International Conference on New Horizons in Science Engineering Technology (NHSET-2018)
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 4 | Issue 5 | ISSN : 2456-3307

Intelligent Lighting Network Applications Using Can Bus

S.Ramakrishnan[1], T. Muni Prakash[2]
[1]Asst. Prof. EEE Department New Horizon College of Engg., Banglore, Karnataka, India
[2]Sr.Asst. Prof. EEE Depaartment New Horizon College of Engg., Banglore, Karnataka, India

ABSTRACT:
In this paper describes a new embedded system based on CAN bus protocol for remote monitoring and controlling of lighting networks, where the network nodes are lighting lamps and environment sensors. The applications such as: light dimming control of a single lamp, or a group one, through one lighting network node having an environment sensor. The embedded system was implemented in a small prototype lighting network based on CAN 2.0B with three 28 Watts fluorescent T5 lamps, one 13.86 Watts HBLED lamp composed of six LEDs, and two environment sensors. The proposal can be expanded to more than 2048 nodes and other kind of lighting lamps can be used. Individual and group control for dimming and turning on/off, fault detection condition of lamp tubes and environment sensors monitoring. The main characteristic of the embedded system is its non-master capability, allowing implementation of a novel fully functional CAN bus lighting network with a reliable two wire remote control. Applications for this CAN bus lighting network include building management or studio lighting where it is desired to control lamps for saving energy consumption, performing lamp maintenance or creating precision lighting effects.

I. INTRODUCTION

The term "intelligent lighting system" refers to a system where multiple lighting fixtures are connected to a network, The intelligent lighting system providing the necessary light dimming and on/off to desired location actually construct a fundamental experiment system based on that concept; and verify the effectiveness of the newly developed control method. . The use of electronic embedded systems for driving fluorescent lamps has been notably increased in last years, the main reason is their extensive advantages compared with electromagnetic ballasts. The design goal has been extended to provide the right light using more efficient systems with design issues like: low harmonic distortion, high power factor, light dimming and maintenance-oriented features, reducing in this way lighting energy consumption and maintenance time response. One important lighting feature is the lamp remote controllability, which requires lamp capability to send and receive useful information, using some reliable communication protocol through a network, and allowing a complete remote control of a lighting environment.

The Controller Area Network (CAN) is an asynchronous serial CSMA/CD communication protocol for microcontrollers networks, supporting distributed real-time control with a very high level of security. CAN communication protocol is based on a distributed scheme, there is no central unit, allowing a direct data transfer between any two or more nodes without a master node mediation. The Standard ISO 11898 defined CAN bus as a two wire reliable protocol for high-speed applications. A standard CAN bus configuration is implemented with CAN nodes composed of: microcontroller, CAN controller and CAN transceiver, an N nodes network is shown in Figure 1.

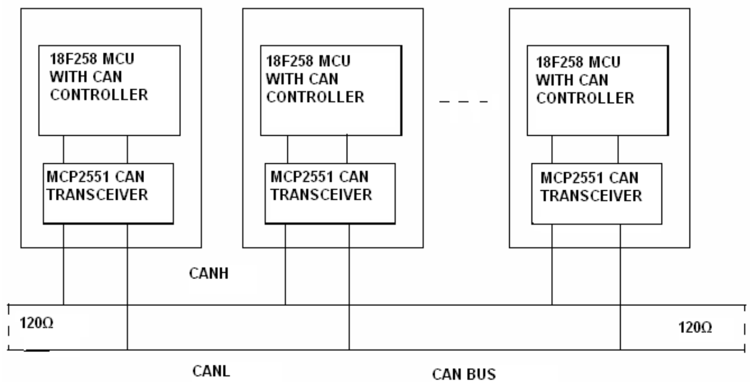


Fig1. General Can Bus Standard Configuration

The identifier field length of CAN 2.0B protocol is 29 bits. Data frames are used to transmit up to 8 bytes of information from one specific CAN node to one or several CAN nodes. An 29 bits identifier field length allows more than 2048 available identifiers or logical addresses, where each one can be assigned as one specific functional node. J1939 provides a communication protocol over a CAN network. The CAN network is comprised of two or more interconnected Electronic Control Units (ECUs).As per the SAE J1939-11 specification. The ECUs are connected using linear shielded twisted pair wiring, with a data rate of 250 Kbits/second.

II.BASIC CONCEPTS OF CAN

CAN has the following properties

- Prioritization of messages
- Guarantee of latency times
- Configuration flexibility
- Multicast reception
- Multimaster
- Error detection and signaling
- Automatic retransmission of corrupted message as soon as bus idle again

29 BIT MESSAGE IDENTIFIER

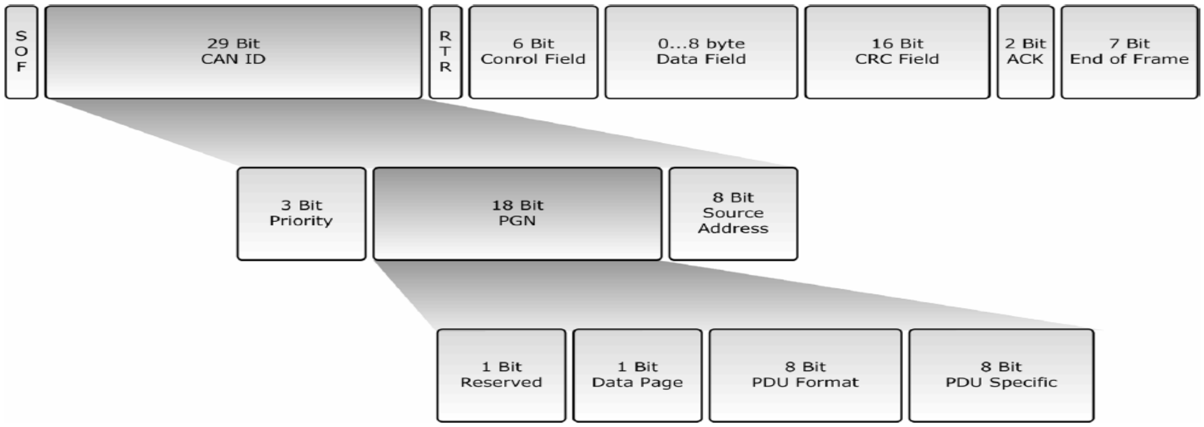
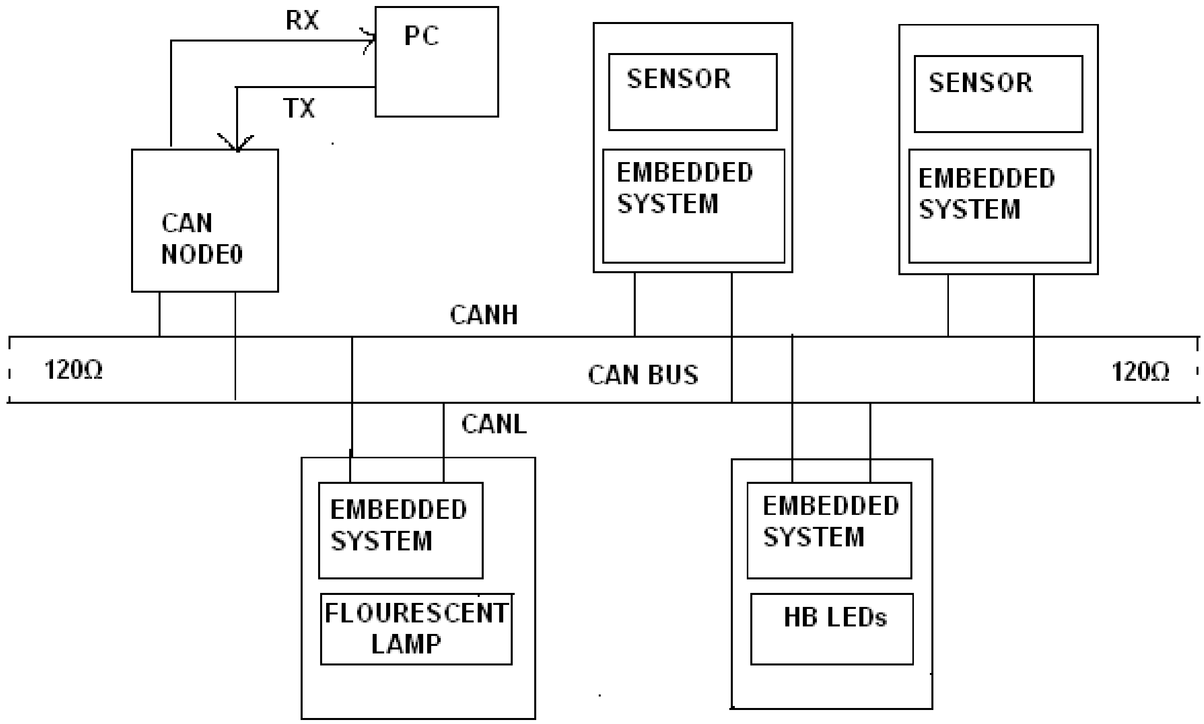


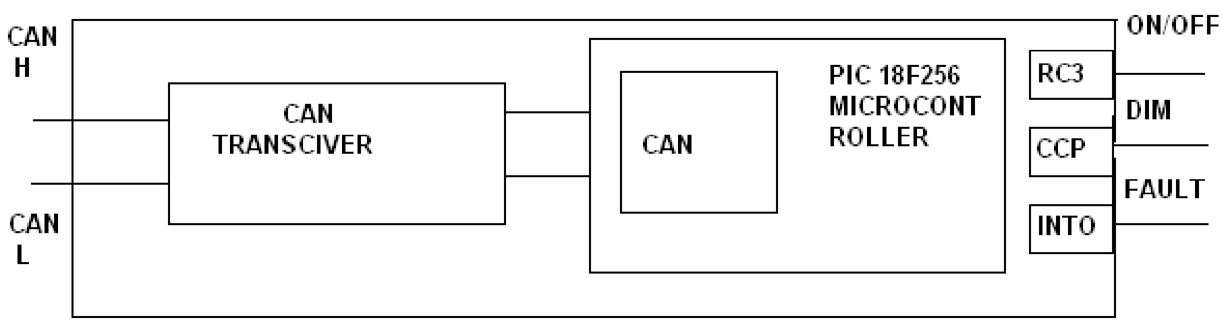
Figure 2

III.FUNCTION OF LIGHTING NETWORK

The defined network functions include: dimming and turning on/off for individual or group of lighting lamps, environment sensors monitoring and fault detection condition such as lamp removal, end of life or broken tube. The daylight sensor will sense the light intensity and gives analog voltage as input to the controller. Using the analog voltage the controller will generate corresponding PWM signal. The duty cycle of the PWM signal will control the dimming operation. The dimming level voltage is obtained from the average voltage of a 40 kHz PWM signal, generated within the Compare/Capture/PWM (CCP) module, through RC filtering. Occupancy sensor will sense the presence or absence of the image and send the analog value to the controller. Then the RC3 microcontroller pin controls the ON/OFF signal. The fault detection condition triggers external interrupt event and the corresponding interrupt service routine (ISR) sends a warning through the lighting network.



Block diagram of lighting network using CAN bus

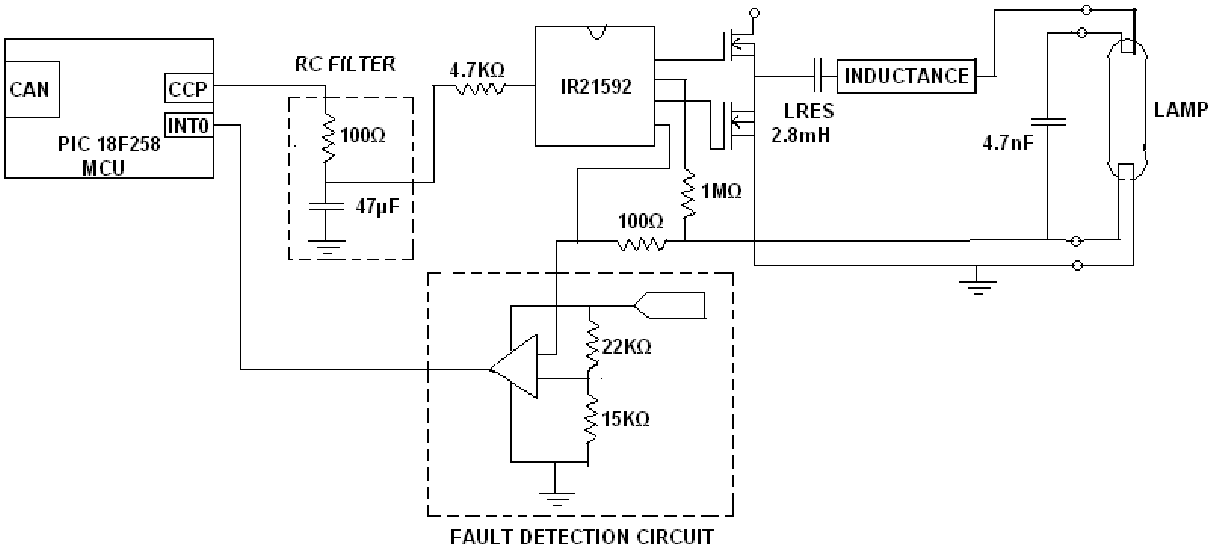


Block diagram of embedded system

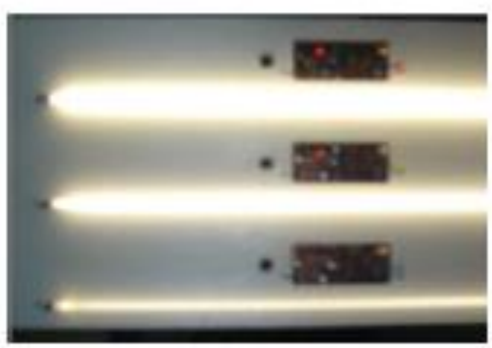
Each CAN network node has an individual and unique assigned 29 bit identifier. The addressing map is divided to achieve the lighting group control, where each lighting lamp has two identifiers: an individual and a group one. Also some identifiers are reserved for the environment sensors to send data through the lighting network. a PC-node communication one or a group of specific lighting lamps is requested to execute a network function in two phases. First the function command is sent through the PC serial port to CAN node 0 as a 4 bytes code. This code indicates both the instruction to be executed and the specific node (or group) identifier to be applied on. In second phase the CAN node 0 transmits the instruction code as a CAN data frame to the addressed node (or nodes), where identifier field includes the 11 bits identifier

International Conference on New Horizons in Science Engineering Technology (NHSET-2018)
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 4 | Issue 5 | ISSN : 2456-3307

and data field includes one byte instruction code. In the same way two phases are done in a node-PC communication where a specific node message is received by the PC, such as lamp fault condition or sensor monitoring. In first phase a CAN data frame is sent by the specific node to the CAN node 0, including its 11 bits identifier and a fault message code. In second phase CAN node 0 sends the received message code and node identifier, through the serial port, to the PC in a 5 byte format.



Circuit of microcontroller connected to fluorescent lamp & fault detection



Fluorescent lighting lamp at 100%, 50%, 10%.

In the below Figure is shown an individual lighting dimming test for the three fluorescent ballasts controlled through the CAN node 0 operating at 100%, 50% and 10%. The obtained power values were: 27.77 watts, 15.79 watts and 3.37 watts, respectively. As the results show the proposal successfully performed the lighting dimming function, in the same way all other defined functions were accomplished.

IV.CONCULSION

The embedded system based on CAN bus protocol for two wire remote monitoring and controlling of lighting networks is presented. The embedded system was implemented in a small prototype lighting network with three fluorescent lamps, one HBLED lamp, and two environment sensors namely occupancy and daylight sensor were used. According to obtained results the proposed system performed established network functions successfully, allowing the implementation of a novel fully functional CAN bus lighting network with a reliable remote control. The non master-slave scheme characteristic of CAN bus protocol allows the addition of intelligent lighting network features.

V.REFERENCES

[1] T. Marchesan, G. Dernardin, R. Silveira, A. Campos, and R. Prado, "Development of a control fieldbus for HPS electronic ballasts using power lines," Proc. of 35th Annual IEEE Power Electronics Specialist Conference, Aachen, Germany, pp. 3593-2596, 2004.

[2] K. Kutluay, I. Cadirci, A. Yafavi, and Y. Cadirci, "Dual 8b microcontrollers–digital control of universal telecommunication power supplies," IEEE Ind. Appl. Magazine, vol. 12, no. 1, pp. 59-67 Jan/Feb 2006.

[3] C. Contenti and T. Ribarich, "Digitally Addressable DALI Dimming Ballast," Proc. Applied Power Electronics Conference and Exposition, Dallas Texas, USA, pp. 936-942, 2002.

[4] J. M. Alonso, J. Ribas, J. J. del Coz, A. J. Calleja, E. L. Corominas, and M. Rico-Secades, "Development of a distributive control scheme for fluorescent lighting based on LonWorks technology," IEEE Trans. On Industrial Electronics, vol. 47, no. 6, pp. 1253-1262, Dec. 2000.

[5] M. Miki, T. Hiroyasu, and K. Imazato. "Proposal for an intelligent lighting system, and verification of control method effectiveness," Proc. on IEEE Conference on Cybernetics and Intelligent Systems, pp. 520-525, ingapore, 2004.

[6] ALONSO J M, RIBAS J, DEL COZ J J, CALLEJA A J, LOPEZ E, RICO-SECADES M Intellignt Control System for Fluorescent Lighting Based on LonWorks Technology. Proc IEEE IECON, Vol.1998, No.Vol.1, Page92-97, (1998)

[7] 1. A Comprehensible Guide to Controller Area Network by Wilfried Voss

[8] J1939-based application profiles by Holger Zeltwanger – CiA.