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FPGA Based Real Time Wireless Communication for Tele Health Using Android Phone

P. Vivek Karthick, N. Renith, G. Srinidhi, S. Priyadharshini, M. Vidhya

Electronics and Communication Engineering, Kathir College of Engineering, Coimbatore, Tamil Nadu, India

ABSTRACT

In order to enhance the people's health, real time wireless communication system is introduced to monitor the patient's pulse by using an Android OS through FPGA. The end user receive the monitored data by means of GPRS, a wireless communication device. This paper presents the design and implementation of real time monitoring using GPRS between FPGA based embedded system and Android smart phones. This system offers a maximum performance, minimum power and 24 hours real time remote monitoring for tele health.

Keywords : FPGA, GPRS, Android Phone, Sensor, Wireless Communication

I. INTRODUCTION

Due to compatibility and mobility, smart phones have become people's personal assistance. This lead to the revolution of interfacing smart phones with other electronic devices, for example, pulse monitoring equipment. Wireless capability of a smart phone enables the user to control and monitor a wide array of sensors remotely. Android applications are easy to develop, open source and also offers flexibility.

As human health is unpredictable, an alert is required at the time of emergency. Remote medical monitoring allows to collect and view the health related data at the right time. This data is then easily accessed by the health care providers as smart phones are easily synchronized with online database that hosts a Content Management System(CMS).

This paper establishes a wireless communication between the FPGA and Android operating system running on a smart phone via GPRS connection. This design offers a real time monitoring of data such as pulse rate and instantaneously communicating the measured values. For this purpose, sensors are synchronized with FPGA along with a GPRS connector for communicating with the Android application. This system offers long distance connectivity at lower maintenance cost.

II. METHODS AND MATERIAL

1. Architecture

A. Hardware Tools

The FPGA used as the platform for the embedded system is Xilinx Spartan 3E. This extensible processing platform enables the developers to apply a combination of serial and parallel processing to the embedded systems.

The GPRS interface supports the communication between FPGA and Android phone. The board has a SIM connector which is used to connect the SIM with the module and give access to the network.

B. Software Tools

Any Android smart phone with internet access capability can run the application, provided it is compiled for the OS version the phone is running.

Xilinx ISE was used to develop the circuit on FPGA using Verilog. Multisim is used for simulation.

C. System Architecture

Figure 1 shows the architecture of the developed system. The FPGA Spartan 3E is the base of the system and is configured to acquire data from Pulse Sensor via UART interface. To verify reliable communication, the FPGA configured to send a binary number is controlled by 8 switches on the board.

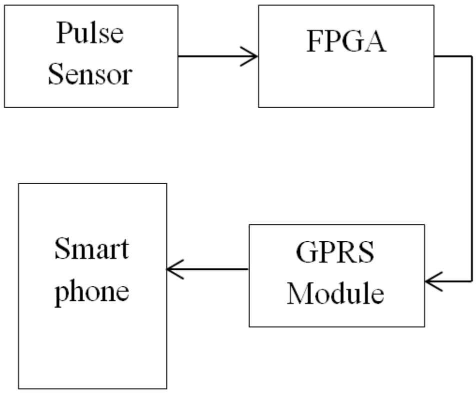

Figure 1. System Architecture

The smart phone hosts the Android application which receives data from FPGA and displays it. The application is built upon to add uploading functionality so that the data received is stored online.

2. Design and Implementation

A. Board Level

Development of the board consists of interfacing the FPGA with the GPRS, developing a system to control the sending and receiving of bits, and configuring the FPGA to read input from the switches.

Power is automatically taken care of by the IC since the GND pins are connected to the board's ground, while the VCC pins are connected to the board's voltage source supplied through the USB2 port. The pins of interest are TX, which serially transmits bits to a receiver who buffers these bits at the RXD pin. RTS and CTS are 1-bit signals sent and received by the sender and receiver to indicate readiness for transmission.

The block shown in figure 2 contains the code that builds the interface between the FPGA and the GPRS module via UART.

On the RECEIVER block; TXD will receive the value from the UART interface (from Bluetooth) bit by bit then collect them together and output them as a single 8-bit bus to the FPGA through DATA_IN. DATA_IN_RDY works as a done signal to indicate the data is completely received and ready to be transmitted to the FPGA.

On the TRANSMITTER block; DATA_OUT is an 8-bit bus of the data that would be transmitted to the Bluetooth. DATA_OUT_RDY is a 1-bit signal to indicate that there is data to be transmitted. The transmitted data will be sent through the RXD signal bit by bit to the UART interface. CTS is clear to send and used in software handshaking. CTS will not be actively used in the current design. It is put there in case there is a future expansion to the design that needs a CTS signal.

A clock convertor inside each converts the clock speed to support a 9600 baud rate. To limit inaccuracies in the transfer of data from the FPGA, the sampling baud rate at the UART will be set to 16 times the clock or the rate of the incoming bits. This will mean that each bit is sampled 16 times, decreasing the probability of errors during transfers.

The reset in the UART interface is active low. The inverter is used to convert the reset signal from active high to active low.

B. Android Application

The focus of this paper will be on the implementation details regarding the application's receiving of data via Bluetooth.

Upon turning on the FPGA when connected to the GPRS module, it becomes discoverable by Android device. Ensure that the phone is able to access internet.

Now that the phone is paired with the FPGA board, it becomes the responsibility of our application to set up the communication channel and begin the receiving of data.

III. RESULTS AND DISCUSSION

We develop a versatile embedded system with an FPGA platform which will communicate information wirelessly to an android phone through GPRS module while not interruption or error, as values send from the board to the phone's display accurately and in real time.

IV. CONCLUSION

Real time low power wireless system can be implemented with the help of FPGA, GPRS module and android system as user interface for application like tele health, has been introduced in this system. The use of FPGA in such systems provides higher processing speed and lower power usage. The system was simulated and tested in hardware level using Xilinx Spartan 3E development board and verify the correctness and working operation of the whole system. Ease of connection between the devices makes the connection faster and easy for tele health applications.

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