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An effective infusion monitoring in hospitals using embedded system

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ABSTRACT

The wide use of Embedded Systems, especially smart wearable plays an important role to improve the quality of medical care, convenience for patients and to improve the management level of hospitals. However, due to the limitation of communication, there exists non unified architecture that can connect all intelligent things in smart hospitals, which is made possible. In view of this, a method is introduced to connect intelligent things in smart hospitals and introduce edge computing to deal.

INTRODUCTION

An embedded system is a controller programmed and controlled by a real-time operating system (RTOS) with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety-eight percent of all microprocessors manufactured are used in embedded systems.Examples of properties of typical embedded computers when compared with general-purpose counterparts are low power consumption, small size, rugged operating ranges, and low per-unit cost. This comes at the price of limited processing resources, which make them significantly more difficult to program and to interact with. However, by building intelligence mechanisms on top of the hardware, taking advantage of possible existing sensors and the existence of a network of embedded units, one can both optimally manage available resources at the unit and network levels as well as provide augmented functions, well beyond those available. For example, intelligent techniques can be designed to manage power consumption of embedded systems.

EXISTING SYSTEM

The block diagram of “A Smart hospital using IOT” device is shown in Fig 1

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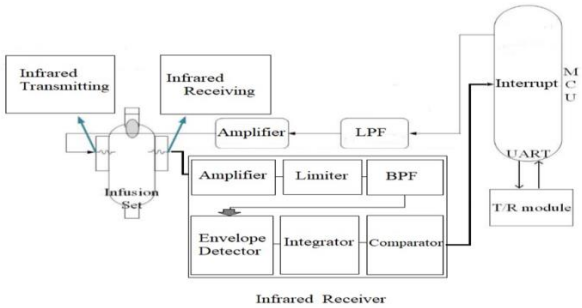

Fig 1 Block diagram of existing system

AMPLIFIER

An amplifier, electronic amplifier or (informally) amp is an electronic device that can increase the power of a signal (a time-varying voltage or current) [1-5]. It is a two-port electronic circuit that uses electric power from a power supply to increase the amplitude of a signal applied to its input terminals, producing a proportionally greater amplitude signal at its output.

LPF

A low-pass filter (LPF) is a filter that passes signals with a frequency lower than a selected cutoff frequency and attenuates signals with frequencies higher than the cutoff frequency. The exact frequency response of the filter depends on the filter design. The filter is sometimes called a high-cut filter, or treble-cut filter in audio applications.

BPF

A band-pass filter, also band-pass filter or BPF, is a device that passes frequencies within a certain range and rejects (attenuates) frequencies outside that range. Bandpass is an adjective that describes a type of filter or filtering process; it is to be distinguished from passband, which refers to the actual portion of affected spectrum. The band pass filter is shown in Fig 2.

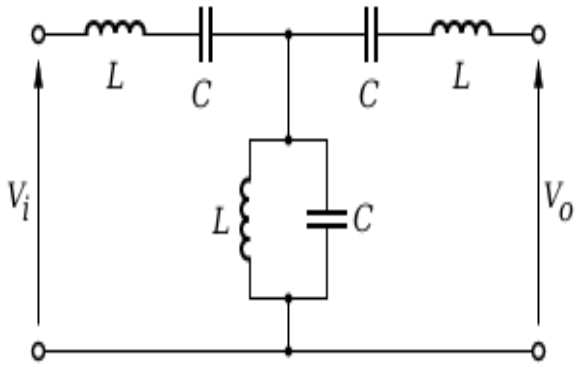

Fig 2 Band pass filter

INTERRUPT

An interrupt is a signal to the processor emitted by hardware or software indicating an event that needs immediate attention. An interrupt alerts the processor to a high-priority condition requiring the interruption of the current code the processor is executing. The processor responds by suspending its current activities, saving its state, and executing a function called an interrupt handler (or an interrupt service routine, ISR) to deal with the event. Fig 3 shows interrupt.

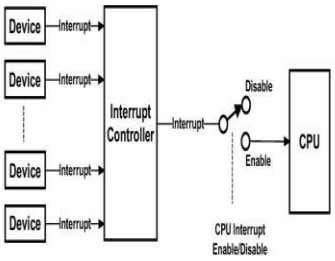

Fig 3 Interrupt

LIMITER

A limiter is a circuit that allows signals below a specified input power or level to pass unaffected while attenuating (lowering) the peaks of stronger signals that exceed this threshold. Limiting is a type of dynamic range compression. Clipping is an extreme version of limiting. Limiting is any process by which the amplitude of a signal is prevented from exceeding a predetermined value.

INTEGRATOR

An integrator in measurement and control applications is an element whose output signal is the time integral of its input signal. Mechanical integrators are the oldest application, and are still used in such as metering of water flow or electric power. Electronic analogue integrators are the basis of analog computers and charge amplifiers. Integrator is shown in Fig 4.

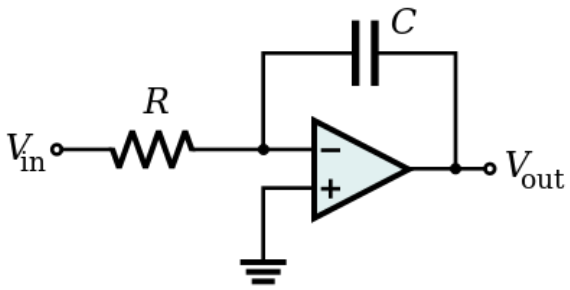

Fig 4 Integrator

COMPARATOR

A comparator circuit compares two voltages and outputs either a 1 (the voltage at the plus side; VDD in the illustration) or a 0 (the voltage at the negative side) to indicate which is larger. Comparators are often used, for example, to check whether an input has reached some predetermined value. In most cases a comparator is implemented using a dedicated comparator IC, but op-amps may be used as an alternative. Fig 5 shows comparator.

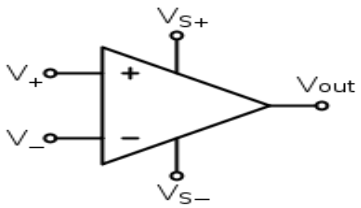

Fig 5 Comparator

EXISTING SMART HOSPITAL MANAGEMENT SYSTEM BASED ON IOT

In IOT based technology applied in the medical field some scholars put forward IOT in medical care, medicine based on IOT, IOT in health care and other related concepts, which have the same essence, only different in angle and range of description.

Smart hospital, based on the technology of IOT and constructed with the vector of various application service systems, is the concentrated reflection of IOT applied in the special place of hospital and it is a new kind of hospital integrated the function of diagnosis, treatment, management and decision. And also, integrating the concepts of informative hospitals, intelligent hospital and digital hospital [6-8], it is the more specific, comprehensive, dynamic description about hospital. Through the implementation of smart hospital, it can implement the application system based on digital environment and people can fast and accurately obtain the relevant service information, thus it can realize diagnosis informatization, management standardization and scientific decision.

Analysed from existing projects the major problems are Complexity, Multiple risks, Vulnerabilities, Cost effective and Infusion pump and pain management wasn't under control.

BLOCK DIAGRAM OF PROPOSED METHOD

Block diagram of infusion monitoring system contains the various components that is used for specific process. Every pin of arduino is connected to Ultrasonic Sensor, LCD and GSM. The bottle has a certain level for the indication. The infusion monitoring is shown in Fig 6.

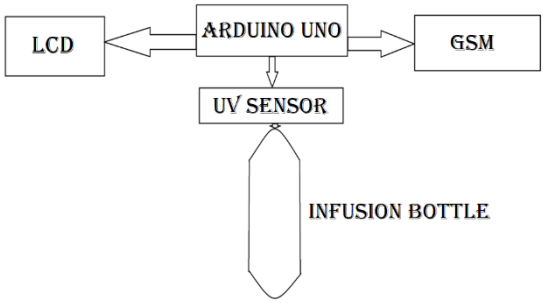

Fig 6 Block diagram of Smart Infusion Monitoring System

ARDUINO UNO

The Arduino Uno is based on the ATmega328, a microcontroller board. It has 14digital input/output pins of which 6 can be used as outputs, 6 analog inputs, it consist of 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. Arduino Unois shown in Fig 7.It supports the micro-controller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Fig 7 Arduino Uno

LCD

A liquid-crystal Display (LCD) is a flat-panel display or other electronically modulated device that uses the light-modulating properties of liquid crystals. Liquid crystals don't emit light directly, instead employing a backlight or reflector to provide pictures in color or monochrome. LCDs are available to display images or fixed images with low information content, which can be displayed or hidden, like preset words, digits, and seven-segment displays, as in a very digital clock. It is shown in Fig 8.

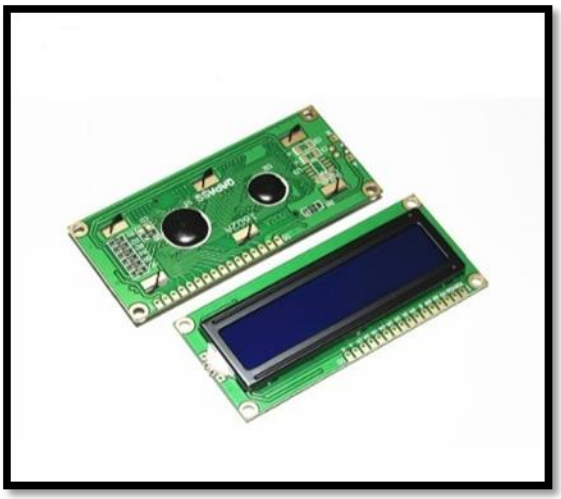

Fig 8 LCD

GSM

GSM (Global System for Mobile communications) is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. 2G networks developed as a replacement for first generation (1G) analog cellular networks described a digital, circuit-switched network optimized for full duplex voice telephony. Fig 9 shows GSM

Fig 9 GSM

Ultrasonic Sensor

Ultrasonic transducers or ultrasonic sensors are a type of acoustic sensor divided into three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound.

Fig 10 Ultrasonic Sensor

Infusion Bottle

Infusion bottle is the bottle which has a liquids or drugs for patient's intravaneous infusion. For example, glucose bottle has a certain glucose level in it. These levels are changed as per the requirements. The glucose infusion speed can also be changed. The drugs in the bottle have to be checked before use. Fig 11 shows infusion bottle.

Fig 11 Infusion Bottle

EMBEDDED SYSTEM BASED ON INFUSION MONITORING SYSTEM

While using conventional drip systems for intravenous infusion, it is essential that a nurse or a companion watches the process, ensuring that the tube is removed upon completion of infusion. if on complete drainage of the bottle, the needle is not removed from the patient, it results in back flow of blood into the tube. Overdosing of drugs or excess infusion of electrolytes and saline may also occur. the number of incidences of back flow of blood due to inattention of medical staff is quite high. this results in undue stress on nursing staff who have to constantly monitor the drips even as they manage multiple patients. Infusion pumps are very expensive and not suitable for use in general wards in the Indian context where income levels of individuals are not comparable to developed nations and affordable health care is the need of the hour [9].

A gap is identified in the healthcare sector, and wants to bridge this gap. We have developed a simple and cost effective solution to address this need. our proposed infusion monitoring device is suited to all segments of the market. The device gives an alarm on completion of infusion of desired volume of fluid. in addition to giving an alarm, it has a mechanical component which will choke the tube and block further infusion of fluid as well as prevent back flow of blood into the tube. The device consists of 2 components. The first one is the sensor strip, which is to be attached to the fluid bottle, at the level till which fluid needs to be administered. the second one is a control unit, which will be attached to the stand of the drip system and consists of a buzzer that will ring when the desired volume of fluid has been infused and a mechanical component to stop the flow. The device operates on electricity and also contains a battery backup with a charge level indicator.

It is compatible with all fluids and can therefore be used for medications, saline and electrolytes. This device can be reused for different patients without any need for sterilization as it does not come in contact with the fluid being infused. the device will not only benefit the patient and his companions, who would otherwise have to monitor the infusion process for hours, but also reduces the stress on nurses who have to keep tab of all the patients under her observation. the device is simple to use and does not require technical training for the users. in addition, it is compatible with all bottle sizes and fluids, and is provided with rechargeable battery, to prevent the additional expense of fresh batteries. The system can be easily configured to suit individual hospital needs, by interfacing the alarm system to the bedside alarm.

For Smart Hospitals, Infusion Monitoring System is used. Here Ultrasonic Sensor is used to send and receive Ultrasonic waves. Arduino Uno microcontroller is used for monitor drop lets and amount of increasing or decreasing liquids in Infusion Bottle. The Program is dumped in Arduino Uno microcontroller. The Ultrasonic Sensor sends signals by microcontroller to Liquid in the infusion bottle for every time duration. Those time durations are converted to distances like inches and centimetres. By this process can be found the amount of liquids present in the infusion bottle. If there arise any change in the infusion system, then buzzer sound and LCD display can be identified. Nowadays patients are increasing in the hospital and so these monitor systems will be useful for their emergency.

Output for the smart infusion monitoring system using embedded system

CONCLUSION

In this paper, an application scheme is proposed and it changes the existing hospital clinic model incase of smart infusion. It is based on embedded mobile electronic medical records application platform. This smart monitoring method is used in hospitals to overcome human errors. This will lead to smart heart beat monitor in future. As UV sensor is used in smart monitoring system, the infusion level is indicated digitally to doctors through LCD or GSM. This will play a major role in future various monitoring systems in smart hospital.

FUTURE SCOPE

In future the advanced model of monitor can be made and paves the way for smart hospital. The main application of embedded system is IoT. The IoT has various applications in hospital. Body-worn sensors and non-contact sensors in hospital rooms can capture patient health care parameters, thus digitizing health information at the source. It has enabled healthcare monitoring to become more widespread and effective. In the past, patients could only be monitored in a medical facility or under the care of family or home nurses. If a patient decided to heal in a hospital, their vital signs - blood pressure, blood sugar levels, and heart levels - could be monitored by healthcare professionals. But the image sensors that can be incorporated into hospital infrastructure to make the hospital a contact-free health monitoring environment. Simultaneously, imaging systems can beendowed with communication capabilities so that medical images can be directly sent to a central imaging repository. This allows for easier handling of medical images and makes them available to a physician on demand and remotely.

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