

Interface Design for Multi Parameter Health Monitoring System Based on PLC

Panduranga H V¹, D S Suresh², Rajendra C J³, R Sekar⁴

P.G. Student, Department of Electronics & Communication Engineering, CIT, Gubbi, Karnataka, India¹

Professor, Department of Electronics & Communication Engineering, CIT, Gubbi, Karnataka, India²

Assistant Professor, Department of Electronics & Communication Engineering, CIT, Gubbi, Karnataka, India³

Associate Professor, Department of Electronics & Communication Engineering, CIT, Gubbi, Karnataka, India⁴

ABSTRACT: In India, especially in rural and remote areas, people find it difficult to receive medical treatment. The patients who lives in remote areas struggle to travel for treatment purpose since there are lack of physicians in rural areas. In this project, Muliti parameter health monitoring system is designed based on PLC which helps to record and analyze the multiple parameters of patient from their home. The monitoring system consists of several sensors such as temperature sensor for body temperature measurement, pulse oximeter to find the oxygen saturation and haemoglobin of a person. A pair of EPIC sensors with differential amplifier is used to measure the electrical activity of a patient's heart. Methodology of this system is, the analog output of each sensor which is connected to patient is directly given to Programmable Logic Controller where it stores in the memory of the controller and from PLC through serial port it is transferred to personal computer. This system monitors the human health condition through SCADA system.

KEYWORDS: EPIC sensors, PLC, Pulse Oximeter.

I. INTRODUCTION

The transfer of electronic medical data is referred as telemedicine. The telemedicine can provide medical services where distance plays a prominent role. In recent times, the health care services for aged people have increased. For them who live in home, the health monitoring is essential and it requires various monitoring devices to measure vital signals. The body temperature is measured to determine the health condition of a person, a normal body temperature is about 37 degree Celsius if body temperature rises it leads to fever, hyperthermia and hypothermia, if temperature falls then there is an occurrence of cardiac problems leads to death. Pulse oxygen saturation (SPO2) measures the O2 saturation of a person, hemoglobin and heart rate. Electrocardiogram (ECG) is a measure of electrical activity of heart Reason to perform ECG test suspect myocardial infarction, pulmonary embolism and fainting or sudden collapse. The low power, durable, portable, wearing system is designed and developed in this proposed work.

This proposed work has been planned with biosensors & host PC. It comprises of a body temperature sensor, EPIC sensor and pulse oximeter. This system records all the parameters continuously. Recorded information is transferred to the computer by using the PLC controller.

A monitoring system measures the vital signals of the human body like temperature, Electrocardiogram (ECG), and Pulse Oxygen Saturation (SPO2). The PLC controller is employed as a part of this work to gauge the parameters of human body and that will show on PC by using SCADA. The parameters are measured steadily, progressively and stored in the PLC memory and then transferred to PC.

II. RELATED WORK

Initial research was conducted to determine the types of vital signals that are routinely measured amid a visit to specialist. These vital signals are body temperature, heart rate, Oxygen Saturation (SPO2) and ECG. As part of this

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project, simple device based on PLC is developed. The business interest for this sort of device was found and research on similar devices at present sold was performed. The market for Health monitoring system was \$ 11 Billion in the year 2008 according to the report of Berg Insight. It is found some devices which offers similar physiological monitoring system.

Several Microcontrollers were used to design the patient monitoring system which consists of transmitter and receiver, in the transmitter part there are microcontroller, ADC, Power supply, LCD and the transmitting modem. 8051 controller used to design monitoring system in which several biosensors output are given to ADC where the analog output is converted to digital and it is connected to the input terminals of the controllers. The output of the controller is stored and displayed on PC. Later stage, the patient monitoring system was updated with other controllers like ATMEL which replaced the earlier 8051 controllers. In which AVR064 and similar kinds of controller were used to record the physiological parameters through different sensors and analog to digital converters.

ATMEGA 128 AVR controllers, 89s52 Controllers, ATMEGA 32 controllers and many similar controllers were used to design health monitoring system which required analog to digital conversion and the data which is recorded through biosensors were not able to store.

Zigbee based patient monitoring system were designed in later stage in which zigbee transceivers were used in both transmitter and receiver part and the AVR controllers were used to capture the data from various biosensors, SMS based health monitoring system was the additional application which updated in later stage which used the GSM modem as shown in figure 1.

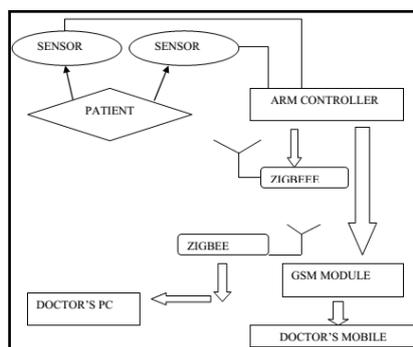


Fig.1: ZIGBEE based Patient monitoring System

The physiological monitoring system was designed using several medical sensors and those are connected to patient's body and continuous analysis will be done by medical staff or doctor. The sensors are connected to controllers and the data is stored and displayed on PC. Similarly by using GSM modem the output is sent to physician or family doctor he analyze the patient and give better treatment. Later stage wireless shirts were designed for few parameters in which several sensors were incorporated in it which records the medical data and through controller such as MC9s08GB it is stored and displayed on computer system. 3v 50mAh rechargeable batteries, ADC, 2.4GHz wireless module were used to design the system. In later stage, the high level controllers were used to design the physiological parameter monitoring system in which LPC1768/67/65/64/63 part of ARM cortex-M3 based controllers were used. It is the next generation core which offers system enhancement such as enhanced features.

ARM-9 Embedded system was the latest technology used in the design of multi-parameter health monitoring system which consists of arm-9 s3c2440 embedded system, data acquisition board, Bluetooth communication module, GSM module, and other modules. The system used to measure various medical parameters such a Blood pressure, Heart rate and ECG of the patient which is recorded through various sensors to data acquisition board the board is connected to controller in which data can be stored and send to personal computer through serial bluetooth module and to doctor's mobile through GSM module. Later stages, researches were conducted to find the non contact sensors which can record the vital signals of human body. This technology became a boon for the medical field and many physiological parameters were measured through non contact sensors.

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In this project, the DS18B20 temperature sensor is used. Similarly for ECG measurement, instead of using conventional electrode such as Ag/AgCl pair of PS25251 EPIC sensors is used. In case of conventional electrodes, the gels and adhesive can cause skin disturbance to the patient and chest straps can be hard to fit, uncomfortable to wear and not generally dependable.

Given all previous work, the main contribution of this project is as follows,

1. The implementation of real time, light weight, wearable sensors to send physiological parameter to PC and to store large amount of medical data in controller for further analysis
2. The implementation of output using supervisor control and data acquisition (SCADA)
3. EPIC sensors are used instead of electrodes which are noncontact and avoid gel and other chest straps which cause skin irritation.
4. Real-time storage using microSD slot and Ethernet options are implemented in PLC.

III. METHODOLOGY

The figure 2 depicts the simple outline of the system hardware. The proposed work intended to accept few inputs to measure physiological parameters of human such as body temperature, SPO2, and ECG. The inputs from the sensors are incorporated and handled. Then the outcomes are given to host PC which stores the information into a database. The analysis can be shown on Graphical user interface (GUI) running on a PC. Once the user has connected to the receiver unit, information is consequently upgraded on the screen. Temperature, SPO2, and ECG are displayed on the screen. The information is plotted on a period chart which can be altered to show information received from any of the sensors.

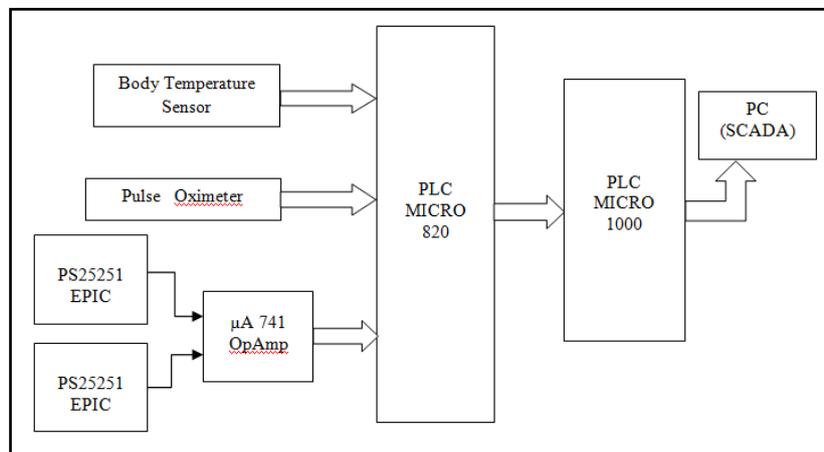


Fig.2: Block diagram

IV. HARDWARE REQUIREMENTS

A. Temperature measurement

The body temperature is measured through a temperature sensor, the temperature reading depends on which part of the body is used to measure temperature, usually temperature at arm is used to measure and it is about 36.5 degree Celsius. The temperature sensor used here is DS18B20.

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B. SPO2 measurement

SPO2 is said to be a fifth vital signal of the human body, Pulse oximeter is used to measure the SPO2; pulse oximeter is a noninvasive method in which it measures the person's blood oxygen saturation.

C. Programmable Logic Controller

Programmable logic controller is an extraordinary type of controller which usually accepts the data in any format and controls the machine. The instructions and special functions are stored in memory of the PLC controller which includes on/off control, timing, counting, arithmetic and data handling. Unlike general purpose computer, PLC is designed for multiple inputs and outputs arrangements. Each sensor which is interfaced with body is directly given to the controller without any analog to digital converters since PLC have the application of direct digital converter (DDC) in it. PLC is a best illustration for hard real time system since output results must be generated in response to input conditions within stipulated period.

There are four fundamental segments in PLC, that is processor or controller, I/O (Input/output) modules, power supply and programming software that runs in a PC in addition to these PLC have SDcard slot to store the large medical data for further analysis and PLC also consist of network interface. The PLC used in this project is Micro820 and Micro Logix 1000.

V. SOFTWARE REQUIREMENTS

- CCW vesion-6
- Ladder logic programming
- RS-Linx
- RS-Emulator
- SCADA

SCADA (Supervisory control and data acquisition) is a graphical user interface tool for recording and analyzing real time information through PLC controller into personal computer. In this project, SCADA systems are used to monitor and display the vital signals of the human body.

VI. RESULTS

The designed prototype shows the 12V power supply, DS18B20 temperature sensor, two PS25251 EPIC sensor, specially designed dual power supply, μ A741 differential amplifier and two Programmable logic controller's Micro820 and MicroLogix1000.

The USB cable which is connected to MicroLogix 1000 PLC shown in figure 3 will be connected to Personal computer system and then parameters measured are displayed on the SCADA.

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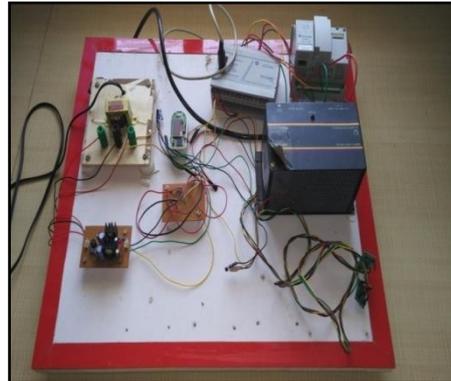


Fig.3: Hardware setup

After hardware connections and each sensors which are connected to the patient records the vital signals of a person and stores in a controller then it is displayed on the SCADA system as shown in below figure 4.

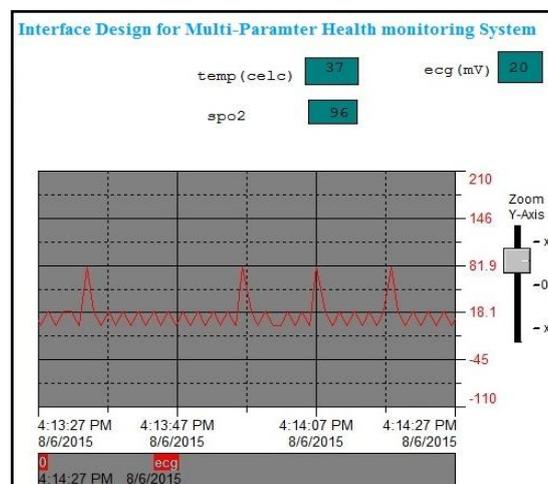


Fig 4: Snap Shot of results

VII. CONCLUSION

The proposed system uses PLC controllers and a SCADA system to screen and showcase the vital signals of a person. The system also consists of a dry contact sensor for a measurement of ECG which doesn't require any sort of direct contact or gel contact to the human body. The direct digital controller minimize the processing operation by connecting three thermistor outputs from the sensors directly to the PLC controller. SCADA (Supervisory Controller of Data Acquisition) is used to display the results graphically and with clear response.

VIII. FUTURE SCOPE

By knowing the methodology of PLC controller used in the proposed work, it can be used to measure other physiological parameters such as blood pressure measurement, skin response measurement and stress measurement. The

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additional analog card will be used to capture the thermistor values of such parameters. Also by knowing the methodology of PS25251 sensor it can be used to measure other parameters such as EEG,EMG and EOG.

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