CAN Protocol Establishment Using EX-OR Masking Technique

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***Abstract* - The Controller Area Network (CAN) is a serial, asynchronous, multi-master communication protocol for connecting electronic control modules in automotive and industrial applications. CAN was designed for automotive applications needing high levels of data integrity and data rates of up to 1 Mbit/s. In this paper CAN protocol establishment is done using EX-OR masking technique to reduce jitter noise during trans-receiving a long sequence of identical bits to improve the features of CAN protocol.**

***Keywords*: Controller Area Network, Jitter.**

I. INTRODUCTION

CAN is a serial communication technology used especially for reliable data exchange between electronic control units (ECUs) in the automobile & low-cost embedded systems. As a consequence of its popularity and widespread use, most modern microcontroller families now include one or more members with on-chip hardware support for this protocol. The bit representation used by CAN is "Non Return to Zero" (NRZ) coding. If (for example) two CAN controllers are linked, then their clocks are synchronized by means of the data edges.

In recent years, the Distributed Control Systems are preferred in industries to improve production, quality, operation control, and automatic stock registry management with cost effectiveness. Distributed system's backbone depends upon communication between central control nodes. Field bus communication is the best option to establish channels between embedded systems based central control nodes for reliable and stable network communication. CAN protocol field bus based features like collision avoidance, multi-master transmission, message filtering, variable communication speed support, stability control etc are more preferable in automobile, robotics and in different industrial applications. CAN bus communication is asynchronous type transmission which need not transmit clock pulses along with information. Because of this reason, synchronization between node clock and information bit timing is required at receiver node [2]. Due to long sequence of identical bits of information, unit-bit length time increases during transmission that affects the next bit timing as a jitter-noise. To minimize adverse effect of Data Dependent Jitter (DDJ), many researchers have developed techniques like software based Bit Stuffing and EX-OR Masking techniques [2]. In this paper we will develop an algorithm for "EX-OR masking technique" to enhance different features of CAN bus communication efficiency and reliability.

II. CONTROLLER AREA NETWORK (CAN)

Start Of frame	Arbitration field(frame identifier value)	Control field	Data field(8 Byte)	CRC field	ACK field	End of frame

Fig.1-Frame format for CAN bus data transmission.

The CAN protocol supports two message frame formats, the only essential difference being in the length of the identifier (ID). In the standard format the length of the ID is 11 bits and in the extended format the length is 29 bits. The message frame for transmitting messages on the bus comprises seven main fields. A message in the standard format begins with the start bit "start of frame", this is followed by the "arbitration field", which contains the identifier and the "RTR" (remote transmission request) bit, which indicates whether it is a data frame or a request frame without any data bytes (remote frame).

The "control field" contains the IDE (identifier extension) bit, which indicates either standard format or extended format, a bit reserved for future extensions and - in the last 4 bits - a count of the data bytes in the data field. The "data field" ranges from 0 to 8 bytes in length and is followed by the "CRC field", which is used as a frame security check for detecting bit errors.

The "ACK field", comprises the ACK slot (1 bit) and the ACK delimiter (1 recessive bit). The bit in the ACK slot is sent as a recessive bit and is overwritten as a dominant bit by those receivers which have at this time received the data correctly (positive acknowledgement). Correct messages are acknowledged by the receivers regardless of the result of the acceptance test.

The end of the message is indicated by "end of frame". "Intermission" is the minimum number of bit periods separating consecutive messages. If there is no following bus access by any station, the bus remains idle ("bus idle").
Multi -master policy of CAN allows multiple nodes can be a master at the same time it can start communication but only one node can do transmission on a serial field bus at a time. When multiple nodes are ready to transmit frame at a time, the Carrier Sense Multi Access with deterministic collision resolution (CSMA) policy activates to decide priority between nodes. CSMA policy assigns highest priority to node with lowest identifier field value (arbitration field) and then it allots CAN bus to the node. CAN communication is multi node multi master based communication on Twisted pair physical link as shown in Fig. 2.

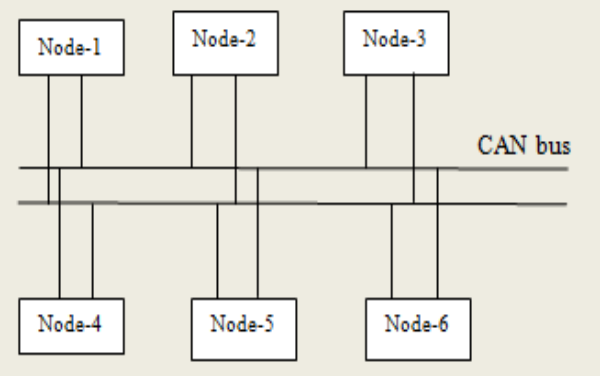

Fig.2 - Structure of Controller Area Network

III. PROPOSED WORK

In this paper our main objective is to design and implement a CAN protocol using XOR masking techniques Nolte A, Nolte B.

A. Nolte A

All data bytes are EX-ORed with 10101010 binary bits pattern. This technique is simple and all 8-byte data space of CAN frame is used for Data purpose i.e. no bandwidth loss in Nolte-A technique [2, 3].

B. Nolte B

In this method, we check each CAN frame and if a sequence of five identical bits is detected then EX-OR the whole frame with the bit masks (10101010…).

At Receiver side all received information is decoded by using same masking bit pattern 10101010 to get original information back.

IV. BLOCK DIAGRAM

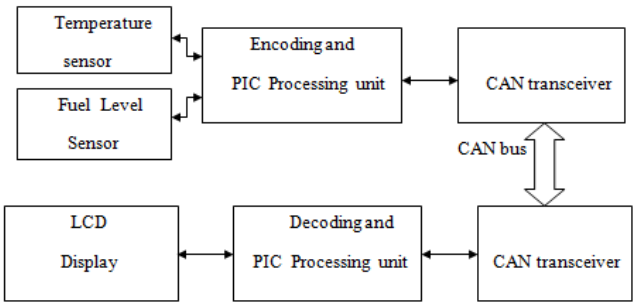

Fig.3 - Block Diagram Of Proposed Work

A. Block diagram description

Fig. 3 shows the block diagram of CAN vehicle control system. It consists of input nodes and LCD Display. CAN with PIC is used as nodes to receive the inputs of vehicle status. In this project we are using a temperature sensor as one node (A) & fuel level sensor as another node. Which are connected to CAN through PIC. The communication between these sensors is done by using CAN controller. Input from sensor is encoded and processed and then it is transmitted through CAN bus. At receiver side is decoded and displayed on LCD.

In this system, an algorithm for EX-OR masking has been developed and then it is implemented using two Free scale Demo boards. These demo boards contain CAN trans-receiver module and PIC controller. The Algorithm performs EX-OR operation

to convert the message in to a form having a sequence of the maximum of four identical bits followed by a complemented bit appears in the new sequence of the message. The proposed technique can improve data quality by reducing DDJ jitter-noise and sequence of identical bits with respect to Data pattern.

V. CONCLUSION

This EX-OR masking technique will reduce jitter noise and drift during trans-receiving a long sequence of identical bits. Also using this technique we will reduce the number of stuff-bits inserted by the CAN protocol.

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