



A Blood Leakage and Patient Condition Detection System during the Hemodialysis

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Abstract: *The purpose of this paper is to design of a (ESRD end stage renal disease) patient condition detection system and blood leakage during the hemodialysis treatment .The design includes a LPC2148(Linear Programming Control) microcontroller,ARM7TDMI(Advanced RISC Machine) ,GPRS Modem, WIFI module, LCD Display(16x2Lines),Temperature sensor ,pulse sensor and MEMS ,blood leakage circuit it includes IR sensor and photodiode, SIM, alert Buzzer and power supply. In this system it will continuously monitors the patient conditions like body temperature, pulse rate, body positions and blood leakage in homodialysis therapy systems. The validation results show that is only needs a very small amount of Blood(0.01) ,and takes1.6s to detect a Blood leakage. If any abnormal conditions are detected then automatically it will give the alert and also continuously sends the data to the attendant with the help of WIFI technology and also sends the patient conditions continuously to the doctor with the help of GPRS technology in web page*

Keywords: *LPC2148,GPRS,WiFi,Pulse,Mems,Temp.*

I .INTRODUCTION

Annual data report of 2013USRDS (United States Renal Data System), it indicates that the reported rates of incident end stage renal disease (ESRD) across the globe

noticed an important trend. In 2011, the top three countries with the highest rates of reported incident ESRD are Jalisco (Mexico), United States and Taiwan. Furthermore, the top three countries with the highest rates of reported prevalent ESRD in 2011are Taiwan, Japan and United States. Hemodialysis therapy continues to be the most common method of treating ESRD worldwide. Data shows that in over 76 percent of reporting countries, at least 80 percent of patients are on this therapy method [1]. In addition, it also reports that more than 90% of dialysis patients in the United States are on hemodialysis therapy . Venous needle dislodgement has been reported to be a potentially serious complication during the hemodialysis therapy.

In 2012, the American Nephrology Nurses' Association (ANNA) carried out an investigation on the venous needle dislodgement. The survey results revealed that 76.6% (n = 894) of the 1166 participants indicated about their observances of venous needle dislodgement in the past five years, and with 8.2% (n = 96) of those having seen five events or more in this time period. Moreover, slightly more than half (57.9%) of the 1166 participants pointed out that venous needle dislodgement occurs very often or often. An additional 23.1% rated their concern as occasional [3]. From the above reported data, it shows a high frequency of occurrence on venous needle

dislodgement, and indicates that the venous needle dislodgement is indeed a potential problem during hemodialysis therapy.

II. METHODOLOGY

2.1 Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

2.2 ARM7TDMI:

ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

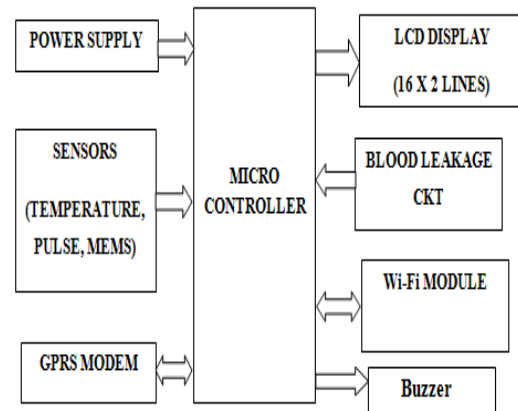


Fig.1: Block diagram

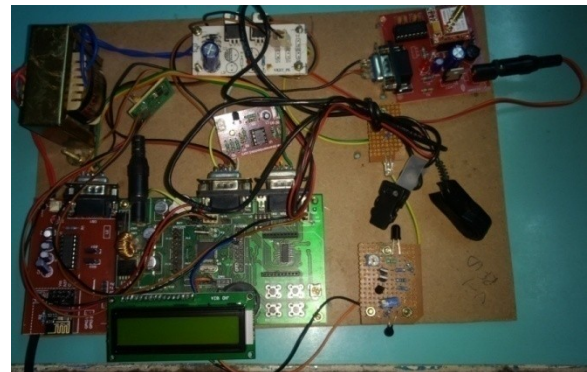


Fig .2: Hardware kit

3.1 Liquid-crystal display (LCD):

It is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

III HARDWARE SYSTEM



3.2 Buzzer:

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave ovens, & game shows. The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep. The "Piezoelectric sound components" introduced herein operate on an innovative principle utilizing natural oscillation of piezoelectric ceramics. These buzzers are offered in lightweight compact sizes from the smallest diameter of 12mm to large Piezo electric sounders. Today, piezoelectric sound components are used in many ways such as home appliances, OA equipment, audio equipment telephones, etc. And they are applied widely, for example, in alarms, speakers, telephone ringers, receivers, transmitters, beep sounds, etc.



Fig.3: Types of Buzzers

3.3 Pulse sensor:

Attach to finger and get Analog out from the sensor based on heart beat pulse. You can read the analog output with microcontroller ADC and then plot it or calculate readings like heart beat per minute. It is simple to use and accurate results.

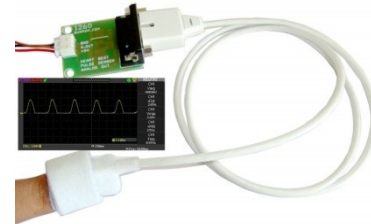
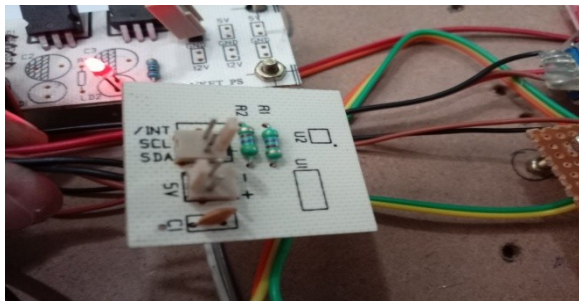


Fig .4: pulse sensor

3.4 MEMS:

Micro-Electro-Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro fabrication technology. While the electronics are fabricated using integrated circuit (IC) process sequences (e.g., CMOS, Bipolar, or BICMOS processes), the micromechanical components are fabricated using compatible "micromachining" processes that selectively etch away parts of the silicon wafer or add new structural layers to form the mechanical and electromechanical devices. MEMS promises to revolutionize nearly every product category by bringing together silicon-based microelectronics with micromachining technology, making possible the realization of complete systems-on-a-chip. MEMS is an enabling technology allowing the development of smart products, augmenting the computational ability of microelectronics with the perception and control capabilities of micro sensors and micro actuators and expanding the space of possible designs and applications. Microelectronic integrated

Circuits can be thought of as the "brains" of a system and MEMS augments this decision-making capability with "eyes" and "arms", to allow micro systems to sense and control the environment. Sensors gather information from the environment through measuring mechanical, thermal, biological, chemical, optical, and magnetic phenomena. The electronics then process the information derived from the sensors and through some decision making capability direct the actuators to respond by moving, positioning, regulating, pumping, and filtering, thereby controlling the environment for some desired outcome or purpose. Because MEMS devices are manufactured using batch fabrication techniques similar to those used for integrated circuits, unprecedented levels of functionality, reliability, and sophistication can be placed on a small silicon chip at a relatively low cost.



Fig

.5: MEMS

3.5 Temperature sensor - The LM35:

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). You can measure temperature more accurately than using a thermistor. The sensor circuitry is sealed and not subject to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

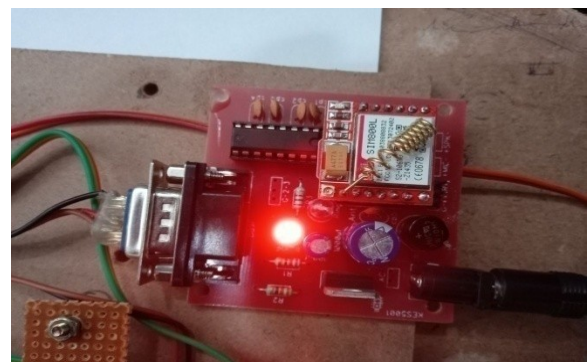


Fig.6: Temperature sensor- The LM35

It has an output voltage that is proportional to the Celsius temperature. The scale factor is $.01\text{V}/^\circ\text{C}$. The LM35 does not require any external calibration or trimming and maintains an accuracy of $\pm 0.4^\circ\text{C}$ at room temperature and $\pm 0.8^\circ\text{C}$ over a range of 0°C to $+100^\circ\text{C}$.

3.6 GPRS:

This section consists of a GPRS modem. The modem will communicate with microcontroller using serial communication. The modem is interfaced to microcontroller using MAX 232, a serial driver. The Global Packet Radio Service is a TDMA based digital wireless network technology that is used for connecting directly to internet. GPRS module will help us to post data in the web page directly.



3.7 WIFI:

Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. A common misconception is that the term Wi-Fi is short for "wireless fidelity," however this is not the case. Wi-Fi is simply a trademarked phrase that means *IEEE 802.11x*. Wi-Fi works with no physical wired connection between sender and receiver by using radio frequency (RF) technology, a frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. The cornerstone of any wireless network is an access point (AP). The primary job of an access point is to broadcast a wireless signal that computers can detect and "tune" into. In order to connect to an access point and join a wireless network, computers and devices must be equipped with wireless network adapters. Wi-Fi is supported by many applications and devices including video game consoles, home networks, PDAs, mobile phones, major operating systems, and other types of consumer electronics. Any products that are tested and approved as "Wi-Fi Certified" (a registered trademark) by the Wi-Fi Alliance are certified as interoperable with each other, even if they are from different manufacturers. For example, a user with a Wi-Fi Certified product can use any brand of access point with any other brand of client hardware that also is also "Wi-Fi Certified". Products that pass this certification are required to carry an identifying seal on their packaging that states "Wi-Fi Certified" and indicates the radio frequency band used (2.5GHz for 802.11b, 802.11g, or 802.11n, and 5GHz for 802.11a).

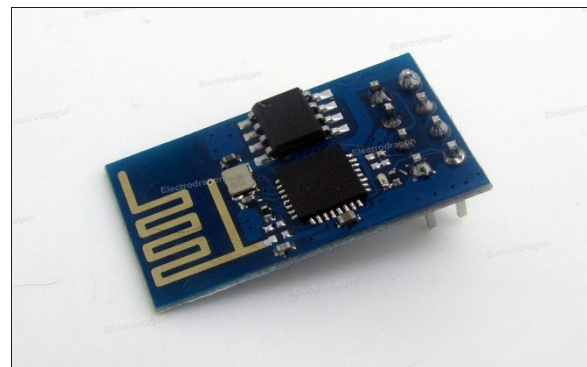
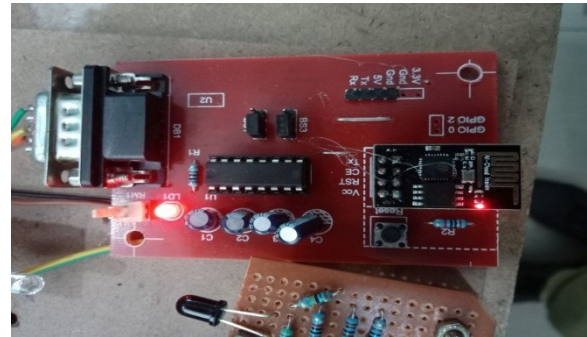


Fig .7: WIFI Module

VSD03 is the new third-generation embedded UART-WIFI modules studied by VSD TECH. UART-WIFI 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. Through the UART-WIFI module, the traditional serial devices can easily access to the wireless network. VSD03 does a comprehensive hardware and software upgrades based on the products. Its main features include.

3.8 IR (Tx and Rx):

Transmitter and receiver are incorporated in a single housing. The modulated infrared light of the transmitter strikes the object to be detected and is reflected in a diffuse way. Part of the reflected

light strikes the receiver and starts the switching operation. The two states – i.e. reflection received or no reflection – are used to determine the presence or absence of an object in the sensing range. This system safely detects all objects that have sufficient reflection. For objects with a very bad degree of reflection (matt black rough surfaces) the use of diffuse reflection sensors for short ranges or with background suppression is recommended.

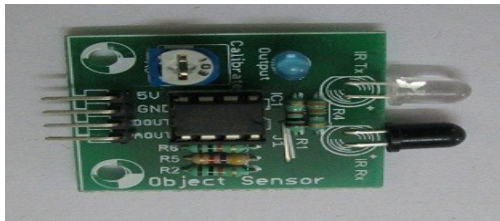


Fig .8: IR sensor

IV. EXPERIMENTAL RESULT:

4.1 Working condition of circuit:



Fig .9: Welcome to the person detection



Fig .10 : GPRS connected display on LCD

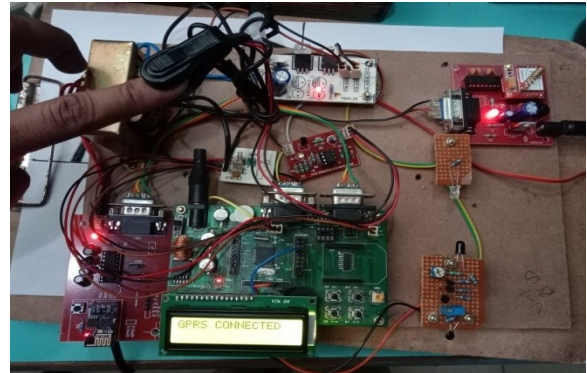
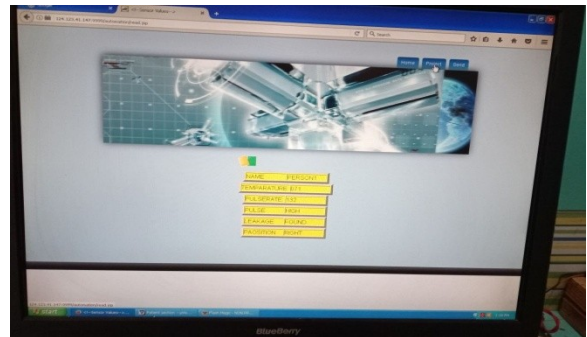


Fig .11: Pulse measurement



Fig .12: Pulse, Temperature, Body positions are display on LCD

4.2 GPRS webpage output:



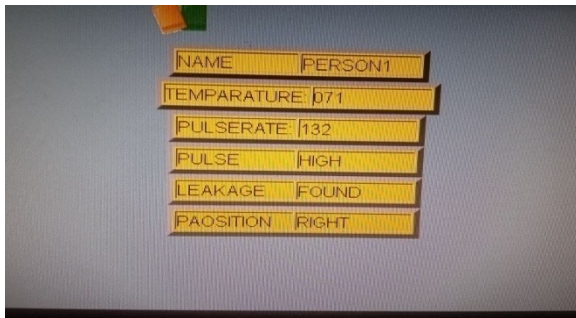


Fig .13: Patient condition details in web page

4.3 Blood leakage detection output:

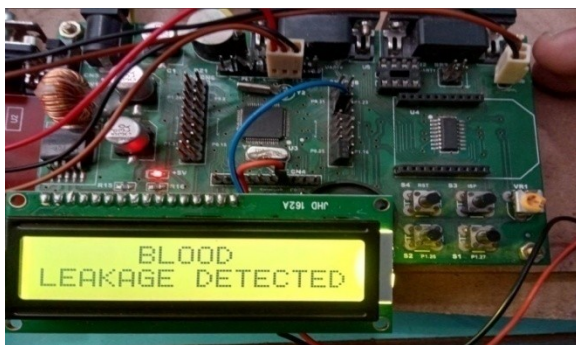
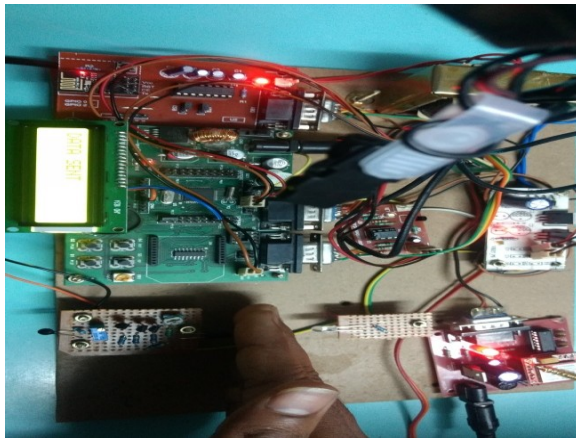


Fig .14: Blood leakage detected display on LCD

4.4 WIFI and message output :

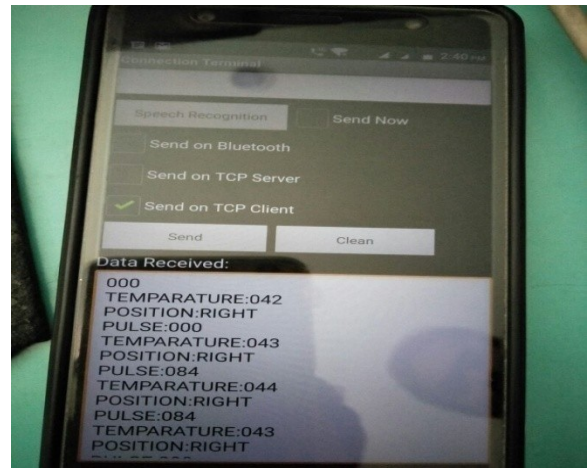


Fig .15: Display on mobile phone



Fig .16: Message sending display on LCD

CONCLUSION

In this study, the developed blood leakage monitoring system is an independent system, and thus, it could be simply used along with the current hemodialysis equipment. In addition, it is a non-invasive monitoring device, which enables an easy installation of the detector on the human arm. The main feature of the developed blood leakage monitoring system is that once the blood leakage is detected, the alert sound and a warning light will be activated, and the alert signal will also be sent to a monitoring computer with the developed user interface software installed, such as a healthcare station, through WIFI wireless transmission

method. Thus, the relevant healthcare workers could give appropriate treatment immediately. In addition, a common toilet paper after trimming to a suitable size (40 × 10 mm) could be used as the absorbent material for the capillary action, and therefore, reducing the cost of the sensing expendables. Last, test results show that the blood leakage detector only requires a very small amount of red ink (0.01 ml) and takes just 1.6 seconds to detect a leaking condition, which produces a fast monitoring system on the hemodialysis therapy.

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