Portable medical monitoring device for indoor environments with wireless optical communication capabilities

General introduction

A portable health-monitoring device for indoor environments has been implemented & will be demonstrated. Its main purpose is to diagnose various medical cases in indoor environments like an aircraft cabin (its initial target application), where the implemented application has been tested over an innovative diffused IR wireless optical network.

The device incorporates 4 types of sensors generating 5 different medical measurements, an electrocardiograph, a pulse oximeter, as well as blood pressure, body temperature, and respiration rate. Special software interprets the output of the medical device, which communicates with the sensors using an RS232 interface at 115200bits/s. The medical box utilizes 3 AVR microcontroller modules, from Alvidi GmbH. Two of these are controlling a pair of sensor modules each via standard UART interfaces. The third Master microcontroller controls and polls each "slave" module for acquired data using I^2C interconnection and forward them to the output port.

Special framing is also performed in order to be able to differentiate each stream of measurements from each other and represent the values of each measurement type. The framing and forwarding task it performed by an Atmel AVR 8-bit microcontroller operating at 16MHz.

The medical module communicates with a base station, which gathers information and stores it in a database. Each base station supports data acquisition from multiple modules in parallel. Diffused IR with alternating wavelength per medical modules is used and 10Mbit/s per modules using the standard 10Base-T protocol. The electrical 10Base-T is converted to optical voltage levels, amplified and driven to a high power LED array for transmission. On the reception side, a large area silicon PIN diode collects the light using a concentration lens for maximizing electrons

Demonstration

Because of the infrastructure required for the full cabin optical communication system, we will present the implemented devices separately. One part of the demonstration will be based on the diffuse in-cabin network, an extensive explanation on the network cellular architecture will be presented in conjunction to the physical implemented optical interfaces and their functionality. It is important to present some figures of merit regarding the link budget in terms of the optical transmitted power and BER. However, it is also essential explain the protocol stack (10Baset-Tx) that the system is based on and to analyze the differentiation on the physical layer with regard to the wired Ethernet.

On the other hand, we will demonstrate the portable health-monitoring device. An explanation of the inner core units of the medical box will be provided and demonstrated allowing a person to acquire a full health monitoring measurement (ECG, Blood pressure, pulse oximeter, temperature, respiration rate) and display them on the integrated LCD. The medical box has been build using commercial microcontroller modules offering 2 UART and I2C interfaces. Using the above properties, we have implemented a Master-Slave architecture, where two of the Slave microcontrollers are interfacing two simultaneous sensors and both of them forwarding the measurements to the Master microcontroller, via I2C, in order to output them via standard RS232 format. Special frames have been added encapsulating the health measurements and allowing the passenger identification throughout the network. The total data rate in a full-scale measurement is 5.4Kbit/s including the frame overhead. The overall application has been implemented keeping in mind that such measurements can be crucial and must not contain any transmission error.