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CAN Bus Implementation in an Embedded System for a Dairy Plant

M.V. Gavade[1] and S.B. Patil[2]

[1]Department of Electronics & Telecommunication,
D.Y. Patil Polytecnique, Kolhapur, India
[2]Department of Electronics,
D.Y. Patil College of Engineering & Technology, Kolhapur, India
E-mail: [1]maheshgavade12@gmail.com, [2] s_b_patil2000@indiatimes.com,

Abstract

CAN, Controller Area Network is widely used in industrial control applications, where robust environment exist. It is serial network that efficiently support distributed real time control with very high level of data integrity. Advantages of this bus are - 1.It gives high speed up to 1 Mbps. 2. Low cost. In above application this protocol plays an important role can be connected to central monitoring processor (Master Control) for example different zones of milk processing plant needs different environmental conditions such as temperature and humidity is very vital as milk need good hygienic conditions. These zones connected to central control processor (master) this can be achieved by CAN BUS networking. PC screen, where graphical user interface (GUI) is used to get exact status of zone in real time monitoring. At each zone, separate dedicated processors are used to get information of the zone and these processors are connected through CAN BUS serial interface with master/Main Processor, Using the parameters of each zone on Central Control (Master Processer) we can store information of respective zone. This information is further used for milk or milk powder storage life. By interfacing master processor to our main computer. Due to the Implementation of this system, large amount of time & information is easily accessed at remote place.

Keywords: CAN BUS, Protocol, Interface, Data Logging.

Introduction

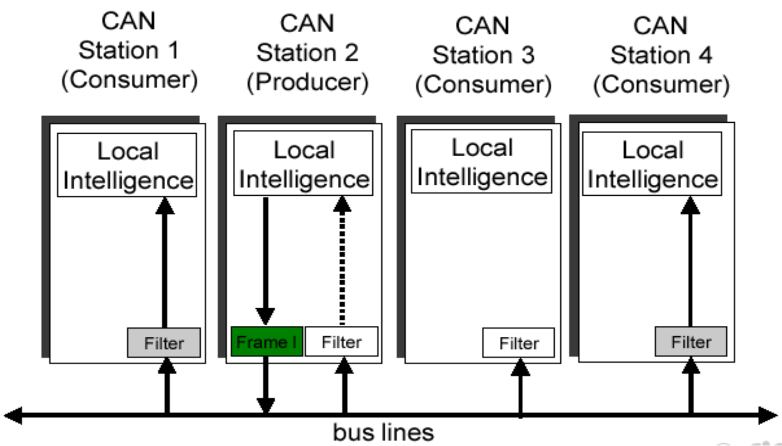
CAN (Controller Area Network) is a serial bus system, which was originally developed for automotive applications in the early 1980's. The CAN protocol was internationally standardized in 1993 as ISO 11898-1 and comprises the data link layer of the seven layer ISO/OSI reference model. CAN provide two communication services: Sending of a message (data frame transmission) and requesting of a message (remote transmission request, RTR).

CAN provide a multi-master hierarchy, which allows building intelligent and redundant systems, broadcast communication. A sender of information transmits to all devices on the bus.

All receiving devices read the message and then decide if it is relevant to them. It provides sophisticated error detecting mechanisms and re-transmission of faulty messages.

Application of CAN

CAN is used as embedded network in medical devices such as in X-ray machines. Complete operating rooms are equipped with a CAN network that manages all functions. CAN is deployed in hospital beds connecting the control panels, the various motors, the scale. A hospital bed includes 5 to 10 CAN nodes in new generation of beds. X-ray collimator, X-ray generator and patient table uses CAN. In addition, Here we use in textile industries application where robust environment exist this industries it requires controlled Humidity and temperature. This can be measured using CAN BUS. For each environment, the complexity and number of electronic modules can vary up to 20 independent microprocessors communicating together. By taking into account the above requirements, the CAN BUS system is being implemented.



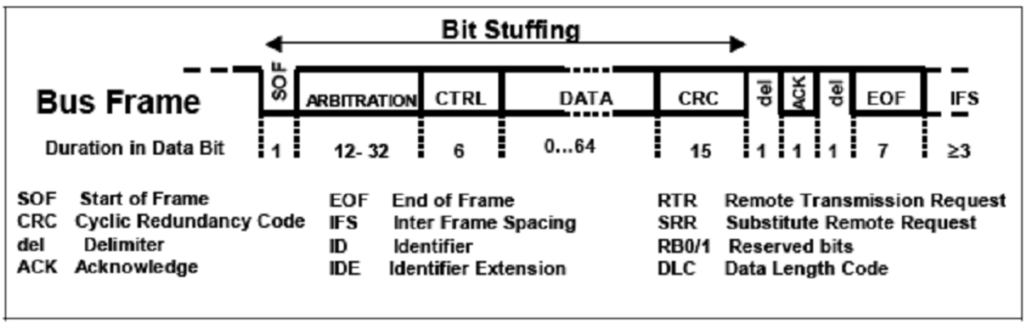
CAN Protocol

Principles of data exchange:

As a result of the content-oriented addressing scheme, a high degree of system and configuration flexibility is achieved. It is easy to add stations to an existing CAN network without making any hardware or software modifications to the present stations as long as the new stations are purely receivers.

This allows for a modular concept and also permits the reception of multiple data and the synchronization of distributed processes. Data transmission is not based on the availability of specific types of stations allowing simple servicing and upgrading of the network.

Message Frame Format

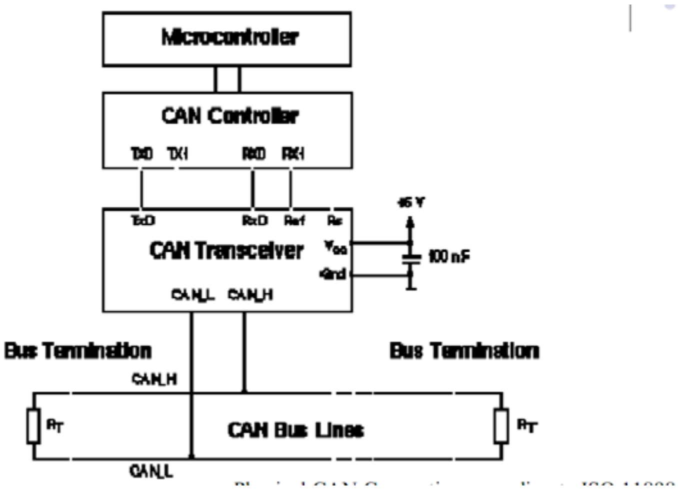


The CAN protocol supports two message frame formats, the only essential difference being in the length of the identifier. The “CAN base frame” supports a length of 11 bits for the identifier and the “CAN extended frame” supports a length of 29 bits for the identifier.

Detecting and Signaling Errors

For error detection the CAN protocol implements three mechanisms at the message level: Cyclic Redundancy Check (CRC), Frame check, ACK errors. The CAN protocol also implements two mechanisms for error detection at the bit level: Monitoring: Each station that transmits also observes the bus level and thus detects difference between the bit sent and the bit received. Bit stuffing: The bit representation used by CAN is "Non Return to Zero (NRZ)" coding. The synchronization edges are generated by means of bit stuffing. This stuff bit has a complementary value, which is removed by the receivers.

Physical Layout & Topology



Figure

Operation of Dairy Plants

Figure **b**

Figure **c**

The above **fig b** shows milk powder filler and **fig c** shows milk powder handler machine. The milk processing plants needs good hygiene as well as Zero Degree temperature with controlled Humidity. So Milk can be preserved with low bacteria contain. Milk processing plants having number of Byproducts such as milk powder, Cheese, butter etc. But most of the milk is preserved by making milk powder. In this powder handler unit it needs specified temperature and humidity.

Main System Hardware

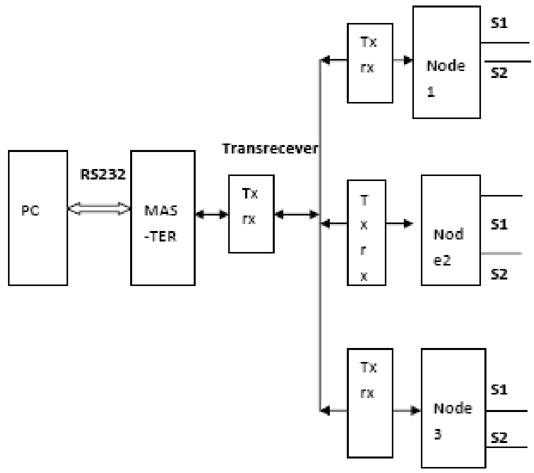


Figure d

This monitoring prototype consist of a PC, It inter face with Master controller Through RS-232, .PC is the system core of control and data storage as shown in **fig d**. Master is connected through CAN bus with different Slaves, Slave's having it's won processor In this Prototype design we use PIC18F2480 Microcontroller. Slave having sensor 1, sensor 2 or **S1, S2** as shown in **Fig. d**

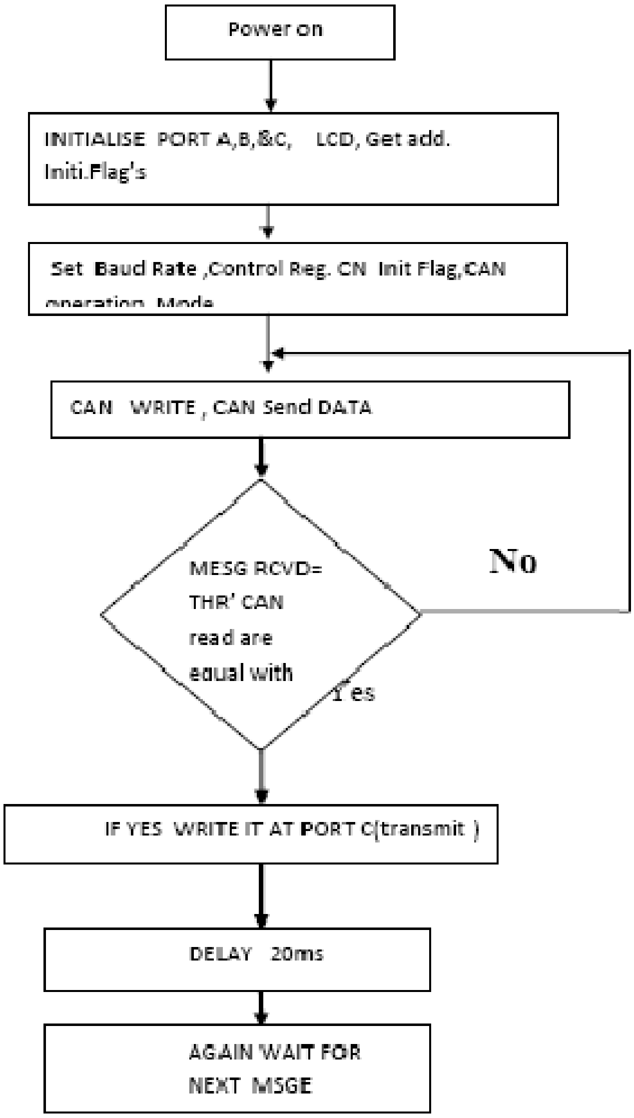
These Slaves are in different area's called as Zones where sand is heated up to 300-315 Degrees and mixed with resin this can be sensed S1 temperature sensor and other sensor is humidity S2 etc. here we used sensor module SY-HS220 These module Convert the relative humidity to output voltage 30% -990mv&90%-2970mv. This milli voltage is amplified and processed and gives corresponding relative humidity of the zone. This information is transferred to the master controller and further to PC, Thro' RS232 interface

Software of the System

Software of the system has two parts, one is the program working with control module and other one is the Monitoring and logging software running on the PC.

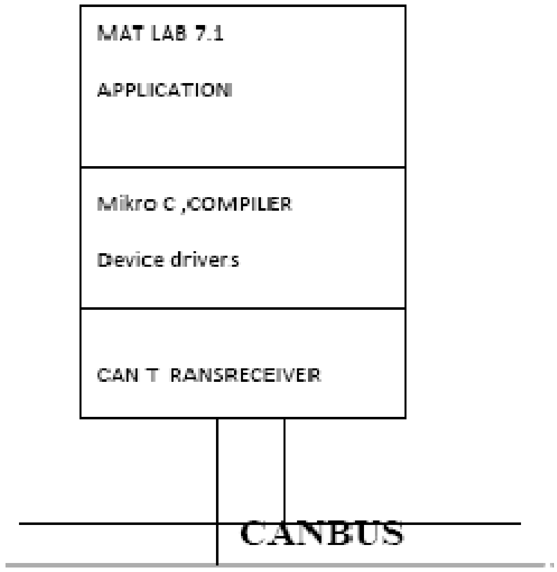
After power on, The Master & Node1's ports have been initialized, LCD initialized in command data mode. After this, CAN control built in functions ie CAN init() etc being initialized, Now read the sensor port, process this data and out put it on the LCD screen of the Node1and transfer this data to master through CAN bus using CAN bus protocol after transfer of the Message, Master identify the node ID and if this message is valid then it will be displayed on the LCD screen of the Master. If invalid it will check next message. Data transferred from slave to master and master to through RS232 port Monitoring or Control PC.

Flow Chart of the System



Software on PC

On **PC,** control software runs under **MATLAB**. In which GUI is designed to view the real time parameters and device driver written in **Mikro C** Compiler



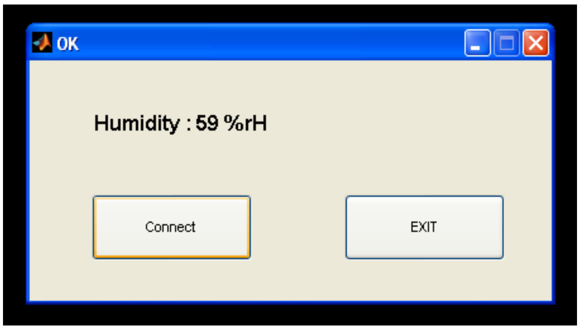
Study & Results

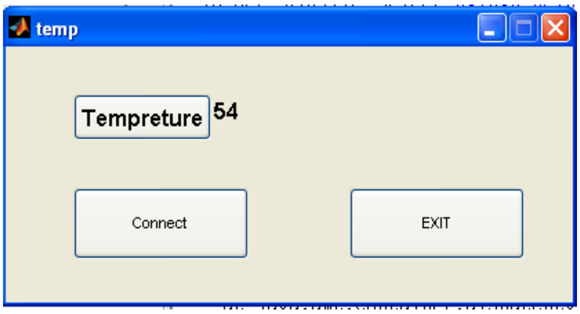
Name of the bus	Number of wires*	Type of communication	Multi master support	Data rate	Number of devices on the bus	Cable length (meters)
UART	2	Async	No	3kbps to 4Mbps	2	1.5m @128kbps
SPI	3	Sync	No	>1Mbps	<10	<3m
I^2C	2	Sync	Yes	3.4Mbps max	<10	<3m
CAN	2 or 1	Async	Yes	20kbps to 1 Mbps	128	40m @1mbps
LIN	1	Async	No	20kbps max	16	40m

The above table shows comparison of different serial protocols. Data rate offered, number of devices supported by the bus, distance covered, multi master support etc. points if considered CAN is better as compared to other protocols. From this discussion it is clear that CAN is the suitable protocol for robust environment.

Real Time *GUI* on the Control PC

In this system prototype we use only one humidity sensor, as shown in GUI, when we press the **Connect** button On the GUI Our system will start sensing the Temperature / humidity Of the NODE1, and it start showing the actual Temperature/humidity of that Particular ZONE where it has been placed at remote place. If we want to Exit from the system just press **EXIT.**





Conclusion

This monitoring & data logging is tested in the laboratory as well as Industrial environment with a humidity sensor connected to slave (NODE) up 20 meter and it gives Excellent data integrity. Purpose of the system is to study CAN BUS protocol, It's high speed and low cost. Physical Medium is unshielded twist Ware UTP. Different NODE can be connected with CAN and viewed in PC'S GUI with different windows.

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