Biraj Kharel

Mechanical Engineer

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PROFESSIONAL INTEREST

- Application of Machine Learning to Dynamic System Modeling and Control
- Advanced Thermal Management and Safety for Energy Storage
- Predictive Control and Health Management for Energy Systems
- Safe and Efficient Vehicle Control Systems (Autonomous and Human-in-the-Loop)
- System Identification and Digital Twin Development for Real-World Validation

EDUCATION

Bachelor's in Mechanical Engineering, *Kathmandu University, Dhulikhel,2023* GPA: 3.47/4

MAJOR COURSES

Calculus and Linear Algebra, Advanced Calculus, Differential Equations & Complex Variables, Statistics and Probability, Structured Programming, Object-Oriented Programming, Numerical Methods, Entrepreneurship Development

LANGUAGES

English, Nepali

WORK EXPERIENCE

Research Engineer, *Energy Systems and Technology Research Laboratory (ESTRL), June 2023 - Present*

- Engineered a novel modular vehicle platform with four interchangeable configurations designed for diverse rural transportation needs, allowing for a complete role change in under 60 minutes. This project is funded by the *Royal Norwegian Embassy under the Energize Nepal Program from 2023-08-01 to 2024-10-15.*
- Led the system integration and simulation for the conversion of a public ICE bus to a fully electric drivetrain, achieving a projected 60% reduction in energy cost per kilometer. Developed system-level models in MATLAB/Simulink to optimize powertrain component selection and validate performance against real-world driving cycles.
- Spearheaded research in battery State-of-Health (SOH) prognostics, developing machine learning models with >95% accuracy to forecast degradation using real-time data from a fleet of 5 public electric buses. This work directly supports predictive maintenance strategies and informs models for second-life battery applications.

Internship at Heavy Equipment Divison, *Department of Roads, Government of Nepal, Jan 2023 - Mar 2023*

- Learned to perform routine maintenance on heavy and light vehicles (trucks, bulldozers, excavators), ensuring operational safety and efficiency by diagnosing and repairing mechanical issues such as engines, transmissions, and brakes.
- Gained experience in diagnosing mechanical faults and assisting senior engineers with complex repair jobs, enhancing problem-solving and technical skills while maintaining detailed maintenance records.
- Acquired hands-on skills in lathe operations, arc welding, and forklift operation, applying these techniques as needed for vehicle repairs and maintenance tasks.

Vehicle Optimization and Design Team, *Team Junkiri, Shell Eco Marathon, Oct 2022 – Nov 2022*

- Participated in the Shell Eco-Marathon Asia 2022, a global energy efficiency competition held in Lombok, Indonesia.
- Designed a lightweight, aerodynamic three-wheeler vehicle using SolidWorks.
- Led the technical team in vehicle fabrication, engine installation, and EFI tuning.
- Conducted structural and aerodynamic analyses using Ansys Workbench to ensure efficiency and reliability.
- Ensured the vehicle passed rigorous technical inspections and successfully competed in the event.

PATENT AND PUBLICATIONS

Patent under review in Department of Industries, *Ministry of Industries, Commerce and Supplies, Government of Nepal*
"Retrofitting Process of Internal Combustion Engine Vehicle to Electric Vehicle."

Published in IOP Conference Series, *Earth and Environmental Science (EES).*

- Sustainable Manufacturing Practices in the Hydropower Industry: A review
- Integrated analysis of on-road energy consumption and range optimization in the conversion of an IC engine vehicle to a battery-electric vehicle: a comprehensive research study

PROJECTS

Research and Analysis on the Factors Affecting On-Road Energy Consumption and Range of Electric Vehicles,
Mar 2022 - Feb 2023

- Conducted a comprehensive study on factors influencing energy consumption and range of electric vehicles (EVs) during real-world driving conditions.
- Analyzed data on driving behaviour, road conditions, and vehicle parameters.
- Used MATLAB and Python for data analysis and developed models to predict energy consumption.

Conversion of an IC engine vehicle to battery electric vehicle, *May 2020 - April 2021*
- Converted a 28-year-old Maruti 800 into a fully electric vehicle.
- Designed and installed the electric drivetrain, including motor, battery pack, and controls.
- Conducted testing and optimization, proving the feasibility of retrofitting vehicles to reduce emissions.

Building Energy Consumption Prediction for Nepal Using Machine Learning, *Jan 2023 - Aug 2023*
- Developed a machine learning model to predict energy consumption in buildings across Nepal.
- Collected data on factors like weather, building materials, occupancy patterns, and energy use.
- Applied data pre-processing and used regression algorithms for prediction.

Enhancing Battery Cycle Life and Safety through Optimized Liquid Cooling Design Simulaiton, *Nov 2024 - Sept 2025*
- Developed a high-fidelity CFD model in ANSYS Fluent to simulate thermal dynamics, validating it against experimental data with less than 5% error.
- Analyzed 5 distinct liquid cooling channel designs, from standard serpentine paths to parallel mini-channels. The optimized configuration utilized a variable-width serpentine channel to strategically increase coolant velocity over known thermal hotspots.
- This final design reduced peak temperature gradients across the pack by over 5°C, improved temperature uniformity by 15%, and is projected to increase battery cycle life by up to 20% under high-load conditions.

CERTIFICATIONS

Solidworks Certificates :: Associate-Mechanical Design | Professional-Advanced Drawing tools | Professional-Advanced Surfacing | Certified SOLIDWORKS Associate (CSWA) (28 Feb, 2023)

Supervised Machine Learning - Regression and Classification: Stanford (7 Feb, 2023)

Motors and Motor Control Circuits: University of Colorado Boulder (Jan 24, 2025)

Sensors and Sensor Circuit Design: University of Colorado Boulder (Jan 21, 2025)

ADBI Policy Maker E-Training: Low-Carbon Cooling: ADBInstitute (27 May, 2025)

Green Investments: Renewable Energy: ADBInstitute (26 May, 2025)

Energy Economics, Environment, and Policy: ADBInstitute (26 May, 2025)

MATLAB: Simulink Onramp (7 July 2025), Simscape Battery Onramp (13 July 2025)

Introduction to Renewable Energy: Solar Energy Internation (July 18, 2025)

PROFESSIONAL DEVELOPMENT TRAINING

- Capacity Development Program on Electric Vehicle Technology and Its Importance in Nepal
- Capacity Development Training on Transient System Simulation Program
- Application of Crystal Ball Software for Production, Manufacturing, and Project Planning
- Introduction to Modeling and Design for Manufacturing, Autodesk
- Data Analytics using Excel, Great learning Academy

EXPERIENCES AND ACTIVITIES

- Volunteer for AIU NORTH ZONE VICE CHANCELLORS' MEET 2024 organizee by Association of Indian University (AIU) and Hosted by Kathmandu University : Dhulikhel, Nepal.
- Participated in a virtual training session provided by Shell Eco on autonomous programming, energy consumption reduction, and improved performance through optimized aerodynamics.
- Worked as an Organizing Member for AMES Bulletin board : Kathmandu University, Dhulikhel
- Participated in a 24-hour hardware hackathon "Mechathon:Innovation for Impact" Organised by AMES, Kathmandu University
- Participated in 17th International Computer Olympiad "COFAS-2014" held by City Montessori School : Lucknow, India.October,2014.

SKILLS

Technical/Engineering Skills:
- EV Powertrain Modeling
- Battery SoH & EoL Prediction
- Thermal Management
- Real-Time BMS Data Acquisition (CAN bus, OBD-II)
- CFD Analysis
- Structural & Thermal Simulations
- Digital Twin Development
- Additive Manufacturing Concepts

Software/Programming Languages:
- MATLAB (Simulink, Optimization Toolbox)
- Python (NumPy, pandas, scikit-learn, Matplotlib, SciPy)
- C++, R, Excel/VBA, Crystal Ball (Oracle)
- ANSYS (Fluent, Workbench),
- CAD - SolidWorks, Fusion 360, AutoCAD
- LabVIEW
- ROS