture 5).

1) Pattern Machining from MDF:

2) Fixing patten parts and finishing the pattern:

3) Glass fiber Mold Making:

4)Vacuum bagging for the final Carbon fiber part:

5) Carbon fiber Car shell for Shell Eco Marathon 2015:

My contribution to Team Eta
(Co-curricular activities)

Transmission Design Lead (Shell ECO Marathon 2015):

- Designing a completely new drive train mechanism based on the planetary gearing & and timing belt system.
- Considering the motor torque output and torque required at the wheel designed a transmission with a reduction of 32:1
- Optimized Chassis Mounting to get accurate location of Transmission Components.
- Drive-train components were machined from solid aluminium.

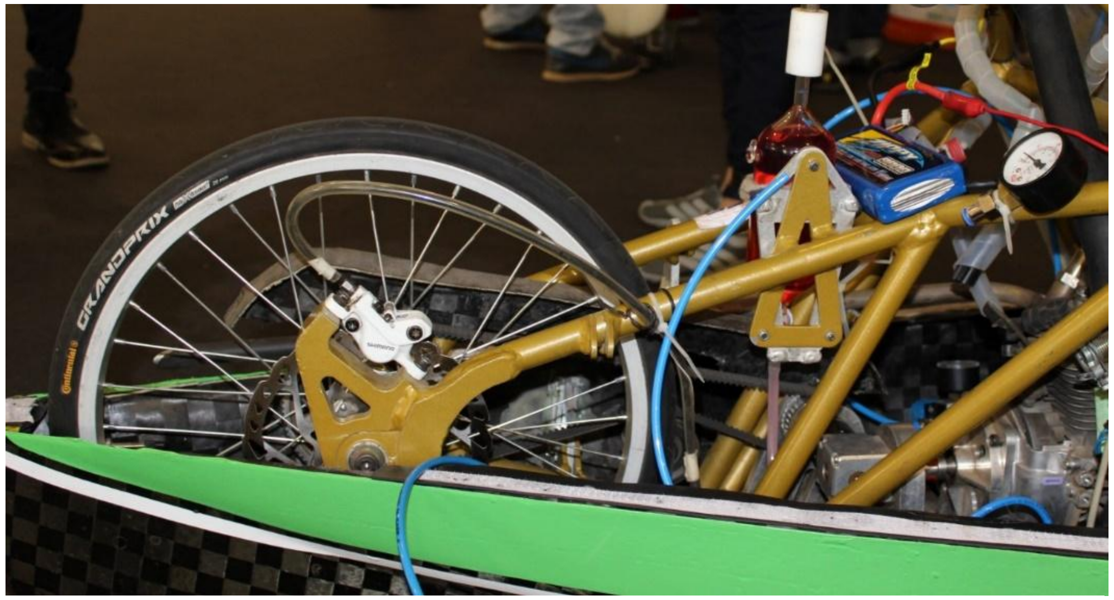
Conversion of crank start engine to Electric switch start (Shell ECO Marathon 2015):

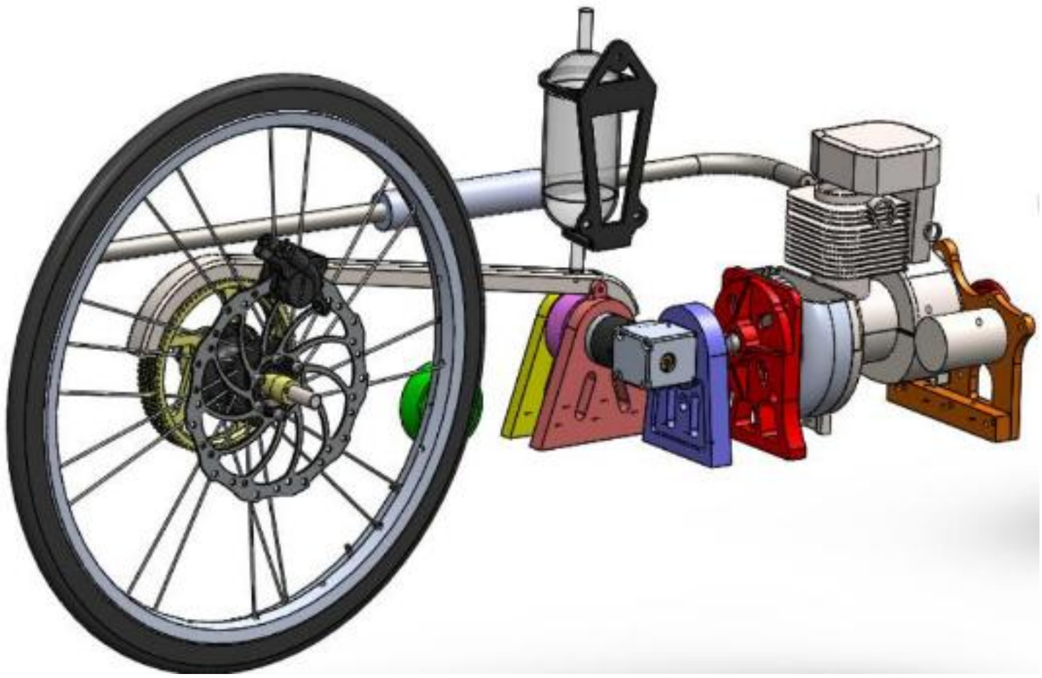
- We used a Honda GX35 engine for powering the car, The engine comes with a hand crank for starting the engine.
- I did a calculation of the starting torque required for the engine and designed a gear reduction powered by an electric motor to make it switch start.

Steering system Lead (Shell ECO Marathon 2013):

- Designed steering system for Shell Eco-Marathon 2013 Car, the main objective is to decrease the energy loss due to wear and sliding of tyres when cornering and also to design a responsive and smooth steering mechanism considering ergonomics.
- After calculation decided to go with Ackerman geometry with tie rod steering mechanism.

Transmission Design for Shell Eco-Marathon 2015:





Honda Engine with hand crank :

Engine with an electric start:

Auto disengagement clutch design
(Bachelor of Engineering Final Year Project)

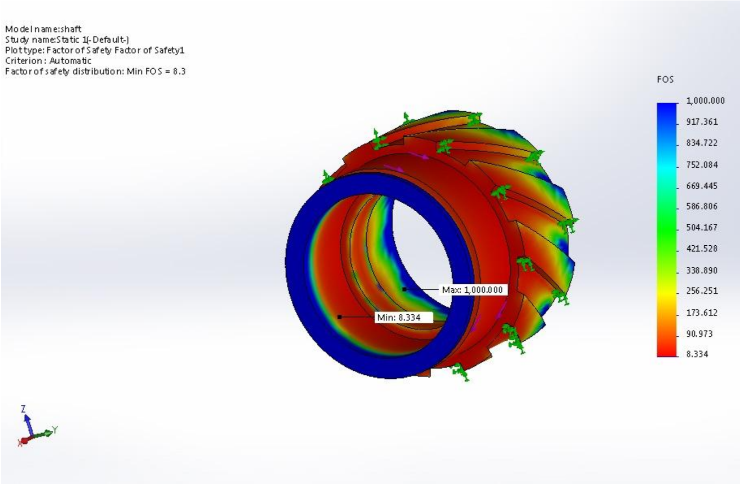
Problem:
- When a vehicle is not accelerating and the engine clutch is disengaged from transmission Because the wheel is still connected to the gearbox there is an energy loss due to the rotation of the gearbox and belt drive.
- The aim was to design an auto disengagement clutch to address this issue and install it in Team Eta 2015 Prototype car to enhance efficiency.

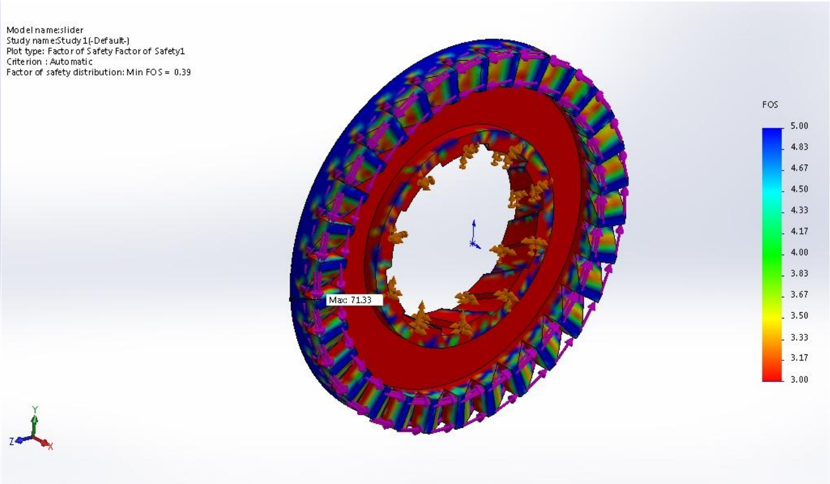
Approach:
- My approach was to design a clutch that automatically disengages the transmission from the wheel when the engine stops accelerating and the vehicle is coasting. It should function without any external power source and fit directly onto the rear wheel hub.

Solution:
- I designed a clutch system based on the principles of inertia, thread friction angle, and clutch teeth similar to a dog clutch. This system engages with the wheel due to inertia and automatically disengages when the drive shaft speed decreases relative to the wheel, thanks to the teeth profile.
- Implementing this clutch on the rear wheel hub of the Shell Eco-Marathon 2015 car reduced system losses by 48%, significantly improving coasting and overall efficiency.

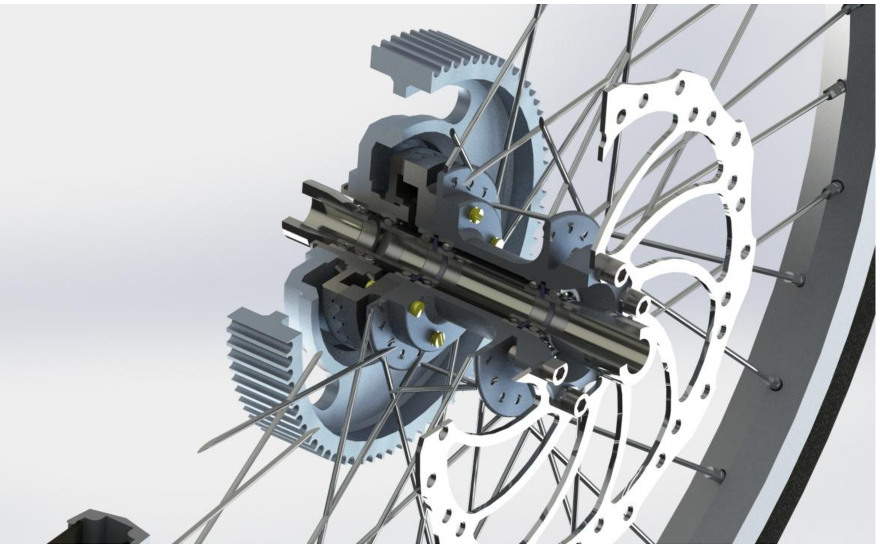
My Role:
- Conceptualization
- CAD & Production drawing GD&T
- Design for Manufacturing & Assembly
- Manufacturing from vendors
- Assembly, Testing

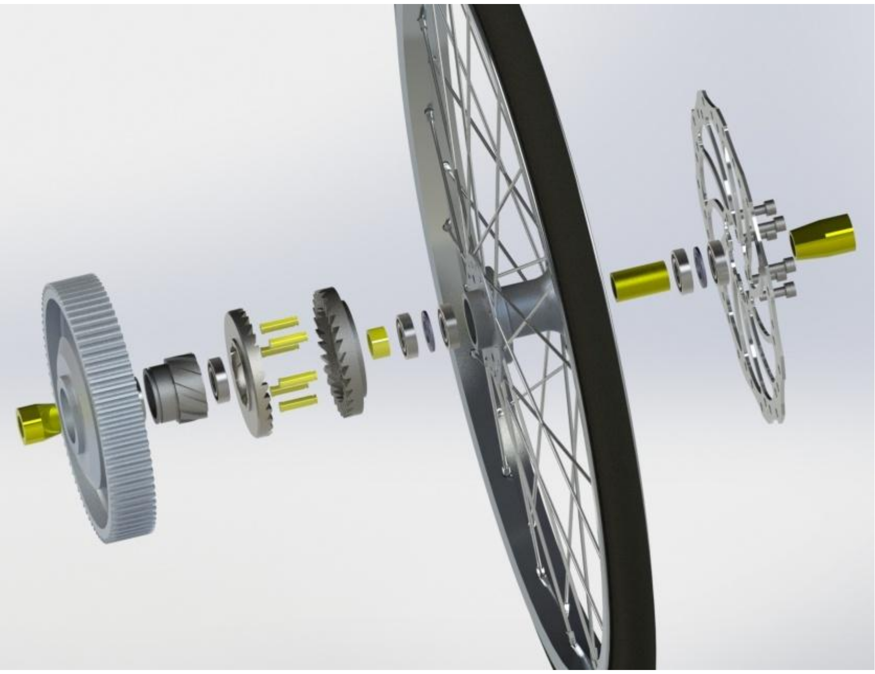
Static analysis of clutch components Shell Eco-Marathon 2015:





CAD design of clutch Shell Eco-Marathon 2015:





Magnetic Gearbox

Project Detail:

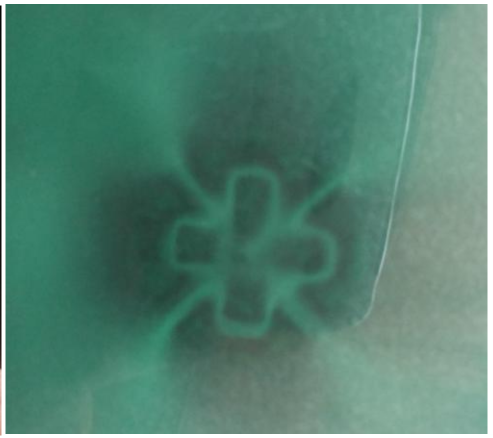
- During my undergraduate studies, I led a team of 30 to design a fuel-efficient car for the Shell Eco-Marathon, focusing on reducing drivetrain losses, air drag, and friction in the gearbox.
- While researching, I became interested in magnetic bearings and frictionless magnetic gearboxes. I studied papers on magnetic gearbox design, magnet materials, Halbach arrays, magnetic fields, and pole arrangements. This led me to build a prototype gearbox and test it to better understand its functionality.
- I sourced Neodymium magnets locally and imported magnetic film from the USA to study magnetic poles.- Secured sponsorship for two torque sensors from Sensor Technology Ltd, UK, to test the prototype. I also developed fixtures to manufacture and assemble the middle ring of the gearbox using cold-rolled, non-oriented soft iron lamination. The gearbox, with a 3:1 ratio, was tested using the torque sensors, achieving a maximum output torque of 2.87 N-m.

Learnings:

- Developed an understanding that a gearbox with a smaller pole width and a higher number of poles ensures smoother operation and reduces jerks.
- Realized the need to design an electromagnet stator that integrates motor and gearbox coils for more efficient performance.
- Learned that utilizing magnets of different shapes can enhance the strength of the magnetic field.

- **3D Printed Rotor of Prototype 1:**

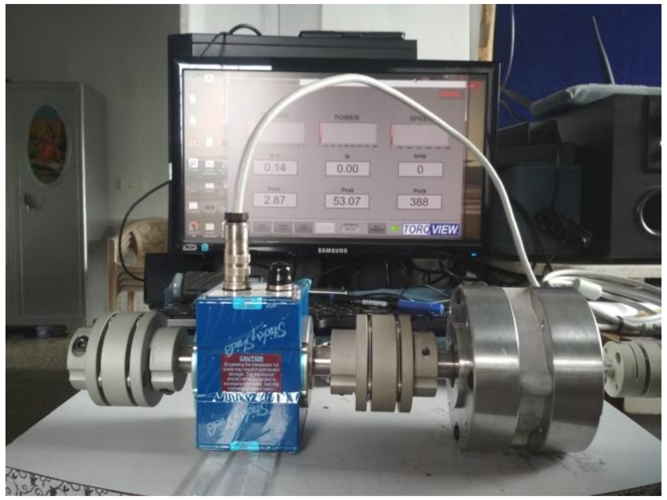
- **Rotor four Poles viewing using magnetic film:**

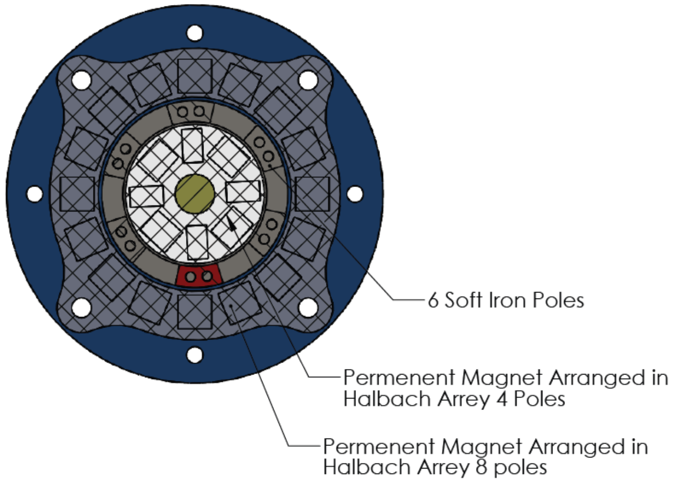


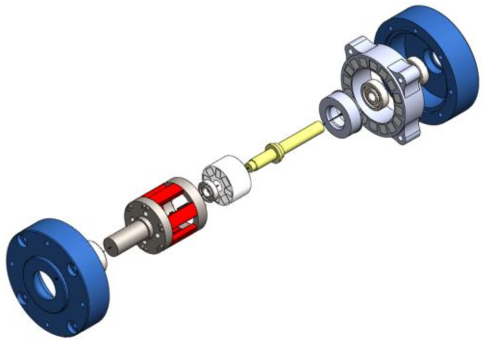
- **3D Printed Stator of Prototype 1:**

- **Stator six Poles viewing using magnetic film:**

- **Functional Prototype 2 of Magnetic gearbox attached to torque transducer to measure slip torque:**







- **Prototype 1 of Magnetic gearbox for proof of concept:**

Mars rover Team Mentor (IIT Bombay)

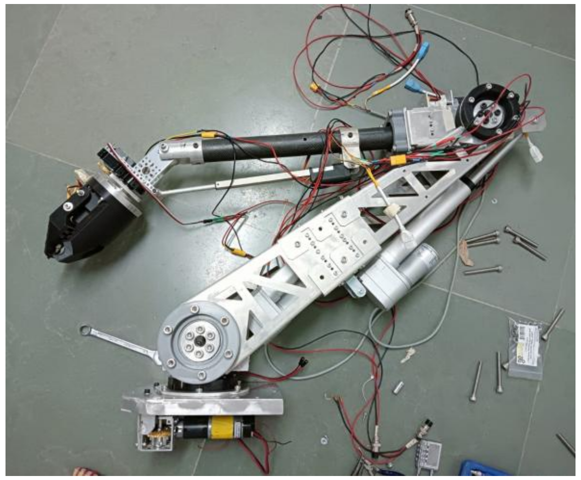
My Role:
I mentor a team of students at IIT Bombay who are designing a rover for the University Rover Challenge. I assist them in selecting manufacturing processes and guide them on design for manufacturing and assembly (DFMA). Additionally, I provide insights into the limitations of various manufacturing processes.

Problems and Solutions :

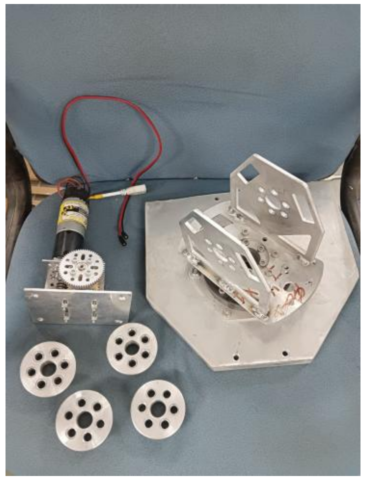
- The coupling connecting the D-bore shaft of the motor, which drives the wheel, was experiencing wear and failure due to the high torque generated by the motor.
- The coupling was made from aluminium casting, while the motor shaft was made from hardened alloy steel. The main challenge in manufacturing this coupling was that conventional machining methods were not suitable for accurately machining the D-bore to the required tolerances.
- To address this, I guided the team through the design and manufacturing process. I suggested splitting the coupling into two parts, with one part made from surface-hardened material to prevent damage from the sharp corners of the D shape.
- I also leveraged my industrial connections to have the parts manufactured using wire cutting and designed a locating fixture for precise assembly. Additionally, I assisted them in designing the gear system for the robotic arm.

Trans Mars rover for University Rover Challenge 2023:

Robotic Arm made from Sheetmetal to make it lightweight :



Rover Rims made from Sheetmetal using a fixture to make it lightweight :



D Bore Coupling:

Sheet Metal Product design

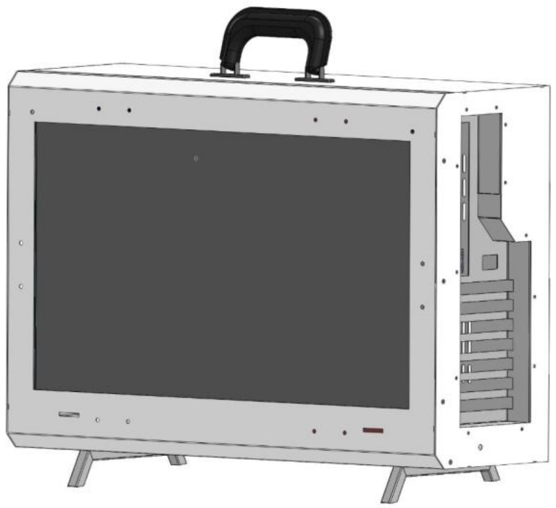
Product Description –

- I designed and manufactured sheet metal enclosures for various applications using aluminum, stainless steel, and mild steel. I considered the manufacturing process and aesthetics for a visually appealing overall appearance while also ensuring proper ventilation for electronic components.

My Role (Freelancing Project):

- Conceptualization
- CAD & Production drawing GD&T
- Blank design, Sheet metal fasteners & tool selection
- Design for Manufacturing & Assembly
- Manufacturing from vendors

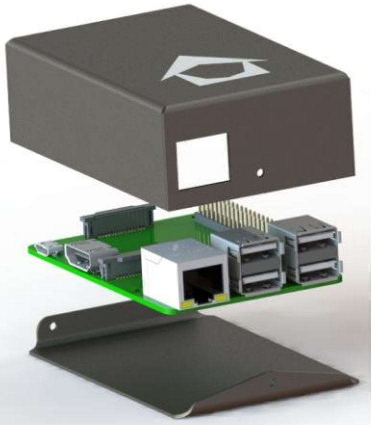
- **Designed a portable enclosure to house high-speed desktop components, complete with a screen and other accessories.**



- **Home automation hub.**

Solid Aluminium with Sandblasting and hard Anodising:

Stainless steel & Powder coated CRS:



- **Aluminium Casing for Custom PCB.**

- **Mini Solar Module EL testing Enclosure.**

- **Developed kiosk for banks**

EV Charger - Flare 30

Project :

- Flare-30 has been specifically designed for public access environments such as community car parking lots, smart cities, and airports, providing an ideal on-street electric vehicle charging solution for users. The charger's housing is robust and built to withstand mechanical stress and severe environmental conditions, including rain.

My Role:

- Conceptualization
- CAD & Production drawing GD&T
- Design for Manufacturing & Assembly
- Prototypes Manufacturing from vendors
- Assembly & Field Testing

Product Specifications:

Power	• 7.2 Kw
Nominal Voltages	• Single Phase 230V 50Hz
Ingress Protection	• IP 55
Socket type	• Type 2
Protection	• Over voltage, under voltage,
	• Over current, short circuit,
	• Surge protection,
	• Over temperature,
	• Ground fault,
	• Residual current
Rated Charging rate	• 1C
Charger & CMS	• OCPP 2
Compliance & Safety	• IEC

Jig for Drilling Motor Casting
Client - Bharat Bijlee Ltd.

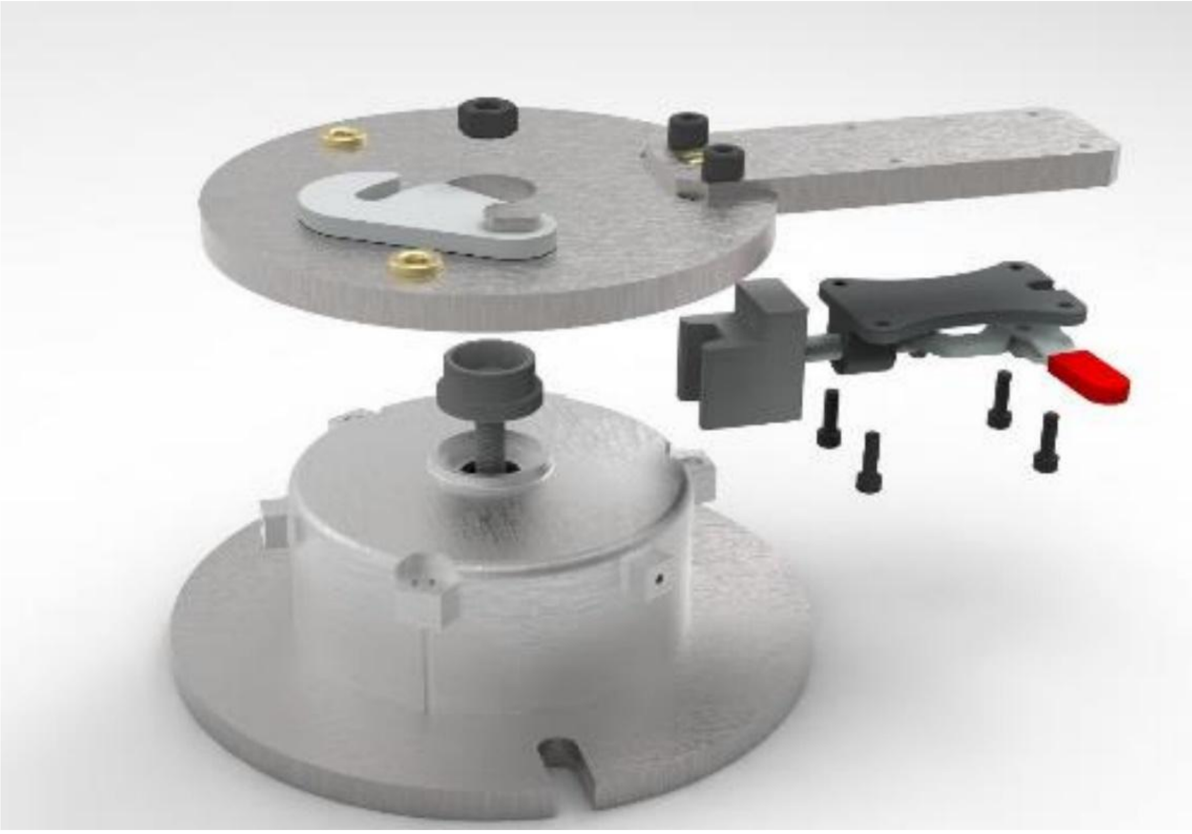
Project Description:

- The location and size of the hole are two important factors in the mass production of components. This is achieved by a device known as a drill jig, whose purpose is to locate and clamp the component firmly.
- These drill jigs enable unskilled workers to produce components that are accurate as well as interchangeable.
- To create holes in motor castings, I designed a drill jig that uses a gunmetal bush and a locating pin, to guide the drill and position the job.
- The drilling operation was divided into two stations. Key design considerations included ergonomics, quick mounting, clamping, and ensuring accurate drilling operations.

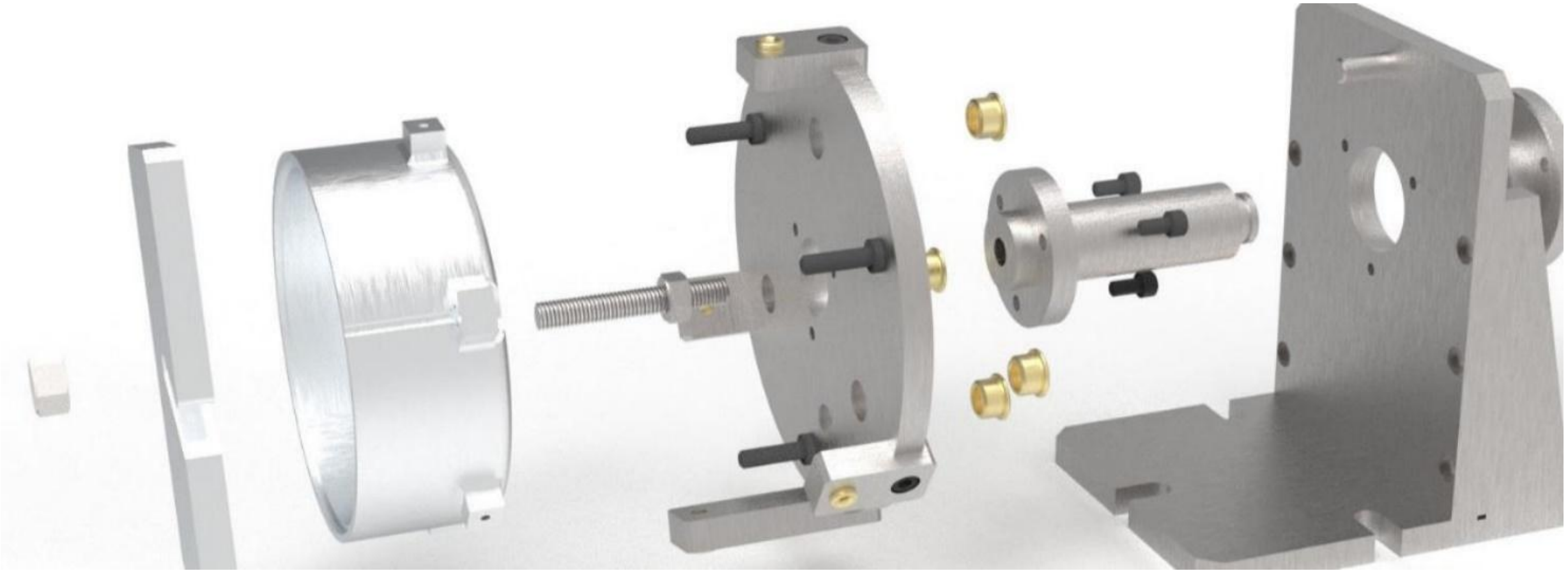
My Role (Freelancing Project):

- Conceptualized the design, created CAD models, and developed production drawings with GD&T while coordinating closely with the client.
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline manufacturing and assembly.
- Manufacturing from vendors and procurement of off-the-shelf parts.
- Assembly and Testing at the client site.

Exploded view drill jig station 1 :



Exploded view drill jig station 2 :



Die Tool for Paper lid

Client - Bharat Bijlee Ltd.

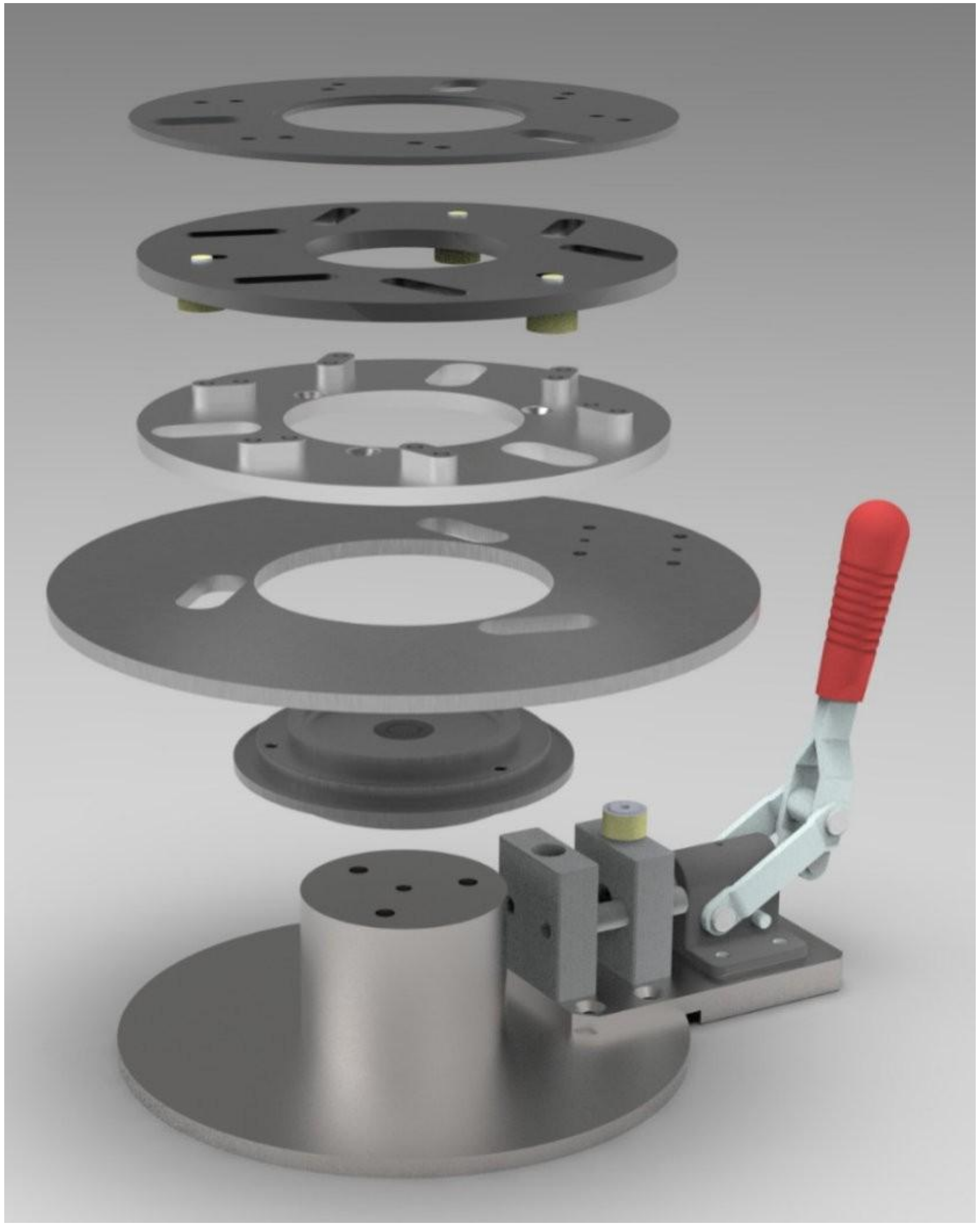
Project Description:

- This die was designed for producing paper lids for paper cups used for Coke floats at McDonald's. Currently, plastic lids are used, but to reduce plastic consumption, we developed an alternative using paper lids.
- This prototype was made using the cam and follower principle, operated by a toggle clamp. The cam and follower press the paper from the sides while a pneumatic cylinder on the machine presses the paper blank down into the die. The die also features a built-in heater to heat and form the paper.
- The die was designed to be compatible with an automated production line, allowing for seamless integration into the existing system.

My Role (Freelancing Project):

- Conceptualized the design, created CAD models, and developed production drawings with GD&T while coordinating closely with the client.
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline manufacturing and assembly.
- Manufacturing from vendors and procurement of off-the-shelf parts.
- Assembly and Testing at the client site.

- **Exploded view of CAM Mechanism:**



Automated Chess (Gaming for next generation)

Project Description (Freelancing Project):

- The purpose was to build an automated interactive chess board, that can imitate the moves made by overseas opponents on a physical chess board.
- The vision was to give the feel of traditional chess to the players when playing overseas or remotely.
- The design of the automated chess board involved the creation of an X & Y axis plotter mechanism to ensure fluent movement of chess pieces. Additionally, an outer casing was crafted from wood for aesthetic appeal.

My Role (Freelancing Project):

- Conceptualized the design, created CAD models, and developed production drawings with GD&T while coordinating closely with the client.
- Applied Design for Manufacturing & Assembly (DFMA) principles to streamline manufacturing and assembly.
- Manufacturing from vendors and procurement of off-the-shelf parts.
- Assembly and Testing.