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Industrial Parameter Monitoring System Using CAN Bus

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Abstract: CAN bus network can be used to monitor and control various parameters in the industries. Large amount of man power and time consumption is required for monitoring and controlling industrial parameters. User safety is also very important factor in Industrial areas and hence unmanned operation is always preferred over manned operation. To overcome the need of huge man power and time consumption this technology was developed which makes use of single person for monitoring and controlling the entire network. Using this method we can reduce the usage of wires and the errors relating to data transfer using CAN bus. In this system variable industrial parameters are sensed by different sensors and this is transmitted to the PC and if any fault recognized the message is sent to the mobile so as to avoid the critical condition. CAN protocols are used for error free data transmission and data reception purpose, ARM7 is used for programming the CAN controller. Compare to other wireless systems the data transmission rate will be higher in this system. This application can be achieved at a very low cost and also user friendly.

Keywords: CAN (Controller Area Network), VB (Visual Basics), LCD (Liquid Crystal Display).

I. INTRODUCTION

User safety is a very important factor in Industrial areas and hence unmanned operation is always preferred over manned operation. Monitoring and controlling of each section involves a big task in a very large area of industries. In an industry we have many tasks to perform at a time so for every task a person is employed to monitor and control them the industry has to invest huge amount for man power and apart from the above case human errors can lead to a huge lose to the industry.

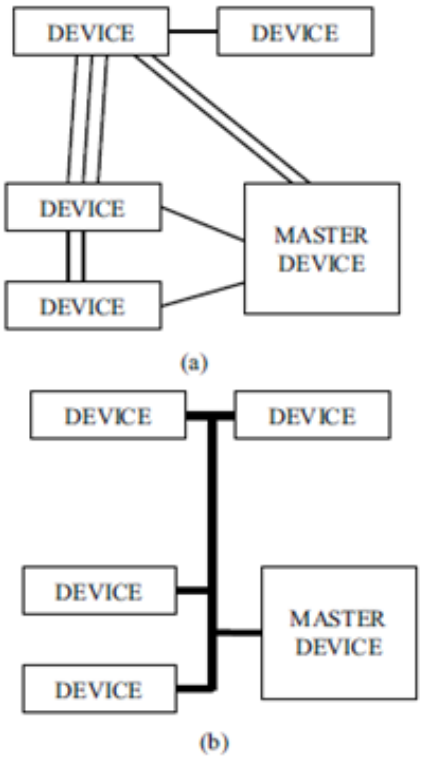

Figure 1: Difference between (a) traditional wiring and (b) CAN methods

A large amount of man power is required and also time consumption. So to overcome these above disadvantages we developed this technology which 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 CAN bus network. It has an alarm which facilitates the safety needs of industry. It alarms the workers of the critical conditions in the industry. It also allows us to schedule task and supports total unmanned operation of the plant.

CAN bus have been widely used in sensors, industrial, data acquisition, instrument device and control systems, and with high reality, reliability, and flexibility.

This paper gives a kind of design of CAN bus for monitoring and controlling the various parameters, which includes CAN bus nodes, sensors network and the whole network architecture. This technology is a cost effective one and it can be used in various applications like medical field, industries, automobiles, and home.

II. HARDWARE-SOFTWARE REQUIREMENT

Hardware LPC2129 controller, different sensors, switches, MCP 2551 CAN controller, CAN cable, smart card, matrix keyboard, RS-232, power supply. Software VB software, Embedded C flashing & debugging tool, Keil software.

III. SYSTEM DESCRIPTION

In our system various sensors are connected to the ARM-7 which acts as a slave node. Sensors sense the various industrial parameters like temperature, accelerometer, fuel level, fire, light and gas and also connected POT.

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3.1 Transmitting Section

In the transmitting section, different sensors like temperature, gas, light, fire connected to the one ARM-7 microcontroller and fuel level sensor, accelerometer are connected to the second ARM-7 microcontroller as shown in the below figure2. These sensors sense the various parameters like temperature, vibration, fire, fuel level, light, gas. These variable parameters are sensed by the slave nodes are sent to the master controller through can bus and can controller using the can protocol. The master controller is programmed in such a way that the parameters are sensed periodically and transmitted. To achieve higher data rate the CAN protocol are effectively used. Master controller can operate the load. The master controller controls the sensor to come below the cutoff point if the value of any sensor is above the cutoff point. The master controller receives the data from the slaves and processes that data to the PC through RS232 serial port. The various nodes on the transmitting section can be monitored on the receiver side by.

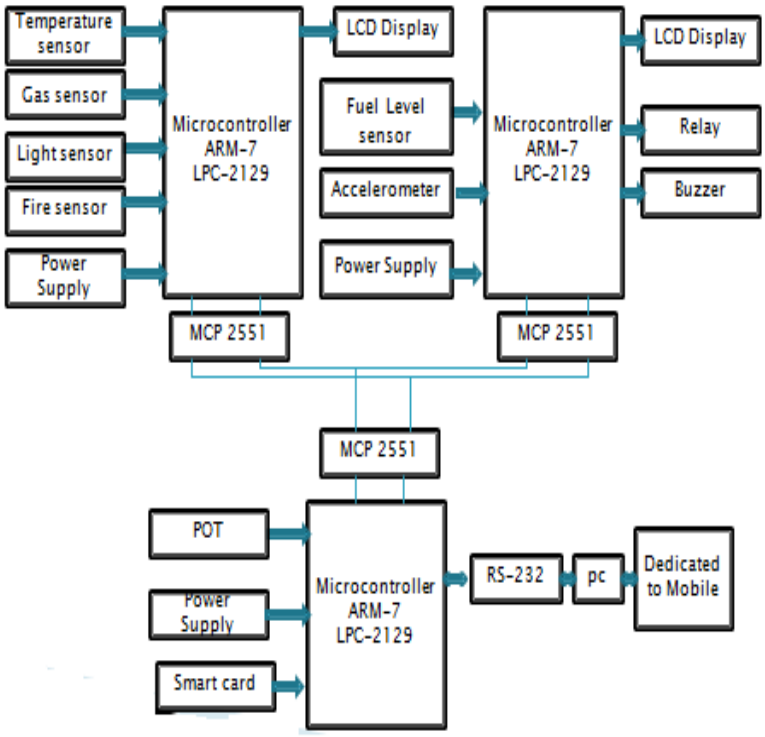

Figure 2: Block diagram of CAN based industrial parameter monitoring system.

3.2 Receiving Section

If anything is going abnormal, the user can control the devices at the other end. These values get updated in the personal computer for later verification

3.3 Block Diagram Description

- Liquid Crystal Display-

LCD is used in a project to visualize the output of the application. LCD can also used in a project to check the output of different modules interfaced with the microcontroller. LCD plays a major role in a system to see the output and to debug the system module wise in case of system failure in order to rectify the problem.

- Microcontroller LPC 2129-

It is a 16/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package. This IC is having 16kB on-chip Static memory. Two interconnected CAN interfaces with advanced acceptance filters. It is also having 128/256 KB on-chip flash memory. 128-bit wide interface/accelerator enables high speed 60 MHz operation. Up to forty-six 5V tolerant general purpose I/O pins present in this IC.

- Analog and digital sensors-

Different analog & digital sensors are used to represent vehicle different parameters. These parameters further diagnosed by creating the faults. Hence signals are generated with the help of these sensors for vehicle signal acquisition & fault diagnosis.

- CAN controller area network

CAN is the field bus control system type used networking. It is a message based protocol device. Using CAN protocol the communication can be achieved between various devices. Control unit, transmitting and receiving unit can be connected together using CAN bus.

In this paper CAN bus is used in industrial environment, which is primarily due to low cost. The multi-master node CAN is able to send and receive messages but not simultaneously. The priority of the message is represented by primarily id of that message. The data's are transmitted serially on to the bus. According to the priority of the message most dominating message will be executed first and the lower priority will sense these and will back-off. Using the CAN bus up to 1MB/S bit rate 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

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protocols used in CAN. To ensure sensor data integrity error control mechanism such as CRC is used. For flow control mechanism both the remote frames and the overload frames are used.

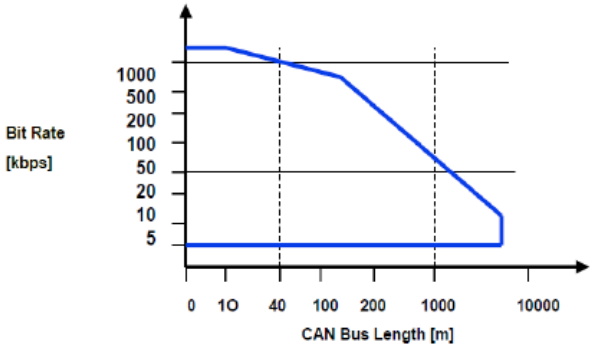

Figure 3: CAN bus length versus bit rate

User can set the communication speed and bus length according to the system. The CAN bus consists of two wires (CAN-High and CAN-Low), and via a transceiver the CAN controller is connected to those two wires. By a potential difference between the CAN-High and CAN-Low wires the bus level is determined.
There are two bus levels 1) Dominant 2) Recessive. The bus assumes either dominant or recessive level at any given point of time. The dominant and the recessive levels are recognized as a logic 0 and logic 1 respectively for logically wire-ANDd buses. By changing these bus levels a transmit unit can send a message to receive units. CAN nodes have the ability to determine fault conditions and transition to different modes based on the severity of problems.

IV. EXPERIMENTAL METHODOLOGY

A. General Working steps

- Two units are used for machine monitoring & diagnosis. Monitored signal parameters will be displayed on respective LCDs of two controllers.
- By using the CAN protocol the data transmission rate increases. The system deals with data transmission between the different units at exact time.
- If any fault is recognized while monitoring parameters that message will be displayed on LCD.
- And it is also display on the PC of the user with the proper message.
- If any fault is found in the machine then system will send a pre-generated SMS to dedicated mobile.

B. Project workflow for individual controller with CAN, LCD & other sensor parameters.

- Start
- Initialize LCD
- Display Project name
- Node " A"
- Select channel1 of inbuilt ADC of ARM
- Store and display machine Temperature on LCD
- Wait for 1 second
- Select channel2 of inbuilt ADC of ARM
- Store and display gas on LCD
- Wait for 1 second
- Read the Digital I/P 1
- Store in µC RAM
- Read The Digital I/P 2
- Store in µC RAM
- Read The Digital I/P 3
- Store in µC RAM
- Read The Digital I/P 4
- Store in µC RAM
- Has CAN bus interrupt detected? NO→" A"
- Yes→ Read the identifier from CAN frame, If identifier is matched then send the sensor data stored in RAM to terminal on CAN bus
- Send the data received from CAN bus stored in µC RAM to PC via RF module
- Go to " A"

V. SIMULATIONS AND RESULTS

A. Hardware results

As describe in the block diagram, LCD displays the Industrial parameters & Diagnosed fault parameter respectively
If any error or fault occurs in any of the sensors used for machine then error message displayed on LCD & also same error message sent to PC.

Following is the snaps LCD showing temperature and gas sensors monitored signal parameter values

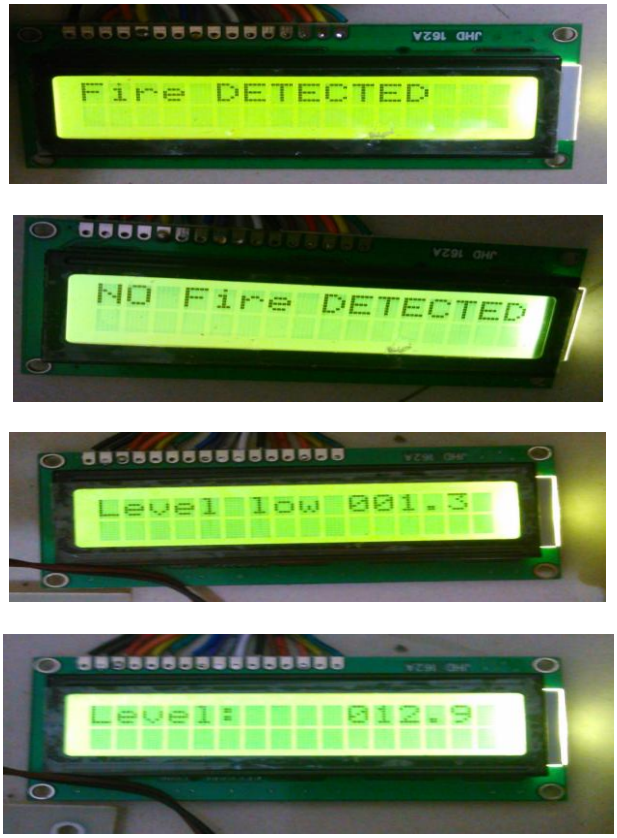

Figure 4: sensors values on LCD.

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B. Software results

VB widow are used at the control end with one dedicated mobile. If any fault is detected then the reading is also display on the PC on VB window so as to control the machine. On VB window different readings of sensor is measured so as to check it' s status according to the standard values and if it exceeds or is low than standard one the error message is display on the screen.

Following is the VB window showing corrective action message for fault occurred in machine parameters.

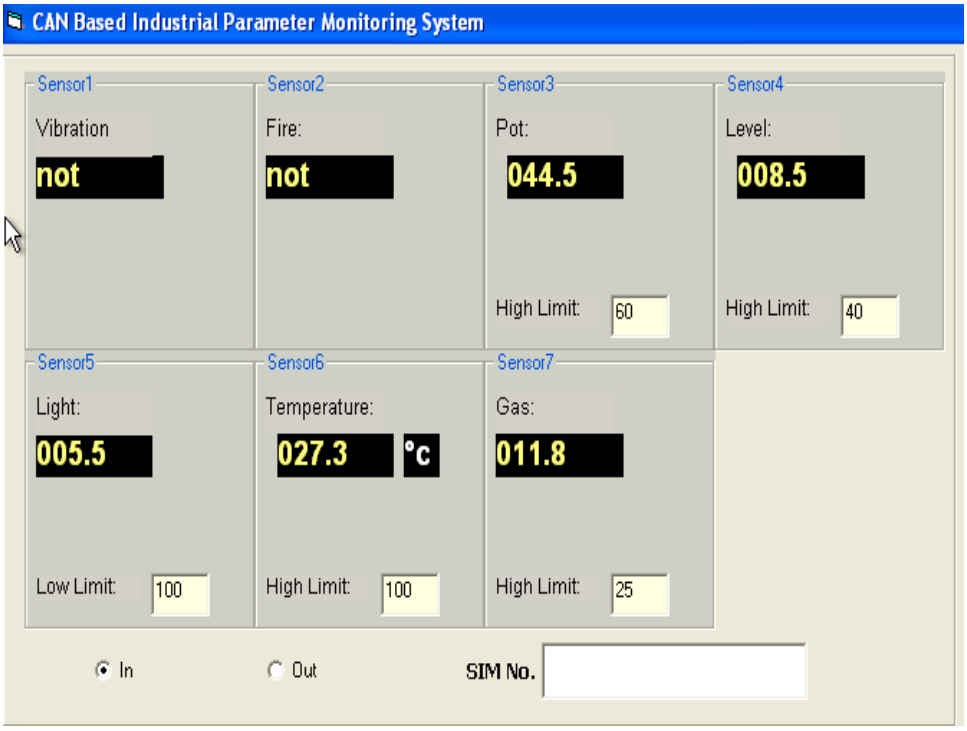

Figure 5: Monitoring on computer of different sensors using VB

VI. SUMMARY AND FUTURE WORK

In previous days manual monitoring and controlling was used for machines in industry. We are using CAN bus to overcome this disadvantage which makes us useful in the designing of number of CAN nodes. Using this system we can transmit the data with more accurate and reliable form without data loss. The data from the slave nodes are transmitted to master controller. The transmitting section will send the data and receiver can check the data in the personal computer. Than any other systems in use the efficiency of this system is much higher.

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