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Architectural Design of On-Rotary CAN BUS Debugging Tool for CT Machine

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ABSTRACT
This system is designed to capture data communicated between the CAN (Controlled Area Network) controlled devices in the rotating Gantry of a CT machine, which are real time sliced using Real Time Clock (RTC) and stored in a log files and send it to the remote PC in a wireless connectivity. Since system placed in gantry which will be on rotating motion, it is powered by battery and working autonomously. Status of operation of the system is immediately displayed on the Liquid Crystal Display (LCD). Users can place this module for systems which are in motion or stationary and need to monitor the data wirelessly. Furthermore this system can be embedded into any machine, turn it ON whenever wanted and read the data communicated between the CAN Bus controlled devices. This system is accurate, stable without number lost, frame dropping, transfer error and transfer error in the data communication and monitor remotely in Wi-Fi connected PC.

Keywords
Controlled Area Network (CAN), Computed Tomography (CT) Machine, Gantry, Liquid Crystal Display (LCD) and Wireless Fidelity (Wi-Fi).

1. INTRODUCTION

1.1 Motivation
The Controller Area Network (CAN) is a serial bus communications protocol developed by Bosch in the early 1980s. It defines a standard for reliable and efficient communication between controllers, sensors, actuators, and other nodes in real-time applications.

The early CAN development was mainly supported by the vehicle industry: CAN is found in a variety of passenger cars, trucks, boats, spacecraft's, and other types of vehicles. The protocol is also widely used today in industrial automation and other areas of networked embedded control, with applications in diverse products such as medical equipment, production machinery, building automation, weaving machines, and wheelchairs.

An in-vehicle network integrates many modules that interact with the environment, and process high and low speed information. This is mainly because parts of the network (like the nodes) have to process high-speed data to satisfy safety and emission requirements. Other parts of the network are low-speed that they are locally connected to lights and switches. As a result, testing this network has become very challenging.

Therefore this paper introduces a new CAN bus monitoring and transfer of captured data to remote Wi-Fi connected PC, which can monitor not only single control units but also complete CAN networks to increase CAN network debugging efficiency and accelerate the development process of medical devices CAN network systems.

Unlike traditional CAN Bus debugging tool, USB technology is added to the CAN bus monitoring system to make it convenient to use and increase the data throughout while possessing as few PC resources as possible. But this rotating debugging tool system can remotely monitor the data transferred between the CAN controlled devices in system.

The CAN BUS has now been widely used in Mechatronics systems for distributed measurement and control, attributed a lot its characteristics such as real time, multicast communication ability, and it performance in heavy network load conditions. The Hardware units such as CAN controller and CAN Transceiver makes the application development job easier, and the integration of CAN controller and Micro-Controller also propels the usage of CAN technology in the different areas. There are also many tools have been designed to ease to use of CAN-BUS, such as PCI based CAN interface card, the USB-CAN transceiver, and the RS232/485-CAN converter. These devices enable the developer integrate the CAN-BUS into the system without having the knowledge of CAN protocols.

However, it is still not an easy thing for a novice to develop a CAN-BUS involved application in an embedded system. In such system, the developer should be familiar with the CAN-BUS protocols, also the interfaces to the CAN communication ICs, which would be hard jobs for any untrained engineers. It is necessary that the CAN-BUS, as a kind of communication media, should be modularized as an embedded CAN module, in order to lower the degree of difficulties in the embedded CAN application development. There are also some other benefits for the On rotating CAN debugging module, such as remote accessing the CAN data and even user can remotely operate and control the CAN controlled devices by send data to the devices with the particular ID name of the devices.

1.2 Comparing Rotating CAN debugging tool with other solutions

In order to simplify the CAN BUS based system design, there several products in the market. The typical examples are PCI-based CAN-BUS interfacing card, USB-CAN converter and RS232/485-CAN converter. These entire products take the name idea: convert the communication protocol from one type to the CAN-BUS protocol and vice versa: The PCICAN interfacing card translate the data between the CAN BUS and the PCI-BUS, the USB-CAN converter does the data translation between CAN-BUS and the USB-BUS, and the RS232/485-CAN converter with the RS232/485 BUS.

However these products are not suitable for the embedded system. The PCI-BUS and USB-BUS are much more difficult and complicated than CAN-BUS, and both are difficult to use if there are originally no such interfaces on the embedded system. The RS232/485-CAN converter is practicable, but the size and cost often weaken the convenience. What's more, the performance of RS232/485 restricts the advantages the CAN BUS communication, especially in the facets of communication speed, network structure and amount of nodes.

Comparing with above CAN products, the CAN Modules has following advantages:

- ❖ Small in size and low in cost;
- ❖ Remotely operation of CAN Bus
- ❖ Can be embedded in any embedded system;
- ❖ Ease of use;
- ❖ Take full use of the CAN-BUS ability in communications;
- ❖ Ability of Plug and Play;

1.3 Concept of Rotating CAN Bus debugging tool

This paper is going to introduce the Rotating CAN Bus debugging tool, its working principles, hardware and software implementations and its performance. The Rotating debugging tool is a module which can be embedded into any embedded system; connecting the host embedded CAN Module as a CAN node of the field BUS network and other end act as the Wi-Fi communication channel to the Wi-Fi connected host PC. This Module runs through a sequence of steps when a message communicated in the CAN Bus which trigger a flag.

2. HARDWARE DESIGN

2.1 CAN module

The CAN module is used to bridge a gap between the Micro-controller and the CAN Bus. One end of the port is connected with the CAN High and CAN Low trough CAN Bus transceiver, which help to receive and transmit the message between CAN module and the CAN Bus.

In the design CAN Transceiver used is MCP2551 High speed CAN Transceiver, fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus. MCP2551 provides differential transmit and receive capability for the CAN protocol controller and is fully compatible with the ISO-11898 standard. MCP2515 used as CAN protocol controller with SPI Interface. It is a stand-alone CAN controller developed to simplify applications that require interfacing with a CAN bus. MCP2515 consists of main three blocks are CAN module, Control logic and registers and SPI protocol block.

CAN module holds the CAN controller which accept the filtered CAN message from the CAN Bus through the Transceiver and stored in the buffer and forwarded further through to Micro-controller. If message are to be send in to the CAN Bus, CAN Controller handle those messages and convert into CAN Bus compactable protocol. Send in to CAN Bus. The structure of CAN Module shown in the figure1.

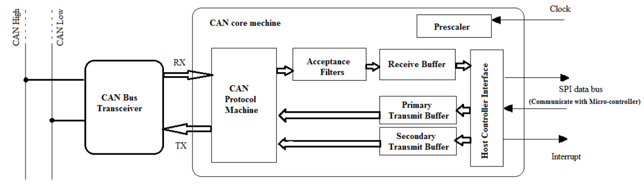

Fig. 1. Structure of CAN module

2.2 Wi-Fi Module

Wi-Fi Module which add up Wi-Fi functionality to the system. ESP8266 used as Wi-Fi transceiver in the design. ESP8266 is and impressive, low cost Wi-Fi module suitable for adding Wi-Fi functionality to an existing micro-controller via a UART serial connection. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking function from another application processor.

Wi-Fi which can act as accessing point or it can connect to available existing Wi-Fi server using it SSID and Password. Wi-Fi module have on-board processing and storage capabilities allow it to be integrated with sensors and other application . With its high degree of on-chip integration , which includes the antenna switch balun, power management converters , it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

2.3 Real Time Clock (RTC)

Real Time Clock have full binary-coded decimal (BCD) clock/calendar. The clock/calendar provides seconds, minutes, hours, day, month and year information. It has a built-in power sense circuit that detects power failures and automatically switches to battery power.

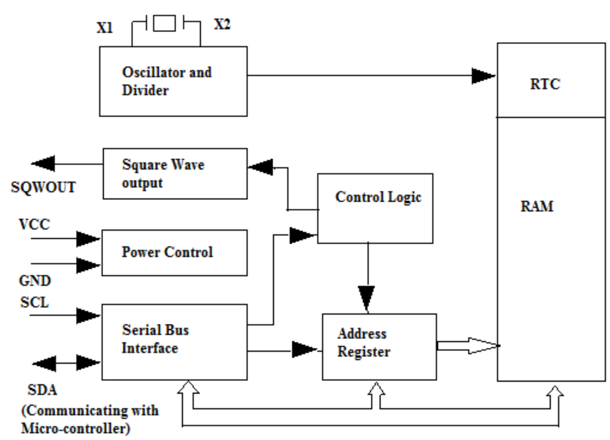

Fig. 2: Real Time Clock

The Real Time Clock operates as a slave device on the serial bus. Access is obtained by implementing a START condition and providing a device identification code followed by a register address. Subsequent registers can be accessed sequentially until a STOP condition is executed. As shown in fig. 2.

2.4 Liquid Crystal Display (LCD)

Liquid Crystal Display (LCD) is used to show the display the status of the module and even it display the message which are been captured from the CAN module. JHD162A is the 16X2 display, which is powered by 5 Volt supply, and 8 data lines from the Micro Controller. Liquid Crystal Display shown in Fig. 3

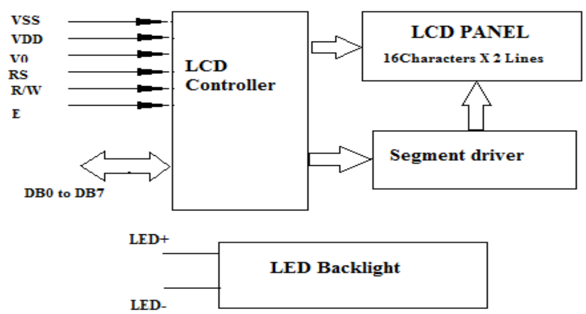

Fig 3. Liquid Crystal Display (LCD)

3. SOFTWARE DESIGN

The main software program unit is divided into: CAN initiation unit, Wi-Fi initiation unit and connected to particular SSID Wi-Fi router, stored the message in log file with real time slice and stored data is send to internet through Wi-Fi module. Each time status of the module and data are been displayed in the Liquid Crystal Display (LCD).

Each stages of the complete software data flow consists of special set of software control programs, which are been flashed in the Flash Memory of the Micro-Controller so that it need not to load each time powered ON the system. This flashed flash program will be present until other program which will flash in to the memory. Complete data flow of software design is shown in the Fig. 4.

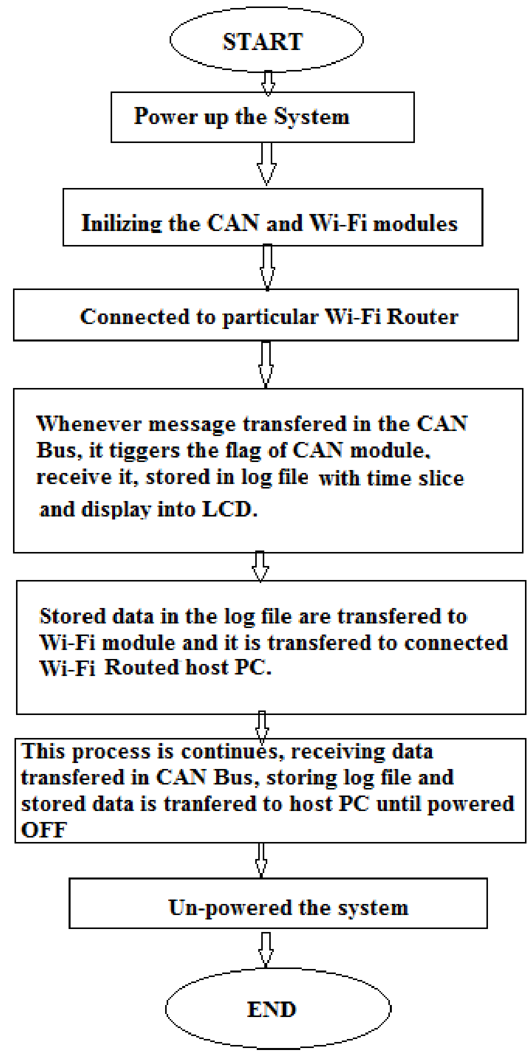

Fig. 4. Complete Data flow of design

4. CONCLUSION

Real-time, reliability and flexibility, all these characteristics make Rotating CAN Bus debugging tool an indispensable network communication applied in CAN Bus network communication technology. In this paper, we worked on the working principle of the CAN module and Wi-Fi module and there interaction with the microcontroller. Make to interact both the module to microcontroller and made it as a single module to service our application.

REFERENCES

[1] Arduino website, http://www.arduino.cc/

[2] L. M. Wang, Design and application of CAN Field BUS. Bejing, China: Electronics Industry Press, 2008.

[3] C. H. Peng and C. L. Wang, “Application of dual-port ram idt7132 in Ionworks smart nodes,” Electronics component and device Applications, vol. 8, no.11, pp. 13-15, 11 2006.

[4] X. M. Li and P. X. Li, “Research on the virtual axis motion synchronization control methology for high-speed hydraulic systems,” Chinese

[5] Y. Bian, Z. C. Wu, F. Shen, X. L. Wang, and Y. Ge, “The development of plug and play network sensor based on ieee1451.2,” Chinese Journal of Sensors and Actuators, no. 1, pp. 50–53, 3 2003.

[6] Wang JJ, Hong TS. Design and implementation of LabVIEW-based CAN bus communication system [J]. Computer Applications and Software [ISSN 1000-386X], 20 10, 27(8): 235-237,262.

[7] Li Renjun, Liu Chu, Luo Feng. A design for automotive CAN bus monitoring system [C). In: IEEE 2008 Vehicle Power and Propulsion Conference, Harbin, September 3-5, 2008: 1-5.

[8] Zhao Xiaojun, Cao Jiankun, Chen Lei,et al. Application of CAN bus in data arm communication system [ClIn: International Conference 20 10 Information Management and Engineering, April 16-18, 20 10: 50-53.

[9] Wan Xiaofeng, Xing Yisi, Cai Lixiang. Application and implementation of CAN bus technology in industry real-time data communication [C).In: International Conference 2009 Industrial Mechatronics and Automation, May 15-16, 2009:278 - 28 1.

[10] Ran Ping, Wang Baoqiang, Wang Wei. The design of communication convertor based on CAN bus [ClIn: International Conference 2008 Industrial Technology, April 2 1-24, 2008: 2 1-24.