SOFTWARE DESIGN AND DEVELOPMENT OF ONLINE MONITORING SYSTEM IN SOC ENCOUNTER

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Abstract - This paper presents the design and development of an online monitoring system that collects data over time or distance with a built-in instrument or sensors. Currently, an online data collection system (Vehicle Data logger) from general vehicle is not available in the market. Only the vehicles' manufacturers have the tool to access the engine ECU to monitor the vehicle's data. Current available automotives meter are display an estimated but inaccurate speed, engine revolution, fuel and temperature data. This paper developed to record the speed of vehicle, engine revolution (rpm), engine temperature, fuel volume and distance parameters. The software design of ASIC has been developed to implement a sophisticated data viewing methods. The program utilized new framework based on track segmenting to better organize data, instantly provides summaries of segment data and attempts to better display the driving performance. The characteristic of fuel sender (to determine fuel volume in Litre) and temperature sender (to determine engine temperature in Celsius) is downloaded to FPGA. All the recorded information are saved in Application IC chip(8051 IC), which can be reset after load the information to the(personal computer) PC using UART communication. All the measurements were carried out on selected road track as the field test of total trips about 3 kilometers.

***Keywords** – V-models, Data Logger, Bench Test, Vehicle Test, ASIC model.*

I. INTRODUCTION

E.Larimore et al (2009) [2] present the identification and monitoring of automotive engines. The main objective is to extend and refine the nonlinear canonical variety analysis (NLCVA). The additional refinements are developed using general bases of non linear functions. The method of Leaps and Bounds with Akaike information criterion AIC are chosen. Delay estimation procedures are employed to consider the state order of the identified engine model and also reducing the number of estimated parameter that affects the identified model accuracy. The linear Gaussian system methods was applied to a 5.3L V8 engine to verify appropriate nonlinear basis functions, engine delay and decrease the model state from 16 to 7.

Herpel et al (2009) [3] exposed a straightforward methodology how to perform prototype measurements on automotive CAN ECU communication and how to derive valuable information about controller-specific startup behavior. Logging and accessing important aspects of data transmission is done in both the early phase of system design by mean of simulation or analytical evaluation of the in-car communication system, and in terms of measurements in real test cars by logging and analyzing communication data in prototype installation. The results from measurement data analysis show the comparison of CAN communication startup durations between the available ECU's in the prototype CAR (German Car AUDI A6 Limousine 3.2 TDI). The advantages of those methods are the high speed CAN with real time data logging.z

William Swihart and Jerry Woll, (1997) [6] have developed an integrated collision and vehicle information system for heavy machine. They have proposed a possible system integration path that would combine existing collision warning system (CWS) onboard computers (OBC) capability with next generation vehicle radar technology and emerging drowsy driver systems. The challenge to the systems integrator is to combine relevant data that provides utility to both the fleet operator and the driver without adding unnecessary system complexity and cost.

II. METHODOLOGY

The objective of this study is to measure and analyze parameters from the developed online monitoring system. The automotive online monitoring system is designed with microcontroller based for data logging purposes and requires no input from the driver of the vehicle. The automotive online monitoring system records a set of data for each journey made in the vehicle which is starts when the ignition is switched on and ends when the ignition is switched off. The V-model is applied for the software development process [8],[10]. The process steps are bent upwards after coding process to form the type V shape.

A. *Software Design and Development*

The V-model demonstrates the relationships between each phase of the development life cycle and its linked phase of testing. The horizontal and vertical axes represents time or project completeness (left-to-right) and level of abstraction (coarsest-grain abstraction uppermost), respectively. The model is illustrated in Figure 1. On the left side of V-model

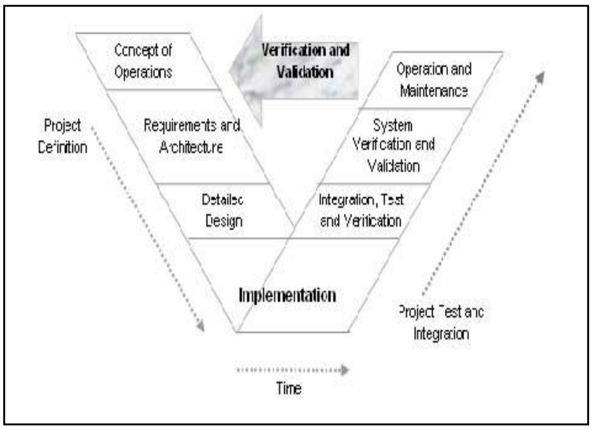

Fig1 V-model

A. Software Testing Technique

The software testing technique is divided into two parts that are bench test for module and system test and vehicle test for real application test. The module test and system test are performed so that the error can be detected earlier and eliminated once the software development has finished. The module test will be performed at the module level development and system test will be performed at the system level development. The equipments used during the module and system test are oscilloscope, DC power supply, function generator and decade box. The test cases with the expected result are drafted before module and system test are performed. Before the vehicle test is conducted, all of sensor inputs on the wire hardness are verified to ensure the sensor input is correct connected to the online monitoring box. Oscilloscope and multimeter are used for the sensor measurement. The data collection from the input sensors of the online monitoring box is done in real time. All the collecting data were stored in PC memory.

B. Hardware And Interfacing

The earlier vehicles were implemented a conventional network topology. However disadvantage of this system is the undetectable sensor failure during the logging system. The data in the CAN BUS are still available in the network although the sensor is failed to provide an input. The integration of CAN network topology with conventional network topology are also valuable for middle class of vehicle. Most of current Malaysian Proton Car such as new Exora, Gen2, Persona and Satria Neo use this combination network topology.

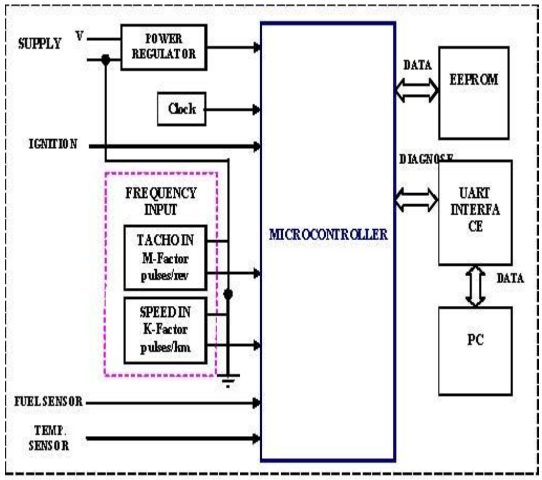

Fig.2 system architecture of the data logger

The conventional network topology was well-matched for the purposes of development of data logger for lower class Malaysian Perodua Kancil 660 and 850 cc car (above year 2002 manufacture). The Perodua Kancil was selected as a target vehicle because the engine is already using the electronic ECU as the instrument cluster. All sensors are integrated with ADC so that outputs are in digital form . These cars still use the mechanical type sensors to log the speed, rpm, fuel and temperature. So these types of vehicle are not practical for a simple and efficient electronic data logger.

A 12V voltage supply is used to regulate a dc supply for microcontroller. The clock generates 8.00 MHz frequency to the Microcontroller. Four input that comes from difference sensor namely as Speed, Tacho, Fuel and Temperature. All sensors used are available in the target vehicle. The speed and tacho sensor will supply a fussy frequency that represents the value of speed and revolution per minutes (r.p.m). The fuel and temperature sensor will forethought the resistance values that indicate the current value of fuel left in the fuel tank and the recent engine temperature.

III. PROPOSED METHODOLOGY

This paper encompass into two major important part of online monitoring system that are hardware and software development. The hardware development describes about the FPGA circuit and circuit interface from vehicle to the online monitoring system. The software development explains the ASIC use in the software design till the verification, validation process. The online monitoring system is functioning to record the speed of vehicle, engine revolution (rpm), engine temperature, fuel volume and distance. The characteristic of Fuel sender (to determine fuel volume in Litre) and temperature sender (to determine engine temperature in Celsius) is dumped to FPGA , which can be reset after load the information to the PC using UART communication with Keyword 2000 protocol.

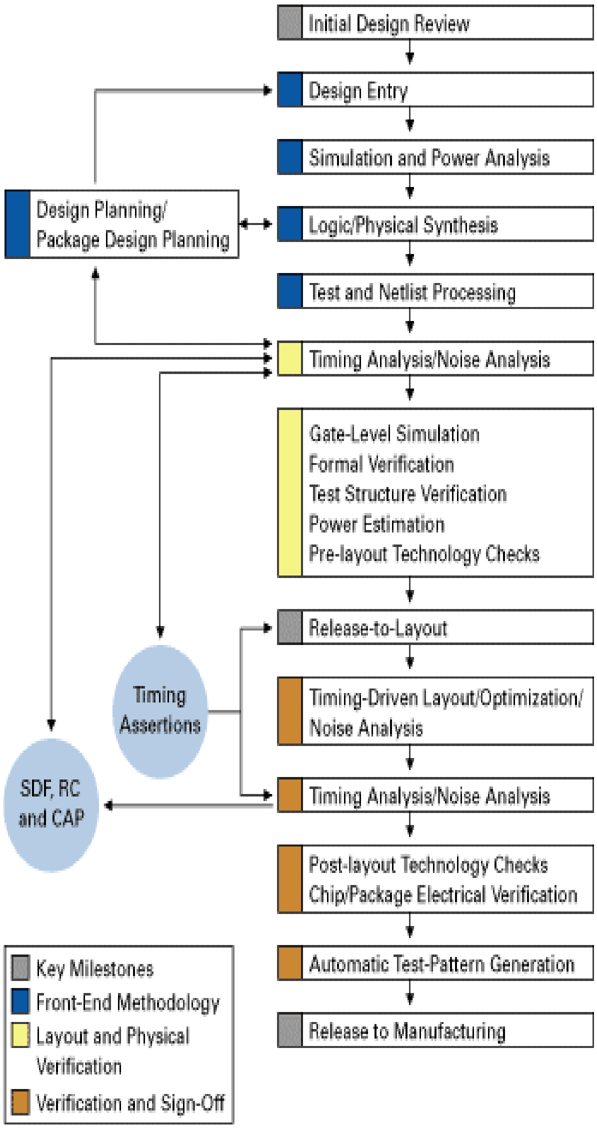

Fig.3 Design Flow For UART IP

ASIC DESIGN FLOW:

This document briefly explains the usage of SOC Cadence Electronic Design Automation (EDA) Tool for the design of the Application Specific Integrated Circuit (ASIC) Flow ASIC Design Any IC other than a general purpose IC which contain the functionality of thousands of gates is usually called an ASIC (Application Specific Integrated Circuit). ASICs are designed to fit a certain application. An ASIC is a digital or mixed-signal circuit designed to meet specifications set by a specific project. The basic ASIC Design Flow is code to GDS II format is SOC Encounter.

The details of the CADENCE Flow for the hierarchical design of large integrated circuits

Phase	Activities
	Requirement Analysis
Verification	System Design
	Architecture Design
	Module Design
	Module Test
Validation	Integration Test
	System Test (Bench Test and Vehicle Test)

Table.1 Software Development

(ICs)and systems-on-chip Hierarchical design methodologies are typically adopted to handle very large designs or to support the concurrent design of a complex chip by a design team. Blast Plan Pro meets both of these requirements and delivers the additional benefit of predictable design closure.

A USI is the microchip with programming that controls a computer's interface to its attached serial devices. Specifically, it provides the computer with the RS-232C Data Terminal Equipment (DTE) interface so that it can "talk" to and exchange data with modems and other serial devices. As part of this interface, the UART also:

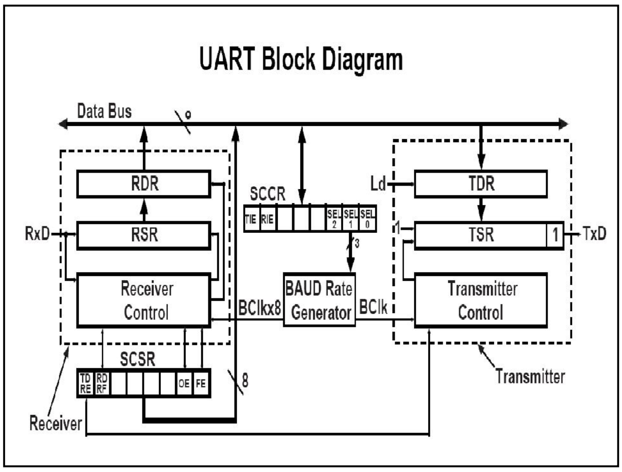

Fig . 4 UART Block Diagram

Converts the bytes it receives from the computer along parallel circuits into a single serial bit stream for out bound Transmission.

On inbound transmission, converts the serial bit stream into the bytes that the computer handles Adds a parity bit (if it's been selected) on outbound transmissions and checks the parity of incoming bytes (if selected) and discards the parity bit. Adds start and stop delineators on outbound and strips them from inbound transmissions. Handles interrupts from the keyboard and mouse (which are serial devices with special ports).

May handle other kinds of interrupt and device management that require coordinating the computer's speed of operation with device speeds Serial transmission is commonly used with modems and for non-networked communication between computers, terminals and other devices. At first sight it would seem that a serial link must be inferior to a parallel one, because it can transmit less data on each clock tick. However, it is often the case that serial links can be clocked considerably faster than parallel links, and achieve a higher data rate.

Speedometer Gauge		Tachco Gauge (Revolution)		Fuel		Temperature of Engine Coolant	
Input Freq (Hz)	Speed (km/h)	Input Freq (Hz)	Revolution (r.p.m)	Fuel (Lit)	Resistant (Ω)	Temp (°C)	Resistant (Ω)
0	0	0	0	5	304	45	222.3
14.16	20	25	1000	8	284	50	181.1
28.31	40	50	2000	12.5	252	112	23.6
42.47	60	75	3000	25	188	117	20.6
56.62	80	100	4000	37.5	124	-	-
70.78	100	125	5000	45	77	-	-
84.93	120	150	6000	-	-	-	-
113.28	160	200	8000	-	-	-	-

Table: 2 Measured Parameters (Bench Mark)

Clock skew between different channels is not an pulses/km number [k-factor] programmed into the issue (for unclocked serial links)A serial connection requires fewer interconnecting cables (e.g. wires/fibres) and hence occupies less space. The extra space allows for better isolation of the channel from its surroundings Crosstalk is less of an issue, because there are fewer conductors in proximity. In many cases, serial is a better option because it is cheaper to implement. Many ICs have Serial interfaces, as opposed to parallel ones, so that they have fewer pins and are therefore cheaper. In telecommunications and computer science, serial communications is the process of sending data one bit at one time, sequentially, over a communications channel or computer bus. This is in contrast to parallel communications, where all the bits of each symbol are sent together.

Serial communications is used for all long-haul communications and most computer networks,

Speed=(f*36000)/k-factor

k-factor is 2548 pulse/km and f is the input frequency. For the Tacho gauge, microcontroller measures the frequency of the pulses received on the input and drives the stepper motor to a position dependent on the frequency. There shall be no visible 'step' movement of the Tacho gauge. The tacho revolution is calculated as (2):

Tacho=(f*60)/m-factor

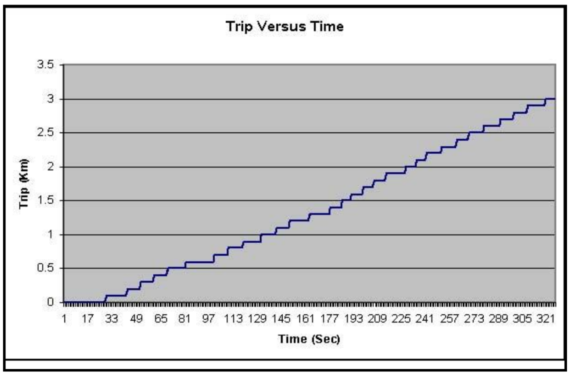

Fig.6 Trip (KM) versus time(seconds)

RESULTS AND DISCUTION

From the data speeds versus time as in Figure 4, it has exposed that the target vehicle was moving after 10 seconds the engine was started. But the oil pedal was pushed before that. The data RPM versus time as in Figure 5 can show clearer evidence at which second the driver start to push the oil pedal. Start from second 4 until second 9 it shows how drastically the RPM was increase from 1153 RPM to 2058 RPM. Normal RPM for engine without ramp (push the oil .pedal) is about 900 RPM to 1100 RPM with air condition on. The minimum speed was recorded at the second of 91, the speed was 2.8 KM/H at 1225 RPM and by the time the trip was about 0.6 KM. The maximum speed was achieved at the second of 237 the speed was 57.9 KM/H at the 3034 RPM. By the time the

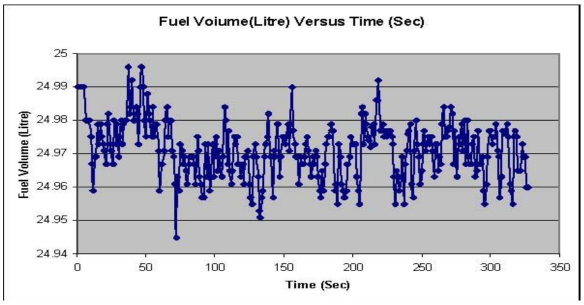

Fig .7 Fuel Volume (litres) versus time (seconds

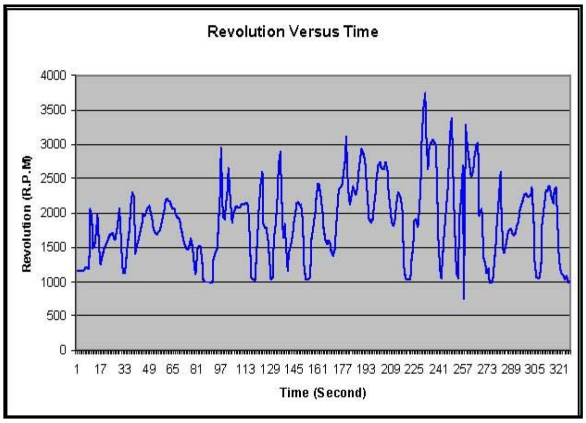

Fig. 8 Revolution versus time (seconds)

trip was about 2.1 KM. The fuel volume was fluctuated due to the tank sender float was going up and down due to the road is bumpy. The car consumed around 0.02 Litre for 3 km. The Engine

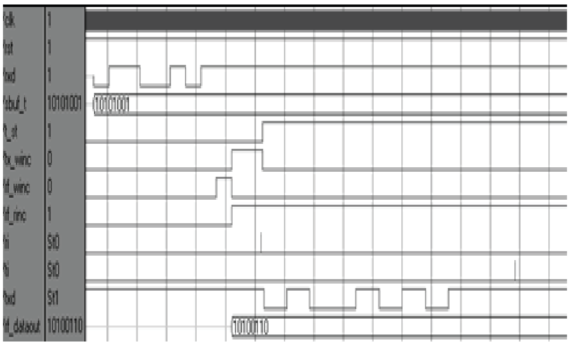

Fig.9 The wave of UART function simulation

Coolant temperature was remains stable at ADC value 153. The Coolant Fan is activated when the engine temperature start to increase. This analysis is done manually and technically from the driving experience and technical knowledge of vehicle engine. This data also has been validated with an External GPS Navigator.

V. CONCLUSION

The ASIC model technique is very helpful for the software development. The bug can be minimized or eliminated by performing the module and bench test. It is also can expedite the time of software development. The FPGA can support for other application likes UART, Serial communication likes Manchester code.

The FPGA has reserved more memory space for expend the application. The UART communication is still can be applied for the data logging The Online monitoring data can save a lot of money and time to measure the data from the sensors. The behavior of the sensor input can be monitored by using the online monitoring data. The existence of the online monitoring system has an advantage for the vehicle consumers. Since the system could retrieve accurate signals such as the fuel volume with resolution 0.01 Litre and the travelling distance in meter with resolution 100m, actual speed in km/h with resolution 0.1 km/h and actual revolution.

Using the online monitoring data the driver can also detect the defective sensor when the sensor input remain at certain value or zero during car moving. The driver could realize the fuel consumption in seconds and can optimized their driving manoeuvre. The retrieved data from the sensor can be studied and analyzed for further improvement of the vehicle. The project is proposed to upgrade the online monitoring data instead of using UART communication .The UART speed is 19.2 KBaud achieved until 1 expensive tool.

The primary benefit of a 16850 USI is a 128-byte FIFO buffer that prevents data loss in high-speed serial communications.The optional 16950 USI provides the following benefits:8x more baud rates due to 1/8th clock pre-scalar,128-byte FIFO buffer,9-bit protocol support and Isochronous mode

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