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Sensor Network for Monitoring Physiological Signals of Multiple Patients Using can Bus

Ms. Prerana Thool*1, Ms. Sonali Pal2, Ms. Vibha Rani3

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Abstract

The project makes use of CAN technology to sense and transfer the physiological signals and parameters of a patient's body. With the help of the project, efficient medical services can be provided to the patient in appropriate time. A microcontroller board is used for analysing the signals from patient's body. If any abnormal value is sensed, the monitoring system gives intimation by raising alarm on the receiver side which are generally in doctor's cabin or monitoring room. All the process parameters will be seen at the hyper terminal window on the computer on receiver's side. This project is designed to monitor pulse rate and body temperature of a patient's body and has been designed considering two patients. It can be achieved using CAN technology. At present this kind of high speed and continuous patient monitoring system has not been implemented

Currently, the continuous manual monitoring is done which consumes lot of time and also increases the skilled manpower. This project shall cover the flaws of speed and interfacing problems of the existing system. This increases the efficiency of hospital staffs and improves the comfort of patients and makes monitoring easier. Another most important point is that system makes sure the parameters of different patients do not get mixed up and are sent by the right name of the patient and recorded accordingly as well, only if needed.

For providing high transmission speeds, this project has been designed as a system that uses CAN protocol which has a high data rate of 1 Megabyte per second at 1 Megahertz frequency.

Keywords: CAN technology, Real time, Physiological signals, sensors.

Introduction

With the use of high performance and fault tolerant wired layout, parameters like Temperature and Pulse rate are taken using sensors from patient's body and transferred to doctors' computer using CAN technology [2]. A Body Sensor Network (BSN) is established at a medical aid providing centre, to eliminate medical errors and reduce workload of nurses and doctors.

Interest among research groups in developing system for recording and monitoring the physiological parameters on real time basis (e.g. ECG, EEG, EOG, EMG, pulse Oximetry, blood flow, blood pressure etc.) from the human body is increased [3]. But here, we are taking Temperature and Pulse rate as parameters into consideration. Most of the current efforts have mainly been focused on the devices that are monitoring sensor signals only from a single patient's body.

Monitoring many physiological signals from a large number of patients at the same time is one of the current needs in order to deploy a complete efficient sensor network system in medical centres. Such an application presents some challenges in both software and hardware designs. Some of them as follows: reliable communication by eliminating collisions of two patients' signals and interference from other external devices, low-cost, low power consumption and providing flexibility of relocating patients anytime.

This work presents a heterogeneous sensor network system that has the capability to monitor physiological parameters from multiple patient bodies (here 2 patients), by means of Medical communication standard MICS (Medical Implant Communication Service) [4]. Instead of applying available standards, this project is designed with hardware operating at the MICS band for data collections from sensors.

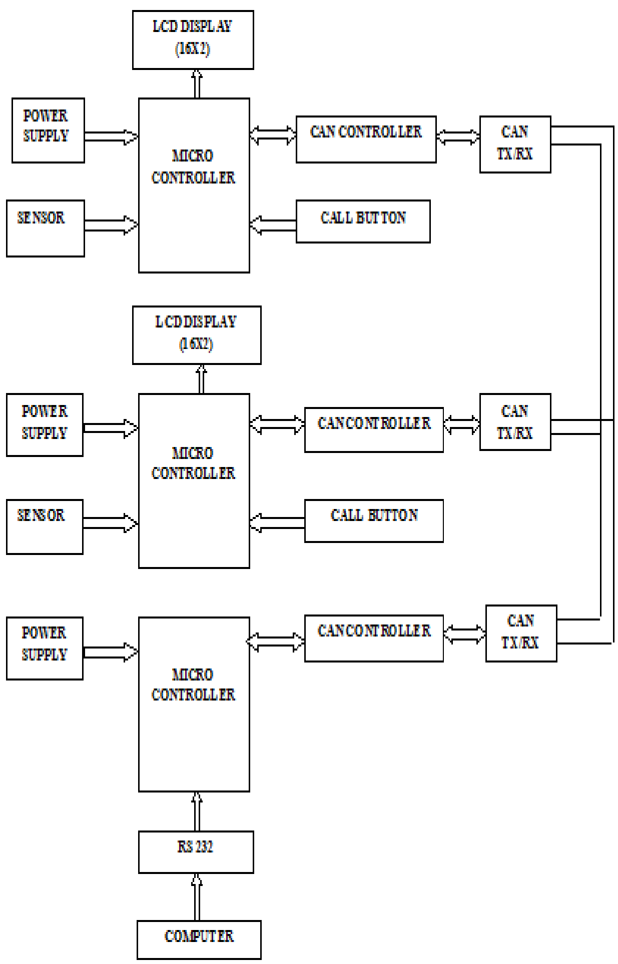
The system targets both implanted and on-body (i.e. external) nodes. Previously, a MICS based BSN had the capability of simplex communication and only allowed one patient's condition to be

monitored locally (i.e. a single body sensor network). But, in our project more than one patient can be monitored simultaneously.

Block Diagram

The system consists of following components:

- AVR Atmega16
- CAN Controller (MCP2515)
- CAN Transceiver (MCP2551)
- Sensors
  -Pulse Rate sensor (infra-red sensor)
  -Body Temperature sensor.
- LCD (16*2)
- Laptop or PC



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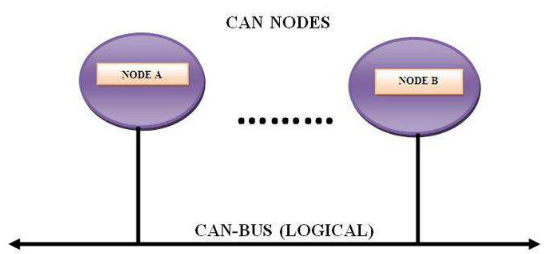
The threshold values taken for this system is 60 to 100 pulses per minute for heart beat. This reference values are taken for the age of above 10 years [9].The reference value for Temperature is 25°C to 39°C [10]. This information of pulse rate and body temperature is then transmitted through CAN bus to the doctor who is not in the vicinity of the patient.

The sensors measure the parameters and transmit it through CAN Protocol, which is a function provided in our microcontroller ATMega16.

CAN Protocol and Operation

Every electronic device (also known as the node) which needs to communicate using the CAN protocol is connected with each other via a common serial bus to transmit and receive messages [5].



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Every node has a Host controller which is responsible for the functioning of the respective node. In addition to the host controller every node has a CAN controller and CAN transceiver. CAN controller convert the messages of the nodes in accordance with the CAN protocols to be transmitted via CAN transceiver over the serial bus and vice versa.

CAN does not follow the master-slave architecture which means every nodes has the access to read and write data on the CAN bus. When the node is ready to send data, it checks availability of the bus and writes a CAN frame onto the network. A frame is defined structure, carrying meaningful

sequence of bit or bytes of data within the network. CAN transmitted frame does have address neither of transmitting node or the receiving node. CAN is a message based protocol. A message can be defined as a packet of data which carries information. A CAN message is made up of 10 bytes of data.

The data is organized in a specific structure called frame and the information carried in every byte is defined in the CAN protocol. Protocols are generally of two types: Address based and Message based. In an address based protocol the data packets contain the address of the destination device for which the message is intended. In a message based protocol every message is identified by a predefined unique ID rather than the destination addresses. All nodes on CAN receive the CAN frame and depending on ID on the node CAN decides whether to accept it or not. In our project we are using address based protocol.

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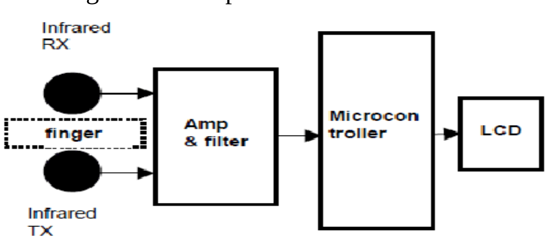
Pulse rate sensor:

Pulse rate sensor works on a very basic principle of optoelectronics. All it takes to measure the pulse rate is an infrared LED and a photodiode sensor [6].

Most of the light is absorbed or reflected by our organs and tissues (skin, bone, muscle, blood), but some light will pass through our tissues if they are thin enough. When blood is pumped through body, it gets squeezed into the capillary tissues, and the volume of those tissues increases very slightly. Then, between heart beats, the volume decreases. The change in volume affects the amount of light that will transmit through the finger tip. This fluctuation is very small, but can be sensed with electronic devices. Sensor will detect the heart beat/pulse and count the pulses to get the beats per minute.



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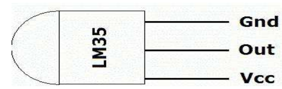

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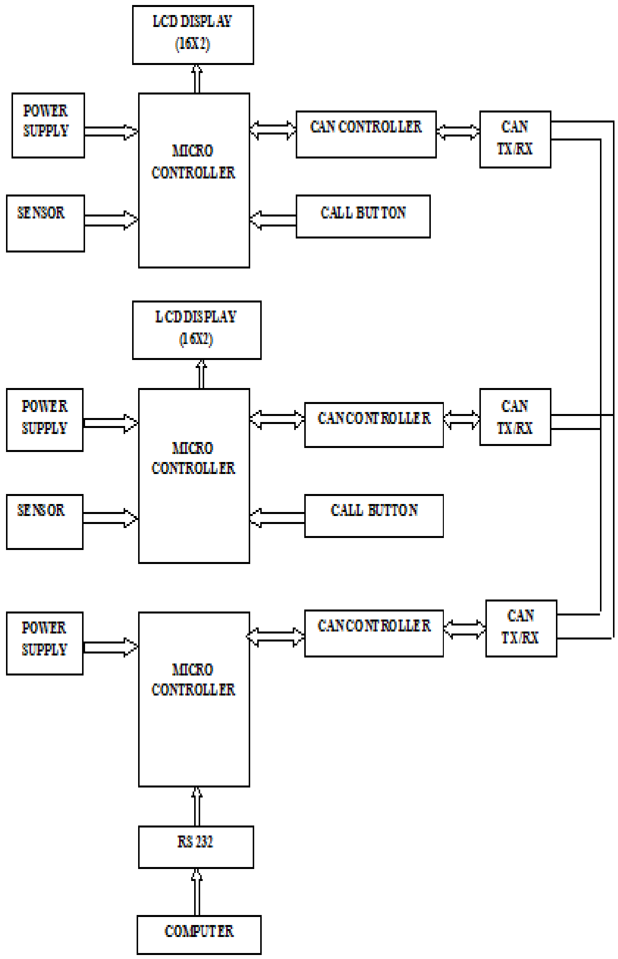

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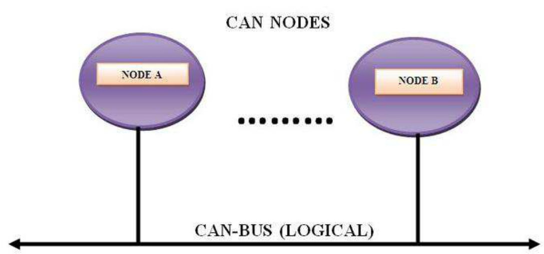

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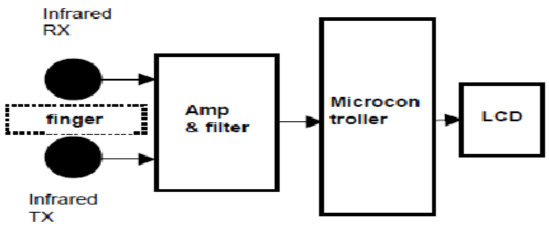

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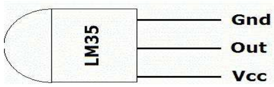

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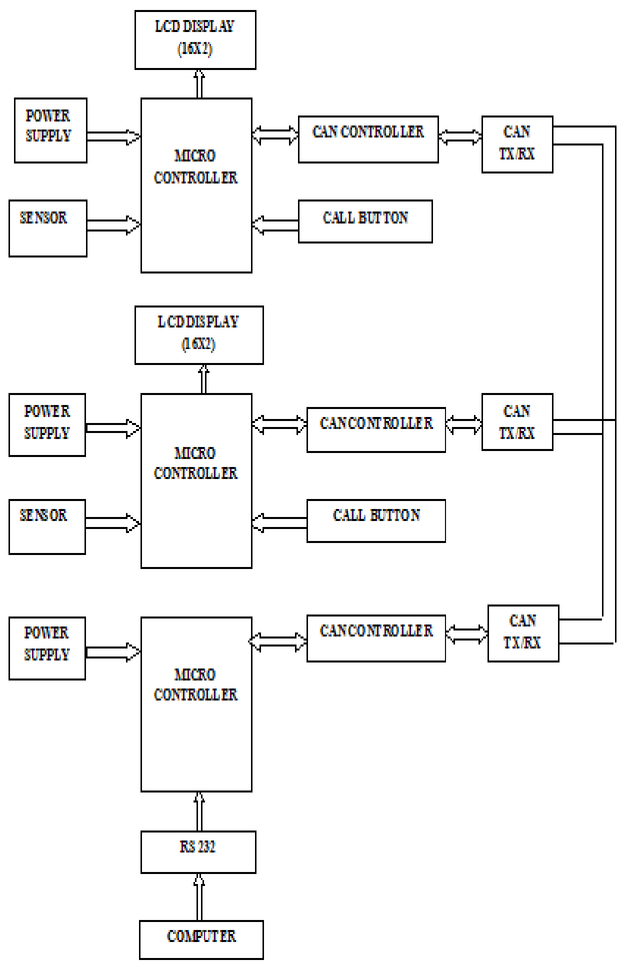

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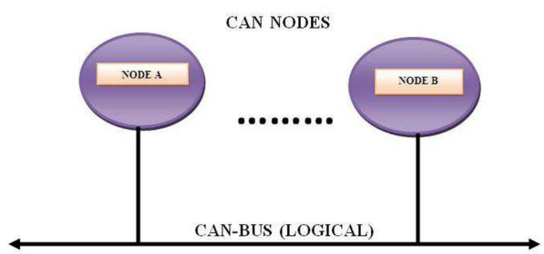

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Pulse rate sensor:

Pulse rate sensor works on a very basic principle of optoelectronics. All it takes to measure the pulse rate is an infrared LED and a photodiode sensor [6].

Most of the light is absorbed or reflected by our organs and tissues (skin, bone, muscle, blood), but some light will pass through our tissues if they are thin enough. When blood is pumped through body, it gets squeezed into the capillary tissues, and the volume of those tissues increases very slightly. Then, between heart beats, the volume decreases. The change in volume affects the amount of light that will transmit through the finger tip. This fluctuation is very small, but can be sensed with electronic devices. Sensor will detect the heart beat/pulse and count the pulses to get the beats per minute.

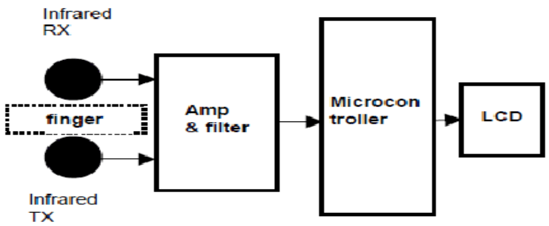

Fig: Pulse rate transmission and display

Body Temperature sensor:

Project will make use of temperature sensor LM35, which senses the patients' temperature and gives the corresponding voltage output at its output pin. This output voltage when multiplied by 100 gives the temperature sensed in degrees. By using this fact the reference can be set accordingly [7].

For every degree rise in temperature, its output voltage increases by 10 milivolt, and this can be calibrated too. LM 35 is highly preferred as it possesses low self-heating and does not cause more than 0.1^{o}C temperature rise in still air.

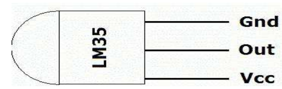

Fig: Temperature sensor

Results and Discussion

The present available systems deal with the observation of physiological signals (body temperature and pulse rate) and noting it on the basis of manual method for pulse rate and thermometer for body temperature. The manual method takes comparatively more time since medical personnel has to take out time for monitoring, who at times may get late and there is delay in observations. Also, minimum time to know body temperature and pulse rate is one minute. The implementation of this paper shall make continuous temperature monitoring possible with pulse rate being observed as and when wished by the medical in-charge with the press of single button.

Fig: Transmitter for 1st patient

A comparison of manual methods against this idea showed that the system produces more accurate results and is comparatively quicker by a good margin. This will save time and manual work and make looking after a patient by the doctor easier.

The receiver board has provision of connecting it with computer and also has a liquid crystal display attached.

Fig: Transmitter of 2nd patient.

The values can be seen on computer screen via hyper terminal on receiver side continuously and also on the screen provided on patient's room board (transmitter board).

Fig: Receiver side board (in doctor's cabin)

The biggest aspect of the idea is to give accurate results, devoid of human errors and on a real time basis. The system runs as long as user wishes. The use of CAN technology makes sure the data travels at a fast speed of 1 Mbps via wires and there is no ambiguity in values or exchange of parameter values of one patient with another. The project emphasizes on giving this facility at a lower cost, in an efficient and reliable way.

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