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COPROCESSOR DESIGN FOR HEALTH MONITORING SYSTEM

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Abstract:In this paper, a 32-bit coprocessor with a high performance and pipelined structure are designed for health monitoring system. A coprocessor with 4-stage pipelined structure is designed by using the 32-bit MIPS instructions. But, nowadays, a continuous monitoring and recording of the patient's body parameters is a difficult task. Hence, the purpose of the paper is to design the health monitoring system by using GSM modem and the sensors. This idea will help out the people to contact the doctors and to know about the health problems, who are living so far away from the hospital area. The real-time body parameters of a patient can be sensed by using the sensors and keeps an extra attention on that under test at any place. The wireless technology has been used as a standard for mobile telephony in this paper. The design of the health monitoring system is very simple in the telemedicine application.

Key Words: *Coprocessor, Health, Wireless Sensors, Real Time, Telemedicine;*

1. INTRODUCTION

Today, the system processors required for various applications needs to be developed for communication purpose with a fast performance, with an efficient low power and with multi-functionality. To achieve this, most of the system developers and SoC designers are used an efficient methodology which is based on microprocessor system. Since the last few years, an ARM processor plays an important role in the embedded system, due to some of its features. The central part of any system is the processor. Here, an FPGA-based coprocessor is designed for the health monitoring system.

A health monitoring is very important to research topic today. To improve the health care services by reducing the health expenses, and also supports for a home-based health care service, a telemedicine system plays a vital role by taking the advantages of the telecommunication and medical information systems. A telemedicine is a transformation of the medical data electronically from the remote areas to hospital centers. Up-to-date, without visiting the physician, the health check-up or monitoring is not possible from the home, till an exponentially growing of mobile phone use in developing countries. Some developers designed a web-based health monitoring system, where patients see the status of the health from anywhere as internet facility is available. Also, some health societies used a paper-based methodology, where vendors use the blood pressure and blood sugar sensors and recorded this status in the notebook manually. For ICU patients in the hospital, continuous monitoring of the health status of the patient can be done by the doctor. To do monitoring,a legion amount of manpowerrequired, though some mistakes may be possible at the recording health values.

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Therefore, to design a portable health monitoring system is the purpose of this paper. By using this system, a continuous monitoring of the body parameters of the patients such as blood pressure, temperature, blood sugar and heartbeat, etc. is possible from anywhere and transfers this monitoring data to the doctors in terms of SMS using the GSM module. This system is also useful for rural areas, where distance is the major problem and where doctors or experts are not available. This designed system is based on the re-programmability, flexibility, stability and wireless technology, and the results obtained have to be expected.

2. PROPOSED SYSTEM

The proposed work of the project is to develop a real-time wireless monitoring system, which is designed and implemented through GSM network and are able to record and transmit bio-signals of patients. In this, the application of the health monitoring system consists of four types of sensors, which are used for monitoring the health parameters of the patient such as temperature, heartbeat, blood pressure, and respiration, etc. These four sensors are designed & implemented for smart monitoring of the health parameters of the patients. In this, the health parameters of the patient are monitored one by one. These monitored analog values give to the signal conditioning unit for certain signal processing. The signal conditioned monitored body parameter values are then given to the coprocessor unit. After further processing by the coprocessor, the digital value of the health parameters of the patient is displayed on LCD and simultaneously delivered the SMS to the doctor's mobile phone through the GSM module. The figures 1 show a block diagram of the overall co-ordination of the proposed system of the project. It shows how the concept is implemented as the real time application.

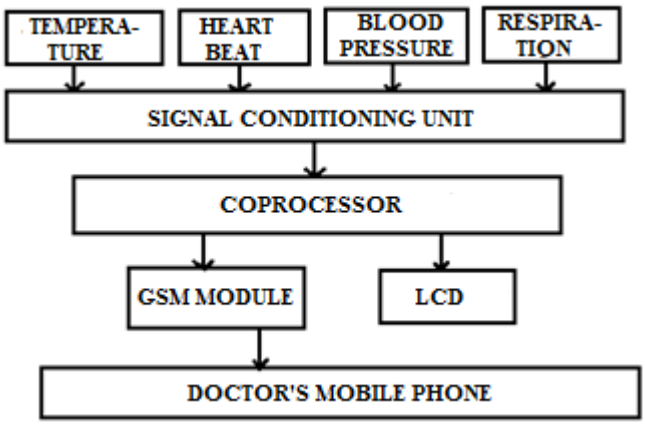

Figure 2.1. Block diagram of proposed System

Block Diagram Description-

The proposed block diagram contains the patient unit and hospital unit.

Patient Unit-

The patient unit is placed on the patient's body. This unit is designed to monitor the specified health parameters of the patient using biomedical sensors. After monitoring the health parameters, the health status is measured by using the processor and further sends these measured values to the doctor's mobile phone through the GSM module.

This unit has main parts: Biomedical sensors, GSM unit.

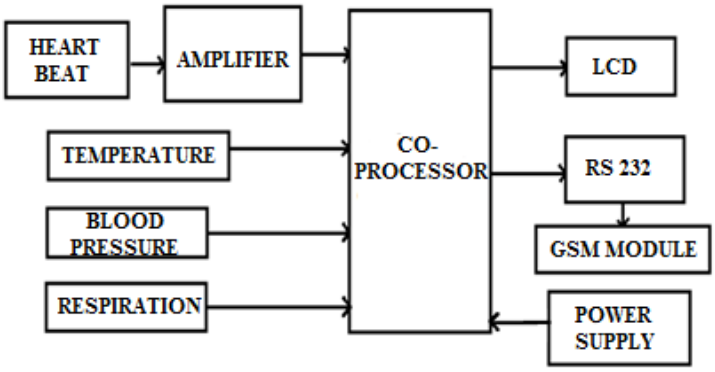

Figure 2.1.2: Block Diagram of Patient Unit

i) Signal Conditioning

Signal conditioning is nothing but the manipulation of an analog signal for meeting the requirements for the next stage for further processing. AC and DC inputsignals accepted by signal conditioners. Here the signal conditioning is used to convert the sensors output to desired analog voltage. The output of signal conditioning is further given to the ADC of the processor.

ii. Coprocessor

The processor plays an important role in controlling all the devices. A coprocessor is designed for health monitoring system for the patients at any time and any place using GSM module to provide a wireless system for monitoring the parameters of the patients. A GSM transmitter is used to transmit the signals from the sensors which are controlled by the processor to the hospital unit.

iii. Liquid Crystal Display

LCD Display is used to display the parameters such as temperature, heartbeat, blood pressure and blood sugar, the information regarding sending SMS.

iv) GSM Module

A GSM (Global System for Mobile Communications) is the world's most popular standard for mobile telephony systems. A GSM (Global System for Mobile Communications) is the world's most popular standard for mobile telephony systems. An SIM300 with a Tri-band GSM engine is used which works on frequencies, such as EGSM 900MHz, DCS 1800MHz, and PCS1900MHz. It also provides provide RF antenna interfacing with antenna connector and antenna pad. For an application like data transfer, GSM module is developed with AT-commands integrated with the TCP/IP protocol.

Here, GSM Module is used to send the SMS to the Hospital unit (to the doctor’s mobile phone), which contains the detailed monitoring and measured value’s information of the body parameters of the patients controlled by the processor.

Hospital Unit-

The Hospital unit keeps placed in the hospital i.e. it is, nothing but, the doctor’s mobile phone, on which the patient unit sends the SMS consisting the patient’s health status. This health status is the measured values of the health parameters of the patient. Upon receiving the SMS on the hospital unit, the health status of the patient is displayed. In this way, the doctor can keep an attention on all the patients.

This unit consists the PC with GSM module.

Figure 2.1.2: Block Diagram of Hospital Unit

Sensors used-

i) Heartbeat sensor:

The heartbeat sensor works on the light modulation principle by blood flow through finger each pulse, which consists of a bright LED and light detector. When a finger is placed on it, it gives digital heartbeat output. After processing by the processor, the beat per minute (BPM) rate is obtained as output.

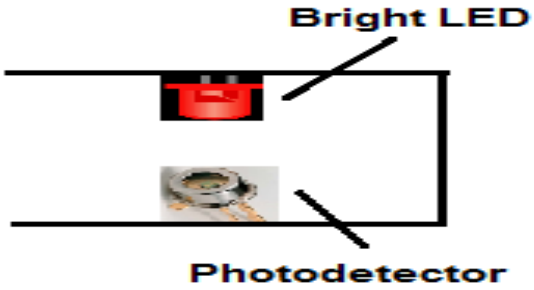

Figure 2.2.1: Heart Beat Sensor

ii) Temperature Sensor (LM35):

It is a precision integration-circuit temperature sensor. The voltage output of the LM35 is linearly proportional to the Celsius temperature, which gives analog output. The scale factor of LM 35 for output voltage is a +10.0 mV/°C linear.

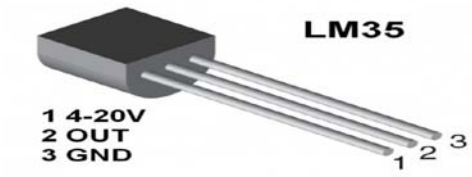

Figure 2.2.2: IC LM 35

iii) Blood pressure Sensor:

A blood pressure sensor is used to measure arterial pressure. Blood pressure is, nothing but, the blood's force pushing up against the blood vessel walls. The heart pumps blood through the arteries to rest of the body, in each heartbeat. The operation of blood pressure sensor is based on the oscillometric method.

Figure 2.2.3: Blood Pressure Sensor

iv)Respiratory Sensor:

The frequency of breaths taken within a certain amount of time is called a respiration rate. This rate can vary depending on the requirement of the oxygen. The correlation of the respiratory rate is the blood's gas composition. This means that the breathing rate can be increased by increasing the carbon oxide concentration, which is derived from an infection.

3. OBJECTIVE OF PROJECT

The main aim of the project is to design a Coprocessor for Health Monitoring System for the patients at any time and any place using GSM module to provide a wireless system for monitoring the parameters of the patients such as heart bit, temperature, blood pressure, blood sugar.

A coprocessor is the logic circuitry that responds to and processes the basic instructions that drive the various types of applications. Here, a coprocessor is designed for a particular use case, rather than intended for general-purpose use. A coprocessor generally consists of the blocks likes data path, controller, and memory.

A coprocessor is designed using an RISC processor using a pipelined architecture. For designing a coprocessor, a 32 bit MIPS instructions set would be used. A coprocessor works in the 4-stages as i) Fetch, ii) Decode, iii) Execute, iv) Memory Read/ Write Back. Hence, this coprocessor contains a unit of fetch instruction, unit of decode instructions unit, thearithmetic and logic unit (ALU) instructions, a register file for operands holding, and the memory that stores instructions and data.

A coprocessor is a multiplexer based design, which implemented with a single data path cycle and random logic decoder based on FPGA. A coprocessor consists blocks such as data path, Arithmetic & Logic unit (ALU), a controller unit and the memory block.

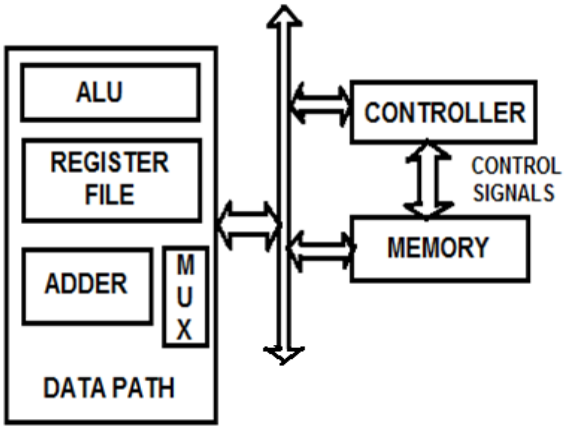

Figure 3.1: Block diagram of coprocessor design

Data Path-

In coprocessor design, data path designed with a single cycle fetch-decode-execute. It is the heart of the processor. The design of the data path block based on general discipline as (1) determination of the required formats and classes of instructions in the ISA, (2) for each instruction class or format, the data path components and interconnections design required, and (3) composed the segments from the second stage to yield a data path. The data path consists of ALU, multiplexer, register file, etc., which are used for performing the various data processing operations. A main part of the processor is a data path, used to

regulate the interaction between the data path and the data itself. Data path module helps to form an instruction set to any function in the processor for performing multiple operations. The Data path unit generally consists of various blocks such as ALU, Register file, Adder, Multiplexer, etc.

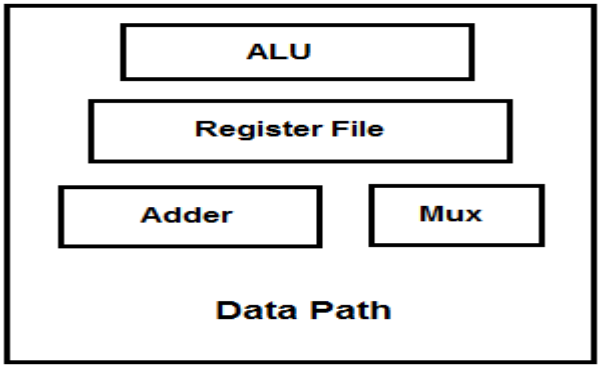

Figure 3.2: Block diagram of Data path

Controller-

A controller unit is a hardware that tells the data path what to do regarding various operations like switching, data movements between ALU components, operation selection, etc. It is very important part in the processor, which controls the various operations performed by the data path and also memory. It generates the control signals required for the execution of memory instructions, which are pure combinational logic signals.

Memory-

In the coprocessor design, the memory is used as a device for storing the information at high-speed, which is used by the processor for further processing. Memory blocks are used for implementing instruction and data memories for an embedded processor using FPGA. The memory is generally implemented using a few blocks of Static RAM. Here, a memory module is 32-bit wide.

4. TESTS AND RESULTS

The proposed scheme is tested using ordinarily Xilinx software. From the simulation of the experiment results, we can draw to the conclusion that this processor is worked satisfactorily forhealth monitoring system.

Simulation Results of Coprocessor:

i) The simulation waveform diagram of the data path & controller is shown below. According to the Controller & ROM instructions, the below output waveform is obtained.

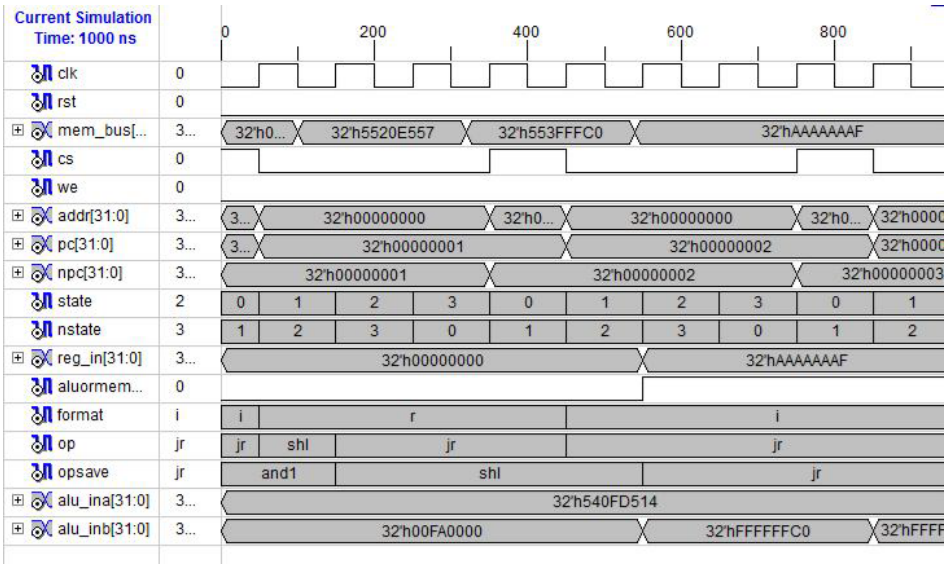

Figure 4.1: Simulation diagram of a data path and controller unit

ii) Following output waveform shows that the complete processor's simulation output. This performance is based upon the various instructions and pipelining structure.

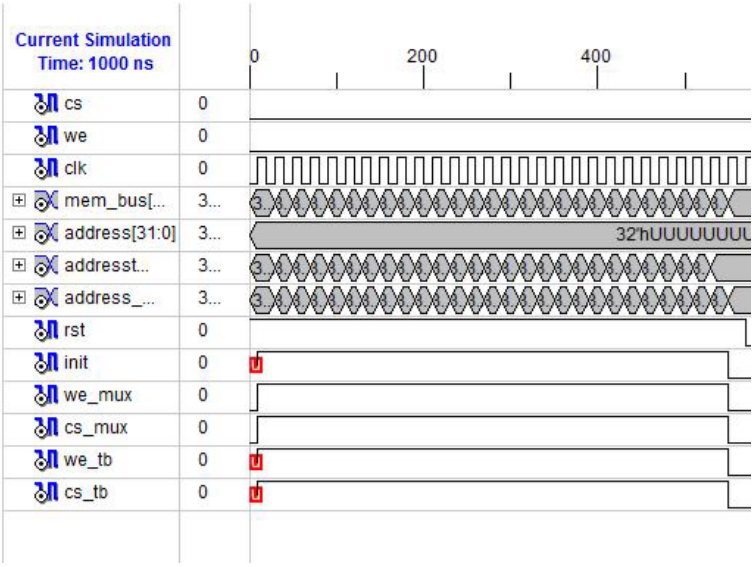

Figure 4.2: Simulation diagram of complete coprocessor

Test Results of Health Monitoring System:

Table 4.1: Result of Health Monitoring System

Sr. No	HB on sensor	Temp on Sensor	Blood Pressure	Respration	HB Manually	Temp On Therm	Message Sent
1	**77**	**27**	**85-104**	**05**	**78**	**27**	**Temp = 27 HB = 77 BP = 85-104 Resp. = 05**

2	**79**	**29**	**89-108**	**09**	**82**	**28**	**Temp = 29 HB = 79 BP = 89-108 Resp. = 09**
3	**73**	**32**	**87-102**	**03**	**71**	**31**	**Temp = 32 HB = 73 BP = 87-102 Resp. = 03**

5. ADVANTAGES OF PROJECT

Some of the advantages of this system are as follows:

• This system is easy to useand also reliable for doctors working in the hospital. Thus, a continuous monitoring of

the critical patient is possible.

• The working efficiency is increased to a great extent.

• By reducing the chances of human error in recording the health parameters status, this system increase the

accuracy of monitoring and recording, as this is a time to time updated system.

6. APPLICATIONS OF PROJECT

The health monitoring system is based on the wireless technology i.e. GSM Modem, provides the updates of the existing health monitoring systems. This system supports to a continuous health monitoring, which yields a better performance in curing a critical condition. The continuous monitoring is provided the vital signs of the patient for long time. This health monitoring system gives a long time capability of monitoring, which is useful for the doctors and staff in the hospitals, which reduces their workload at a great manner.

CONCLUSION AND FUTURE WORK

A coprocessor is designed with a single cycle pipelined structure with MIPS instructions. In this paper, the synthesis and simulation of the coprocessor is done successfully. I developed a wireless health monitoring system successfully, whichmonitors health data from the home and identify the real time health status of the patient. By using this system, we are able to transmit the health data sensed from the patient's body to the doctor's mobile phone by using wireless transmission technology, i.e. GSM Module.

After receiving SMS on a mobile phone, the doctor can keep an attention on the patient's health status from anywhere. Totake an immediate action, the sensors are calibrated properly for accurate and precise parameter measurement, for providing an immediate treatment to the patient in emergency case.

Future work of this paper may include the development of the system with more number of sensors in a single system to provide flexibility. Also, a multi-cycle pipelining structuredprocessor will be designed for faster and better performance. This processor can be used for various applications such as industry applications, medical applications, military applications, etc.

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