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The Design of a Distributed Control System Based on CAN Bus

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Abstract: *We are implementing a RS232 based CAN-Bus Experimental System based on ARM7 using acceptance filter concept. ARM7 (LPC2129) microcontroller having two interconnected CAN interfaces with advanced acceptance filters. By using LPC2129 microcontroller receive the data CAN bus, convert the data in serial format and transfer the data to Personal computer(PC) or Laptop using RS232 serial port or virtual serial port. A CAN transceiver MCP2551 is a high-speed CAN, fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus. The MCP2551provides differentials transmit and receive capability for the CAN protocol controller and is fully compatible with the ISO-11898 standard. The CAN BUS Analyzer is a simple to use low cost CAN bus monitor which can be used to develop and debug a high speed CAN network. The device supports CAN 2.0b and ISO11898-2 and a broad range of functions which allow it to be used across various market segments including automotive, industrial, medical and marine.*

Keywords: *CAN, MCP2551*

1. INTRODUCTION

Controller Area Network (CAN) is a kind of serial communication network that supports the distributed control and the real time control, and has characteristic of high reliability. In the 1980s , in order to solve vehicle controls and data exchange issues, Germany BOSCH company developed a field bus communication structure, which became IS01l898 international standard in 1993 and now widely used in various fields . CAN bus have unique structure and high capability, which is recognized as one of the most application foreground field bus. However, according to the means documents, there are little specialized experimental system about CAN bus. This largely impedes the popularization and development of CAN bus. Therefore, this paper introduces CAN experiment system by which people should have an impressive understanding of CAN bus. This paper also gives the experimental network implementation on both hardware and software, and recounts the design of application layer protocol that is suitable to the experimental system. CAN was designed for automotive and industrial applications needing high levels of data integrity and data rates of up to 1 Mbit/s. Today the CAN bus is also used as a field bus in general automation environments; primarily due to the low cost of some CAN Controllers and processors. CAN bus will be increasingly used in wide range of applications for its superiority. A need arises when using CAN buses to monitor the data on the bus as well as having the ability to inject further data onto it. This provides the ability to fully test a CAN network on both the frame level and the bit level. A low cost and portable CAN bus analyzer is requiring testing or Monitoring the CAN bus in the fields.

2. PROPOSED SYSTEM

In this project we are implementing a PIC microcontroller based CAN network for demon staring the CAN bus analyzer. In this project, CAN bus protocol is studied. ECAN logic in 18F458 Microcontroller and CAN transceiver chip MCP2551 are studied. Various elements like sensors, here initially sensors are used for sensing the parameters such as temperature, humidity etc.., When the sensing element sense the output (i.e., changing the input level from one level to other level) will exceeds threshold level and is given to the input of microcontroller. After that the sensing output will monitor on monitor at one end and at the same time it transmits the data to another end through CAN

transceiver. At receiving end the CAN transceiver receive the data and it gives to microcontroller. Here microcontroller will gives the data to display the output through the serial communication in monitor. For this we required a suitable hardware to designed Microcontroller and CAN transceiver.

Block Diagram

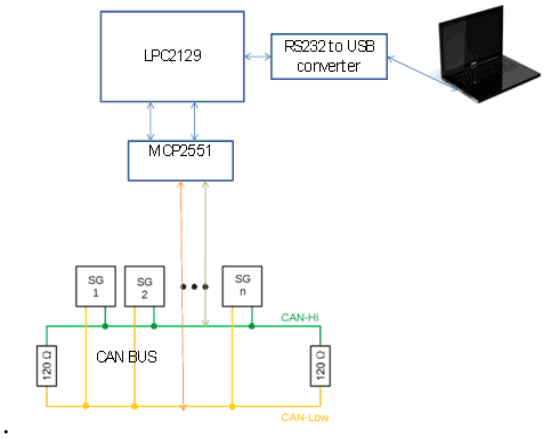

Fig1. *CAN Node*

3. HARDWARE IMPLEMENTATION

3.1. LPC2129 Microcontroller

LPC2129 microcontrollers are based on a 32 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support that combines the microcontroller with embedded high speed flash memory of 512kb. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces the code by more than 30% with minimal performance penalty. CAN interfaces with advanced acceptance filters.

3.2. PIC18F458

40-Pin High-Performance, Enhanced Flash Microcontrollers with CAN

- 10-bit, up to 8-channel Analog-to-Digital Converter module (A/D) with:
  - Conversion available during Sleep
  - Up to 8 channels available
- Analog Comparator module:
  - Programmable input and output multiplexing

3.3. Can Bus Module Features

- Complies with ISO CAN Conformance Test
- Message bit rates up to 1 Mbps
- Conforms to CAN 2.0B Active Spec with:
  - 29-bit Identifier Fields
  - 8-byte message length
  - 3 Transmit Message Buffers with prioritization
  - 2 Receive Message Buffers
  - 6 full, 29-bit Acceptance Filters
  - Prioritization of Acceptance Filters
  - Multiple Receive Buffers for High Priority

Messages to prevent loss due to overflow

- Advanced Error Management Features

3.4. Temperature Sensor (LM35)

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient centigrade scaling.

The LM35 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.01°C of the surface temperature. This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature.

3.5. Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full -55° to +150°C range

3.6. Gas Sensor

Gas sensor (MQ-5) detects the gas leakage. They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, natural gas, town gas, avoid the noise of alcohol and cooking fumes and cigarette smoke. Resistance value of MQ-5 is difference to various kinds and various concentration gases. So, when using these components, sensitivity adjustment is very necessary. When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

4. HARDWARE & RESULTS

The below figure is the CAN Analyzer for data from child nodes and received by parent node

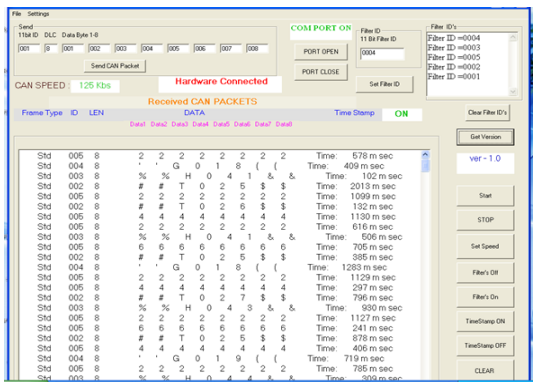

Fig2. *CAN Analyzer*

Below Development board is LPC2129 board which is acting as the parent node

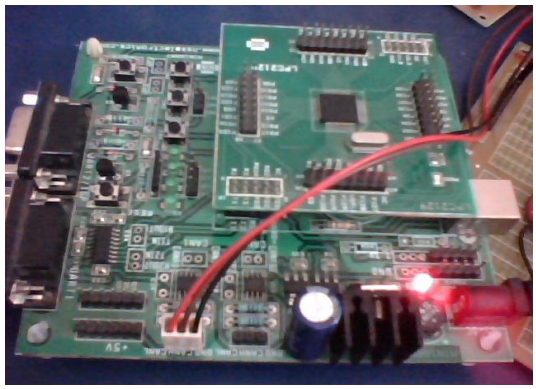

Fig3. *LPC2129*

The child nodes will read the environmental data like temperature and gas. The read data will be given to the PIC18F458 microcontroller. The data is framed to CAN Frame format and send to parent node.

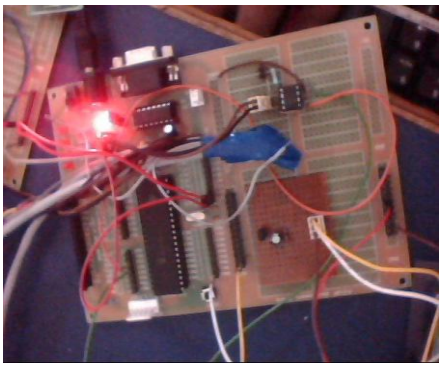

Fig4. *Temperature Sensor Node*

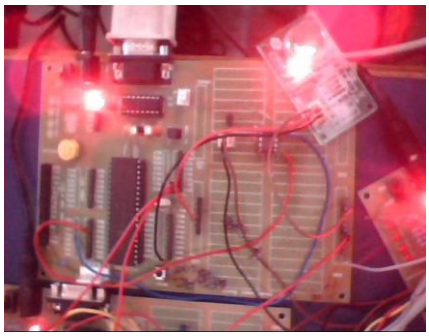

Fig5. *Gas Sensor Node*

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