# SUSTAINABLE DEVELOPMENT OF UNIVERSAL ELECTRONIC CONTROL UNIT FOR FUEL SAVING IN AUTOMOBILES TO PROTECT THE ENVIRONMENT POLLUTION

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***Abstract****— The sustainable development of electronic control unit plays a vital role in the development of road vehicles. The proposing system concentrates on fuel savings, Universal Electronic Control unit, LabVIEW programming based Controller Area Network protocol, android mobile based user interface and Image processing based autonomous vehicle. Fuel savings is achieved with the help of ethanol blended fuel. Universal Electronic Control Unit can be fixed into any fuel based engine like battery, diesel, petrol etc. Before fixed into the system the operating modes of the Electronic Control Unit are programmed earlier. NI Data dashboard based control and NI vision acquisition software and vision assistant module based image processing employs the autonomous vehicle. Programming for the proposing system done in LabVIEW platform and cRIO-9022 is used as the main controller. The adaptability of the LabVIEW software allows up gradation of the program and hence, permits the user to customize the Universal Electronic Control Unit to ends needs. 25-30% of fuel consumption is reduced by the ethanol fumigation to protect the environment from pollution and is also implemented Controller Area Network operating with 250k baud rate at 533MHz clock frequency. Rate of NOx, CO emissions is also reduced because of ethanol fumigation.*

***Keywords:*** *LabVIEW, cRIO, Controller Area Network, Ethanol Fumigation, Image Processing and Autonomous Driving.*

## 1. Introduction

The electronics in today's vehicles has the larger emissions of fuel cause the environment pollution and large transition from easy components to complex semiconductor chips in interfacing the capability of analog electronics and established the reliability and flexibility of digital electronics. The complexity of electronics for circuit design, processing, power control sensing, signal conditioning and transient suppression are predetermined to improve more in future vehicles. Electronic Engine Management is science of electronically equipping, managing and regulating an engine to preserve the performance and fuel economy while attaining the cleanest exhaust stream and diagnosing system faults.

In automotive electronics, Electronic Control Unit (ECU) is embedded system for handling some electrical system in transport vehicle. ECU comprises the Electronic/engine Control Module (ECM), Powertrain Control Module (PCM), Transmission Control Module (TCM), Brake Control Module (BCM or EBCM), Central Control Module (CCM), Central Timing Module (CTM), General Electronic Module (GEM), Body Control

Module (BCM), Suspension Control Module (SCM), control unit, or control module. The modern motor vehicles comprise up to 80 ECUs. Embedded software in ECUs enhances in line count, and complexity. The higher complexity and number of ECUs in vehicle is an essential demand for original equipment manufacturers (OEMs).

## 2. Problem Description

The fuel properties are essential substances that increase the containment of diesel pollutant emission. It is combined with the combustion-related design factors for fuel consumption. Ethanol is an attractive fuel as it is renewable, bio-diesel and oxygenated. Depending on the conditions, fuel emission is decreased by presenting the compression ignition engines. Diesel engine characteristic is ethanol fumigation with considerable attention due to high efficiency and lesser emission. But, it resulted with larger emissions of fuel that resulted in environment pollution. Shortest-Path Stochastic Dynamic Programming (SP-SDP) is used to plan controllers for decreasing the fuel consumption and tailpipe discharges. SP-SDP was used on dual mode EVT HEV with transient catalyst. A set of controllers is devised and estimated. Every controller minimizes the weighted combination of fuel utilization and emissions. However, the normal engine organization was failed to minimize the fuel consumption.A vehicle electronic control unit (ECU) algorithm was introduced for handling different road traffic situations. Longitudinal and latitude are essential needs for preventing vehicles. A model predictive (MPC) vehicle control algorithm was introduced for preserving the vehicle information. A MPC based vehicle control algorithm was performed on the vehicle electronic control unit (ECU). But, the vehicle surrounding behavior was taken. Requirement-Based Testing was carried out for automotive Electronic Control Units to improve the reliability performance of vehicle. However, the integration of Electronic Control Units with Requirement-Based Testing was not possible that resulted in distance failure.

## 3. Objectives

Based on the problem description, this research work has the following objectives:

- Universal Electronic Control Unit is designed with hardware setup for fuel consumption in automobiles for the protection of environment.
- Controller Area Network is designed by LabVIEW in automobiles to transmit between the sensors and actuators
- Data dashboard is designed to display the simulation output result of proposed system

## 4. Organization

The rest of the paper is structured as follows: Section II reviews the existing frameworks and architectures that are related to enhancing the energy and fuel efficiency in vehicles. Section III illustrates the clear description about the proposed ECU and fuel consumption. Section IV evaluates the results of both existing and proposed fuel consumption using different performance parameters. Section IV Designed the CAN protocol and autonomous driving modes with data dashboard .Finally, Section VI concludes the paper

## 5. Related Works

This section reviews some of the existing architectures and frameworks that are related to enhancing the energy and fuel efficiency in vehicles

C. H. ZHENG et al.[11] introduced an energy management of battery-PEM fuel cell hybrid energy storage for electric vehicle. In energy management, batteries were added to assure the load demand and to create the system more sustainable. A combination of fuel cells and battery bank storage were utilized for generating energy without interruption. Then, power management control (PMC) was introduced for applying an electric vehicle without intermission. Subsequently, two algorithms of PMC were also designed where first algorithm was depended on power balance and exposed the power flow between the various storage sources and second one was developed for improving fuel cells energy in case of energy excess. The fuel consumption was not reduced by using energy management of battery-PEM fuel cell hybrid energy storage.

Aishwarya Panday and Hari Om Bansal [5] discussed a fuel efficient energy management strategy for power-split hybrid electric vehicle with the help of modified state of charge estimation method. In fuel efficient energy management strategy, the optimal values of different leading parameters were initially evaluated with genetic algorithm and provided to Pontryagin's minimum principle for choosing the threshold power at which engine is turned on. This process formulated the fuel efficient energy management strategy to be robust and increased the fuel efficiency. An Engine efficient operating region was recognized for functioning vehicle in a well-organized region and minimized fuel utilization. Propagation and transmission delay in fuel efficient energy management strategy was not sufficiently minimized.

Xiaolan Wu et al. [22] introduced an energy management strategy based on cloud model is developed for parallel hybrid vehicles (PHVs). The energy management strategy was developed by employing uncertain conversion capacity between the terminologies of quantitative and qualitative model in the cloud model. Then, a set of rules were designed for resolving the torque split between the internal combustion engine (ICE) and electric motor by the driver input and the state of charge (SOC) of the energy storage. In energy management strategy, a control scheme is also employed for enhancing fuel economy and emission of the hybrid vehicles. Energy management strategy based on cloud model did not consider the bit rate deviation.

Kaijiang Yu et al. [25] presented a model predictive control system to increase the fuel economy for connected hybrid electric vehicles. At first, the battery charge, discharge profile and driving velocity profile were enhanced. Then, energy organization for hybrid electric vehicle (HEV) and energy utilization to minimize the issues of acc control of two vehicles was achieved. Subsequently, the unreliable drag coefficients and the road gradients were considered for designing a system for associated hybrid electric vehicles. Followed by it, a fuel model of a characteristic hybrid electric vehicle was introduced by employing the maps of the engine efficiency individuality. The fuel economy was highly increased by using model predictive control system. Model predictive control system did not address the issues in collision of messages. Shaobing Xu et al. [8] analyzed the fuel-optimal cruising strategies of parallel hybrid electric vehicles (HEVs) and their mechanisms. The fuel-optimal operations were attained by the origination of discontinuous nonlinear optimal control issue with the aid of the Legendre pseudo-spectral method and knotting technique. Three optimal cruising strategies in free/fixed-speed cruising scenarios were also introduced namely, vehicle speed pulse-and-glide strategy (Speed-PnG), SOC pulse-and-glide strategy (SOC-PnG), and constant speed strategy (CS). The behavior of these strategies and optimal performance of the engine and motor were also described along with fuel-saving mechanisms. In addition, two principles were designed for cooperating between fuel economy and ride relieve. Fuel-optimal cruising strategies were not effectively considered in bit deviation rate.

CHENG Anyu et al. [14] introduced a systematic method of manipulating the calibration toolbox of automotive electronic control unit (ECU) depended on real-time workshop (RTW). The hierarchical architecture of the calibration system was separated into bottom driver layer, intermediate interface layer and top application layer for restricting strong coupling of each functional layer. The driver functions concerning the specification of automotive open system were delivered and obtained in the intermediate interface layer. Then, RTW produced portable user codes which offered a development environment from system simulation to hardware implementation for minimizing the developmental costs. Consequently, the calibration codes acquired from the controller area network (CAN) calibration protocol (CCP) module were incorporated into the control codes through a compiler in the daemons. This helped in constructing a respective project, and then downloaded into object board to offer the A2L file. The reliability of automotive ECU was not considered in the systematic method.

## 6. Proposed Method

A single Electronic Control Unit is capable of operating in different fuel based engines and different modes of driving is called universal electronic control unit. The proposing system is capable of working with the above characteristics. Communication protocol, Controller Area Network is designed with 533MHz operating frequency and 250kbs of data transferring rate. Fuel consumption of the vehicle and emission rate of the vehicle is controlled with the help of ethanol blended fuel injection using electronic fuel injector. The autonomous driving is based on the image processing technique. The image processing is employed in the vehicle with the help of NI vision acquisition software and NI vision development module. Android mobile based NI Data dashboard provides the effective interface between the driver and vehicle. For this whole operation,cRIO-9022 used as a main controller in the proposed system. .

### 6.1 BLOCK DIAGRAM OF PROPOSED UNIVERSAL ELECTRONIC CONTROL UNIT

Fig 1. shows the overall block diagram of proposed system. In this syste, cRIO-9022 is acting as a main controller so each and every signal is sends to the actuator according to priority and time delay which set in programming structure. There are many sensors used in this system such as HC-SR04 (Ultrasonic Sensor), LM35 (Temperature Sensor) etc. To acquire signal from the environment there is a need of data acquisition system which emphasized by NI DAQ cards. Mainly, there are 4 DAQ‟s are used over here. NI-9401 (Digital Input Output DAQ), NI-9219 (Universal Analog Input DAQ), NI-9263 (Analog Output DAQ), NI-9472 (Digital Sourcing Output DAQ). These DAQ cards are placed in the NI-cRIO-9022 chassis. The Ardunio board is used interfacing circuit between the ultrasonic sensor and digital input output DAQ. An LM35 sensor is connected to universal analog input DAQ and if the temperature rise is exceeds the pre-set value digital output DAQ. The received signal from the digital output DAQ is driven the coolant pump to reduce the heat generation on the engine. Ultrasonic sensor use for the obstacle detection in the vehicle. The prototype consist of two DC geared motor so to operate that motor there is a need of driver Circuit. H-Bridge (L293D) is used a driver circuit. A single IC is capable driving a two motor in bidirectional ways. Even though,the control signals are received from the NI-cRIO according to the signal received form user interface and sensors. For any sensor, there is a need of power circuit. Each every sensor is employed with dedicated power circuit. The cRIO also can be powered by using normal batteries with rated specification.

The fuel injector used here is the type of an electronic injector dedicated to the ethanol injecting function alone. The pulses are controlled with the help of LabVIEW graphical programming. Web camera is used for the image processing concept to make the device as autonomous in nature.

To make an effective user interface the NI Data dashboard is used to know the real-time values received are generated by the cRIO using shared variable engine. In order to program,the cRIO there is a need of Ethernet cable and Laptop or Personal computer with LabVIEW software package which includes NI LabVIEW Professional Development System and NI Device Drivers and NI RT Module.The Universal Electronic Control Unit consist of the following objectives and social impact in future. The hardware is setup is made successfully also programming platform is selected as LabVIEW to improve sophistication of the system in future.

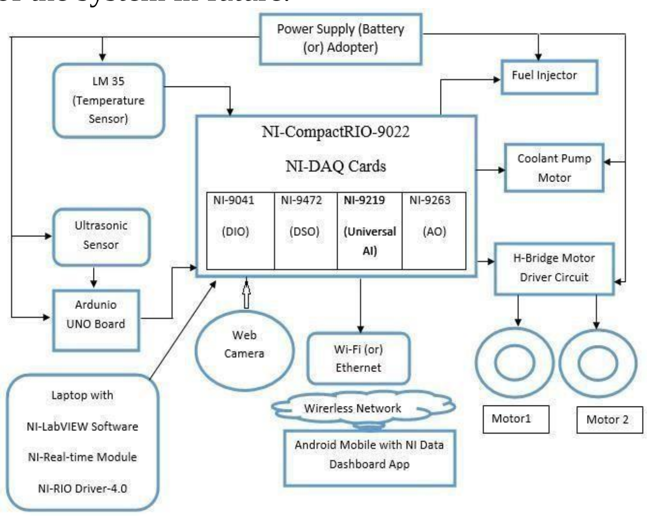


**Fig 1.** Block Diagram of Universal Electronic Control

## 6.2 FUEL SAVING BY ETHANOL FUMIGATION

Ethanol fumigation as shown in Figure 2 is conducted on the diesel engine with the following specifications (MakeKirloskar AV1, Number of cylinder-1, Number of strokes-4, Bore-85mm, Stroke-110mm, Power3.75kw, Compression ratio-18:01, Type of cooling- Water cooling, Cubic capacity- 0.553ltr). Fumigation process is done with electronic injection fitted with the intake manifold system of the engine. The cRIO takes two analog inputs and generates an analog output for controlling the electronic injector rate. MAP (manifold absolute pressure sensor) sensor and crank angle encoder are implemented in the system.

Fig 2.Engine Hardware setup for ethanol fumigation

These sensors provide the two inputs (load and speed) to the cRIO. The cRIO uses these signals to calculate and generate the required pulse to control the injector rate. The ECU monitors and controls the injection system. The injection rate is programmed so that it varies according to change in speed and load of the engine to receive an optimal output. Using Taguchi and Anova method for the table calculation.

The Fig 2. shows the type of fuel pump used in the ethanol fumigation system. After the calculation of injector switching period,It sends to injection system through the motor driver circuit (L293D). Ethanol injection rate control is employed with the help of electrical motor. First, the engine in which the testing is to be conducted is chosen. The ethanol properties and its usage method in the diesel engine are collected as literatures. The fumigation rate for various loads and speed in a diesel engine is obtained from various literatures. The cRIO is programmed for the control of the fumigation rate in the diesel engine. The cRIO is designed such a way that it receives two analog inputs (speed and load) and it process this inputs to give only one analog output (voltage).

The concept of fuels consumed is calculated through the vehicle RPM, Power developed during various load durations so the fuel consumption for a second is estimated as 0.0013liter of diesel fuel is consumed and 0.0007 liter of ethanol fuel is consumed for each second at 1019 rpm where max power is transferred. For one hour,4.68+2.52 liters is consumed. This is the case with double fuel system. The system contains a two fuel tank model an injection pipe and a car engine model for better understanding. The current tank capacity shows the amount of fuel present in the tank at the particular moment. So, calculating the fuel price in case of both systems Rs.32.2784,is cost for an hour in diesel and Rs.300.01 is the cost for double fuel system. So a cost of 21 (i.e.,) about a half liter of fuel is saved while blending is provided. This gives us the implementation of fuel savings meeting the result criteria. For the fumigation ratio of 70% diesel and 30% ethanol the as shown in Fig 3. Engine Performances with the Ethanol Fumigation Ratio Of 30% Ethanol and 70% Diesel.

| S.no | LOAD (s) Kg | SPEED(N) rpm | TIME FOR 50 cc of FUEL (tf) sec of Diesel | Th | Manometer Reading (A) | Manometer Reading (B) | A-B | Exhaust Gas Temperature in deg cel | Water Outlet Temperature in deg cel | MASS OF FUEL (mf) kg/hr | SPECIFIC FUEL CONSUMPTION (sfc) (kg/kw-hr) | HEAT SUPPLIED (kj/hr) | Brake power (BP) in kW | FP (kW) | Indicated power (IP) (kW) | Brake Thermal Efficiency (%) | Indicated Thermal Efficiency (%) | Mechanical Efficiency (%) | CO(% Vol) | CO2(% Vol) | HC PM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1855 | 391.2 | 444 | 12.4 | 89.2 | 1.6 | 204 | 61 | 0.38 | INFINITE | 17109.20 | 0.00 | 1.7 | 1.70 | 0.00 | 35.77 | 0.00 | 0.1 | 2.4 | |
| 2 | 1.8 | 1843 | 279 | 321 | 12.4 | 89.2 | 1.6 | 212 | 62 | 0.54 | 0.43 | 23989.68 | 1.24 | 1.7 | 2.94 | 18.57 | 44.08 | 42.13 | 0.15 | 3.3 | |
| 3 | 3.6 | 1829 | 230.6 | 327 | 12.4 | 89.2 | 1.6 | 262 | 64 | 0.65 | 0.26 | 29024.80 | 2.46 | 1.7 | 4.16 | 30.46 | 51.55 | 59.10 | 0.22 | 4.6 | |
| 4 | 5.4 | 1824 | 192.1 | 266 | 12.4 | 89.2 | 1.6 | 318 | 63 | 0.78 | 0.21 | 34841.85 | 3.67 | 1.7 | 5.37 | 37.96 | 55.53 | 68.37 | 0.22 | 5.8 | |
| 5 | 7.2 | 1811 | 156.8 | 245 | 12.4 | 89.2 | 1.6 | 379 | 64 | 0.95 | 0.20 | 42685.71 | 4.86 | 1.7 | 6.56 | 41.02 | 55.36 | 74.10 | 0.19 | 7.8 | |
| 6 | 9 | 1788 | 134.9 | 192 | 12.4 | 89.2 | 1.6 | 441 | 66 | 1.11 | 0.18 | 49615.42 | 6.00 | 1.7 | 7.70 | 43.55 | 55.89 | 77.93 | 0.14 | 9.6 | |


| S.no | LOAD (s) Kg | SPEED(N) rpm | TIME FOR 50 cc of FUEL (tf) sec of Diesel | Th | Manometer Reading (A) | Manometer Reading (B) | A-B | Exhaust Gas Temperature in deg cel | Water Outlet Temperature in deg cel | MASS OF FUEL (mf) kg/hr | SPECIFIC FUEL CONSUMPTION (sfc) (kg/kw-hr) | HEAT SUPPLIED (kj/hr) | Brake power (BP) in kW | FP (kW) | Indicated power (IP) (kW) | Brake Thermal Efficiency (%) | Indicated Thermal Efficiency (%) | Mechanical Efficiency (%) | CO(% Vol) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1855 | 391.2 | 444 | 12.4 | 89.2 | 1.6 | 204 | 61 | 0.38 | INFINITE | 17109.20 | 0.00 | 1.7 | 1.70 | 0.00 | 35.77 | 0.00 | 0.1 |
| 2 | 1.8 | 1843 | 279 | 321 | 12.4 | 89.2 | 1.6 | 212 | 62 | 0.54 | 0.43 | 23989.68 | 1.24 | 1.7 | 2.94 | 18.57 | 44.08 | 42.13 | 0.15 |
| 3 | 3.6 | 1829 | 230.6 | 327 | 12.4 | 89.2 | 1.6 | 262 | 64 | 0.65 | 0.26 | 29024.80 | 2.46 | 1.7 | 4.16 | 30.46 | 51.55 | 59.10 | 0.22 |
| 4 | 5.4 | 1824 | 192.1 | 266 | 12.4 | 89.2 | 1.6 | 318 | 63 | 0.78 | 0.21 | 34841.85 | 3.67 | 1.7 | 5.37 | 37.96 | 55.53 | 68.37 | 0.22 |
| 5 | 7.2 | 1811 | 156.8 | 245 | 12.4 | 89.2 | 1.6 | 379 | 64 | 0.95 | 0.20 | 42685.71 | 4.86 | 1.7 | 6.56 | 41.02 | 55.36 | 74.10 | 0.19 |
| 6 | 9 | 1788 | 134.9 | 192 | 12.4 | 89.2 | 1.6 | 441 | 66 | 1.11 | 0.18 | 49615.42 | 6.00 | 1.7 | 7.70 | 43.55 | 55.89 | 77.93 | 0.14 |


Fig 3.FUEL SAVING BY ETHANOL FUMIGATION

### 7.1 ENGINE CHARACTERISTICS CURVES WITH ETHANOL FUMIGATION

The fuel consumption level is slightly decreased from the diesel by varying with brake power. The fuel consumption is decreased in the diesel usage by the help of ethanol fumigation

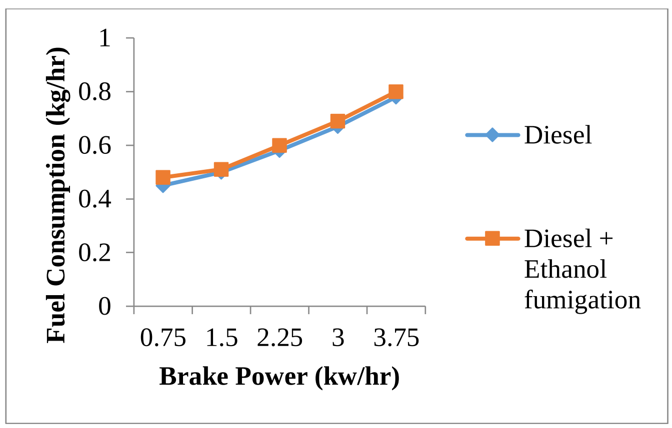


Fig 4. Fuel Consumption Vs Brake Power

The specific fuel consumption level is slightly decreased from the diesel by varying with brake power. In this performance graph, of Fig 4. shows the specific fuel consumption will be slightly increase as comparing with diesel in ethanol fumigation.

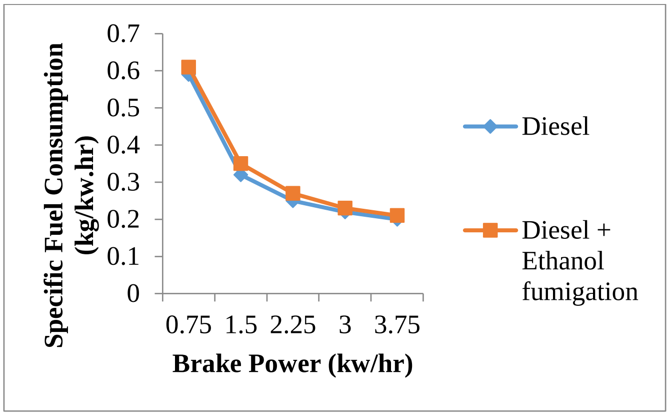


Fig 5. Specific Fuel Consumption Vs Brake Power

The brake thermal efficiency level is slightly decreased from the diesel by varying with brake power. The graph in the Fig 5. shows the brake thermal efficiency will be low in ethanol fumigation on lower load condition. In the middle stage the range in ethanol fumigation is increased after the higher load condition,it is decreased.

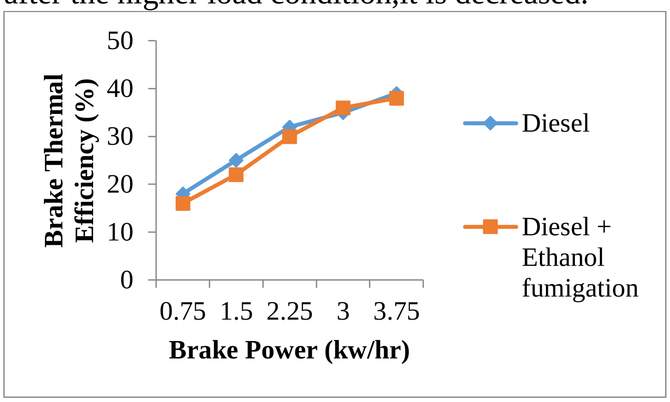


Fig 6. Brake Thermal Efficiency Vs Brake Power

The Fig 6. shows the real-time testing of an engine with ethanol fumigation engine provides a good efficiency with low emission of harmful gases like carbon monoxide and NOx etc.

**7.2 Controller area network implementation in universal electronic Control unit**

In automobiles there are different sensors are connected to the Electronic Control Unit to make the system as more sensitive. In real-time, Electronic Control Unit receives more than one signal at a time. In this situation, there is a need of priority for the different signals. According to the priority alone the Electronic Control Unit sends command signals to the respective actuators. These functions are performed through the controller area network. Designing of CAN digital signal is based on the basic frame model used traditionally. Basic true/false Boolean functions are used for framing the bit. Boolean to digital function is used for conversion of Boolean to digital signal. Two priority and ID is provided for changing the identifier field. During normal condition normal the identifier field will have normal high priority. These signals are sent into queue and signal is processed and actuators are controlled. In abnormal conditions, the second type dominant signals are sent by making Boolean false state. Thus this acquires highest priority among all other normal signals. Entire code set is separately coded for each sensor. Order of priority is given according to the manufacturer needs. The code can be easily changed by the coder simply making changes in the Boolean state. Digital signals are sent to ECU where they are decoded and the data field is used.

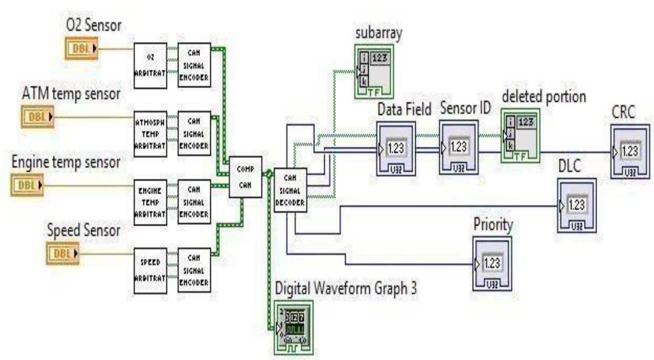


Fig 7. Implementation of Controller Area Network using LabVIEW

Fig 7. shows the designed controller area network with four sensors. Such as oxygen sensor, atmospheric temperature sensor, engine temperature sensor and speed sensor. Each sensors signal are received using the NI-DAQ cards, after the acquisition of an each signal sends to the sensor arbitration sub VI. In sensor arbitration VI each sensor value arbitrated with unique priority, sensor ID and error bit. The CAN protocol handles bus accesses according to the concept called “Carrier Sense Multiple Access with Arbitration on Message Priority”. This arbitration concept avoids collisions of messages whose transmission was started by more than one node simultaneously and makes sure the most important message is sent first without time loss. The arbitrated output sends to the can encoder block. This will frame the CAN message in the order of ISO standard. It also frames the sensor ID, priority, arbitration, data field giving a complete structure for the CAN signal. This is transmitted as a complete digital waveform. These signals are accumulated at CAN comparator. This sub function takes all the signals as input and compares them and sends the high priority message to output terminal. This CAN signal has the sensor ID which is used to determine the place where the critical fault has occurred. This signal is forwarded into the CAN decoder. CAN decoder is used to separate the important parts of CAN signal like Data field, CRC, etc., If a node wishes to request the data from the source, it sends a Remote Frame with an identifier that matches the required data frame identifier. The appropriate data source node will then send a Data Frame as a response to this remote request.

As the main controller used in the proposing system is cRIO-9022. It is a real-time embedded controller operates with 533MHz. Designed programming structure is feed into this RT target. System having a less bit deviation as compared to earlier system. Fig 8. shows the calculated system response related to the bit-rate deviation.

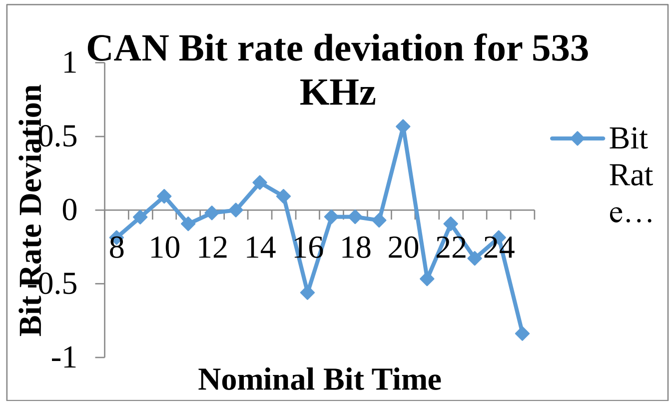


Fig 8 Graph representing bit rate deviation for 533MHz Clock frequency at 250k Baud rate

Designed controller area network with 533MHz operating frequency and 250k baud rate reduces the bit rate deviation. The bit rate deviation reduction is achieved by queue based data logging system. In both manual mode and automatic mode driving, there will be no changes in the designed controller area network.

### 7.4 Modes of driving in universal electronic control unit

Universal Electronic Control unit is compatible with manual and autonomous modes of driving. The driving mode of a vehicle is controlled by the digital logic. In digital logic, there are two states (Low and high). Autonomous mode of driving is activated by sending high state to the diving mode control terminal and low state for manual mode driving. Manual driving is as usual with steering and manual mode driving is implemented with the help of image processing technique using LabVIEW modules.

#### 7.5.1 Manual driving mode

Fig 9. shows designed prototype of the vehicle. Which consists of Real-Time embedded controller cRIO-9022, NI DAQ cards 9219, 9263, 9401 and 9472, sensor interfacing unit and motor driver (L293D), Steering and ardunio with HC-SR04 (ultrasonic sensor). cRIO-9022 is as standalone embedded controller which controls the actuators according to the signal received from the various sensor connected to the vehicle. Proposed system consist of temperature sensor (LM35) to monitor the engine temperature and atmospheric temperature and ultra-sonic sensor is used for the obstacle detection with the help of proximity effect principle. If the obstacle is detected than the vehicle is stopped and direction switched to right direction. HC-SR04 is connected to cRIO-9022 through the ATMEGA 328. The distance between the obstacle and vehicle is calculated and conditions made as a program in LabVIEW. According the dumped program into the RT target vehicle driven in the manual mode of driving.

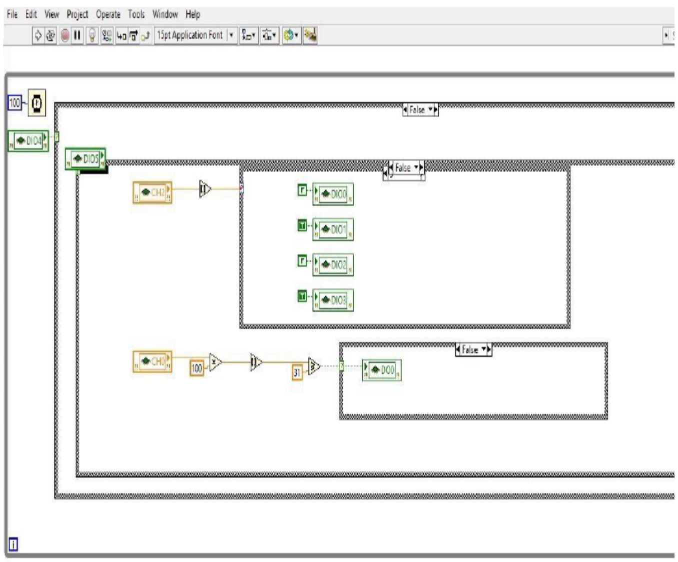

Fig 9. VI for Manual mode Driving

Potentiometer is used as a steering in the proposed system. During wiper action taken place in the potentiometer accordingly the voltage level is varied. Using this voltage variation direction control of vehicle is achieved.

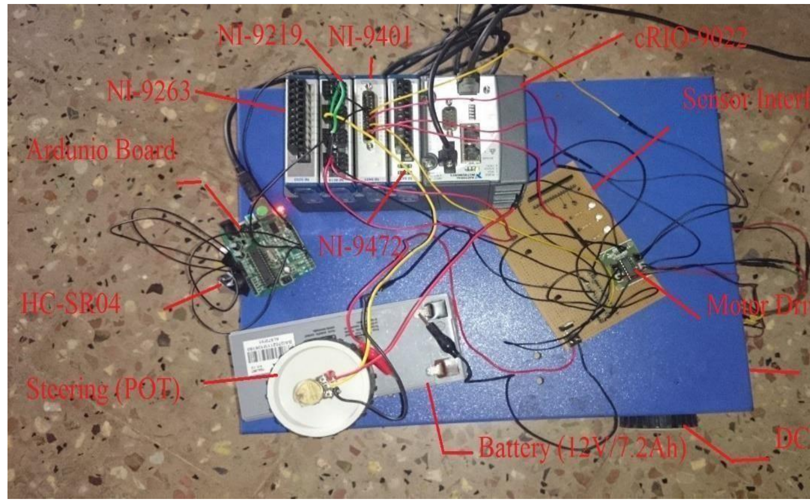


Fig 10. Vehicle Prototype

The Fig 10. Shows the Vehicle prototype. The main control unit which receives signals from various sensors and activates the actuators like coolant pump. There is ultrasonic sensor interface in front of the vehicle which is controlled through Arduino board. When the obstacle is found the ultrasonic sensor detects and produces a Digital high signal at fourth pin which is interface with cRIO digital input/output DAQ. Same acquisition cards are used to acquire the various signals. So this pin will be high if detected the vehicle stops. The temperature control is done through LM35 temperature sensor. It is used to control the coolant pump actuator.

### 7.5.2 Automatic driving mode

There are two modes of operation one is automatic and other mode is manual mode in manual mode the controls for A/C are under user control. If the user needs that to turn on simply switching can be done to do that and for controlling the direction of car steering is used. The pot is used in this case where the voltage is used for switching the control to the motor driver circuit.

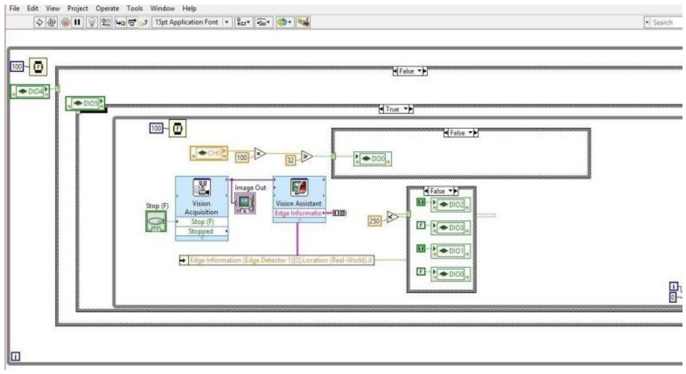

Fig 11. VI for Autonomous Mode Driving

In automatic mode the image processing is used instead of steering block and here all the control like A/C control is done programmatically and its showed in Fig 11. The edge detection technique is used to sense the position of vehicle. Reference point of the edge detection is made automatically in vision assistant.

The obstacle position is compared with the reference point of the vehicle accordingly the vehicle direction is controlled over here. The below Fig 12. shows the front panel of obstacle detection.

a). b).

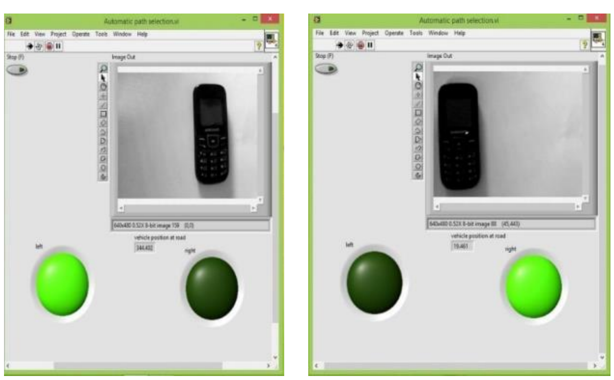

Fig 12. a). Left Obstacle Detection using NI Vision Assistant
b). Right Obstacle Detection using NI Vision Assistant

In image processing USB camera is used for the image acquisition from the environment. IP camera (android application) also can be in the acquisition process. Acquired image sends to the vision assistant. Edge detection and color RGB process are done in the vision assistant and the X and Y parameter of the detected image was calculated and which is used to define the vehicle direction.

### 7.6 Data dashboard

Dashboard is a common user interface to know recent vehicle status such as check engine, low oil, low fuel, low beam lights etc. In the proposed system NI Data Dashboard is used an interface between the user and vehicle. As cRIO-9022 is a main controller, the parameter need to display or control is sends to shared variable engine. Shared variable engine is a block in which the variable converted and to make available that variable in the server. cRIO-9022 is directly connected to router through LAN cable. So, the parameter which is available inside cRIO can communicate with router. The android mobile or tablet is connected to the router in wireless mode. The proposing dashboard is not only for displaying the data but also for some control cases like steering control through mobile. Mobile or tablet is a portable one in future with the proposed system some other future also can added. Which contains the steering control, status of coolant pump and air conditioner. and air conditioner.

## 8 Conclusion and Future Work

As the technology improves a lot day by day even though present scenario. There is a need of conservation of available resources. Implemented fumigation methodology is gives the good performance with reduced fuel consumption. In addition, the emission like NOx, Carbon monoxide are comparatively reduced and also environment pollution also reduced due to less fuel consumption. In any communication system, it should free from data loss with high speed. CRIO-9022 and LabVIEW based CAN protocol provides the communication platform with no data loss at

533MHz operating frequency and 250k baud rate. Automatic mode driving is added the sophistication to the user. Dash board is in wireless mode with android platform. So.it will provide the user friendly environment.

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