EV.Engineer

The Future of eMobility & EV Software Development

Sudarshana Karkala | ✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

EV Cybersecurity

EV.Engineer

The Future of eMobility & EV Software Development

Sudarshana Karkala

Co-founder - EV.Engineer, CAR Software Systems

Advisor @ iTelematics Software Private Limited

Agenda

YouTube | Creative Etc Made a Solar Electric Car at Home

- EV Innovation
  - The Future of eMobility & EV Software Development
  - Research - EV Battery Safety

- EV Jobs & Career Opportunities
  - EV.Engineer - Workshop | Personal Branding

Introduction

iTelematics Software Private Limited is a Bengaluru-based company, specialising in **EV & Automotive Telematics Engineering**, focusing on **In-Vehicle Communication** and **Vehicle-to-Vehicle Communication**.

The company supports

- Research & Development,
- Academic partnerships,
- Startup projects and
- Researcher assistance in patents and doctoral theses.

Telematics Engineering

EV Battery Safety

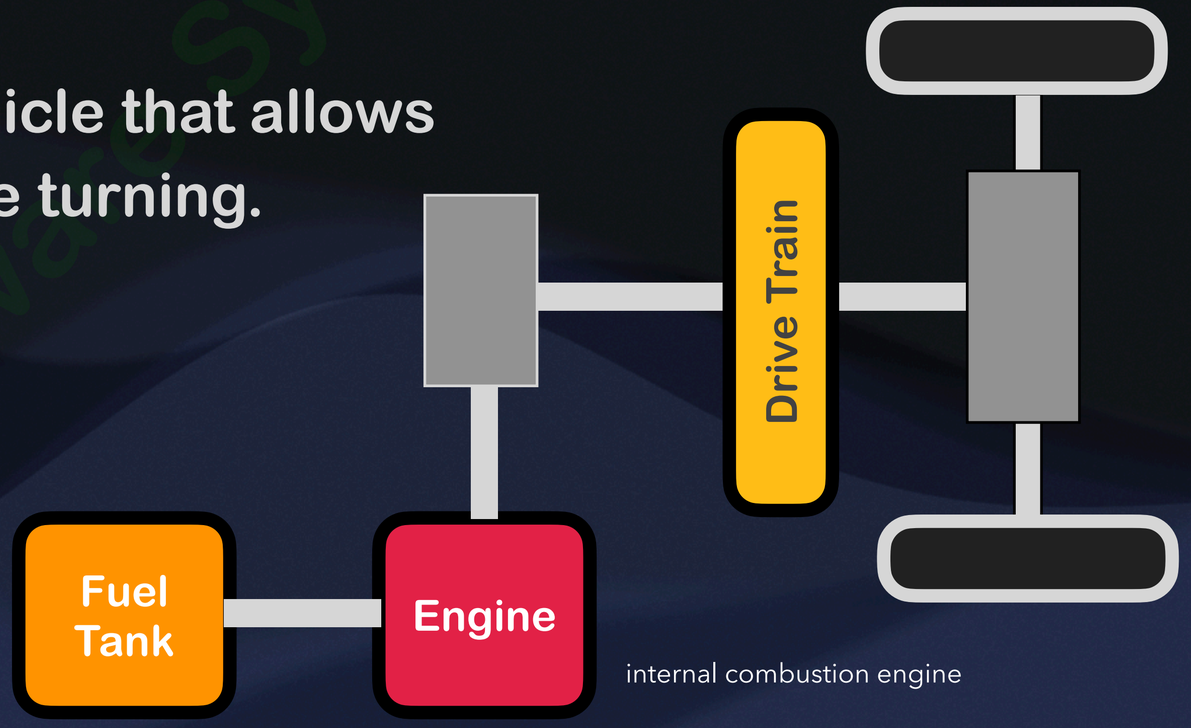
Automotive Cybersecurity

Drive Train for Petrol Vehicles

The drivetrain in a petrol vehicle is the system
that transfers power from the engine to the wheels, allowing the car to move.

It includes the engine, transmission, driveshaft, differential and axles.

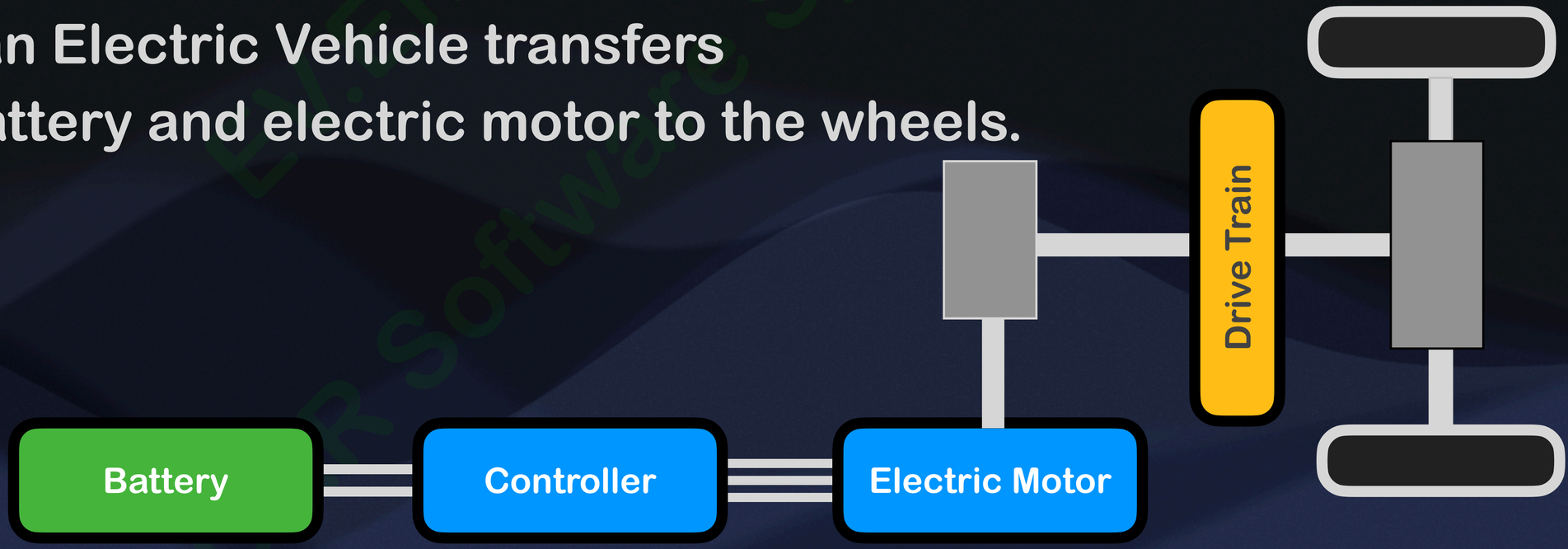
A differential is a mechanical system in a vehicle that allows
the wheels to rotate at different speeds while turning.



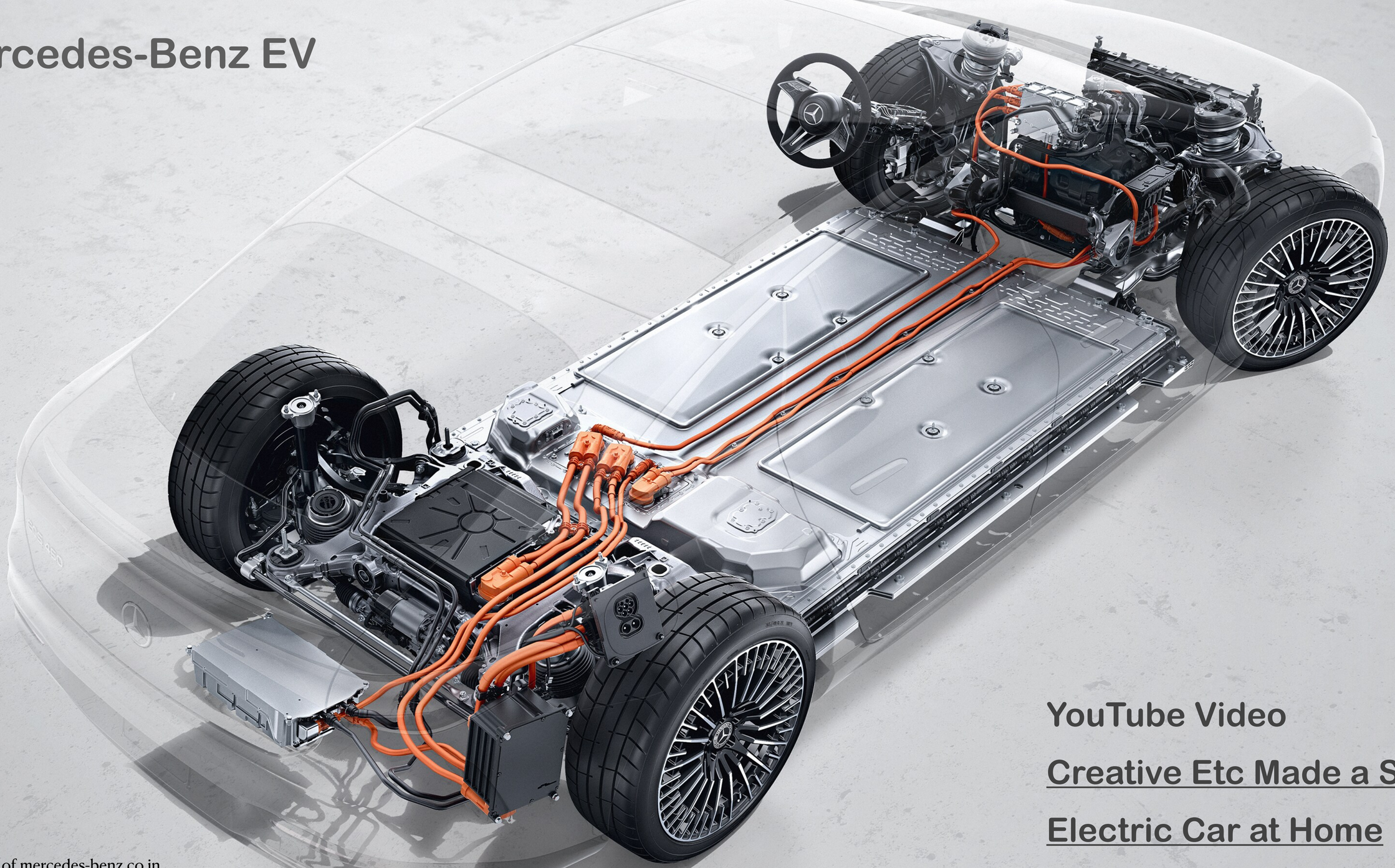
Drive Train for Electric Vehicles

Electric Vehicles (EVs) are automobiles powered by electric motors,
using energy stored in rechargeable batteries or
alternative energy sources such as hydrogen fuel cells.

The drivetrain in an Electric Vehicle transfers
power from the battery and electric motor to the wheels.



Mercedes-Benz EV

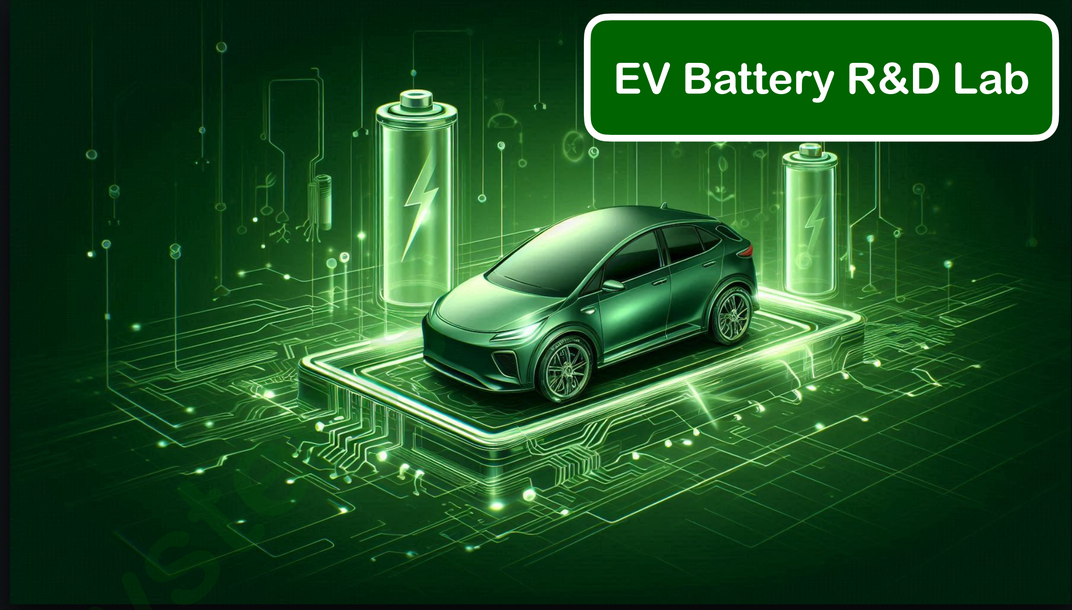


YouTube Video

Creative Etc Made a Solar Electric Car at Home

Courtesy of mercedes-benz.co.in

https://www.mercedes-benz.co.in/content/dam/hq/passengercars/cars/eqs/eqs-v297-pi/overview/charging-and-range-electric-drivetrain/08-2022/images/mercedes-eq-eqs-v297-exterior-electricdrivetrain-3302x1858-08-2022.jpg/1740016001113.jpg



AI-Powered EV Battery Fire Prevention System

Ensuring a Fire-Free, Secure & Sustainable EV Future

Sudarshana Karkala

EV.Engineer, iTelematics Software Private Limited

Information Technology, NIT Karnataka, Surathkal

Electric Vehicle Engineering & Development, CODE, IIT Madras

AI-Powered EV Battery Fire Prevention System

The Problem

EV Battery Fires are a Major Concern

- Frequent thermal runaway incidents leading to fire hazards.
- Lack of real-time battery health monitoring & risk alerts.
- Fleet operators & EV owners suffer from unexpected breakdowns and expensive battery replacements.
- Regulatory pressure (AIS-156) for stricter safety measures.

Example : Bangalore has seen a 300% increase in EV fire incidents in 2023-24.

Project / Module Details

AI-Powered EV Battery Fire Prevention System

- Battery Temperature Monitoring System
- Battery Voltage & Current Analysis
- State of Charge (SOC) Estimation
- EV Battery Health Prediction
- Real-Time Battery Monitoring with IoT
- Intrusion Detection in Battery Management System (BMS)

The Solution

Leverages AI & Machine Learning to predict battery failures before thermal runaway.

Real-Time Monitoring of critical parameters:

- Temperature fluctuations
- Voltage imbalances
- Cell inconsistencies

AI-Driven Predictive Analytics for early detection of anomalies.

Automated Preventive Actions:

- Controlled discharge to prevent overheating
- Active cooling mechanisms (liquid/air cooling)
- Emergency shutdown & alerts

Seamless BMS Integration:

- Works with existing Battery Management Systems
- Adds AI-powered safety layer

Cloud-Based Analytics & OTA Updates:

- Continuous learning from real-world battery failures
- Over-the-Air (OTA) updates for AI model improvements

Access devices / sensors from connected EV / Software Defined Vehicles

CONNECT	Connect to the Vehicle from Mobile device and Authenticate.
DETECT	Detect Devices & Sensors (Battery Details, Telematics Information.. etc)
READ	Read the status of the Devices & Sensors
WRITE	Change the device / sensor status
DISPLAY	Display Device / Sensor’s info on Dashboard
COLLECT	Collect and upload device details to Cloud for Analysis
ANALYSE	Device analysis using Machine Learning
CONTROL	Control vehicle using mobile (Lock, Unlock, Start, Stop | CAN Bus)

✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

Intrusion detection in connected EV / Software Defined Vehicles

SCAN	Scan the Devices | Sensors | Battery | Telematics | WiFi in the Vehicle (On demand basis)
MONITOR	Monitor the vehicle system for accidental attack
DETECT	Detect Intrusion of attack from Network | Internet | Other IoT | Apps
ALERT	Alert the user about the issues / problems
COLLECT	Collect and upload Intrusion details to Cloud for Analysis
ANALYSE	Intrusion analysis using Machine Learning
REPORT	Generate the report (Detected Issues and other analysis information)
RECOMMEND	Recommendation | Recovery | Protection

✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

Intrusion detection in Battery Management System

- Collect Battery Data Logs (or Use Sample Data)
- Analyse Normal vs. Anomalous Data
- Implement an Anomaly Detection Model
- Real-Time Intrusion Detection Simulation
- Secure Battery Data with Encryption

Potential Cyber Threats:

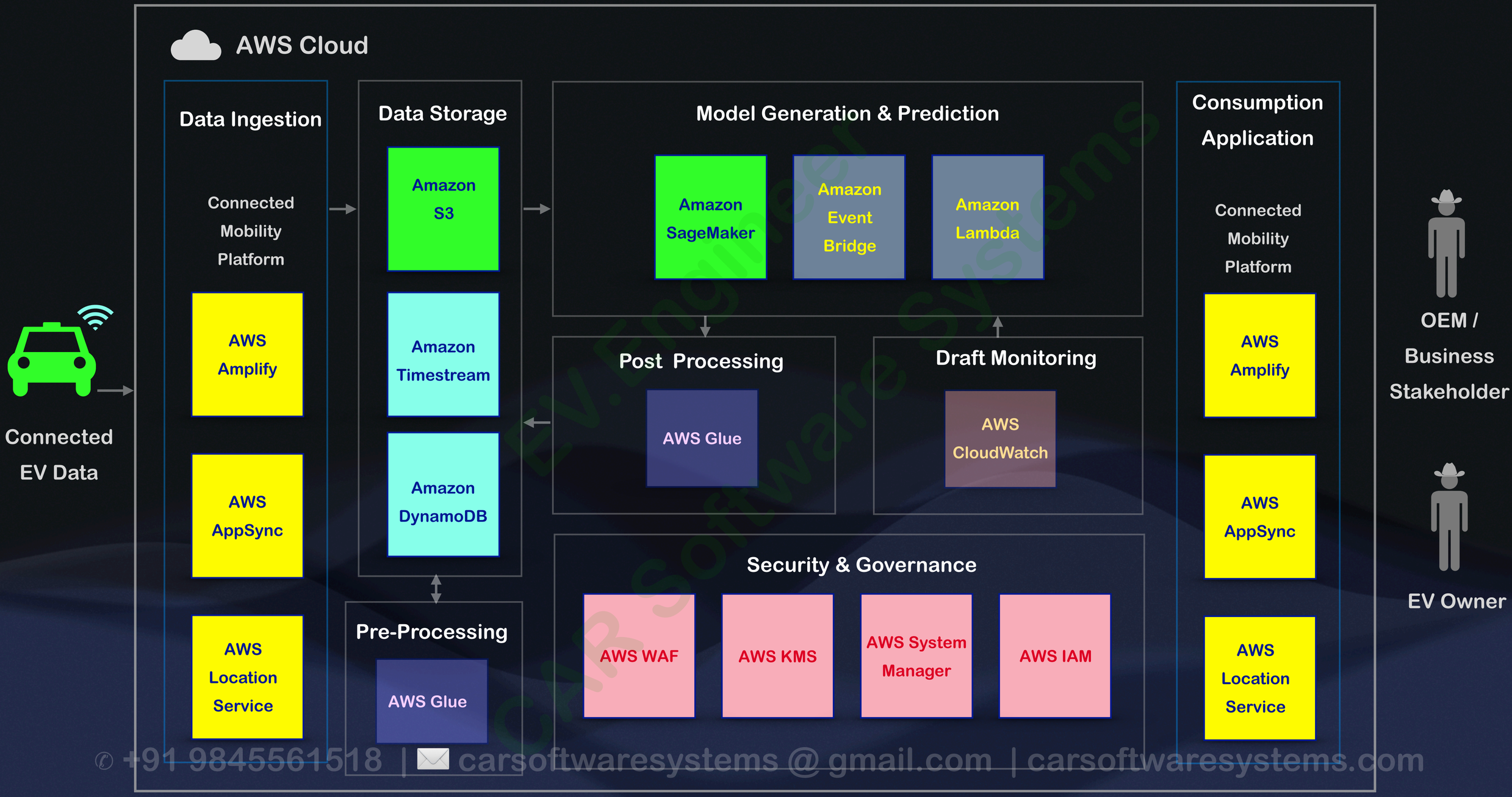
- **Spoofing Attack**: Fake voltage readings injected
- **Man-in-the-Middle Attack:** SOC data modified
- **Malware in BMS:** Unauthorised data manipulation

Battery Diagnostics Reports / Fault Status

Short Circuit	Deep Discharge	Health
Imbalance	Over Heating	Safety Level
BMS Fault	Reserve Current	Energy Level
Charger Fault	Voltage Drop	SOC
Aging	Water Damage	SOH

✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

Cloud Architectural Design



Architecture of EV Battery Management Systems

INPUT

Battery Pack Parameters
- Current
- Voltage
- Temperature

Motor Inputs
- Power
- Torque demand

Surrounding Input
- Temperature
- Humidity

Telematics
- Data from Telematics Control Units

Other Inputs
- Power demand from Auxiliary units

SENSOR INTERFACE

- Current Sensor
- Voltage Sensor
- Temperature Sensor

BATTERY MODEL

- Electrochemical / EMC
- Thermal Model

SAFETY MANAGEMENT SYSTEM

- On-board diagnostics
- Safety Controls

Charging controller

THERMAL MANAGEMENT

Execution of cooling method
- Passive
- Active
- Adaptive

CELL BALANCING MODULE

Execution of Balancing topology
- Passive / Dissipative
- Active / non-dissipative

Memory Storage

STATE ESTIMATION MODULE

- SOT Estimation
- SOP Estimation
- SOC Estimation
- SOH Estimation
- RuL Prediction
  - DOD
  - EOD

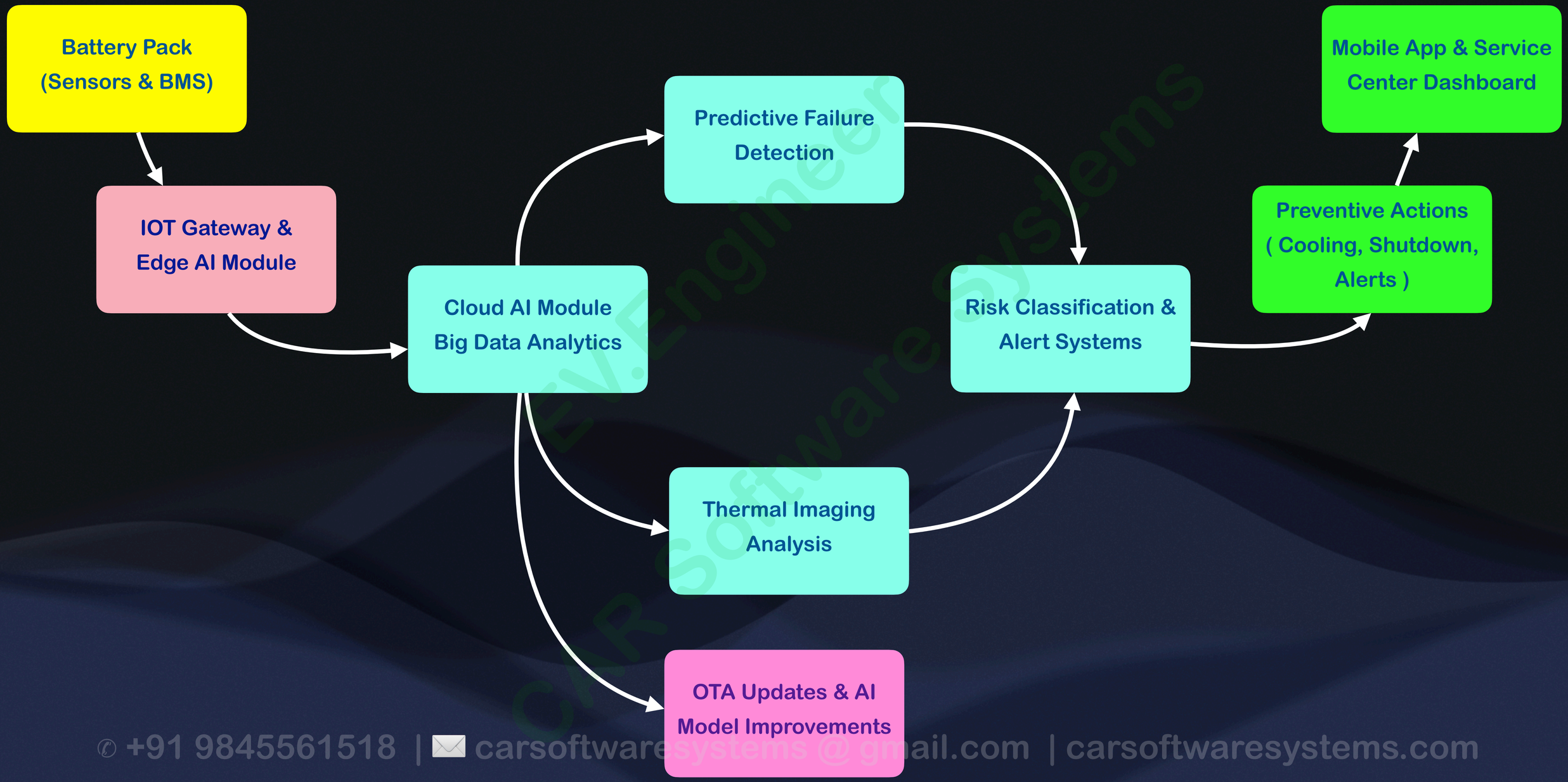
DOD (Degradation Onset Detection)
EOD (End of Degradation)

CAN BUS

OUTPUT

- Vehicle Control Unit
- Motor Control Unit
- Cell Balancing Circuit
- Dashboard
- Diagnostic Port
- Safely Functions
- Cooling System

AI-Powered EV Battery Fire Prevention System



✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

AI & Quantum Computing - Layered Architecture

Cloud & Edge Quantum Computing Infrastructure

(Top-Level Control & Computation)

Secure Quantum Cryptography Layer

(Ensures Data Integrity & Security)

AI-Powered Anomaly Detection & Prediction Layer

(Early Warning System - Classical AI Approach)

Quantum Computing Optimisation & Decision Making

(Advanced AI with Quantum Computing)

EV Battery Data Collection & Monitoring Layer

(Real-Time Execution & Sensor Data Processing)

Hybrid Quantum - Classical AI System :

- Uses IBM Qiskit, Microsoft Azure Quantum, Google Cirq for cloud-based quantum simulations.
- Supports real-time Quantum AI execution for battery analytics.
- Balances computational workload between Classical AI and Quantum AI for optimised processing.

Quantum Edge Computing for Real-Time Battery Monitoring

- Processes data locally for fast response and battery failure prevention.
- Reduces latency by executing Quantum AI models at the edge.

AI & Quantum Computing - Layered Architecture

Cloud & Edge Quantum Computing Infrastructure

(Top-Level Control & Computation)

Secure Quantum Cryptography Layer

(Ensures Data Integrity & Security)

AI-Powered Anomaly Detection & Prediction Layer

(Early Warning System - Classical AI Approach)

Quantum Computing Optimisation & Decision Making

(Advanced AI with Quantum Computing)

EV Battery Data Collection & Monitoring Layer

(Real-Time Execution & Sensor Data Processing)

Quantum Key Distribution (QKD) for Secure Over-the-Air (OTA) Updates

- Ensures BMS firmware updates remain protected against cyber threats.
- Integrates with AI-driven cybersecurity to detect and mitigate potential breaches.

Post-Quantum Cryptography (PQC) for Secure EV Data Storage

- Encrypts battery logs, BMS firmware, and user data to prevent hacking.
- Provides resilience against classical and quantum cyber threats.

AI & Quantum Computing - Layered Architecture

Cloud & Edge Quantum Computing Infrastructure

(Top-Level Control & Computation)

Secure Quantum Cryptography Layer

(Ensures Data Integrity & Security)

AI-Powered Anomaly Detection & Prediction Layer

(Early Warning System - Classical AI Approach)

Quantum Computing Optimisation & Decision Making

(Advanced AI with Quantum Computing)

EV Battery Data Collection & Monitoring Layer

(Real-Time Execution & Sensor Data Processing)

Classical AI/ML for Initial Anomaly Detection

- AI models trained on historical EV battery failure incidents.
- Identifies early warning signs of thermal runaway.
- Uses probabilistic models and deep learning for failure prediction.

Deep Learning for Fire Risk Estimation

- Neural Networks classify battery safety levels and generate alerts.
- Implements explainable AI (XAI) to interpret failure causes.

Classical Optimisation Algorithms for Battery Management

- Uses Reinforcement Learning & Heuristic Search to optimize battery efficiency.
- Enhances battery longevity and optimal energy usage.

AI & Quantum Computing - Layered Architecture

Cloud & Edge Quantum Computing Infrastructure

(Top-Level Control & Computation)

Secure Quantum Cryptography Layer

(Ensures Data Integrity & Security)

AI-Powered Anomaly Detection & Prediction Layer

(Early Warning System - Classical AI Approach)

Quantum Computing Optimisation & Decision Making

(Advanced AI with Quantum Computing)

EV Battery Data Collection & Monitoring Layer

(Real-Time Execution & Sensor Data Processing)

Quantum Machine Learning (QML) for Battery Health Prediction

- Uses Variational Quantum Circuits (VQC) for complex pattern recognition.
- Enhances AI's ability to process non-linear battery degradation patterns.

Quantum Neural Networks (QNNs) for Thermal Runaway Risk Assessment

- Quantum-enhanced deep learning models predict potential failures.
- Simulates high-dimensional battery behaviour for precise anomaly detection.

Quantum Approximate Optimisation Algorithm (QAOA) for Energy Management

- Optimises battery charging, discharging, and thermal management.
- Uses quantum annealing techniques for highly efficient decision-making.

Quantum Annealing for Battery Safety Optimisation

- Uses D-Wave's quantum annealers for efficient battery performance tuning.
- Applies quantum-enhanced combinatorial optimisation for fire prevention strategies.

AI & Quantum Computing - Layered Architecture

Cloud & Edge Quantum Computing Infrastructure

(Top-Level Control & Computation)

Secure Quantum Cryptography Layer

(Ensures Data Integrity & Security)

AI-Powered Anomaly Detection & Prediction Layer

(Early Warning System - Classical AI Approach)

Quantum Computing Optimisation & Decision Making

(Advanced AI with Quantum Computing)

EV Battery Data Collection & Monitoring Layer

(Real-Time Execution & Sensor Data Processing)

Real-time Sensor Data Acquisition

- Captures data from EV battery sensors (temperature, voltage, current, SOC, SOH).
- Uses IoT & Edge Computing at the Battery Management System (BMS) for real-time processing.
- Implements self-healing AI models that adapt to sensor noise and environmental variations.

Edge Computing at BMS

- Low-latency, real-time analysis to detect early battery anomalies.
- Integrates AI-driven edge computing for preemptive failure response.

Secure Data Transmission:

- Utilises Quantum Cryptography (QKD) for secure communication between EV and cloud servers.
- Ensures tamper-proof data logging for compliance and traceability.

1. Battery Temperature Monitoring System

Goal: Read temperature data, analyse trends, and detect overheating.

Concepts: File handling, NumPy, Pandas, Matplotlib

Tasks:

- Read a CSV file containing battery temperature data
- Calculate average, max, and min temperatures
- Plot a temperature trend graph using Matplotlib
- Detect overheating conditions (e.g., alert if temp > 60°C)

Outcome: Basic battery monitoring using Python

2. Battery Voltage & Current Analysis

Goal: Analyse voltage & current data to detect anomalies..

Concepts: Pandas, Data Visualisation, Time-Series Analysis

Tasks:

- Load battery voltage & current datasets
- Identify voltage drops and current spikes
- Plot Voltage vs. Time & Current vs. Time
- Set a rule: Alert if voltage drops below a threshold

Outcome: Detect battery performance issues

3. State of Charge (SOC) Estimation

Goal: Estimate battery SOC using voltage and current data.

Concepts: Numerical computing, Basic Machine Learning

Tasks:

- Load historical battery data (Voltage, Current, SOC)
- Train a simple regression model to predict SOC
- Validate results using test data
- Display real-time SOC values for a given input

Outcome: SOC estimation using Python

4. EV Battery Health Prediction

Goal: Use AI to predict battery degradation over time.

Concepts: Machine Learning, Data Science

Tasks:

- Load battery charge-discharge cycle data
- Identify patterns in battery degradation
- Train an ML model (Scikit-learn) to predict Remaining Useful Life
- Visualise predictions with graphs

Outcome: AI-based battery health prediction

5. Intrusion Detection in Battery Management System

Goal : Detect anomalous activities in an EV Battery Management System using Python. (Hacking attempts, data tampering, or unauthorised access)

Concepts Used:

- Log Analysis & Data Forensics
- Anomaly Detection (Machine Learning)
- Cybersecurity Threat Detection

Project Overview

The Battery Management System (BMS) logs critical parameters:

- Voltage, Current, Temperature
- State of Charge (SOC), State of Health (SOH)
- Communication logs (CAN messages)

Potential Cyber Threats:

- **Spoofing Attack**: Fake voltage readings injected
- **Man-in-the-Middle Attack:** SOC data modified
- **Malware in BMS:** Unauthorised data manipulation

Expected Outcomes

- Build a Battery Intrusion Detection System (IDS)
- Detect cyber attacks on BMS data
- Train an ML model to differentiate between normal and attack conditions
- Secure BMS communication with encryption (Advanced)

STEP 1 : Collect Battery Data Logs (or Use Sample Data)

- Use a CSV file containing battery logs with timestamps
- Add a column for intrusion detection labels (Normal / Attack)

STEP 2 : Analyse Normal vs. Anomalous Data

- Load the dataset using Pandas
- Visualise voltage/current variations using Matplotlib
- Identify unexpected spikes, drops, or inconsistent SOC values

STEP 3 : Implement an Anomaly Detection Model

- Use Scikit-Learn to train an ML model for intrusion detection
- Algorithms: Isolation Forest, Random Forest, or Logistic Regression
- Train model on normal vs. attack data samples
- Detect real-time anomalies from live battery logs

STEP 4 : Real-Time Intrusion Detection Simulation

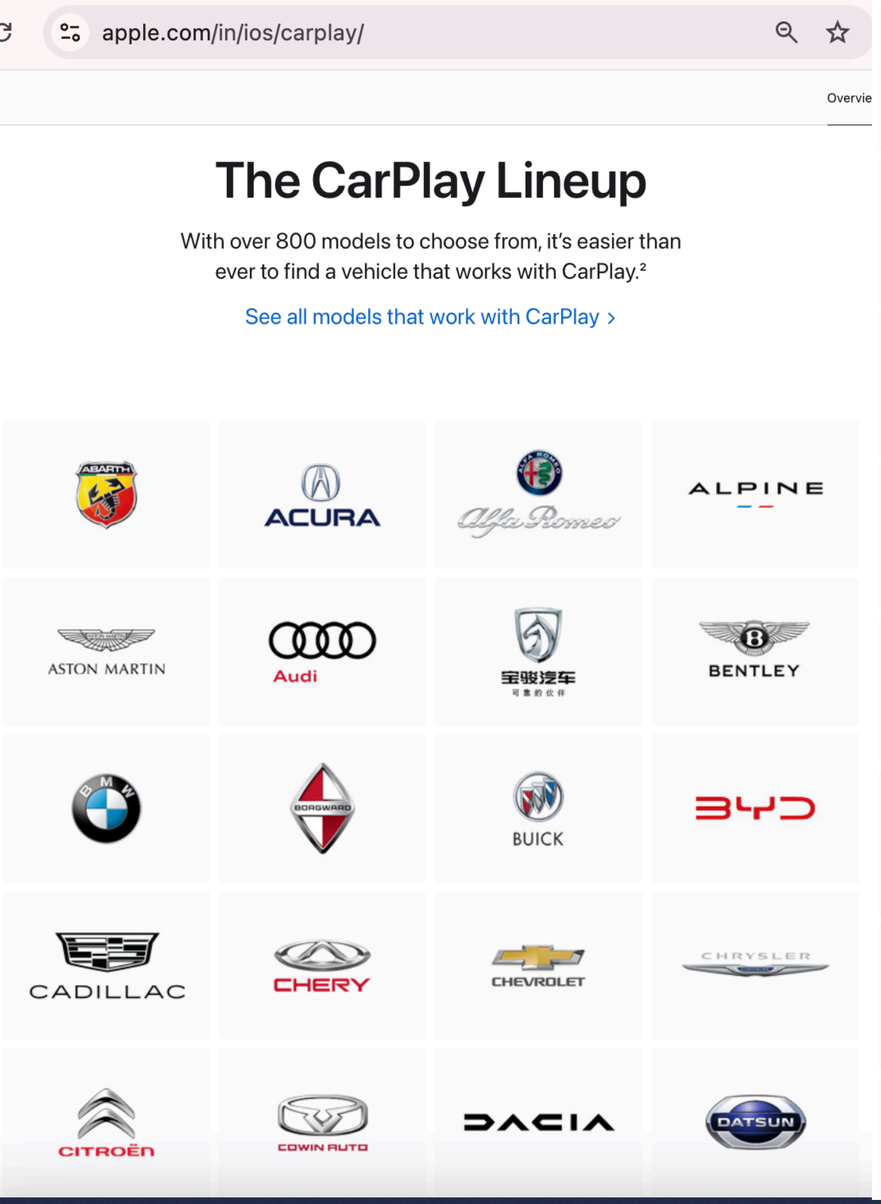
- Simulate incoming battery data (live stream using Python)
- Detect unauthorised activities and trigger alerts
- Implement logging system to save security breach attempts

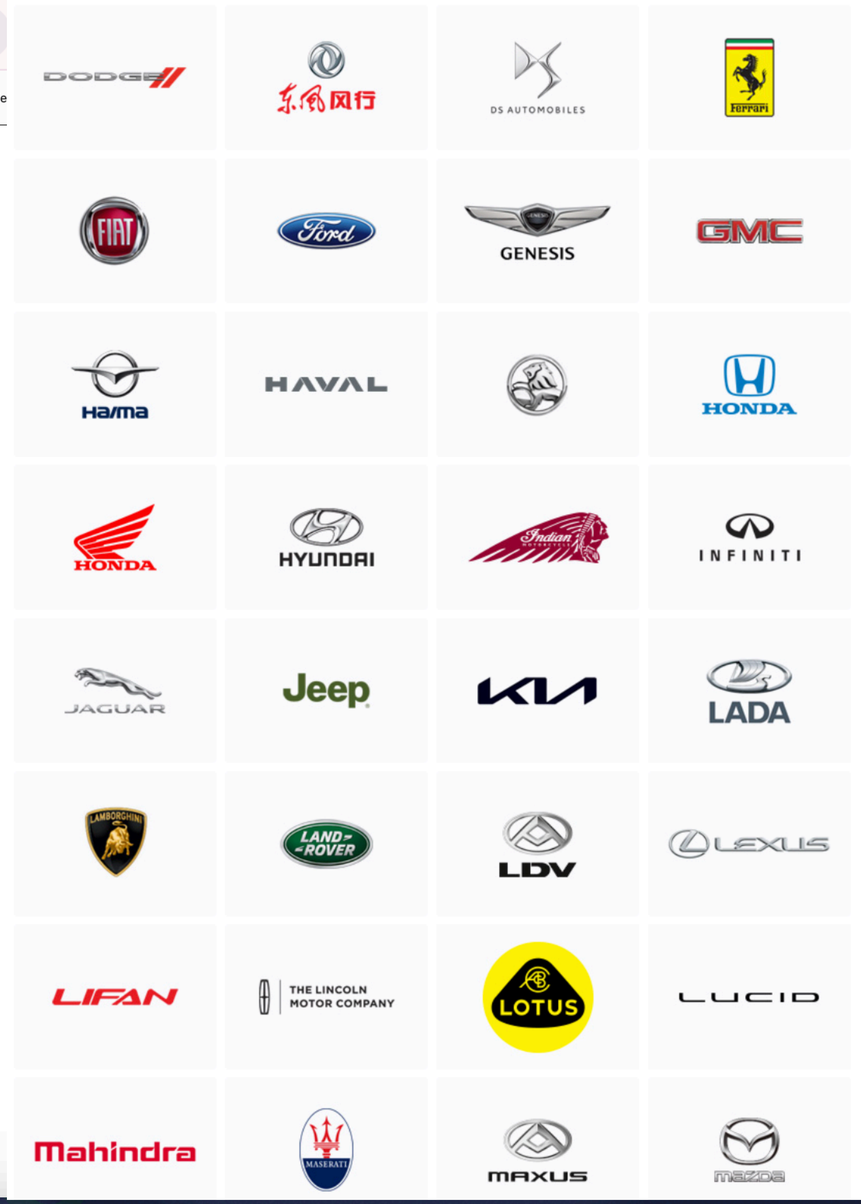
STEP 5 : Secure Battery Data with Encryption

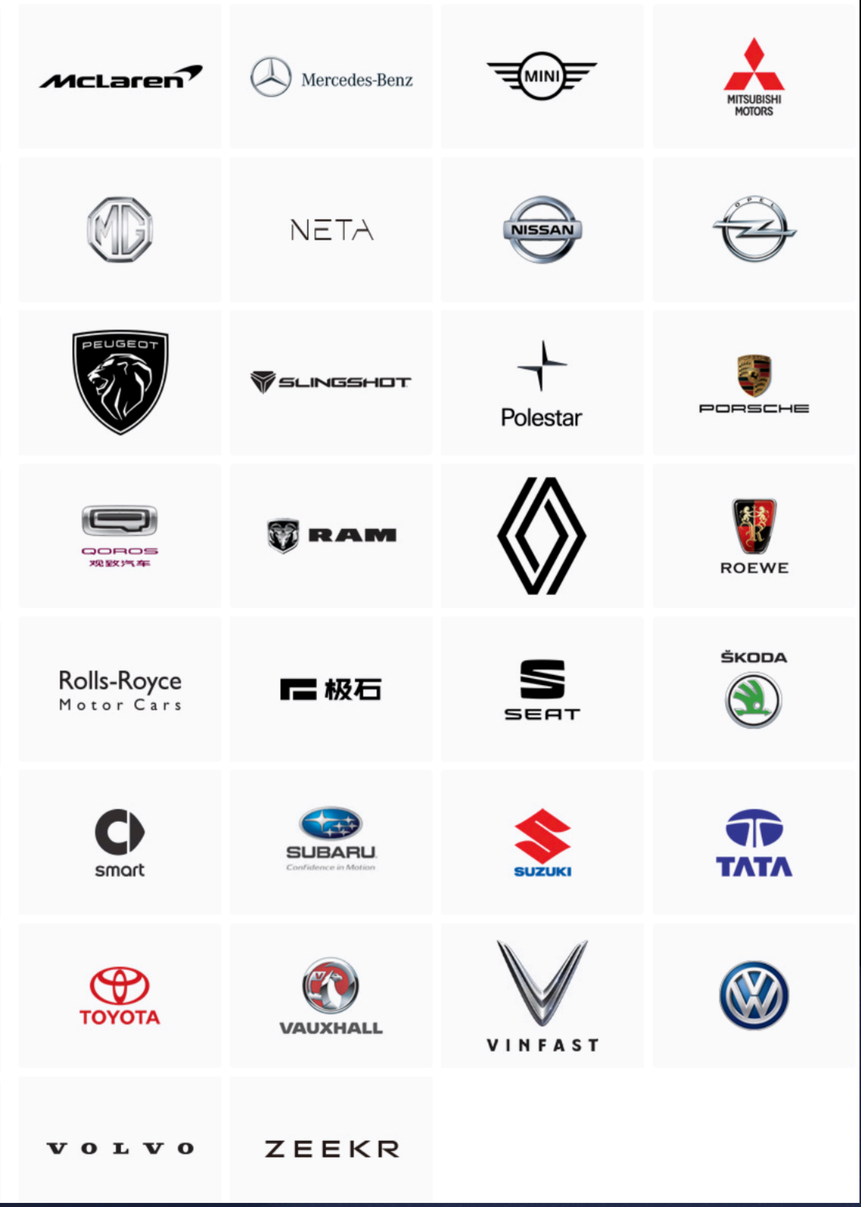
- Use AES Encryption (Python pycryptodome module)
- Encrypt critical BMS data before transmission \
- Ensure only authorised systems can decrypt it

EV & Automotive Companies

EV & Automotive Software Companies







Apple - CarPlay

https://www.apple.com/careers/in/

Courtesy : https://www.apple.com/in/ios/carplay/images/overview/dashboard_next_generation__cvyi4onfhyc2_large_2x.jpg

Tesla - EV & Solar Panels

https://www.tesla.com/

BYD - Ultra-safe Blade Battery

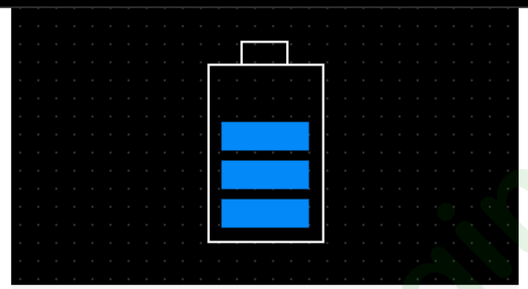
https://www.byd.com/en-hk/car/m6

Filter

RESET

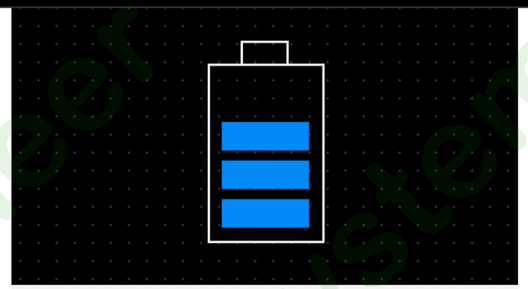
Usecase 2

- Energy & Charging
- Vehicle Status
- Fleet Management
- Retail
- Infrastructure & Mapping
- Insurance
- Public Sector
- Repair & Maintenance



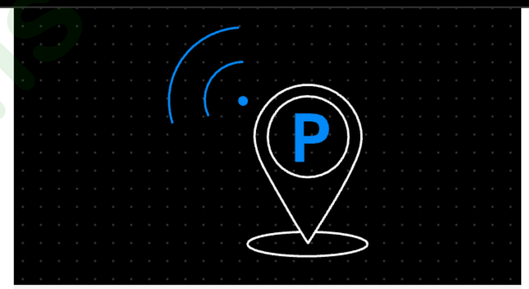
Electric Vehicle Status 2.0

Get remote access to all relevant charging data of a vehicle.



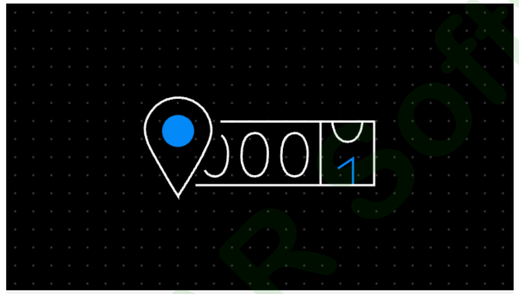
Electric Vehicle Status 3.0

Remotely control your customers charging



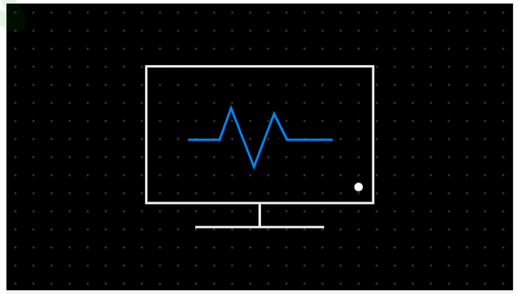
Parking Monitoring

Get anonymized data on the real-time parking behaviour from the Mercedes-Benz vehicle fleet to improve your own applications.



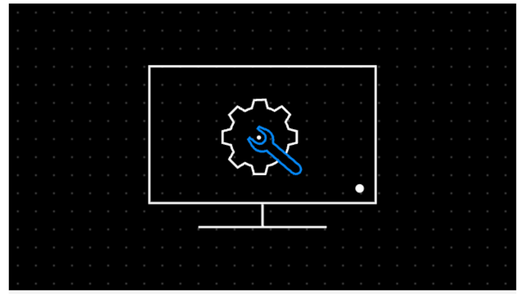
Pay As You Drive 2.0

Get actual odometer information and geo position to offer distance & usage based insurance services.



Remote Diagnostic Support

Get Mercedes-Benz diagnostic vehicle data and functions for your own application.



Remote Maintenance Support

Get Mercedes-Benz maintenance-relevant vehicle data for your own application.

waymo - Autonomous Vehicle

https://waymo.com/

EV Jobs & Career Opportunities

✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

EV Jobs & Career Opportunities

Explore the latest job openings and career opportunities in

- Electric Vehicles & Battery Technology,
- AI & ML and Telematics,
- Automotive Cybersecurity,
- Renewable energy,
- Quantum Computing,
- Software-Defined Vehicles.

We offer training, mock interviews, resume shortlisting, & career guidance to help EV engineers land the right opportunities.

We connect you to top EV job listings and provide expert support for your career growth.

✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

EV.Engineer - Career Opportunities

- EV Software Engineer
- Electric Drivetrain Engineer
- Test & Validation Engineer
- EV Battery Engineer (BMS)
- Vehicle Diagnostics Engineer
- Control Systems Engineer
- AI / ML & Quantum AI
- Thermal Management Engineer
- Simulation & Modeling Engineer
- Automotive Cybersecurity
- EV Systems Engineer
- Vehicle Integration Engineer
- Telematics Engineer
- Power Electronics Engineer
- Functional Safety Engineer
- Renewable Energy Engineer
- Embedded Systems Engineer
- [... Many More]

EV.Engineer - Career Opportunities

- EV Software Engineer
- EV Battery Engineer (BMS)
- AI / ML & Quantum AI
- Automotive Cybersecurity
- Telematics Engineer
- Renewable Energy Engineer
- Electric Drivetrain Engineer
- Vehicle Diagnostics Engineer
- Thermal Management Engineer
- EV Systems Engineer
- Power Electronics Engineer
- Embedded Systems Engineer
- Test & Validation Engineer
- Control Systems Engineer
- Simulation & Modeling Engineer
- Vehicle Integration Engineer
- Functional Safety Engineer
- [... Many More]

✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

EV Jobs & Career Opportunities

Engineering Colleges

CS, AI&ML, IS

E&E, E&C,

Mech & Automobile

Freshers

EV.Engineer

EV Battery Research

EV Trainings & Mock Interviews

EV Career Guidance

Internship

EV Company

EV Startup

Hiring Manager

HR (Internal & External)

Company Career Site

Job Portals | Hubs

Internship

EV Jobs

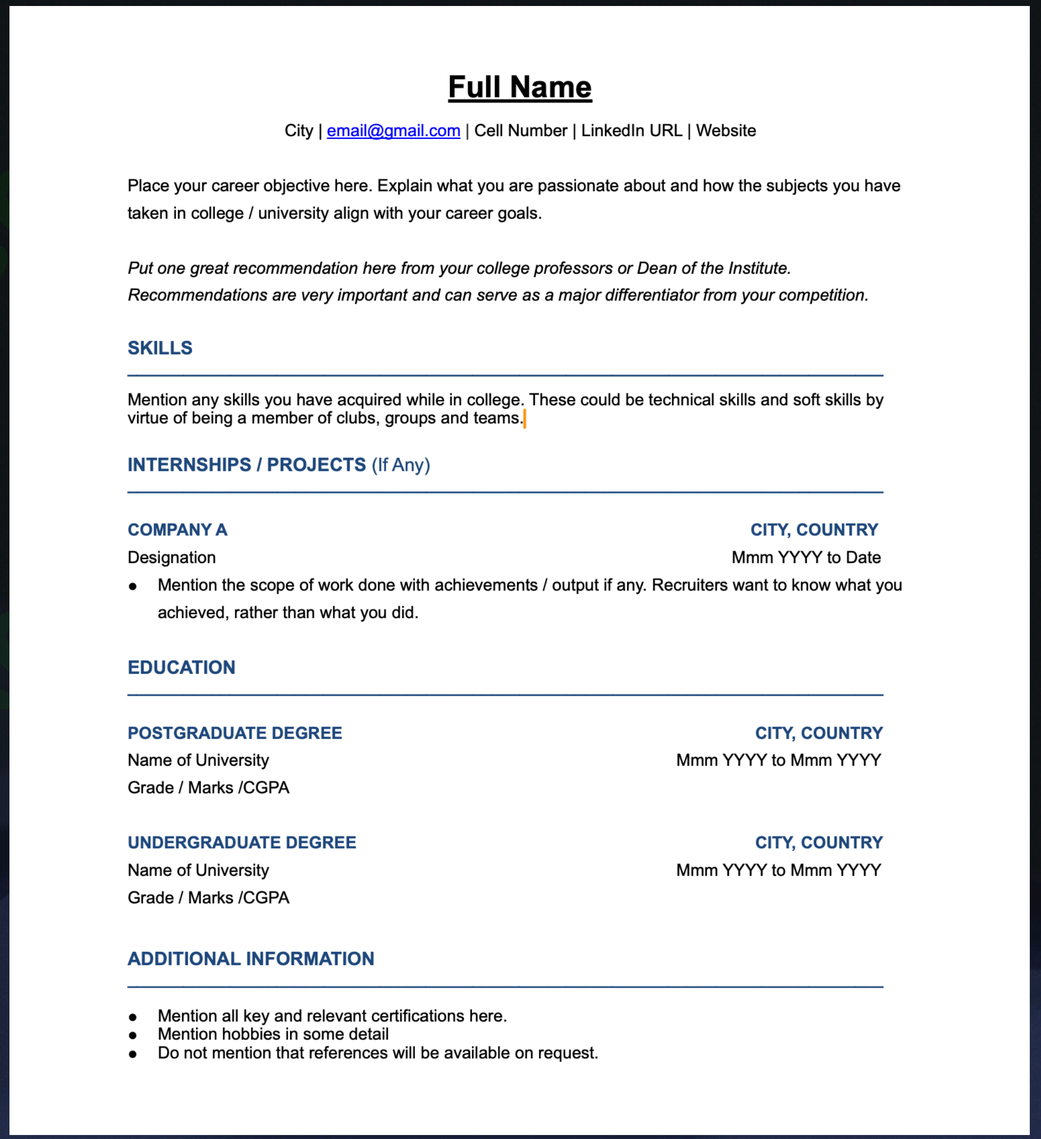
Resume Optimisation, LinkedIn & Networking, Interview questions & Answers

Interview Preparation - (Before, During, After), Personal Branding

✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

Resume Template - Fresher

- Introduction
- Skillset / Domain
- Internship / Projects
- Company / Experience
- Education
- Additional Information
  - Key Accomplishments
  - Licenses / Certifications
  - Recommendation



Full Name

City | email@gmail.com | Cell Number | LinkedIn URL | Website

Place your career objective here. Explain what you are passionate about and how the subjects you have taken in college / university align with your career goals.

Put one great recommendation here from your college professors or Dean of the Institute. Recommendations are very important and can serve as a major differentiator from your competition.

SKILLS

Mention any skills you have acquired while in college. These could be technical skills and soft skills by virtue of being a member of clubs, groups and teams.

INTERNSHIPS / PROJECTS (If Any)

COMPANY A — **CITY, COUNTRY**
Designation — Mmm YYYY to Date

- Mention the scope of work done with achievements / output if any. Recruiters want to know what you achieved, rather than what you did.

EDUCATION

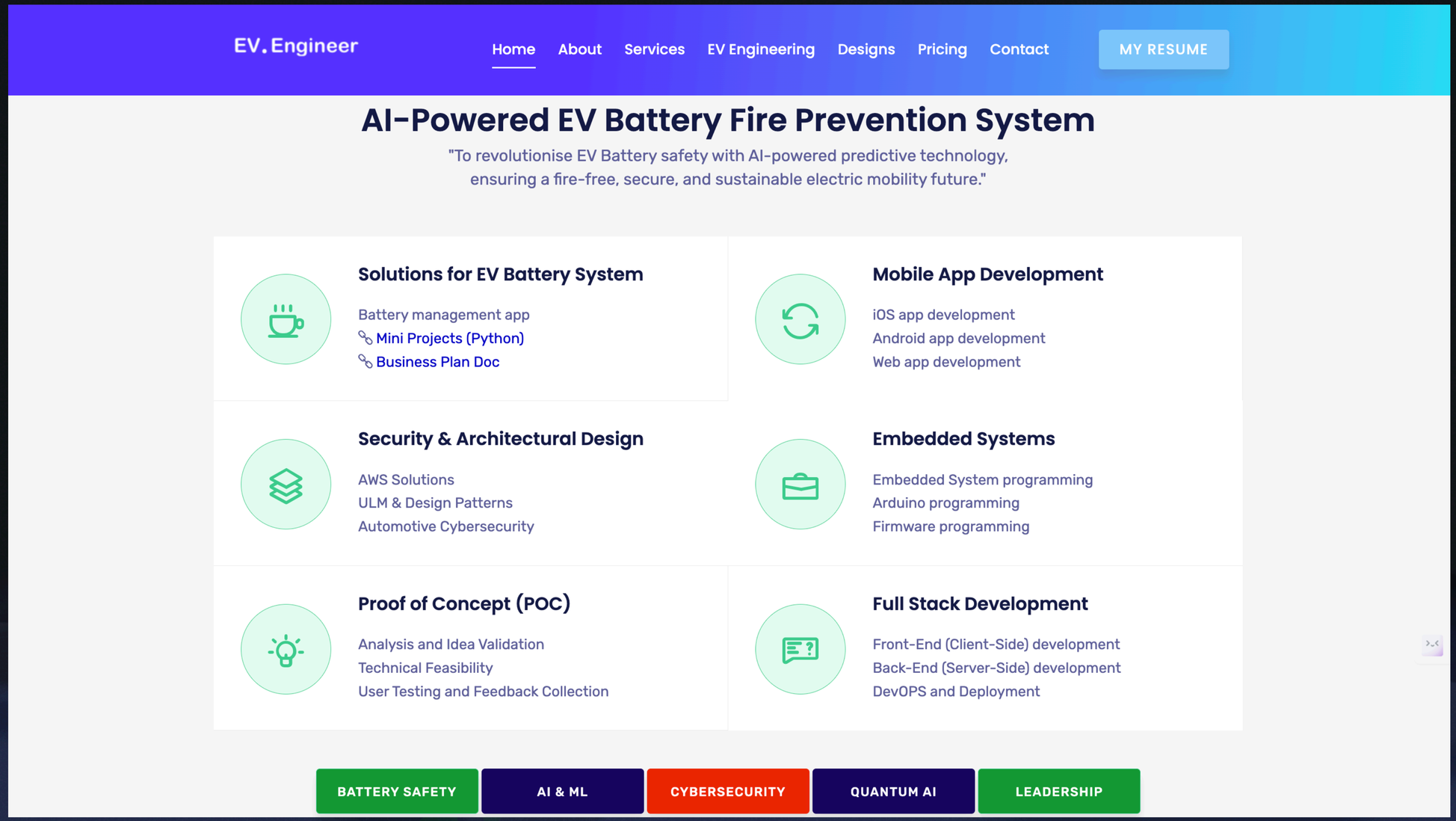
POSTGRADUATE DEGREE — **CITY, COUNTRY**
Name of University — Mmm YYYY to Mmm YYYY
Grade / Marks /CGPA

UNDERGRADUATE DEGREE — **CITY, COUNTRY**
Name of University — Mmm YYYY to Mmm YYYY
Grade / Marks /CGPA

ADDITIONAL INFORMATION

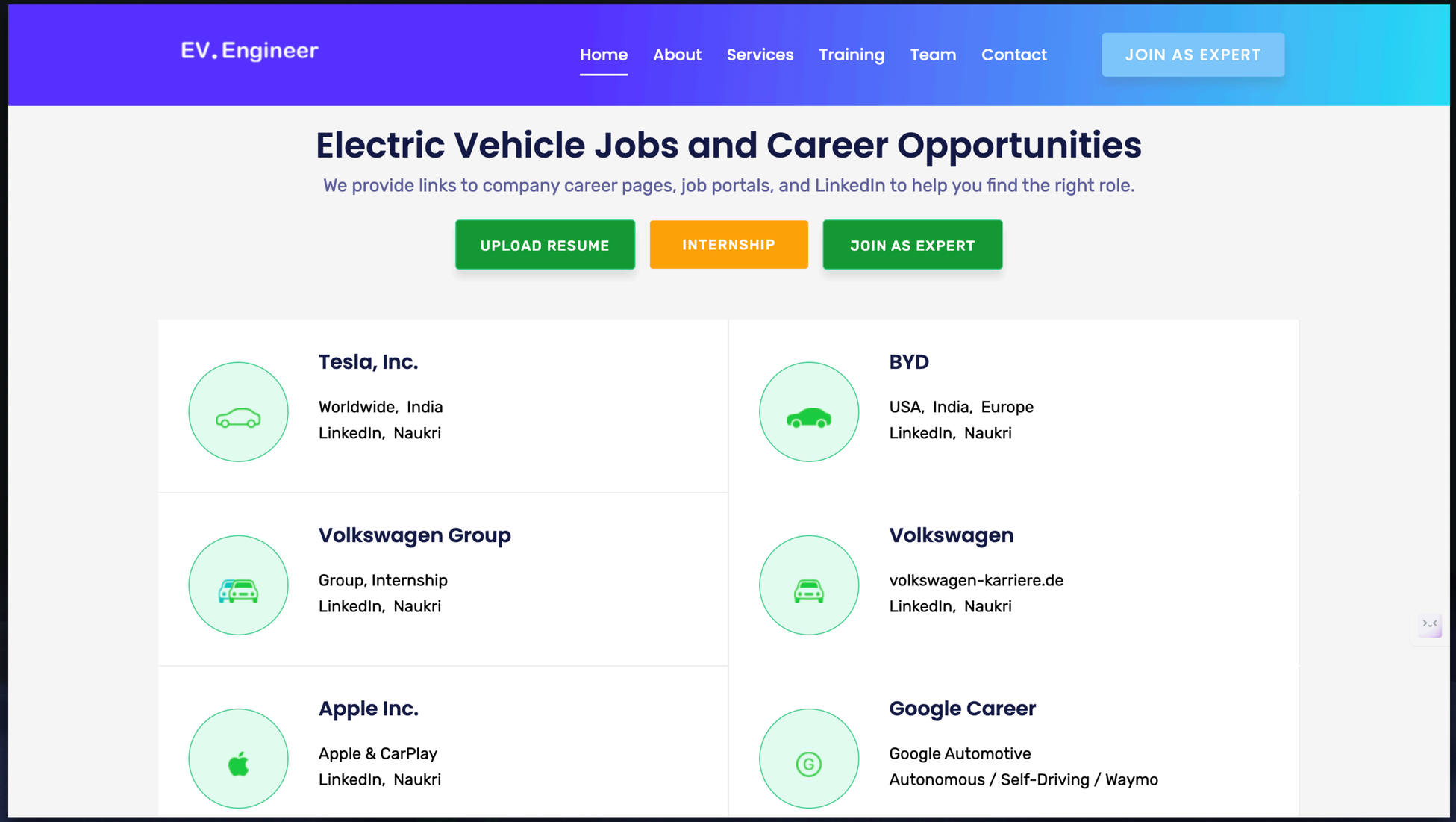
- Mention all key and relevant certifications here.
- Mention hobbies in some detail
- Do not mention that references will be available on request.

Personal Branding - https:// CAR Software Systems (.com)



✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

EV Jobs & Career Opportunities



Personalised coaching to get your dream job

EV.Engineer

Home | About | Services | Training | Team | Contact | JOIN AS EXPERT

Electric Vehicle (EV) Training Programs

Electric Vehicle Engineering | Telematics Engineering | Software Defined Vehicles | EV Battery and Charging Management

Telematics Engineering

Telematics is the technology that deals with computerised information transmission generally used for sending and receiving data
- in vehicles,
- between vehicles or
- between a vehicle and a third party device.

VIDEO TUTORIALS

iTelematics.com | 25 March, 2025

CAR Software Systems

For the automotive service providers, who would like to make their customers' life simpler, CAR Software Systems provides solutions to diagnose car's health and notify when something goes wrong, that helps customers keep track of information about their CAR.

DOWNLOAD

CAR Software Systems | 30 Nov, 2025

Electric Vehicle Engineering

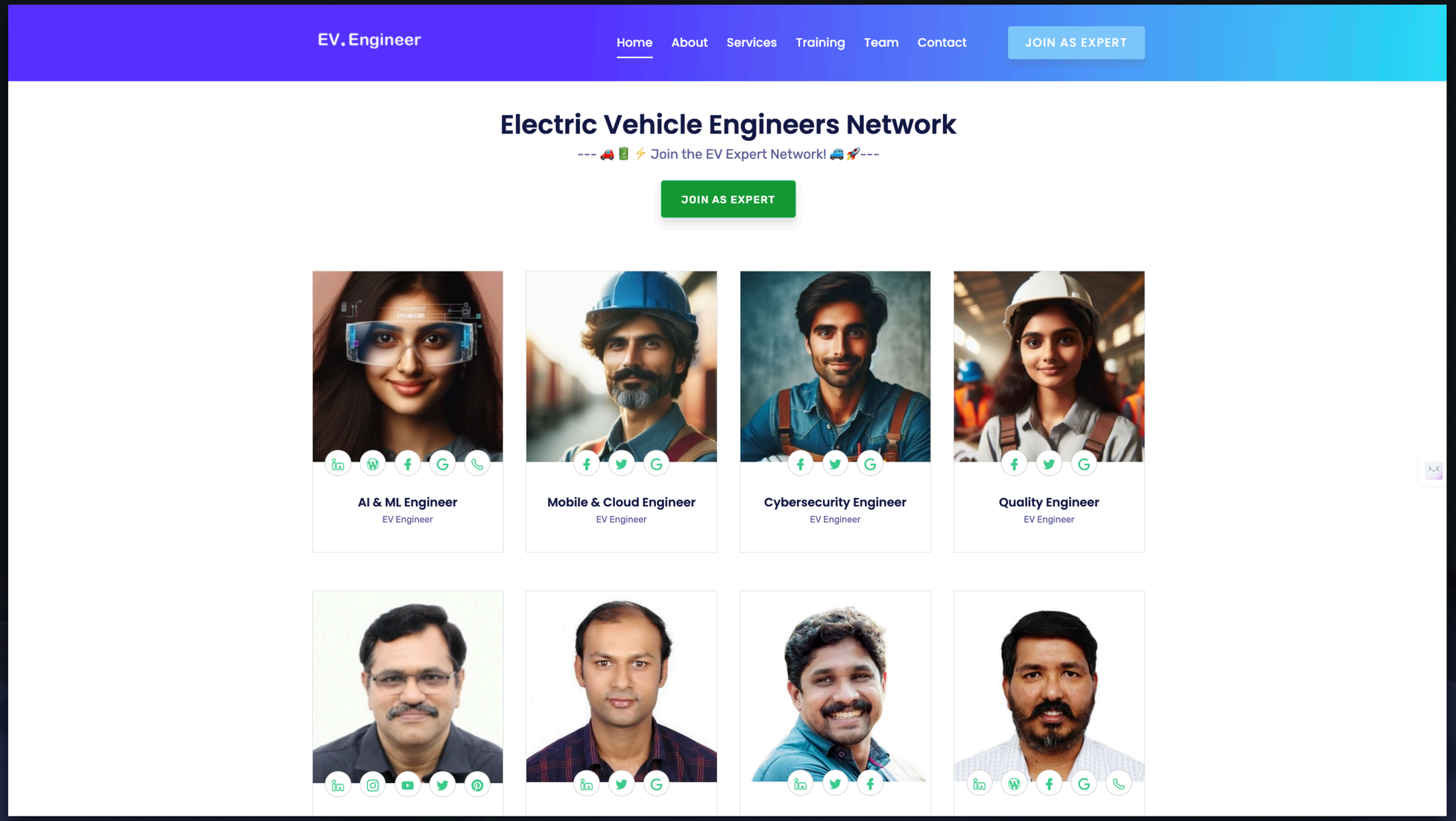
This course offers an in-depth exploration of electric vehicles (EVs), guiding students from basic concepts to advanced design and development. It covers the evolution of EVs, including hybrids, plug-in hybrids, and battery electric vehicles (BEVs).

LEARN MORE

CAR Software Systems | 30 April, 2025

https://ev.carsoftwaresystems.com

Certified EV Engineers Network



Engineering Colleges

CS, AI&ML, IS

E&E, E&C,

Mech & Automobile

Freshers

Q&A

EV.Engineer

EV Battery Research

EV Trainings & Mock Interviews

EV Career Guidance

Internship

EV Company

EV Startup

Hiring Manager

HR (Internal & External)

Company Career Site

Job Portals | Hubs

Internship

EV Jobs

Resume Optimisation, LinkedIn & Networking, Interview questions & Answers

Interview Preparation - (Before, During, After), Personal Branding

✆ +91 9845561518 | ✉ carsoftwaresystems @ gmail.com | carsoftwaresystems.com

EV.Engineer - Workshop

https://github.com/CARSOFTWARESYSTEMS/EV.Student/

Thank you

Sudarshana Karkala

Co-founder - EV.Engineer, CAR Software Systems

Advisor @ iTelematics Software Private Limited