DEVELOPMENT OF WIRELESS BIO-TELEMETRY SYSTEM USING FM STEREO METHOD

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Abstract- Development of telemetry system is used for Transmission and detection of vital body signals. The transmitting unit detects and sends two kinds of patient’s vital signals. The stationary receiving unit receives and analyzes the signals and alerts a nurse to the dangers of the patient if necessary. The system could be simplified and minimized in size by using commercialized electronic components. The main aim of this project to inform doctor about patient condition continuously. In this project two parameters namely temperature and heart rate are measured. Abnormality in any one of the parameter will be informed to the doctor through FM receiver. The main aim of this project to inform doctor about patient condition continuously. In these project two parameters namely temperature and heart rate are measured. Abnormality in any one of the parameter will be informed to the doctor through FM receiver. Temperature is sensed by using, two terminal IC AD590 which gives current output directly proportional to absolute temperature variations. This is amplified using instrumentation amplifier, and read to analog and digital converter. A microphone sensor is used to detect patient’s heart sound. The standard FM stereo modulation method and a commercialized single IC chip were incorporated to reduce the size of the transmitter and increase signal-to-noise ratio. In the receiving unit a standard FM receiving module could be used to restore the original signal with very low cost. After detecting, the signal is processed by digital filters, and the extracted patients’ parameters are displayed on CRT monitor.

I. INTRODUCTION

Biotelemetry is defined as the transmission of biomedical signals and parameters to a remote recorder by means that do not cause substantial disturbances and restraints to the human being monitored. The classification of systems is based on the technical principle of transmission (i.e., wireless or by wire, radio wave, ultrasonic wave, or light wave). Further classification is according to the range of transmission, number of simultaneous data channels, modulation technique, and application.

Telemetric transmission of functional and physiological information offers many advantages in medical diagnostics and patient surveillance. The telemetric data link avoids direct connections to the recording or monitoring equipment, which are sometimes embarrassing and restraining, thus leaving the patients freely movable. They can be monitored in their natural environment and during work. Accordingly, the measurement does not influence the physiologic system under study. Thus avoiding severe artifacts. This advantage is especially important in behavioral studies involving both humans and animals. Implantable telemetry systems transmit internal physiologic signals. Or serve to control and program implanted devices. Such as stimulators and drug infusion systems.

Without the need of transcutaneous wire connections which always carry the risk of infection. Depending on the distance between patient and remote recorder, on-wire transmission is realized either as a direct connection between transducer and recorder or uses interference-reducing pre amplifier-driven cable connections. Wireless telemetry transmits the signals by modulation of a carrier wave that serves as a transmission link. Besides the commonly used battery-operated systems, passive telemetry transmitters, which do not require any power supply, exist for applications in long-term implantable devices, offering unlimited operation times.

II. METHODOLOGY

Telemetry is defined as the sensing and measuring of information at some remote location and then transmitting that information to a central or host location. There, it can be monitored and used to control a process at the remote site. The basic concept of telemetry has been in existence for centuries. Various methods of transmitting data from one site to another have been used. Telemetry using radio waves or wireless offers several distinct advantages over other transmission methods. Some of these advantages are:

- Faster response time
- No transmission lines to be cut or broken
- Lower cost compared to leased lines
- Ease of use in remote areas where it is not practical or possible to use wire or coaxial cables
- Easy relocation
- Functional over a wide range of operating conditions.
Properly designed radio links can provide low cost, effective and flexible data gathering systems that operate for many years with very little maintenance.

**Components of a Telemetry System**

At the remote site, a sensor or sensors are typically the data source. The output of the sensors is converted to digital data by a small computer device or RTU (Remote Terminal Unit). The RTU is interfaced to a modem device that converts the digital data into an analog signal that can be transmitted over the air. The radio transmitter then transmits the signal to the host site radio receiver. Now the process is reversed. The modem takes the analog signal received and converts it back to a digital form that can be processed by the data recovery equipment. In a typical application, the base or host site requests data from the remote sites. The base transmits a request to the remote unit telling it to send its data. The base reverts to a receive mode and awaits the transmission from the remote site. After the remote sends its data, it goes back to a receive mode waiting for further instructions to come from the base. Once the base receives the remote site information, it may send additional instructions to that site or continue on to request data from the next remote site. This polling process continues until all the remotes in the system have sent their data.

**III. PROPOSED METHODOLOGY**

![Figure 1](image)

1) **TEMPERATURE MEASURING PART**

It consists of temperature sensing transducer which converts temperature into its equivalent voltage; this voltage is further amplified by instrumentation amplifier and fed to analog to digital converter. The two terminals IC AD590, used for temperature sensing, of which current output which is directly proportional to absolute temperature variations, over a range of -50°C to +150°C.

The projected output of the AD590 varies at the rate of 1µ A/K and is inherently linear, thus requiring no external linear circuit. Please note that zero degree centigrade is equal to 273.2 K. The IC is pre-calibrated to give an output of 298.3µA at 298.2 K but external calibration can also be performed.

Thus the temperature sensor works over a wide range of voltages, starting from +4v to +40v, which adds to the versatility of its application in various temperature sensing circuits. The current output of the transducer needs to be converted to suitable proportional voltage level

2) **HEAR SOUND SIGNAL**

The heart sound signal to be detected by a microphone sensor is frequency-modulated by voltage-controlled oscillator and fed to the microprocessor and then to left audio channel input of the standard frequency modulation IC (BH1416F, Rohm).

The sensor for the heart sound detection will be designed by using a condenser microphone and should be attached on the body surface.

Heart sounds can be utilized more efficiently by medical doctors when they are displayed visually, rather than through a conventional stethoscope. A system whereby a digital stethoscope interfaces directly to a PC will be described along with signal processing algorithms adopted. The sensor is based on a noise cancellation microphone, with a 450 Hz bandwidth and is sampled at 2250 samples per second with 12-bit resolution. Further to this, we discuss for comparison a piezo-based sensor with a 1 kHz bandwidth. A major problem is that the recording of the heart sound into these devices is subject to unwanted background noise, which can override the heart sound and results in a poor visual representation. This noise originates from various sources such as skin contact with the stethoscope diaphragm, lung sounds (patient breathing), and other surrounding sounds such as speech. Furthermore we project a solution using ‘wavelet denoising.’ The wavelet transform is used because of the similarity between the shape of wavelets and the time-domain shape of a heartbeat sound. Thus coding of the waveform into the wavelet domain can be achieved with relatively few wavelet coefficients, in contrast to the many Fourier components that
Microprocessors operate on numbers and symbols represented in the binary numeral system.

Microprocessors integrated into one or a few large-scale ICs the architectures that had previously been implemented using many medium- and small-scale integrated circuits. Continued increases in microprocessor capacity have rendered other forms of computers almost completely obsolete (see history of computing hardware), with one or more microprocessors used in everything from the smallest embedded systems and handheld devices to the largest mainframes and supercomputers.

3) MICROPROCESSOR KIT

Microprocessor is the heart of the project. The two parameters namely temperature and heart sound detector will be fed to input port of microprocessor which should be able to discriminate between normal and abnormal condition. If any abnormalities occur, then it will automatically inform to the doctor A silicon chip that contains a CPU. In the world of personal computers, the terms microprocessor and CPU are used interchangeably.

A microprocessor (sometimes abbreviated µP) is a digital electronic component with miniaturized transistors on a single semiconductor integrated circuit (IC).

One or more microprocessors typically serve as a central processing unit (CPU) in a computer system or handheld device.

Microprocessors made possible the advent of the microcomputer.

At the heart of all personal computers and most working stations sits a microprocessor.

Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.

Three basic characteristics differentiate microprocessors:
Instruction set: The set of instructions that the microprocessor can execute.

Bandwidth: The number of bits processed in a single instruction. Clock speed: Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

A microprocessor incorporates the functions of a computer's central processing unit (CPU) on a single integrated circuit or at most a few integrated circuits. Microprocessor is a multipurpose, programmable device that accepts digital data as input, processes it according to instructions stored in its memory, and provides results as output. It is an example of sequential digital logic, as it has internal memory.

4) TELECOMMUNICATION PART

This unit consists of the following components.

Buffer

Voice bank

FM transmitter and receiver

BUFFER:
The buffer is connected between the microprocessor kit and voice bank. If there is no buffer then the voice bank may draw input current and it will load the processor. Hence to avoid the loading effect buffer is used. A buffer is a region of a physical memory storage used to temporarily store data while it is being moved from one place to another. Typically, the data is stored in a buffer as it is retrieved from an input device (such as a microphone) or just before it is sent to an output device (such as speakers). However, a buffer may be used when moving data between processes within a computer.

This is comparable to buffers in telecommunication. Buffers can be implemented in a fixed memory location in hardware—or by using a virtual data buffer in software, pointing at a location in the physical memory. In all cases, the data stored in a data buffer are stored on a physical storage medium.

A majority of buffers are implemented in software, which typically use the faster RAM to store temporary data, due to the much faster access time compared with hard disk drives. Buffers are typically used when there is a difference between the rate at which data is received and the rate at which it can be processed, or in the case that these rates are variable, for example in a printer spooler or in online video streaming.

VOICE BANK:

It is a special kind of chip purposely made for recording and playback. This chip can store eight messages each of seven seconds duration.
V. FM TRANSMITTER AND RECEIVER:

The output of the voice bank will be given to the FM transmitter and the signal is transmitter. Then the FM receiver receives the signal and the recorded voice heard through the speaker.

The single chip IC BH1416F for generation of standard FM stereo signal has a built-in voltage-controlled oscillator (VCO), a phase-locked loop (PLL) circuit, a pre-emphasis circuit, and a low-pass filter (LPF) circuit. A 3V power from the battery pack was supplied to the transmitting unit and boosted to a 5V by using a voltage converter IC (MAX777, Maxim).

We project to developed a low-power FM transmitter that operates at 433 MHz. This frequency is chosen because it is the closest short range devices (SRD) band to the FCC-approved Medical Implant Communications Service (MICS) band at 402-405 MHz. The ISM band is suitable for testing and development purposes. The MICS band was established in 1999 and is an ultra-low power, unlicensed radio service for transmitting data in support of diagnostic or therapeutic functions associated with implanted medical devices. This band is divided into 10 channels each having a bandwidth of 300 kHz. For applications where the antenna is to be positioned directly underneath the skin, such as in this work, tissue absorption can attenuate any RF signal. It has been shown that at 433 MHz, penetration through skin and tissue with high water content has a length constant of 3.57 cm. Thus, transmission from just underneath the skin should be reasonably effective.

![Figure 2](image)

RECEIVING UNIT:-
(Refer figure 2)This unit consists of:-
Antenna
An antenna (or aerial) is an electrical device which converts electric power into radio waves, and vice versa. It is usually used with a radio transmitter or radio receiver. In transmission, a radio transmitter supplies an oscillating radio frequency current to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves (radio waves). In reception, an antenna intercepts some of the power of an electromagnetic wave in order to produce a tiny voltage at its terminals that is applied to a receiver to be amplified.

Demodulator
Demodulation is the act of extracting the original information-bearing signal from a modulated carrier wave. A demodulator is an electronic circuit (or computer program in a software-defined radio) that is used to recover the information content from the modulated carrier wave.

Low Pass Filters
Filters are networks that process signals in a frequency-dependent manner. The basic concept of a filter can be explained by examining the frequency dependent nature of the impedance of capacitors and inductors. Consider a voltage divider where the shunt leg is reactive impedance. As the frequency is changed, the value of the reactive impedance changes, and the voltage divider ratio changes. This mechanism yields the frequency dependent change in the input/output transfer function that is defined as the frequency response.

A low-pass filter is a filter that passes low-frequency signals and attenuates (reduces the amplitude of) signals with frequencies higher than the cutoff frequency. The actual amount of attenuation for each frequency varies depending on specific filter design. It is sometimes called a high-cut filter, or treble cut filter in audio applications.

Analog to Digital Converter
An analog-to-digital converter (abbreviated ADC, A/D or A to D) is a device that converts a continuous physical quantity (usually voltage) to a digital number that represents the quantity's amplitude.

The conversion involves quantization of the input, so it necessarily introduces a small amount of error. Instead of doing a single conversion, an ADC often performs the conversions ("samples" the input) periodically. The result is a sequence of digital values that have converted a continuous-time and continuous-amplitude analog signal to a discrete-time and discrete-amplitude digital signal.

An ADC is defined by its bandwidth (the range of frequencies it can measure) and its signal to noise ratio (how accurately it can measure a signal relative to the noise it introduces). The actual bandwidth of an ADC is characterized primarily by its sampling rate, and to a lesser extent by how it handles errors such as aliasing. The dynamic range of an ADC is influenced by many factors, including the resolution...
(the number of output levels it can quantize a signal to), linearity and accuracy (how well the quantization levels match the true analog signal) and jitter (small timing errors that introduce additional noise). The dynamic range of an ADC is often summarized in terms of its effective number of bits (ENOB), the number of bits of each measure it returns that are on average not noise. An ideal ADC has an ENOB equal to its resolution. ADCs are chosen to match the bandwidth and required signal to noise ratio of the signal to be quantized. If an ADC operates at a sampling rate greater than twice the bandwidth of the signal, then perfect reconstruction is possible given an ideal ADC and neglecting quantization error. The presence of quantization error limits the dynamic range of even an ideal ADC, however, if the dynamic range of the ADC exceeds that of the input signal, its effects may be neglected resulting in an essentially perfect digital representation of the input signal.

An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number proportional to the magnitude of the voltage or current. However, some non-electronic or only partially electronic devices, such as rotary encoders, can also be considered ADCs. The digital output may use different coding schemes. Typically the digital output will be a two's complement binary number that is proportional to the input, but there are other possibilities.

VI. APPLICATIONS

This project is particularly for patient in ICU ward but can be extended to general wards also by using advance sensing devices.

If the patient temperature is rising, who is in home? It can be said automatically to the doctor through transmitter.

As same as body temperature, if there is abnormalities in heart rate it can be said automatically to the doctor which avoids the reverse flow of the blood from the body to bottle.

This project can be used in big and busy hospitals, where the doctor has to attend many patients at a time.

The developed system in this study can help that exercising patients’ vital signals can be monitored remotely in real time. Physical therapists can monitor patients’ present quantity of exercise and decide the time and degree of physical therapy and check patients’ vital safety.

In addition, the size of the transmitting unit reduced by incorporating stereo FM method and dedicated IC chips, and this decreased patients’ restriction in exercising activity.

Effective noise elimination algorithms and sophisticated monitoring algorithms are required to detect the dangerous status of the exercising patients and warn the therapists of the dangers of patients.

CONCLUSION AND EXPECTED RESULT

This is just the theoretical part of the project done by careful and elaborate study of a few related projects and developments. We have tried to keep in mind all practical implications of the project but still cannot be sure how it will turn out. The expected output should in form of waveforms or graphical representations ,the temperature is also displayed. We expect that the data received the antenna can be restored properly and effect of noise is reduced . The exact output can only be achieved once the project is finish ed..

REFERENCES

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