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Wireless Patient Monitoring System using UWB Antenna Interfaced with CC3200

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Abstract: The modern patient monitoring system has a greater impact on patient monitoring system. The existing diagnostic tools are replaced with Ultra wideband antenna in which a short range electromagnetic pulse. In our proposed methodology a novel patient monitoring system is model with a micro strip ultra wide band antenna. The patients recovering from critical state is monitored from remote place with an UWB interfaced with wireless node microcontroller unit. This system also diagnosis an early stage detection of abnormality in biological signals and update the information to hospital authority.

I. INTRODUCTION

Modern technology has emerged to wireless communication and this leads to more devices compactible with short range communication pulse. The wireless communication has a greater impact on medical devices and this leads to the evolution of wireless patient monitoring system. The wireless patient monitoring system provides a continuous monitoring for the patient recovering from critical stage. This wireless monitoring system is achieved with the development on ultra wideband technology. Ultra-wideband antennas replaces the electrode and body contact diagnosis tool.The UWB is used in the medical imaging produces a very short and it can penetrate through the body and the variation of receiving pulse imaging the function of internal organs provides the required information for the diagnosis of human body. This pathologic imaging in medicine that generates low radio pulse which is safe for human body and for the environment of hospital.The UWB pulses are very short and have strong space resolving ability and high precision ranging at the centimetre level. It has strong multipath resolving capability and also high resolution with less energy consumption, which enlarges the life of the battery devices used.A wide variety of antennas are suitable for use in ultra-wideband applications and the antennas may be classified as directional and non-directional. Directional antenna includes horn and reflector and small antennas like dipoles or loops are preferred for Omni directional coverage which is limited for a particular medium. Traditional large sized antennas can be made into use only if the wave form dispersion across the field of view could be tolerated. These antennas are frequency independent like log periodic or spiral antennas.Antennas can be further classified as electric or magnetic antennas. A micro strip antenna realized directly by means of proper conductive layer tissues within clothes [5]. A microwave Doppler radar systems allow the monitoring of the heart activity in a non-invasive and contactless way for the patient [6]&[7].Another approach of CMOS fully integrated versions of a radar for noncontact cardiopulmonary monitoring is used [8]. The UWB pulses are separated by two medium for parametric estimation [9]&[10].The electromagnetic pulses of short frequency range is determined using UWB characteristics[11]&[12]. In our proposed system an Ultra-wide band antennas are used for transmitting and receiving very short time durations of electromagnetic waves to patients. This uses a radio technology that can utilize a very low energy level for short-range, and very high bandwidth communication over a large portion of the radio spectrum. Ultra-wide band antennas are widely used in medical imaging and monitoring. The UWB has developed its wide range of applications in wireless communication. UWB is a very good choice and has many suitable features in medicine and uses low power ultra-short sub nanoseconds pulses. The rest of the paper is organized as follows Section 2 describes the use of UWB in medical imaging, patient monitoring and the sensor interfaced for diagnosis. In Section 3 the proposed UWB provides a novel patient monitoring system. Section 4 surveys the sensor data and the parameters for patient condition diagnosis. Finally, in section 5 the proposed work is concluded.

II. EXISTING ULTRA WIDEBAND APPLICATIONS

The evolution of Ultra wide band antenna in medical field has replaced the contactable diagnosis tool and the most important UWBs parameters must be carefully observed to detect the microscopic activity. The antenna with peak value, wider impedance bandwidth, gain should be designed more precisely. The UWB antennas are categorized of two applications in diagnosis ie)external body parameter applications and internal parametric applications. The UWB has developed its applications widely in medical imaging and medical monitoring.

A. *Medical Imaging*

The purpose of medical imaging is to capture the human body layer image which enables the system for the doctors to diagnose the human body structure. The UWB antenna play a major role in cancer detection as the electric pulse received has a different property compared to normal human tissue [1]. Another aspect of UWB radar enables the doctors to monitor the heart movement as the human dilated tissue has electric properties different from the non-dilated tissue. The UWB is used in imaging the internal organs of the human body because of high gain and the short pulses can penetrate through any obstacles. The UWB antenna is widely used in various imaging like cardiology, pneumology, Obstetrics, ears nose throat imaging.

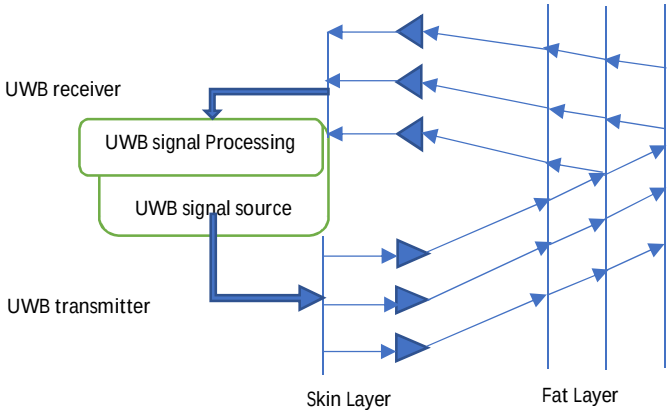

Fig: 1 Medical imaging using UWB

B.Patient Monitoring

The recent technological development in medical field has made it possible for smart monitoring system which involves contactable diagnosis devices. A short pulse communication in Ultra wideband technology plays an important role in patient monitoring. In this system a highly intense pulses uses a radar for remote monitoring and measuring the patient's motion fromto monitor bed ridden and for old people.

The patient monitoring function could be applied in intensive care units, emergency rooms, home. The UWB radars in hospital is a fixed component and it is possible to monitor the patient every second.The wearable UWB such as textile antenna are being developed which are capable of monitoring, alerting, and demanding attention whenever hospital emergency is needed for the patients [2].

In addition to the in-home healthcare monitoring, the body area network controller (BNC) can display several basic vital signals such as human body temperature, heart rate (HR), blood pressure (BP), and oxygen saturation (SpO2). However, for in-hospital healthcare and during surgery in an operating room, a more powerful computer is necessary to display more complex signals such as ECG. This computer is referred to as patient monitor (PM) and is connected to the BNC through a high-data-rate UWB interface, namely, the ECMA-368 radio interface [3]. This radio interface works on multiband orthogonal frequency division multiplexing (MB-OFDM), and can support 480 Mbps within distances of up to 3 m and 110 Mbps up to 10 m.

C. *Sensor Interface in UWB*

The medical sensors operate in close proximity to the patient's skin and the data rate requirements for medical sensing is achieved using electromyography sensing. The continuous EMG monitoring requires signal of electrocardiogram and electroencephalogram that require 10 to 200 kbps data rate respectively. The characteristics of the UWB wireless interface for on-body sensors involves on-body transceivers in the lower part of the UWB spectrum with 3.4–4.8 GHz. There is a reduction in data rate of on-body IR-UWB.The UWB antenna with short pulse provides efficient data transfer as the receiver can be placed on the skin or at some distance away. By placing the receiving antenna on the body surface, the nonradioactive near-field components can be collected by the antenna thus improving the link quality significantly.

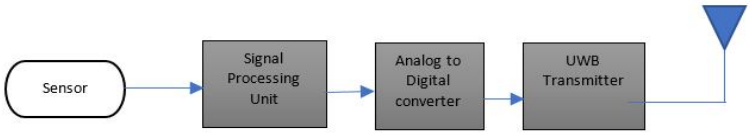

Fig 2: Block diagram of sensor interfacing using UWB

In addition to UWB in sensor interface, it provides the way to diagnosis urinary retention. Small ultra-wide band antennas have been widely proposed in the medical field to monitor heart beating. The UWB is also used in the safe guarding of the medicine in the storage medium and the planar dipole antenna with various shapes of bowtie and flair were used for the imaging of the cancer in early stage. This UWB antenna is used in the detection of the Breast cancer. Other possible medical application areas of UWB include The UWB technology is also being used in biofeedback-based rehabilitation protocols such as: respiratory rehabilitation, cardiovascular rehabilitation, and occupational therapy. UWB is also used in artificial prosthesis control and actuation of wheelchair driving systems that is very useful for the bed ridden patients.

D. Proposed Patient Monitoiring System

The proposed modelling of patient monitoring system uses an integrated UWB transceiver unit and a Wi-Fi control module for remote monitoring as well as provides alertness for hospital authority. This Patient monitoring system (PNS) is used for monitoring physiological signals including oxygen saturation in human blood (SpO2), electro cardiograph (ECG), respiration, invasive and non-invasive blood pressure, body temperature and other gases. These parameters keep the patients to be observed frequently and the UWB signal replaces the multisensory and electrodes for receiving different parametric variation such as physiological signals like as ECG electrodes blood pressure cuff, SpO2finger sensor and temperature probe to measure the physiological signals.Physiological signals such as ECG are obtained from UWB antenna (Transmitter/Receiver) which converts biological signals like pressure into electrical signals. These signals are amplified and conditioned through an amplifier and signal conditioning circuit. The threshold limit for these signals are fixed based on the biological parameters and the monitoring and alertness to hospital authority is provided through CC3200 Wi-Fi module.

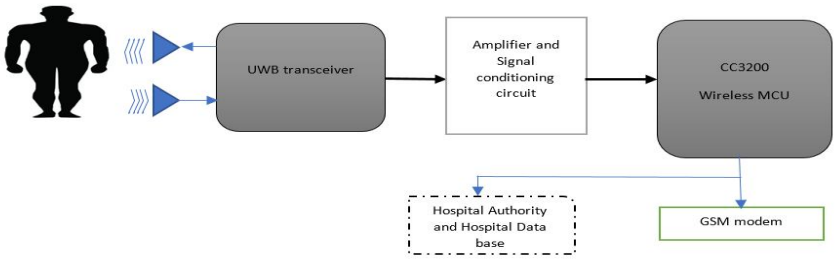

Figure 2: UWB interface for patient monitoring

Similar to traditional techniques, the UWB transceiver allows to monitor heart rate and this provides a continuous wave signal and receive the echo reflected by the target. The frequency of the reflected signal varies from that of the transmitted one by an amount proportional to the relative velocity of the target with respect to the transceiver.
The UWB act as pulse radar by sending a short electromagnetic pulses and by receiving the echoes reflected by the target. The time delay between the transmission of the pulse and the reception of the echo is proportional to the distance from the target to the transceiver. The pulse received is subjected to noise removal and amplified for parametric analysis.

III. RESULTS AND DISCUSSION

The parametric analysis performed on UWB antenna is shown in Table-1.The precise data received from the patient is based on gain and directivity of antenna.

Table 1: UWB antenna parameters

PARAMETERS	PROPOSED METHOD
Return Loss	4.16dB
Gain	27.4545dBi
Directivity	5.0718dBi
Radiated power	1.4615×10^{-3} watts
Efficiency	0.006

The fabrication of UWB antenna is achieved using Antenna design software as shown in Figure: 3

Figure 3: UWB antenna fabrication block

The scope of ultra wideband in medical have the capability if the receiver getting the data were the line of sight is not interrupted by passing through a human body. The future UWB is with the Integral part of 4G communications networks that saves time with very high data rate requirements. This model develops the Super-high-density wireless sensor networks which is very much necessary for patient monitoring and reduces more amount of wires near the patients

IV. CONCLUSION

The scope of ultra wideband system has emerged to realize miniaturized low power transceiver. These transceivers are employed to determine the vital signs from patient. The heart rate, breath rate and the diagnosis of patient skin layer is performed through the proposed methodology. The transceiver pulse provide the required data for parametric analysis by CC3200 controller and these data are transferred to a remote data acquisition unit or even in the Internet by means of a personal server. Thus the physiological data of a person under observation are monitored in real time by the doctors and it provides the instant act in time in case of anomalies in the vital parameters monitored.

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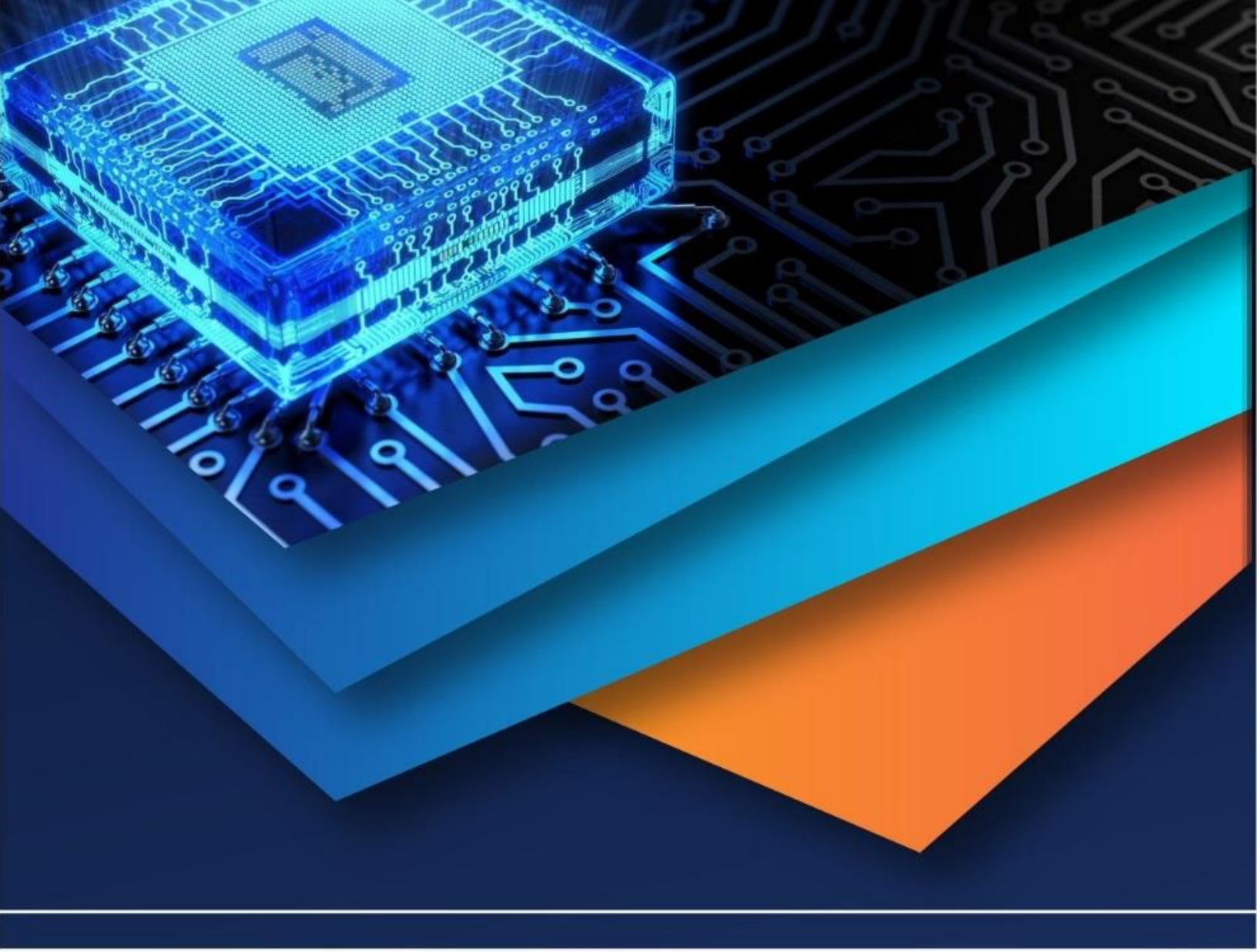

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