BATTERY THERMAL MANAGEMENT SYSTEM FOR TWO WHEELER ELECTRIC VEHICLE

GROUP PROJECT

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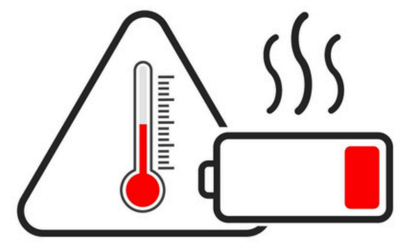
Where does the energy go?

PROBLEM STATEMENT

- EV scooter battery packs generate significant heat during charging and discharging.
- Excessive temperature rise reduces battery life and can cause thermal runaway.
- Conventional flat battery enclosures provide limited heat dissipation.
- Hence, an improved Forced air-cooling method is required

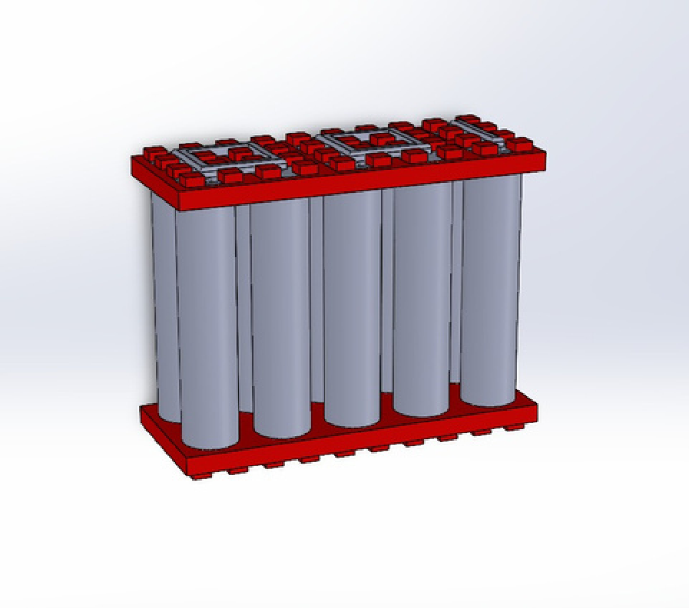


OBJECTIVE OF THE PROJECT

- To design an forced air-cooling system for an EV scooter battery pack
- To replace the plain battery outer plate with a finned structure

- To improve heat dissipation using forced air cooling
- To analyze the forced air cooling and finned battery enclosure

BATTERY PACK SPECIFICATIONS



Battery Pack Specifications

1. Battery type: Lithium-ion cylindrical cells (18650)
2. Number of cells: 54
3. Maximum voltage: 12 V
4. Maximum allowable temperature: 40 °C
5. Battery configuration: Cylindrical cell pack mounted inside enclosure

EXISTING DESIGN – PLAIN BATTERY ENCLOSURE

1

Battery pack enclosed in a flat metallic outer casing

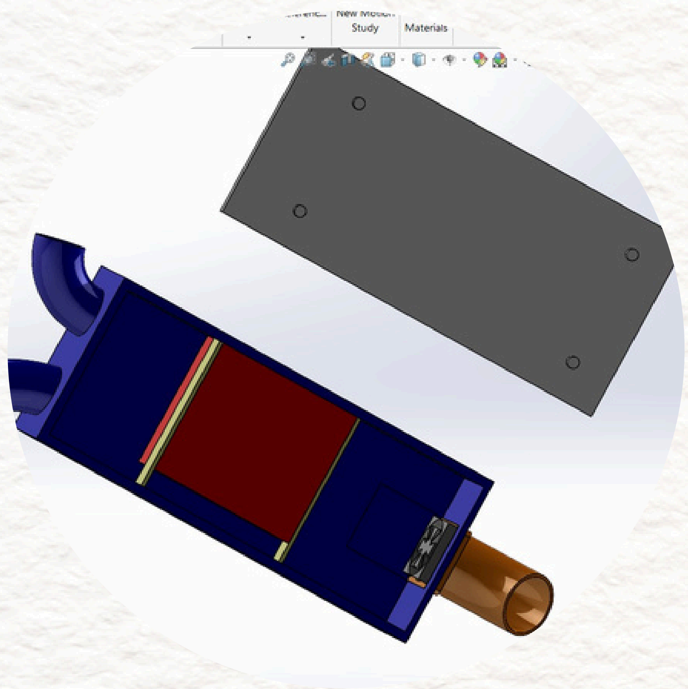
2

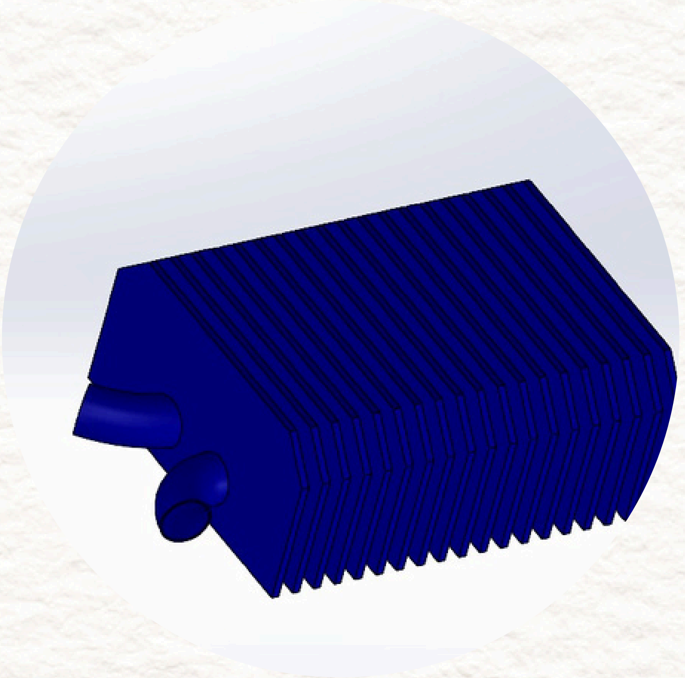
Limited surface area available for heat dissipation

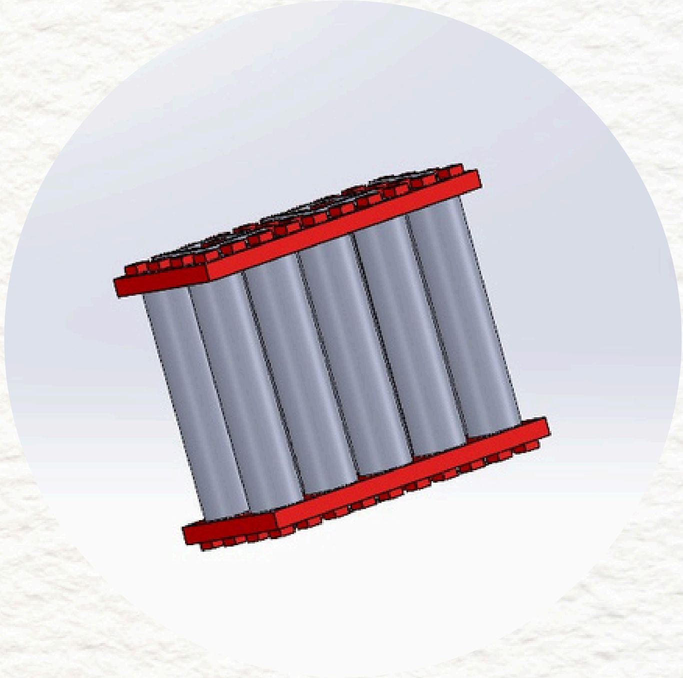
3

Natural convection is insufficient at low vehicle speeds

PROPOSED COOLING SYSTEM DESIGN







An Forced air-cooling mechanism is proposed.
Cooling air flows over the battery enclosure.
Air intake and exhaust are positioned to ensure continuous airflow.
A finned heat sink is attached directly to the battery outer plate

FAN SELECTION

DC axial fan selected for forced air cooling

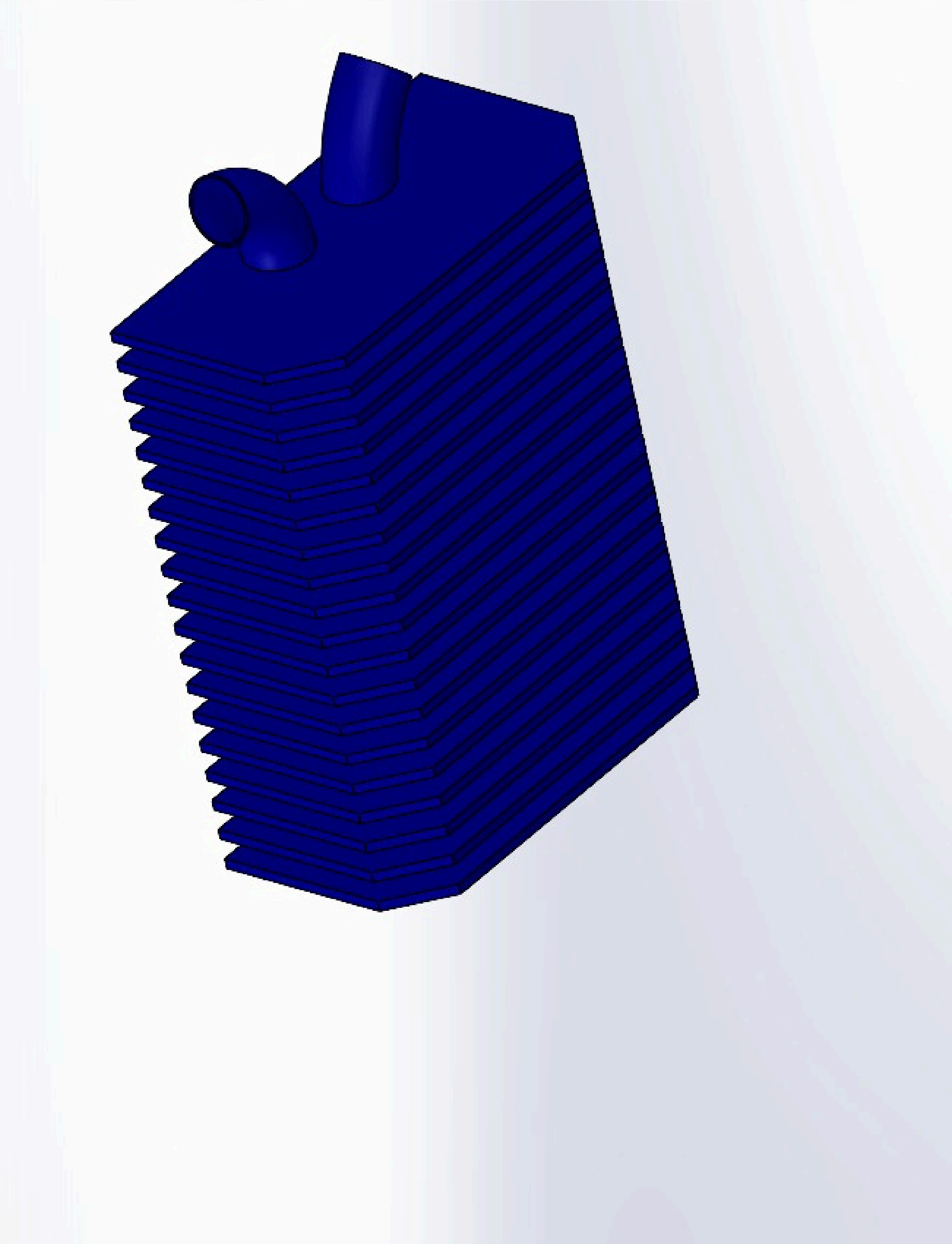
Minimum airflow rating: 2 CFM

Maximum airflow: up to 60 CFM at 0.1 inch WC

Fan ensures consistent cooling even at low scooter speed

HEAT SINK / FIN DESIGN

- Fins are provided on the external surface of the battery enclosure
- Fins increase effective surface area for heat transfer
- Material selected: Aluminum (high thermal conductivity)
- Direct contact between battery pack and fin base ensures efficient conduction



EXISTING DESIGN (FLAT PLATE)

- Battery enclosed in flat aluminum plat
- Limited surface area
- Poor convection heat transfer
- Hotspots during operation

PURPOSED DESIGN (FINS)

- Flat plate replaced by aluminum fins
- Surface area increased 4–6 times
- Better airflow contact
- Faster heat dissipation

HEAT TRANSFER PRINCIPLE

$$Q = h \times A \times \Delta T$$

- Fins increase surface area (A)
- Fan increases convection coefficient (h)
- Heat transfer increases significantly

Practical Heat Calculation

Left side (Flat Plate):
Area ≈ 0.12 m^2 Q ≈ 120 W

Right side (Fins):
Area ≈ 0.6 m^2 Q ≈ 600 W

Nearly 5× heat dissipation

ADVANTAGES OF FORCED AIR COOLING SYSTEM

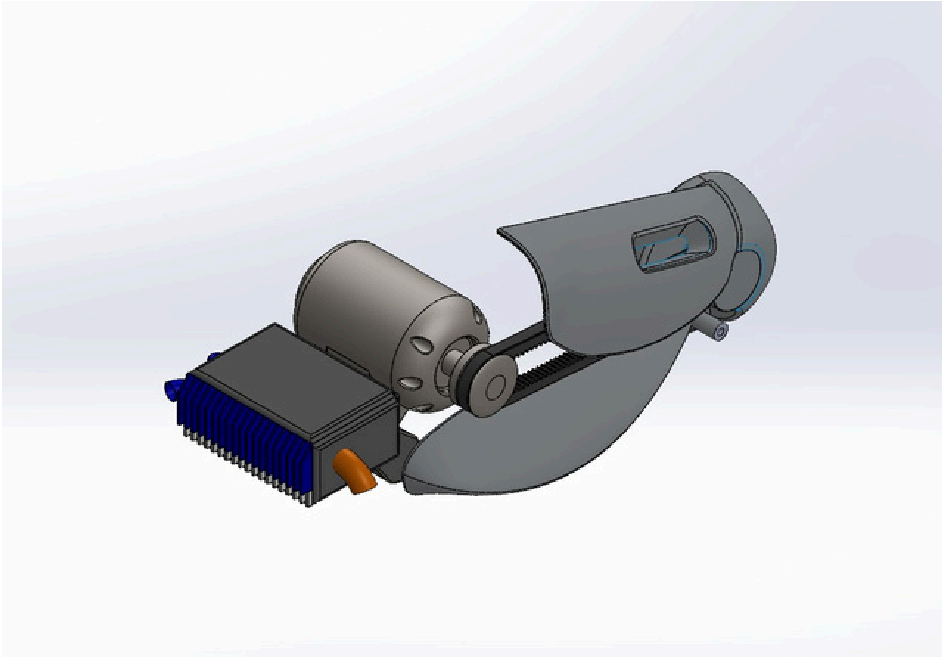
- Higher Heat Transfer Rate
- Better Temperature Control
- Simple and Low Cost
- Compact and Lightweight
- Easy Maintenance

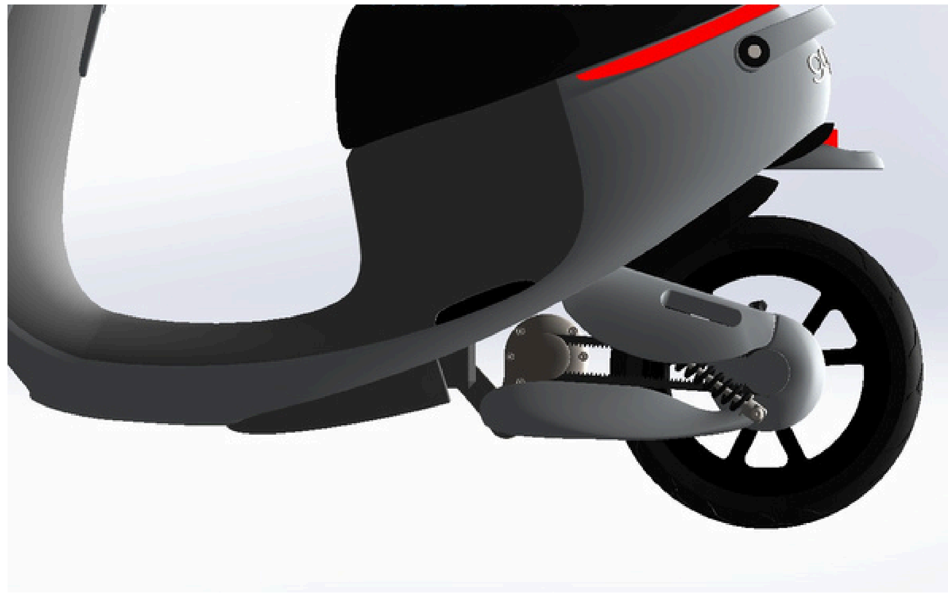
DISADVANTAGE OF FORCED AIR COOLING SYSTEM

- Limited Cooling Capacity
- Dependent on Ambient Temperature
- Noise Generation
- Dust and Moisture Issues
- Not Suitable for High-Power EVs

Assembly Integration in EV Scooter

- Battery pack is mounted below the scooter footboard
- Finned surface is exposed to ambient airflow
- Fan-assisted airflow improves heat dissipation during riding
- Compact design ensures no interference with vehicle structure





CONCLUSION

- External finned air cooling is effective for EV scooter batteries
- Replacing flat plates with fins significantly improves heat dissipation
- Forced air cooling further enhances thermal performance
- The proposed design is practical and suitable for real-world application

FUTURE SCOPE

1

CFD-based airflow optimization Experimental temperature validation

2

Optimization of fin geometry

3

Integration with smart thermal monitoring systems

THANK YOU

Project Mentor - Y SHANMUKH RAVI TEJA SIR

“We sincerely thank our mentor for their continuous guidance and support throughout this project.”