

## **Collaboration with Formula bharat - Ather Energy Software Awards (2021)**

Formula student teams can participate and attempt one or more categories of software challenges shared below. In this document, they will find 3 categories / problem statements well-described and the format in which submissions are required are mentioned underneath them.

### **1) “Connected Tech”- Problem Statement**

Real time parsing and analysing data emulating from IoT devices with a frequency of about one request every 2s with a payload of about 100 variables (device id as primary identifier) preferably in json or CSV structure. This payload has to be stored in a database which should give easy access for querying. Following scenarios/outcomes have to be fulfilled as part of the problem statement.

#### **Outcomes:**

1. Ability to handle above given payload for a concurrent request size of 100, 500 and 1000.
2. Ability to handle errors/issues by logging the request.
3. Showcase data from different devices at different intervals combined by using device id and storing it in a database.
4. Time sorting data and analyzing if the data is complete between the above time intervals.
5. Collecting data with a definition of what would be a shortest time interval to have meaningful information per device.
6. A database where this above mentioned payload gets stored in real time with ability to read data via primary identifier like device id, timestamp, interval frequency.
7. Data above 6 in the database should be sorted based on device id and frequency at which it has come in.
8. Also the database should have a view of aggregation of data based on a particular device, particular day and breakdown up to different hours of the day.
9. Showcase aggregation by few variables for a particular date/day range.
10. A Visualization tool or APIs using which we can look at the data at storage i.e in database fulfilling points 6,7,8 and 9 above.

The participants are advised to bring out maximum outcomes as possible.

Submission: Feel free to use any format to share the solution which best depicts the working demo.

## 2) “System Intelligence” - Problem Statement

An electric vehicle is more than a battery and a motor, in every aspect of the EV experience intelligent algorithms play an important part in controlling the ride experience and feel of the vehicle. In this assignment we would like to challenge Formula Bharat teams to present methods to modulate the performance of their EV. Teams would be judged on the ingenuity of their methods, and for satisfying established judgement criteria on the following topics.

- Drive Mode Definitions & Frameworks: Design and present framework to achieve:
  - Predefined Range: How can we reduce “range anxiety”. How can we make sure that the vehicle will always achieve a predefined range.
  - Predefined Power: What is power output of the vehicle, what bearing does this have on the ride feel/acceleration numbers? Is there any way for smart control of vehicle output power?
- Other bonus Points:
  - Throttle mapping and its effect on drivability
  - Mathematical formulations to control motor torque/power

Students must demonstrate mathematical design and present data to substantiate their claims.

Submission: A presentation format with all the details as part of the solution.

### 3) **“Vehicle Tech” - Problem Statement (Vehicle Software + Charging)**

A typical EV has multiple components, and software/firmware which drives these components and achieves the functionality/feature. Battery Management System, Body Control Module, Dashboard, Connectivity etc. are basic building blocks for any EV solution. Since we are looking at multiple domains, the challenges/innovations could be in one or more of the following areas:-

a) Security/Penetration testing framework/model.

EVs inherently have the connectivity solution which exposes them to a bigger network. Penetration testing to uncover potential security issues as an IoT node perspective would be the goal. Also, to look at vehicle network security testing framework/standards.

b) (Software) Test Automation framework for the vehicle components

Since testing a module for features, safety, performance is integral part of any product development. Solution/ideas to define the method of testing for various sub-system of the Vehicle. E.g. a BMS system could have an automation framework which takes it through cycles of charge/discharge, and validates the parameters during the test for safe operation with the help of automation.

c) Vehicle ECU Simulation model/Better known as Digital Twin solution.

Simulation model (home grown) implementation for any of the software components, which would mimic the behaviour of the physical system (inputs/outputs). For e.g. a brake input in the physical system, could be forwarded to simulation model, via a communication channel and the same be reflected visually.

d) Charging/Charging Infrastructure Simulation model.

Extending the concept of vehicle module simulation to charging solution as well. Since, charging cycles, safety, impact on battery life, etc, is also a critical element for the EV ecosystem.

e) Smart Devices integration/solution with use-cases.

Smart devices/smart home integration solutions are growing, a solution to integrate EV to smart home devices, explore various use cases, which focuses on improving the overall customer experience.

Submission: A presentation format with all the details as part of the solution.