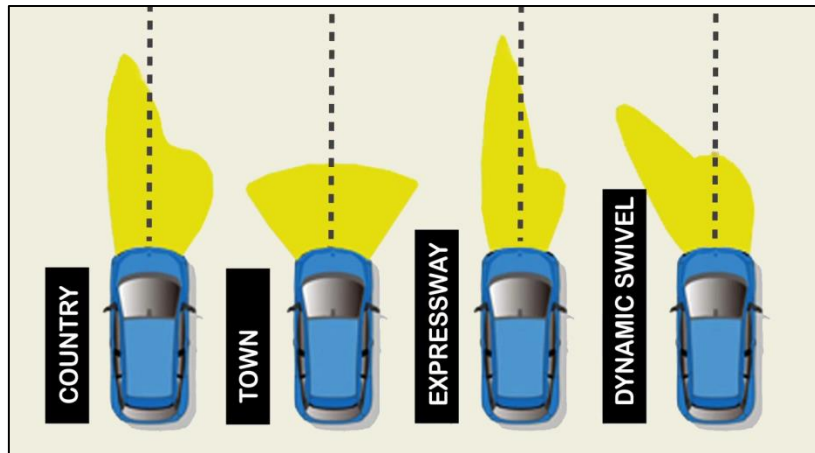


## **Adaptive Front Lighting System (AFLS)**



### **Technology**

**Adaptive Front-Lighting System (AFLS) suitable for Indian Road and Traffic conditions**

**TRL: 6 (Prototype with Verification and Validation)**

### **Properties/ Features**

- Provides wider visibility in town and country roads during night driving
- Provides longer range of visibility at higher speeds especially on expressways
- Avoids excessive glare on oncoming passengers as the system encourages use of Low Beam
- Enhances visibility around bends owing to its Dynamic Swivel Functionality
- Automatically aims light according to the passenger occupancy
- Tuned to Indian road and Traffic conditions
- Cost-effective Indigenous solution

### **Application**

- Applicable for Advanced Lighting Technologies in passenger and commercial vehicle segment
- Application for 2&3 Wheelers can also be developed
- Specific application for Off-Road vehicles and Construction & Mining equipment/vehicles can also be developed

### **Scale of Validation Achieved**

The AFLS equipped vehicle was driven through various road geometries and traffic conditions including Ghat sections for verification of Dynamic Swivel, and on expressway for high speed related testing. Calibration and verification of this system was carried out on test tracks and steering pad. The system and its functionalities have been evaluated as per standards AIS-008 and AIS-127, equivalent to ECE-R48 and ECE-R123 respectively.

### **Intellectual Property**

NA

## **Abstract**

The Automotive Research Association of India has developed indigenous and cost effective technology solution for Adaptive Front Lighting System (AFLS) for mid-segment cars and SUV/MPV. The algorithm is designed to address needs of Indian road and traffic conditions. AFLS adapts the headlamp beam pattern to driving conditions encountered by the vehicle. The AFLS operates in different modes, viz. Expressway Mode, Country Mode and Town Mode. The developed prototype AFLS ECU has been integrated with a Utility Vehicle's Electrical & Electronic architecture via CAN network to achieve these modes.

These AFLS modes are achieved with less sensor inputs as compared to the similar solutions available in the market, on existing mid-segment utility vehicle architecture. The vehicle speed thresholds are optimized to meet the Indian traffic requirement.

With this AFLS technology development, ARAI is now able to offer the following development services in automotive lighting.

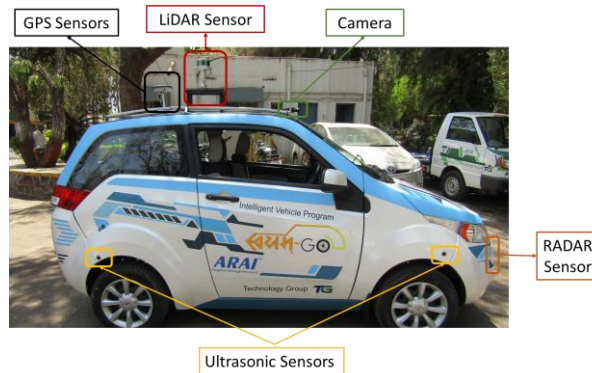
- Functional Architecture Development
- Control Algorithm development for Intelligent Lighting Technologies
- Software development using MATLAB & Simulink/ C
- Verification and Validation Methodologies
- Consultancy for AFLS development and new technologies in the area of lighting

ARAI is also keen to develop similar AFLS technologies for 2&3 wheel vehicles, Buses, Commercial vehicles, off-road vehicles and Construction & Mining equipment/vehicles as well.

## **Beneficiary Industry**

- Vehicle Manufacturers of 2W, 3W, Cars, SUV/MPV, Buses, Commercial Vehicles etc.,
- Lighting Systems Manufacturers supplying to vehicle OEMs
- Off road vehicles and Construction & Mining equipment/vehicles

## Autonomous Vehicle Deployment Platform



### Technology

#### Autonomous Vehicle Development Platform

**Technology Readiness Level: 7 (System prototyping demonstrator in an operational environment)**

#### Features

- For a typical electric 4-wheeler (Car, LCV, SUV segment) with full drive by control capability
- CAN / TCP-IP option for communication with vehicle controller
- Actuation Systems for Steering, Brake, Accelerator
- Sensors for ADAS/Autonomous functions/Data monitoring
  - Vision system
    - Stereo camera for Object Detection
    - Mobileye Camera for Blind spot detection
    - Integration of reference Cameras (up-to 6)
  - Radar system
    - Mid-range front collision warning radar
    - Short and long range radars For Adaptive Cruise Control and Driving in close vicinity
  - LiDAR
    - 16 channel LiDAR for Objects and Obstacles Detection
  - GNSS (Global Navigation Satellite System) for localization
  - IMU (Inertial measurement unit)
- Complete hardware and vehicle package ready for Autonomous / ADAS deployment
- Safety mechanisms
- Selective Auto or manual drive capabilities

#### Application

- Complete platform package for development of ADAS / Autonomous vehicle functionality
- Useful for On Road trials and validation
- Useful for Traffic data acquisition

#### Scale of Validation Achieved

The current package is ready with selected sensors and is being used for ARAI's internal program of Intelligent Vehicle Development.

#### Intellectual Property

NA

## Abstract

The Automotive Research Association India is working on internal R&D program titled “SwayamGO”. The main objective of this program is to work on improvement of safety making use of latest electronic and software technologies. As part of this program, ARAI has made prototype of Autonomous vehicle using standard electric passenger car. The actuators of the vehicle (accelerator pedal, brake and steering) have been automated. The sensors like GPS, cameras, RADARs and Lidar have been integrated. This prototype is being used for on road trials of developed control systems.

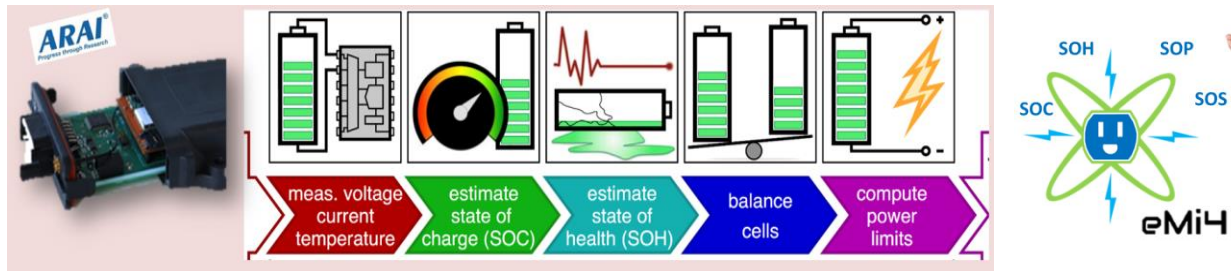
This ARAI's autonomous vehicle deployment platform offers complete packaged solution for customers to jump start their ADAS/AV functionality development. It offers options for sensor selection as per customer's specific requirement. The platform can be used for on road deployment, development and validation of ADAS/AV functionality.

This complete packaged vehicle prototype can be offered as solution to interested parties. It will help customers to jump start their ADAS/AV functionality development.

## Beneficiary Industry

- OEMs
- Tier 1 industries
- Service Industries
- Research Institutes/Academies/Universities
- Startups

## Electric Vehicle Battery Management System (EV-BMS)



### Technology

Electric Vehicle Battery Management System (EV-BMS) Hardware and Software suitable for Indian conditions

Technology Readiness Level - TRL8 (Actual system completed and qualified test and demo operational environment)

### Features

- Software development using Model Based Design (MBD) approach
- Monitoring of every cell Voltage , pack current and temperature
- Cell balancing (Passive)
- Advanced Estimation Techniques for State of Charge (SoC) and State of Health (SoH)
- Advanced Estimation Techniques for State of Power (SoP) and State of Safety (SoS)
- Active Monitoring and Derating
- Thermal Management
- Compatible with wide range of lithium-ion cells
- Failure detection and Diagnostics
- Modular and Scalable Architecture
- State of Art GUI for Monitoring, Configuration and Calibration

### Applications

- Applicable for 2w/3w/4w Electric and Hybrid Electric Vehicles
- Applicable for fuel cell and Ultra capacitor based systems
- Applicable for Energy Storage Systems
- Applicable for Agricultural and Off Road vehicles
- Applicable for Unmanned aerial vehicle (Drones)

### Scale of Validation Achieved

The software package is verified and validated in Model in Loop (MIL). Interface of the control strategy with different type of Battery packs has been tested. This package is MATLAB Simulink based configurable software and its compatibility with general Simulink based plant model is validated. The developed BMS is validated for automotive test compliance of EMI/EMC (Radiated Emission, Radiated Immunity, Conducted Emission, Conducted Immunity) as per AIS 004 Part 3, Electro static Discharge Test and Environmental Tests for Temperature, Humidity and Vibration.

### Intellectual Property

NA

## Abstract

Automotive Research Association of India has developed indigenous and India specific cost effective technology solution for Energy/Battery Management system. This Intelligent energy management system 'ARAI-eMi4' is a complete software and hardware platform comprising of advanced algorithms for energy management and an automotive compliant hardware to interface with the energy source.

The system software and hardware is designed to accommodate a wide range of lithium ion battery chemistries. The algorithm is designed to monitor Current, voltage and temperature of the cells in the battery pack. It further calculates and estimates 4 important states of the energy source (SOC, SOH, SOP, and SOS) using advanced estimation methods. The software and hardware platform so developed is scalable and provides flexibility to end users with master/slave topology, which allows multiple units to be connected together to support up to 800 VDC systems. The hardware is designed with highest levels of safety using automotive-grade components. The UI Platform is equipped with customizable diagnostic software via CAN and serial interface which manages pack diagnostics, data logging, and provides rapid parameter modification and firmware upgrades.

## Beneficiary Industry

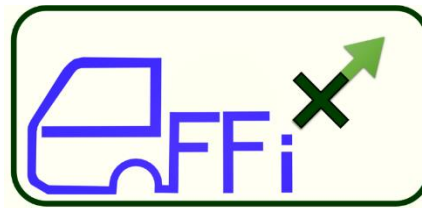
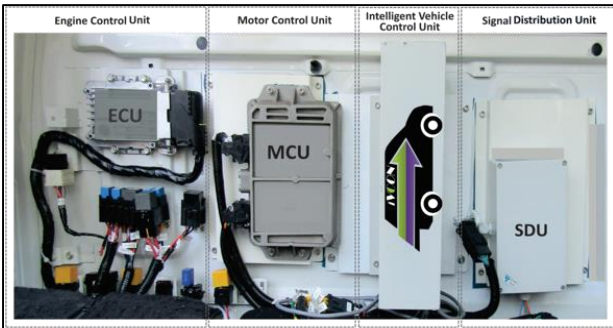
- EV-HEV Vehicle Manufacturers of 2w/3w/4w Electric and Hybrid Electric Vehicles
- Energy Storage System providers.
- Engineering Service Providers
- Battery Pack Manufacturers.
- Research Institutes/Academies/Universities working on Energy Storage programs

### ARAI also offers the following development services in areas of Energy Management.

- Functional Architecture Development.
- Battery Plant model development
- Control Algorithm development for Energy management.
- Verification and Validation methodologies.
- Consultancy for Battery pack and management system development.
- Developing Algorithms in the areas of Balancing of Ultra capacitors other Energy sources

Also visit <https://emobility.araiindia.com/> for other EV/HEV capabilities of ARAI.

## Hybrid P3 Retro-fitment solution for LCV-MT



ARAI - xEV Program

### Technology

#### Hybrid Retro-fitment solution for LCV-MT

Technology Readiness Level: 6 (System model/demonstrator in relevant environment)

### Features

- Retrofit solution for LCVs and above
- Modular and scalable solution
- Frugal solution for low cost integration
- Minimal modifications to existing vehicle
- In-house developed Control strategy with 'idiot proof' interlocks
- Thoroughly engineered system considering all vehicle performance criteria
- Three operating modes:
  - Conventional engine
  - Hybrid mode (with 2 additional control modes in-built)
    - Battery charging
    - Regenerative braking
  - Electric only mode
- Minimal serviceability to add on system; fit and forget
- Advantages of:
  - Higher fuel economy
  - Lower emissions and emission systems
  - Higher service life of vehicle
  - Reduced maintenance costs
  - Cost effective indigenous solution
- Solution also available for OE fitment for new vehicles

### Application

- SCVs and LCVs
- Scalable to bigger commercial vehicles as well

### Scale of Validation Achieved

A working prototype has been developed and tested. Further validation and optimization of the hardware and software is going on considering a broader range of operating scenarios.

### Intellectual Property

Patent application in process

### The Automotive Research Association of India

(Research Institute of the Automotive Industry with the Ministry of Heavy Industries & Public Enterprises, Govt. of India)  
For inquiry please contact – [info@araiindia.com](mailto:info@araiindia.com), Tel – 020-3024-1111, Website – [www.araiindia.com](http://www.araiindia.com)

### **Abstract**

The world is shifting towards low carbon footprint which made it necessary to adopt efficient technologies with fewer emissions. Hybridization is one such solution, which results in improved efficiency with lower emissions that can fulfil the future emission norms. Retrofitting of hybrid components into a conventional IC engine vehicle is one of the best ways to achieve better performance both economically and technologically for in-use/existing vehicles.

ARAI's solution is primarily focused on the design and development of a novel retrofit solution of P3x architecture for the light commercial vehicle. This retrofit solution is different from other hybrid solutions in terms of powertrain. It contains an innovative add-on powertrain along with the existing powertrain. The newly designed powertrain provides 5 different hybrid modes namely engine only mode, electric only mode, motor assist mode, battery charging mode and regenerative braking mode. The retrofit work also focuses on packaging design of hybrid components into the chassis ensuring that it can sustain all load transferring from road along with additional weight without failure. To demonstrate the practical applicability of this indigenous powertrain with P3x hybrid configuration, a prototype has been developed and functionally tested.

### **Beneficiary Industry**

- OEMs working on hybrid platforms
- Tier 1 industries supplying the smart controls for hybrid vehicles
- Service Industries
- Research Institutes/Academies/Universities working on Hybrid Vehicle programs

### **ARAI also offers the following development services in areas of Hybrid vehicles.**

- Similar solution on OE fitment
- Electrical system design
- High voltage safety and interlocks
- Structural analysis on effect of hybridization
- MIL & SIL simulation with feasibility studies
- System and component sizing and identification
- Subjective and objective analysis



## Hybrid technology platform for 2 & 3 wheel vehicles (L-category)



**DVI**

ARAI - xEV Program

### Technology

Fully integrated hybrid powertrain in a compact vehicle

Technology Readiness Level: 6 (System model/demonstrator tested in relevant environment)

### Features

- Innovative integration solution
- Uses an instant response high torque electric motor complementing existing IC engine
- Replaces starting system of existing vehicles
- Packaged within existing vehicles space in an innovative manner
- Simultaneous jerk free shifting between the two drives (engine and motor)
- Operating features include
  - Start-Stop,
  - EV only crawl
  - Assisted engine braking
  - Regeneration
  - E-ride
  - Boost
  - Launch Control
  - Hill start
- Higher low end torque for enhanced low speed performance
- Higher fuel efficiency
- Lower emissions and reduced after-treatment hardware requirement
- Part of the existing system cost is offset

### Application

- 2-3 wheeler vehicles, especially with single cylinder engines

### Scale of Validation Achieved

A working prototype has been developed and is tested. Further validation and optimization of the hardware is also ongoing to further optimize the packaging.

### Intellectual Property

Patent filed (Application number 201821048259)

### The Automotive Research Association of India

(Research Institute of the Automotive Industry with the Ministry of Heavy Industries & Public Enterprises, Govt. of India)  
For inquiry please contact – [info@araiindia.com](mailto:info@araiindia.com), Tel – 020-3024-1111, Website – [www.araiindia.com](http://www.araiindia.com)

## Abstract

With over 72% of registered vehicles in India being 2 wheelers, the environmental impact of this transportation segment is significant due to the sheer number of vehicles plying on the roads coupled with the congested urban environment prevalent.

‘DVI’ (द्वि), Sanskrit for 2, is a fully integrated mild hybrid powertrain in a compact vehicle that efficiently utilizes space and P1 parallel coupling to provide a spirited driving experience, while still being as effective, if not more in bustling urban roads.

All functions listed are inherently possible thanks to its small, compact, integrated drive configuration. Additionally, the driver’s interaction with the vehicle doesn’t feel as alienating or complicated due to the seamless integration of the control strategies of both systems, giving the driver uncompromising performance and efficiency. To an average driver, it feels but like a higher capacity vehicle without the disadvantages that come with a larger, less efficient & heavier engine.

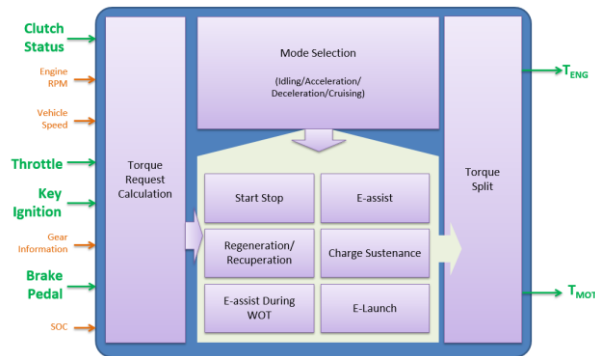
## Beneficiary Industry

- OEMs
- Tier 1 industries supplying the smart controls for hybrid vehicles
- Service Industries
- Research Institutes/Academies/Universities working on Hybrid Vehicle programs
- Motorsports

## ARAI also offers the following development services in areas of Hybrid vehicles.

- Electrical system design
- Structural analysis on effect of hybridization
- MIL & SIL simulation with feasibility studies
- System and component sizing and identification
- Subjective and objective analysis

## Intelligent Vehicle Controller Platform (ARAI-iVCON) for xEV



### Technology

**Intelligent Vehicle Controller (ARAI-iVCON) Platform – A configurable software Package (for P0, P1, P3 & EV configuration)**

**Technology Readiness Level: TRL7 (System prototyping demonstrator in an operational environment)**

### Features

- Software Solution Package for all types of HEVs & EVs
- User friendly customization to hybrid drivetrain i.e. P0/P1/P3 and EV drivetrain
- Also scalable to P2 and P4 HEV configuration
- Open MIL, SIL, PIL & HIL compatible Strategies developed in MATLAB-SIMULINK-STATEFLOW using MBD approach
- Offline and Real-Time Simulation Capabilities
- Contain various easy to parameterize strategies for -
  - Input & Output Processing
  - Start Stop Functionality
  - Charge Sustenance
  - Vehicle mode determination
  - Electric Assist
  - Regeneration
  - Torque request Calculations
  - Electric Launch
  - Diagnostics & Limp home
- Easy Integration with most of-the-shelf plant model
- User friendly GUI for the configuration

### Application

- Vehicle Controller Development platform for Hybrid & Electric Vehicle of any category i.e. 2/3/4 Wheelers

### Scale of Validation Achieved

The current version of the software package is verified and validated in Model in Loop (MIL). Interface of the controllers with different type of plant models has been tested. This package is MATLAB Simulink based configurable software and its compatibility with general Simulink based plant model is validated in offline as well as Real-Time.

### Intellectual Property

NA

### **Abstract**

The Automotive Research Association India has developed the indigenous software package for the vehicle controller of xEVs. The package is named as Intelligent Vehicle Controller (ARAI- iVCON) which is the suite of the standard control algorithm used to control the xEV applications. Especially in case of xEVs, the master vehicle controller is very important since it has to control the demands going to separate systems (like Electric motor, Engine, Battery, etc.). The efficient controller which controls the power flow as per the requirement of the vehicle demand and resources available is key for the hybrid operation.

This software package is user friendly configurable solution which will give the control module in MATLAB environment. User has to select the application HEV/EV and input basic parameters of the vehicle. The utility will create controller in soft format as per the application selected and parameters provided.

### **Beneficiary Industry**

- Vehicle OEMs working on hybrid & electric vehicle platforms
- Tier 1 industries supplying the smart controls for hybrid & electric vehicle
- Engineering Service providers to Auto Industry
- Research Institutes/Academies/Universities working on Hybrid & Electric Vehicle programs