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)

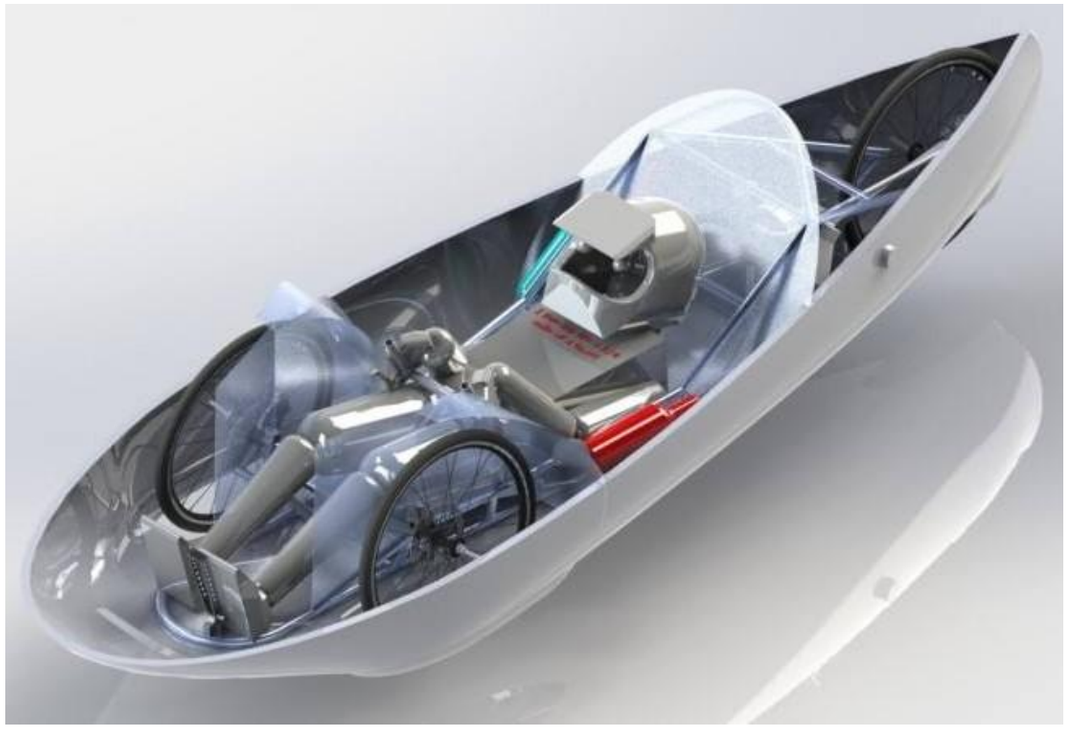
Technical Director & Coordinator (Shell ECO Marathon 2014 & 2015):

- 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).

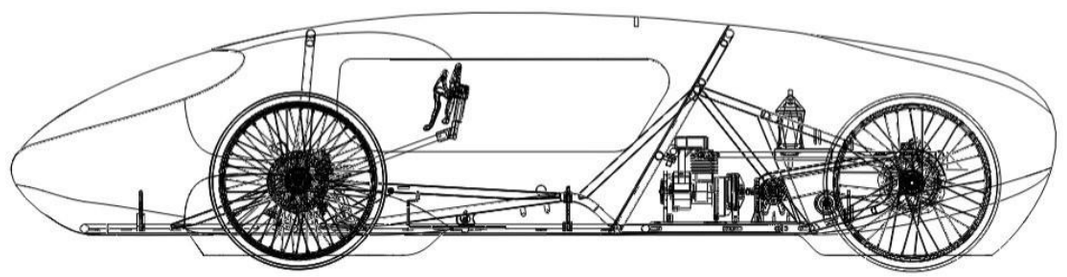
CAD Design & Manufacturing Drawing Manager (Shell ECO Marathon 2013, 2014 & 2015):

- 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

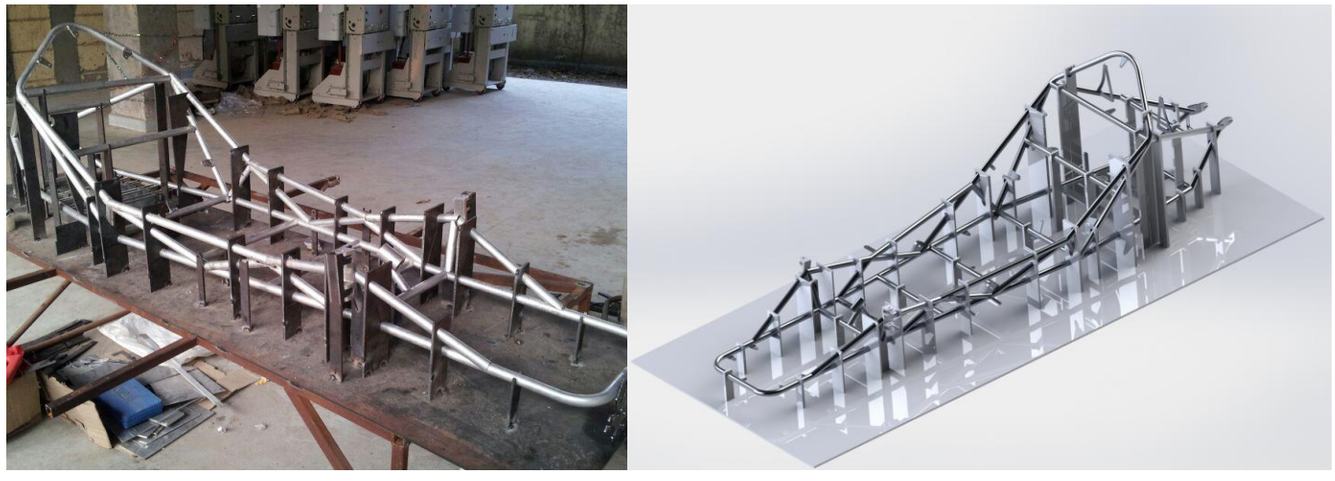
(Co-curricular activities)

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 2015 :

Chassis & Fabrication Fixture Design Shell Eco-Marathon 2014 :



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).
- I 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 50mm thick MDF sheets. The pieces were then stacked and assembled using glue and screws to form the final shape, followed by adding 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.

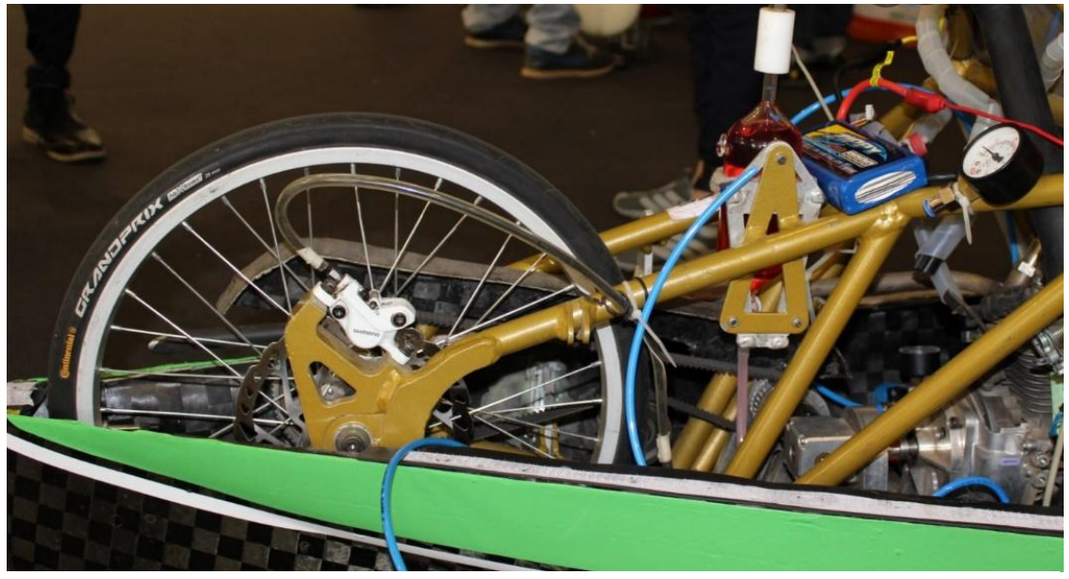
Conversion of crank start engine to Electric switch start (Shell ECO Marathon 2015):

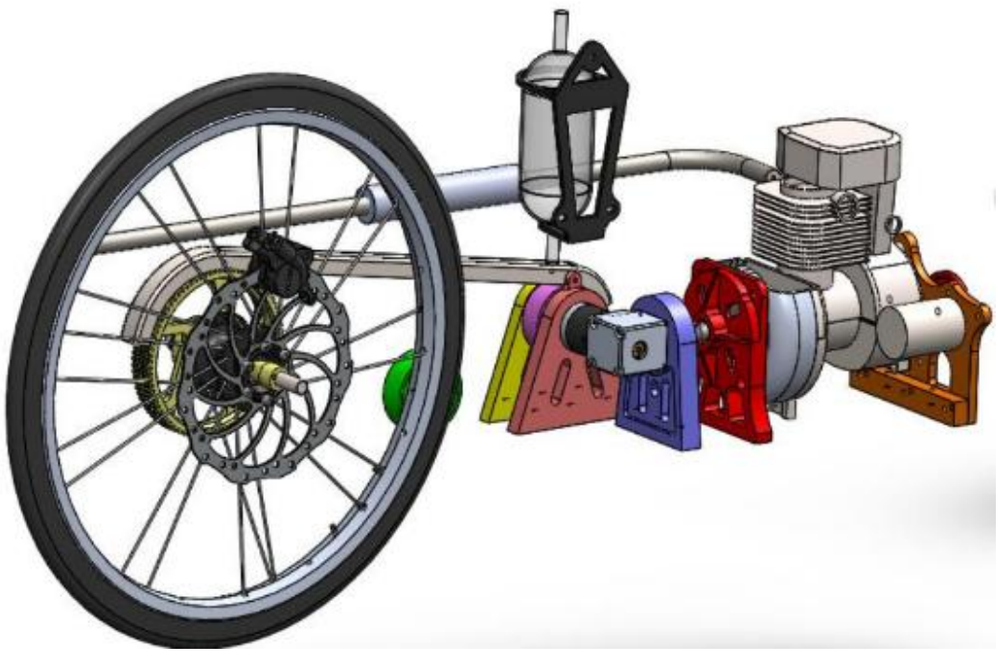
- We used a Honda GX35 engine for powering the car, The engine comes with a hand crank for starting the engine.
- I did a calculation of the starting torque required for the engine and designed a gear reduction powered by an electric motor to make it switch start**.**

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)

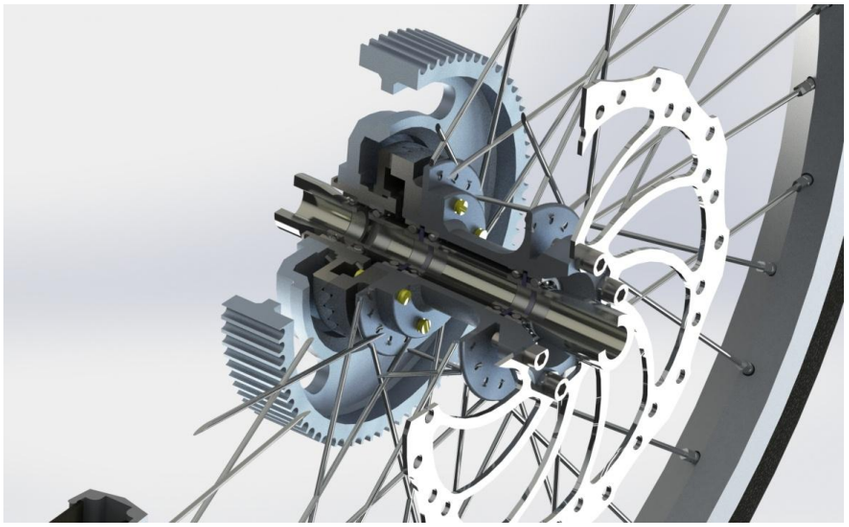
Problem:
- When a vehicle is not accelerating and the engine clutch is disengaged from transmission Because the wheel is still connected to the gearbox there is an energy loss due to the rotation of the gearbox and belt drive.
- The aim was to design an auto disengagement clutch to address this issue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

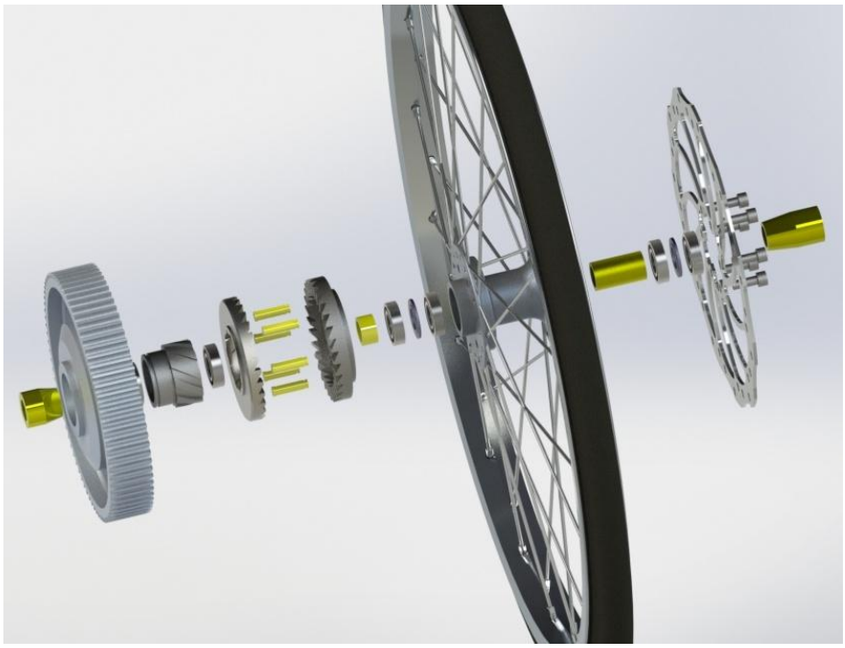
Approach:
- My approach was to design a clutch that automatically disengages the transmission from the wheel when the engine stops accelerating and the vehicle is coasting. It should function without any external power source and fit directly onto the rear wheel hub.

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

CAD design of clutch Shell Eco-Marathon 2015:





Static analysis of clutch components Shell Eco-Marathon 2015: