Design and Implementation of Sensor Communication Model in Vehicle through ARM & CAN Networking

Sunita Pokharkar , Prof. Hajiali Sayyed

***Abstract*— The Automobile Industry has hither to witnessed the advent of various electronic control system that have been developed in pursuit of safety ,comfort ,pollution prevention and low cost .This paper presents development and Implementation of Efficient Sensor Communication system for digital driving of semi autonomous vehicle with combination of ARM and CAN Networking. The proposed System solves the problems of automotive system applications. It takes feedback of Vehicle conditions like whether seat belt is engaged or not , Engine temp, existence of combustible gas ,vehicle speed etc.**

***Index Terms*— CAN (controller area network) , ARM (Advanced RISC Machine), Digital driving, semi-autonomous.**

I. INTRODUCTION

For the sake of automation and safety ,various sensors are being used in vehicles. As sensors are having their own standards and own data rates. So more number of sensors, more complex city and less reliability .Traditional control units uses point to point communication approach which introduces Pet cabling problem ,increased wire harness[2] ,therefore need arose for reducing number of wire harness ,transfer of large amount of data at high speed ,Reduced complexity ,weight and cost. Therefore this system fulfills these requirements with unified management .This leads to easy Data sharing and interoperatability between different control units

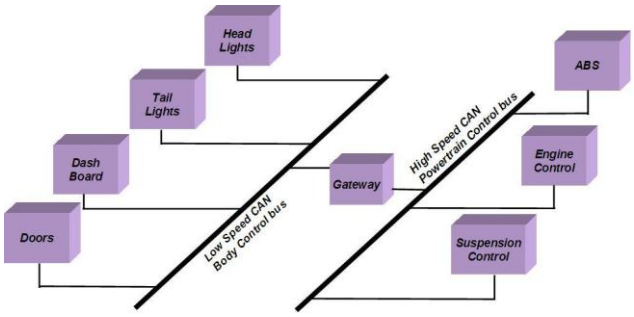


Figure1- typical CAN bus architecture

. Now a day's CAN have gained wide spread use and is used in industrial automation, mobiles as well as in automotives[2,4] .The CAN protocol is implemented in silicon. This makes it possible to combine the error handling and fault confinement facilities of CAN with High transmission speed[5] . This experience is improved by using ARM7 ,as it general purpose ,32 bit processor designed for low budget and it is well suitable for High volume applications with memory restrictions . This paper discuss development of such control framework for vehicle called digital driving behavior for more safety ,comfort and low cost .

Manuscript received February 11, 2015.

II. LITERATURE SURVEY

CAN Bus is message based protocol designed specially for automotive application but now also used in other areas such as industrial automation and medical equipment. First , it was introduced by Robert Bosch in 1983. Douglas w. Gage discusses the History of Developments made in control of unmanned ground vehicles in 1995 .

The Basic idea of digital driving system and How to formulate digital driving system architecture have been discussed by Wuhang wang(2002) ,C.Little(1998), Gerd krammer(2001) ,fei-yue wang et al(2002) ,Julian kolodko etc al(2003) . Luis Manuel et al(2002)and Richard Bishop(2000) have dealt with the various feature that can be included to improve the driving experience in a digital driving system.Tatsuya yoshida et al(2004) discusses the concept of adaptive driving systems. U Franke et al(1999) discusses various approaches to develop autonomous vehicles .The issues in developing a CAN based embedded Network system have been dealt by Robert Boys (2004) ,steve Corrigan (2002) and John Rinaldi et al (2003)

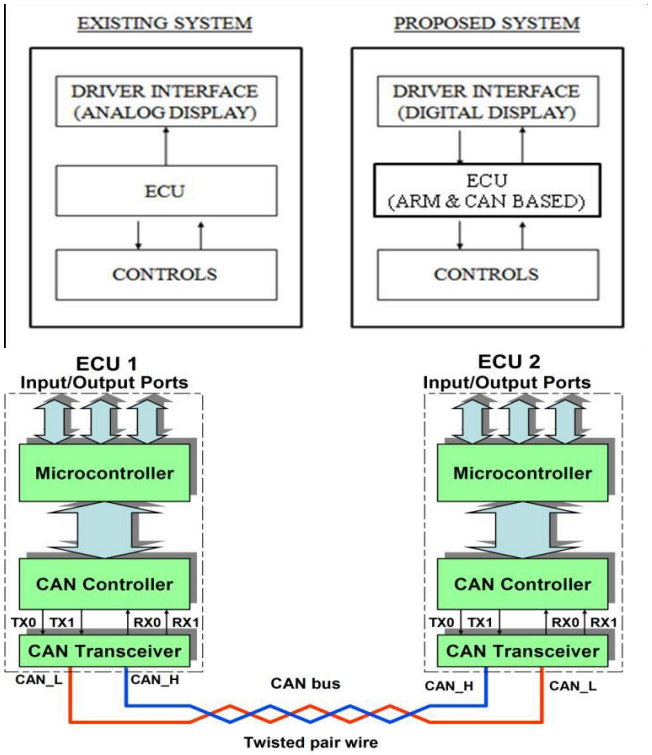


Figure3 – CAN ECU architecture

Fig 3 shows proposed CAN ECU architecture in automotive system .here we an observe can bus interface is used for sending and receiving data instead of direct contact of all

participants. here CAN buses of different speed can be connected.

III. HARDWARE STRUCTURE

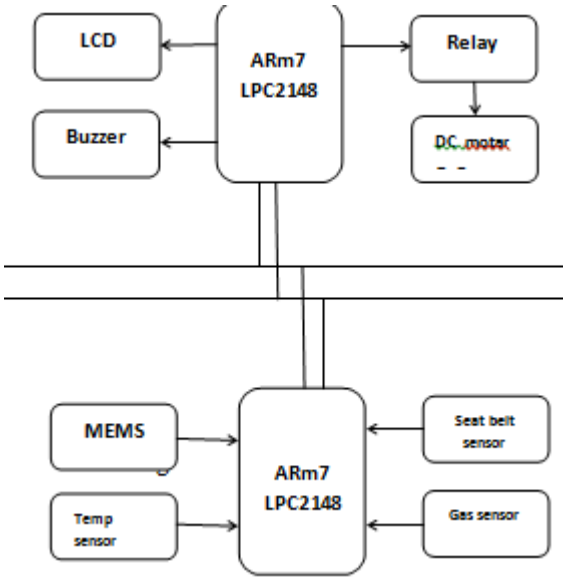


Fig 4- block diagram

Hardware consists of CAN Bus ,CAN controllers ,ARM as main processors ,sensors

A. CAN BUS

CAN is contention based communication media where each ECU uses CSMA/CD (carrier sense multiple access ,collision detector). CAN bus is multichannel system .All subsystem access with each other through CAN Bus . These CAN buses uses data of different speed rate .All units connected to bus can send message. If two or more units starts sending message at the same time ,the unit who has highest priority is granted the rights to send and other units perform a receive operation .

B. CAN BUS SYSTEM FOR DRIVE SYSTEM

A modern drive system consists more than 70 ECU's for various subsystems. Typically biggest processor is Engine control unit and other for transmission fuel injection system ,antilock braking system(ABS), airbag system etc .The main requirement of all these unit is they should meet to real time as they are sensitive to time and reliability. For completion of this demand it is necessary to achieve implementation of public data sharing ,such as engine speed ,wheel speed, throttle pedal location etc. The electronic control unit controls the time interval of two jet 6 ms which injection duration of 30 degree crank angle(1 ms) ,which will provided in remaining 5 ms .The contents include completion of speed measurement, fuel measurement ,A/D conversion ,calculation .

That means sending and receiving data in 1 ms must be completed within electrical control of gasoline in order to achieve real time requirements. Therefore data exchange N/W must be priority based competitive mode.

C. CAN BUS FOR VEHICLE SYSTEM

CAN Bus for vehicle system is main control network which connects several objects like central controller ,4-gate controller ,memory modules and other components like locker, windows ,locker ,mirrors and interior dome light

IV. EMBEDDED SYSTEM BASED ON ARM

A. ARM ARCHITECTURE

ARM stands for advanced RISC Machine. firstly,ARM started as ACORN computer . now designing chips of APPLE's iPod .ARM Architecture is based on RISC principle (Reduced instruction set computer). It is first RISC microprocessor designed for low budget Market .ARM7 TDMI-S stands for ARM – Advanced RISC Machine

7 - Version
T- Thumb
D- Debug
M- Multiplier – enhanced 32*8 Multiplier
I – Interface- Embedded ICE macrocell
S- Synthesizer –distributed as RTL rather than hardened layout

It has low power consumption that's why it is well suited for portable devices like mobile, Laptop .Hence it is dominant in embedded and mobile market.ARM7 TDMI-S uses unique "THUMB" strategy which makes it ideally suitable for High volume applications with memory restriction hence used in variety areas such as embedded control ,multimedia, DSP and multimedia application. The LPC2148 microcontrollers are based on 32/16 bit ARM7 TDMI-S CPU with real time emulation and Embedded trace support that combines Microcontroller with embedded High speed flash memory ranging from 32 kb to 512 kb. A 128 bit wide memory interface and unique accelerator architecture enables 32 bit code execution at Max clock rate. For Critical code size applications, the alternative 16 bit Thumb mode reduces code by more than30 %with minimal performance penalty. Due to their tiny LQFP64 package , it is ideal for applications where miniaturation is key aspect. A blend of serial communication interfaces ranging from a USB 2.0 full speed device ,multiple UART's ,SPI,SSP to I2C and on chip SRAM of 8 kb upto 40 kb makes for suitable for communication gateways and protocol converters ,soft modems, voice recognition and now end imaging providing both large buffer size and high processing power ,various 32 bit timers, single or dual 10 bit ADC(s) ,10 bit DAC ,PWM channels and 45 fast GPIO lines with up to 9 edge or level sensitive external interrupt pin make these microcontrollers practically suitable for industrial control and Medical systems

B. SENSORS AND ACCESORRIES

1) SEAT BELT SENSOR (MEDER)

For we are well known importance to fasten seat belts for a sake of safety &it is almost compulsory in airlines, vehicles. here we are using MEDER Reed switch seat belt sensor showing Reliable way to detect whether seat belt is disengaged or not. ° Whenever seat belt is engaged it isolates the magnetic field of Receiver buckle and when seat belt is

disengaged it shows sensing on front panel of vehicle with symbol .It is Hermetically sealed ,Dynamically tested contacts .It can withstand in dirty environment as well as it can handle high shocks.

2) GAS SENSOR

MQ 6 gas sensor has High sensitivity to propane, butane, LPG and Natural gas .This sensor could be used to detect different combustible gas specially methane. It is with low cost. Here sensitive material of MQ6 is sno2with lower conductivity in clean air, when target combustible gas exists , the sensors conductivity more higher along with gas concentration rising

3) .MEMS (Microelectromechanical system –MMA7260QT)

it is low cost capacitive Micromachined accelerometer features signal conditioning low pass filter ,temp compensation and g-select which allows for selection among 4 sensitivities, Here with increased acceleration, capacitance also increases .So with the measurement of capacitance acceleration can be measured out directly .

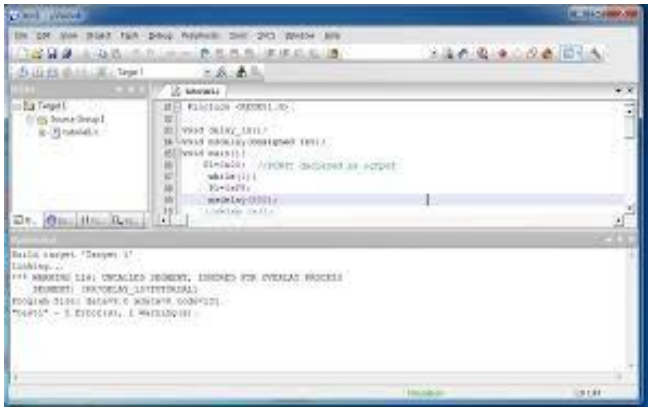
4) TEMPATURE SENSOR(LM35)

LM-35 calibrates Temperature Directly in centigrade .It is Linear +10mv/ °c scale factor 0.5 °c ensured accuracy (at 25 °c) rated for full -55 °c to +150 °c range.LM-35 is suitable for Remote applications. It is low cost Due to wafer level Trimming. It operates from 4 to 30 v and less than 60 µA current drain. it has low self heating 0.08 °c in still air and low impedance output,0.1 Ω for 1 mA load .It shows low level and high level temp measurement and automotive ignition level gas exhausting ,over heat when engine /motor speed was increased gradually .

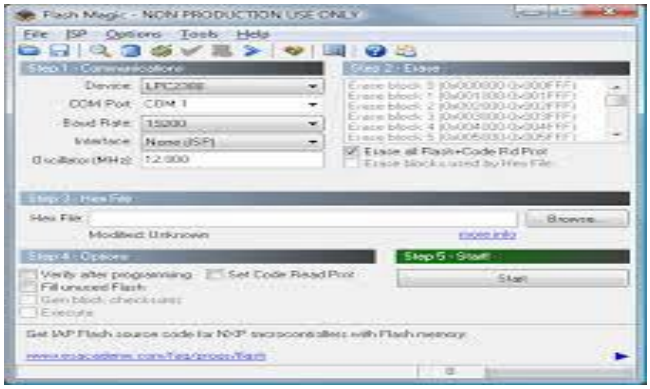
Again it have LCD display , buzzer ,DC Motor. It consists of one node as master and other slave node .ARM is main controller which controls the sensor and slave is used to receive input of vehicle. The communication between sensor is done with CAN controller, slave receivers the input of sensor like seat belt engaged, Temperature ,gas ,acceleration etc. send to master with High speed .Master controls the status and sends feedback to operator panel through LCD display and buzzer with digital information

V. SOFTWARE STRUCTURE

Here system is programmed using Embedded‘ C’ and Debugged Keil software



After writing and compiling program ,it is burned to ARM and other chips using Flashmagic software



VI. CIRCUITS AND WORKING MODEL

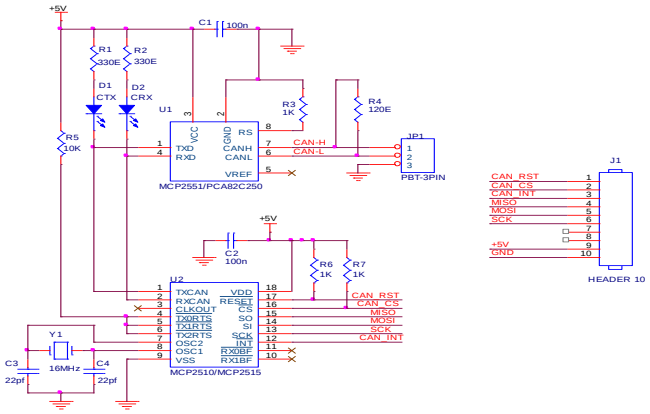


Fig 5-CAN Interface Board

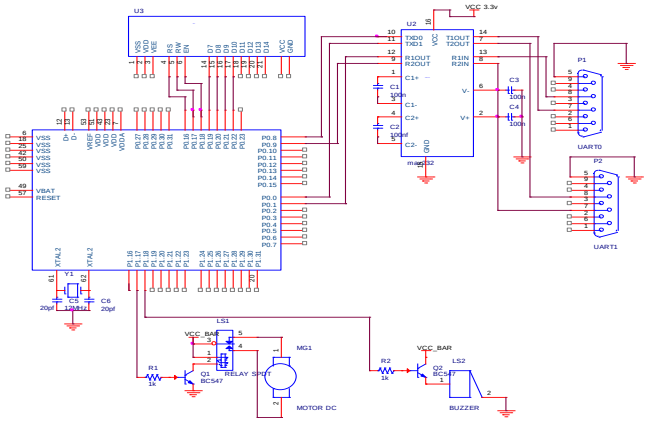


Fig 6- node 1

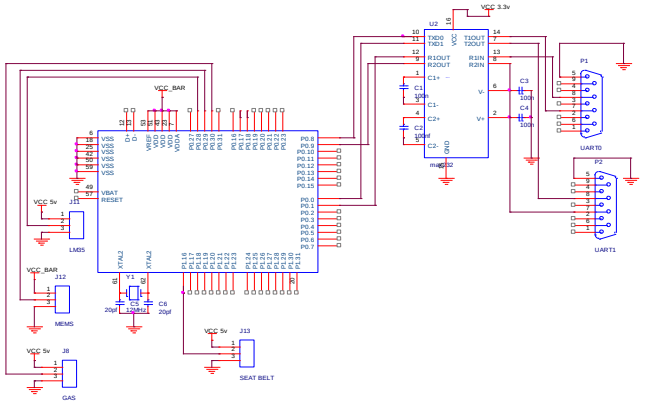
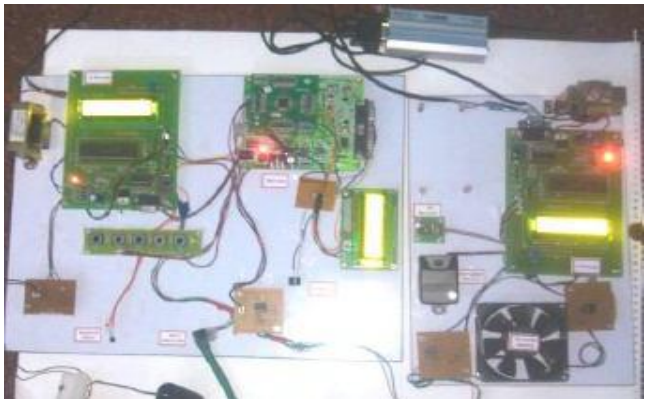


Fig 7- node 2

VII. WORKING MODEL



VIII. RESULTS

IX. CONCLUSION

Better the technology , more user friendly it becomes . With Rapid development in the field of Embedded technology , High performance embedded processor have become Dominant because of low cost ,high reliability ,low power consumption which makes it ideal for modern automobile industry .This proposed system shows efficient sensor communication to improve experience of Digital driving. This paper shows combination of embedded system with CAN Networking. It makes full use of ARM , high speed reduction CAN communication network to achieve full sharing of Data between nodes and enhance their collaborative work.

ACKOWLEDGEMENT

I wish to thank my institution ,' Shivaji college of engineering and Mangement studies ' for giving me the opportunity to write a research paper. A special thanks to ETC Department Head ,prof sayyed for encouraging me and guiding me throughout without whom ,this work would have not been possible.

Last but not the least ,I would like to thank the authors of the various research papers that I have reffered to, for the completion of this work

REFERENCES

[1] Kumar, M. A.Verma, and A. Srividya, Response-Time "Modeling of Controller Area Network (CAN). Distributed Computing and Networking, Lecture Notes in Computer Science Volume 5408, p 163-174, 2009.

[2] Tindell, K., A. Burns, and A.J. Wellings, Calculating controller area network (CAN) message response times. Control Engineering Practice, 3(8): p. 1163-1169, 2005.

[3] Li, M., Design of Embedded Remote Temperature Monitoring System based on Advanced RISC Machine. Electrotechnics Electric, 06, p. 273, 2009.

[4] Prodanov, W., M. Valle, and R. Buzas, A controller area network bus transceiver behavioral model for network design and simulation. IEEE Transactions on Industrial Electronics, 56(9): p. 3762-377, 2009.

[5] ISO (1993). Road Vehicles: Interchange of Digital Information: Controller Area Network (CAN) for High Speed Communication. ISO 11898:1993.

[6] B.Gmbh, "CAN specification" vol 1 Version 2.0, 1991.

[7] Pazul, "Controller Area Network (CAN) Basics", Microchip technology Inc., AN713, May 1999.

[8] Wilfried Voss, A comprehensive guide to controller area network, Copperhill Media Corporation, 2005-2008.

[9] Benjamin C Kuo, M. Farid Golnaraghi, Automatic Control systems, Eight edition, John wiley & sons., Inc 2003.