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# AN AUTOMATED MONITORING SYSTEM FOR CHRONIC HEART FAILURE PATIENTS

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***Abstract***— Nowadays, chronic heart failure (CHF) Affects an ever-growing segment of population and it is among the major causes of hospitalization for elderly citizens. The actual out-of hospital treatment model, based on periodic visits, has a low capability to detect signs of destabilization and leads to a high re-hospitalization rate. To this aim, in this paper, a complete and integrated Information and Communication Technology system is described enabling the CHF patients to daily collect vital signs at home and automatically send them to the Hospital Information System, allowing the physicians to monitor their patients at distance and take timely actions in case of necessity. A minimum set of vital parameters has been identified, consisting of electrocardiogram, SpO2, blood pressure, and weight, measured through a pool of wireless, non-invasive biomedical sensors. A multi-channel front-end IC for cardiac sensor interfacing has been also developed. Sensor data acquisition and signal processing are in charge of an additional device, the home gateway. All signals are processed upon acquisition in order to assert if both punctual values and extracted trends lay in a safety zone established by thresholds. Per-patient personalized thresholds, required measurements and transmission policy are allowed.

***Key words****: LPC2148, Sensors, Bluetooth, Pulse, android.*

## Introduction

In medical field continuous patient monitoring is an important task at the hospital and patients home also. Particularly CHRONIC HEART FAILURE (CHF) patients need an intensive care and continuous

monitoring to avoid Heart attack which leads to death, in hospital and home. The objective of this paper is to continuous monitoring of ECG signal and some other vital signs of Chronic Heart Failure patients from their home to avoid re-hospitalization and increase patient satisfactions. It is achieved by a minimum set of vital signs threshold values are fed in the microcontroller to monitoring the vital signs.

Measured through a pool of wireless, non-invasive biomedical sensors .The Physicians monitor their patients at distance and take timely actions in case of emergency. In general the way to record vital signs data is recording vital signs data on the paper by handwritten, and then transcribed these vital signs data to an information system by typing on a computer. Duplicate to record vital signs data by handwritten and typing to transcribe the data into information system not only increase workload of nurses but also waste the direct care time for providing to patients. Furthermore, it may cause recording error during handwritten and could also Cause error by typing vital signs on the computer. Because of these reasons it may lead misdiagnose. There has a study proposed a clinical documentation

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system with a Tablet PC affixed to the vital signs monitor to achieve machine to computer clinical documentation. Nurses can transcribe vital signs data from measuring device to Tablet PC immediately. The data can be stored into database information system without handwritten and hence shorter the time delay for providing data on information system. Although the result of this study has lower error rate and shorter medical records transcribed delay time, the process of typing values into Tablet PC could still have errors. Because of the vital signs data still can't direct input from a measuring device to the information system, it is means that human involved is still needed. If the vital signs data can direct input from a measuring device to the information system, then it can reduce the error rate and delay time. Therefore, nurses can spend more time on direct care of patient. [7] discussed about an eye blinking sensor. Nowadays heart attack patients are increasing day by day."Though it is tough to save the heart attack patients, we can increase the statistics of saving the life of patients & the life of others whom they are responsible for. The main design of this project is to track the heart attack of patients who are suffering from any attacks during driving and send them a medical need & thereby to stop the vehicle to ensure that the persons along them are safe from accident. Here, an eye blinking sensor is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller.If eye blinking gets stopped then the signal is sent to the controller to make an alarm through the buffer. If spO2 sensor senses a variation in pulse or low oxygen content in blood, it may results in heart failure and therefore the controller stops the motor of the vehicle. Then Tarang F4 transmitter is used to send the vehicle number & the mobile number of the patient to a nearest medical station within 25 km for medical aid. The pulse rate monitored via LCD .The Tarang F4 receiver receives the signal and passes through controller and the number gets displayed in the LCD screen and an alarm is produced through a buzzer as soon the signal is received.

## Design of Proposed Hardware

We can overcome the disadvantage of the existing method by monitoring the patient. Due to lack of resources at medical facilities to support this kind of follow-up, the use of Information and Communication Technologies (ICT) has been identified by physicians and administrator as a possible valid support to overcome this limit. Patient's signs, symptoms, and raised alarms and information by wireless can be received by healthcare providers, and aggravations can be quickly detected and acted upon. By using sensors like accelerometer, thermister, humidity and pulse, we monitor the patient's vital parameters. These vital parameters can be seen by using Ethernet or Bluetooth. The android app is used to monitor these parameters on the android device.

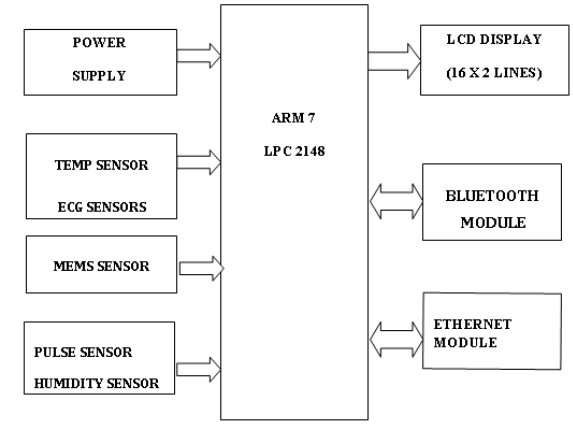


Fig. 1.Patients Section

The block diagram of the project consists of ARM7 board, sensors, Ethernet module, and power supply which are shown in Figure 1.In case of emergency and dangerous situations we have to alert the doctor immediately. For this we are using a Wireless network for doctor to patient communication in the hospital. This way of communication is actually done with Wi-Fi, Bluetooth modules. Each patient will be given this module and with the help of this module the patient health condition is monitored. In this LPC2148 plays a major role of data collection from the sensors and the analyzed data will be passed to the monitoring

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section by using Wireless communication technology. In this first we are connecting the sensors to the patient's body. In this Temperature, MEMS, ECG sensors are producing analog outputs that interface to Microcontrollers analog pins. Pulse sensor data collection we are using Digital I/O pins of controller. After collecting the data from all the sensors controller board analyze the data and send that data to the Doctor using Ethernet module interfaced to the controller board.

## Modules used in this project

Technologies used in our project to get effective data of a patient health details are:

**LPC2148 Microcontroller:**

The **LPC2148** are based on a 16/32 bit ARM7TDMIS™ CPU with real-time emulation and embedded trace support, together with 128/512 kilobytes of embedded high speed flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30% with minimal performance penalty. With their compact 64 pin package, low power consumption, various 32-bit timers, 4- channel 10-bit ADC, USB PORT,PWM channels and 46 GPIO lines with up to 9 external interrupt pins these microcontrollers are particularly suitable for industrial control, medical systems, access control and point-of sale. With a wide range of serial communications interfaces, they are also very well suited for communication gateways, protocol converters and embedded soft modems as well as many other general-purpose applications.

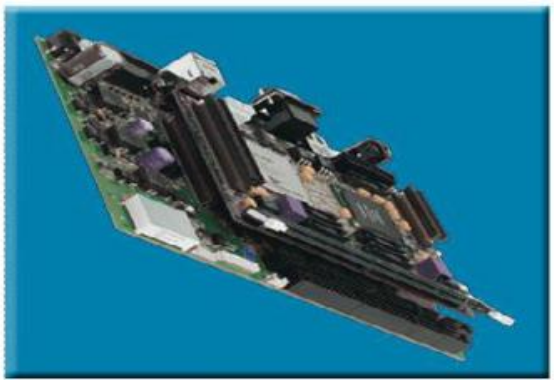

Fig. 2.Microcontroller Board

**Pulse sensor**

Pulse sensor is also called as Heart Beat Sensor. This heart beat sensor is designed to give digital output of heat beat when a finger is placed inside it. When the heart detector is working, the top-most LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

Fig. 3.Pulse Sensor

***ECG:***

The ECG sensor measures electrical potentials produced by the heart (Electro-cardiogram). These small voltages are measured at the skin of the wrists and elbow through electrodes. The ECG sensor can also be used to measures the electrical potentials generated by muscle cells when these cells contract

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and relax (Electromyogram). For safety reasons the sensor uses an optical coupler to avoid any direct electrical contact between the person whose ECG is measured and the measurement interface or computer. The ECG sensor is delivered together with a package of 100 electrode patches.

Fig.4.ECG Sensor

**Thermistor**

A thermistor is a type of resistor whose resistance varies significantly with temperature, more so than in standard resistors. The word is a portmanteau of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting over current protectors, and self-regulating heating elements. Thermistors differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while Thermistors typically achieve a higher precision within a limited temperature range, typically –90 °C to 130 °C.

Fig.5.Temperature sensor

**Humidity sensor**

Humidity sensor is a device that measures the relative humidity of in a given area. A humidity sensor can be used in both indoors and outdoors. Humidity sensors are available in both analog and digital forms. An analog humidity sensor gauges the humidity of the air relatively using a capacitor-based system. The sensor is made out of a film usually made of either glass or ceramics. The insulator material which absorbs the water is made out of a polymer which takes in and releases water based on the relative humidity of the given area. This changes the level of charge in the capacitor of the on board electrical circuit. A digital humidity sensor works via two micro sensors that are calibrated to the relative humidity of the given area. These are then converted into the digital format via an analog to digital conversion process which is done by a chip located in the same circuit. A machine made electrode based system made out of polymer is what makes up the capacitance for the sensor. This protects the sensor from user front panel (interface).

Fig.6. Humidity sensor

**BLUETOOTH**:

Bluetooth was selected as our way of communicating PDA/Mobile with a central system. The reason Bluetooth was selected over Wi-Fi for various reasons. First of all, Bluetooth security is less complex and more stable than that of Wi-Fi. Bluetooth manages a security measure of only permitting certain selected devices to interact with them; Wi-Fi in the other hand establishes a WEP key that has been known to be cracked. Another reason that Bluetooth was selected over Wi-Fi is that Bluetooth has a shorter range of signal emission than Wi-Fi. This is a pro because the shorter the range the less the amount intruders that will try to infiltrate your home system.

AUBTM-22 is a Bluetooth v1.2 module with SPP profiles. The module is intended to be integrated into

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another host system which requires Bluetooth functions. The HOST system could send commands to AUBTM-22 through a UART. AUBTM-22 will parse the commands and execute proper functions, e.g. set the maximum transmit power, change the name of the module. And next the module can transmit the data receive from the UART with SPP profiles.

Fig.7. Bluetooth module

***WI-FI***

VSD03 is the new third-generation embedded UART Wifi modules studied by VSDTECH. Uart-Wi-Fi is an embedded module based on the Uart serial, according with the WiFi wireless WLAN standards, It accords with IEEE802.11 protocol stack and TCP / IP protocol stack and it enables the data conversion between the user serial and the wireless network module.

Fig.8. Bluetooth module.

Through the Uart-Wifi module, the traditional serial devices can easily access to the wireless network. The module supports quick networking by specifying channel number. In the usual course of wireless networking, devices would first scan automatically on the current channel, in order to search for the network built by the target AP. This module provides working channel configuration, when the channel of the target network is known, users can specify the working channel directly, the networking time will be reduced from 2 seconds to about 300 milli seconds, then quick networking is achieved.

***MEMS***

Micro electro mechanical systems (MEMS) are small integrated devices or systems that combine electrical and mechanical components. Their size range from the sub micrometer (or sub micron) level to the millimeter level and there can be any number, from a few to millions, in a particular system. MEMS extend the fabrication techniques developed for the integrated circuit industry to add mechanical elements such as beams, gears, diaphragms, and springs to devices. These systems can sense, control and activate mechanical processes on the micro scale and function individually or in arrays to generate Effects on the macro scale. The micro fabrication technology enables fabrication of large arrays of devices, which individually perform simple tasks, but in combination can accomplish complicated functions. MEMS are not about any one application or device, or they are not defined by a single fabrication process or limited to a few materials. They are a fabrication approach that conveys the advantages of miniaturization, multiple components and microelectronics to the design and construction of integrated electromechanical systems. MEMS are not only about miniaturization of mechanical systems but they are also a new pattern for designing mechanical devices and systems.

**CONCLUSION**

Our proposed system provides the immediate care to the CHF patients in hospitals by continuously detecting the changes in their vital parameters. And also it leads to an improvement in quality of care in hospitals. No need of frequent visit to patients' room. Does not need any internet connection or web browser. And also there is no chance of network failure in alerting doctors and caregivers.

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