CONTROLLER AREA NETWORK FOR MONITORING AND CONTROLLING THE ENVIRONMENTAL PARAMETERS USING ZIGBEE COMMUNICATION

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ABSTRACT
Various parameters in the industries and automobiles can be monitored and controlled using ZigBee Communication integrated with CAN bus network. The method has been implemented in order to reduce the usage of wires used for communication purpose. In this paper sensors are used to sense the variable parameters and the CAN protocols are used for the transmission and reception purpose along with ZigBee. The data transmission rate will be higher than other wireless systems. This application is user friendly and can be achieved at a low cost.

KEYWORDS: CAN (controller area network), ZigBee.

I. INTRODUCTION
When we consider a industry of large area the monitoring, controlling of each section involved in the industry is a big task. It involves a large amount of man power and time consumption. To overcome these above factors we developed this technology makes use of single person for monitoring and controlling the entire network. This can be achieved with the combination of both wired and wireless technologies i.e. CAN bus network with the Zigbee technology, which is the main objective of our paper. This technology is a cost effective one and it is used in various applications like industries, automobiles and home.

The rest of the paper is organized as follows. The experimental setups are shown in section II. In section III protocols used are described. The results are shown in section IV. Finally, the conclusions are given in section V.

II. EXPERIMENTAL SETUP
A. Sensors Specification
In our experimental setup, various sensors are connected to the ATME 89S52 which acts as a slave node. These sensors sense the various environmental parameters like temperature, humidity, light, gas.

B. Transmitting Section

![Fig-1. Block Diagram of transmitter Section](image)

In the experiment the functions of the transmitting section as described as follows. The variable parameters which are sensed by the slave nodes are controlled by the master controller and the datas are transmitted using zigbee. The master controller AT89S52 is programmed in such a way that the parameters are sensed periodically and transmitted. The CAN protocol are effectively used for achieving higher data rate. The loads can also be operated by the master controller.

C. Receiving section:
The various parameters can be controlled on the receiver side by connecting the receiver section with a personal computer. The zigbee module at the receiver side is used to receive the data.

![Fig-2. Block Diagram of Receiving Section](image)

III. PROTOCOL AND HARDWARE
A. CAN-controller area network
CAN is one of the field bus control system type used in networking. It is a message based protocol device. The communication can be achieved between various devices using CAN protocol. The CAN bus can be used to connect the control unit, transmitting and receiving unit. In this paper CAN bus is used in automation environment, which is primarily due to low cost. The multimaster node CAN is able to send and receive messages but not simultaneously.

The message consists primarily of an id which represents the priority of the message. The data’s are transmitted serially on to the bus. This signal pattern is encoded in NRZ form and sensed by the nodes. whenever the bus is free the most dominating message will be executed first and the lower priority will sense these and will back-off.

Bit rate is up to 1MB/S are possible at network length below 40m and decreases with increase in network distance. Since the CAN shifts the voltage level the differential signal CANH and CANL are used. Carrier senses multiple access protocol with collision detection and arbitration on message priority are two types of protocols used in CAN. Error control mechanism such as CRC is used to ensure sensor data integrity. Both the remote frames and the overload frames are used for flow control mechanism.
B. ATML 8952

Low-power, high-performance CMOS 8-bit microcontroller with 8KB of ISP flash memory. The device uses Atmel high-density, nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pinout. On-chip flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer.

Table 1. Features of Atmel

<table>
<thead>
<tr>
<th>Features</th>
<th>ATML 8952</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM (bytes)</td>
<td>128</td>
</tr>
<tr>
<td>ROM</td>
<td>4K</td>
</tr>
<tr>
<td>Timers</td>
<td>2</td>
</tr>
<tr>
<td>Serial port</td>
<td>1</td>
</tr>
<tr>
<td>I/O pins</td>
<td>32</td>
</tr>
<tr>
<td>Interrupt sources</td>
<td>6</td>
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</tbody>
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C. ZigBee

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. Applications include wireless light switches, electrical meters with in-home-displays, and other consumer and industrial equipment that require short-range wireless transfer of data at relatively low rates.

The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbps best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. ZigBee is a low-cost, low-power, wireless mesh network standard.

The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide.

Data transmission rates vary from 20 to 900 kilobits/second. The ZigBee network layer natively supports both star and tree typical networks, and generic mesh networks. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node.

Both trees and meshes allows the use of ZigBee routers to extend communication at the network level. ZigBee builds upon the physical layer and medium access control defined in IEEE standard 802.15.4 (2003 version) for low-rate WPANs. The specification goes on to complete the standard by adding four main components: network layer, application layer, ZigBee device objects (ZDOs) and manufacturer-defined application objects which allow for customization and favor total integration.

Besides adding two high-level network layers to the underlying structure, the most significant improvement is the introduction of ZDOs. These are responsible for a number of tasks, which include keeping of device roles, management of requests to join a network, device discovery and security. ZigBee is not intended to support powerline networking but to interface with it at least for smart metering and smart appliance purposes.

Because ZigBee nodes can go from sleep to active mode in 30 ms or less, the latency can be low and devices can be responsive, particularly compared to ZigBee wake-up delays, which are typically around three seconds. Because ZigBee nodes can sleep most of the time, average power consumption can be low, resulting in long battery life.

IV. PROPOSED RESULT

In this method the integration of wired and wireless technology is achieved by using CAN and Zigbee. In previous days manual monitoring and control was used. The wireless technology applied also has lower data rates. In this paper the above disadvantage has been overcome using CAN which makes use of only two nodes. The paper gives the method of accurate and reliable transmission of data without data loss. The RS 232 is used as an interface between the master controller and Zigbee. The datas are saved in a PIC microcontroller and then gets transmitted. The
transmitting and receiving sections can send and receive data and also the receiver can send control signals to the transmitter. The efficiency of this system is much higher than any other systems in use. This tends to be an accurate one since the intelligent device uses encoding and decoding method for communication. The main advantage of using this system is because of its high data rates. The comparison of data rates of existing and proposed technique are shown in graph 1. More over the number of nodes is also reduced by using CAN protocols. Graph 2 shows the number of nodes that can communicate in zigbee, Bluetooth and CAN.

Graph 1: Comparison of data rates

Graph 2: Comparison of number of nodes used

IV. CONCLUSION
This paper has been proven to be the cost effective one for communications in a specified area. In future this technology can be extended using other wireless technologies. The technology is expected to be used in medical field for maintaining patient’s record.

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