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EQUIPMENT IMPLEMENTATION OF AN IR-UWB ORGANIZER NODE FOR WBAN APPLICATIONS

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ABSTRACT

IR-UWB correspondence frameworks have moved toward becoming well known for Wireless Body Area Network (WBAN) applications as of late. This paper exhibits the improvement and testing of an IR-UWB organizer hub that incorporates an IR-UWB beneficiary front-end and a Field Programmable Gate Array (FPGA) based controller. The IR-UWB beneficiary front-end down changes over the high recurrence (3.5-4.5 GHz) IR-UWB beats utilizing a blender and a Voltage Controlled Oscillator (VCO) into effortlessly discernible base band beats. IR-UWB beat synchronization is actualized utilizing the FPGA. The execution of the recipient hub is tentatively assessed by leading Bit Error Rate (BER) examination for an on-body to off-body correspondence situation. The BER comes about demonstrate that a BER of 10-4 is achievable for a spread separation of 1m utilizing the IR-UWB organizer hub depicted in this paper.

KEYWORDS: IR-UWB, receiver front-end, synchronization, WBAN.

INTRODUCTION

Motivation Radio Ultra-Wideband (IR-UWB) signals utilizes short heartbeats to transmit information. In IR-UWB transmitters, information bits are balanced by thin IR-UWB beats utilizing straightforward regulation plans, for example, On-Off-Keying (OOK) and Binary Pulse Position Modulation (BPPM) [1]. IR-UWB is picking up notoriety for in-body and on-body correspondence in Remote Body Area Network (WBAN) applications because of its various preferences, for example, high information rate, low power utilization of IR-UWB transmitters. Fig. 1.portrays a common setup of a WBAN. Sensor hubs accumulate imperative physiological information from different sorts of sensors, for example, electrocardiographic sensors electroencephalographic sensors, and remote cases, and transmit remotely to an outside organizer hub. The capacity of the facilitator hub is to get remote information from various sensor hubs and forward that information to other information deciphering/capacity gadgets that are associated with the facilitator hub. Fig. 2 portrays a limit IR-UWB beat stream alongside the comparing recurrence range. An IR-UWB facilitator hub comprises of an IR-UWB front-end and a controller. IR-UWB front-end is in charge of changing over the high recurrence limit UWB beats into base band beats that are effectively perceivable utilizing Simple to Digital Converters (ADC). A controller works the calculations utilized for heartbeat synchronization and medium get to correspondence. This can be executed utilizing a Field Programmable Gate Array (FPGA) or a top of the line small scale controller.

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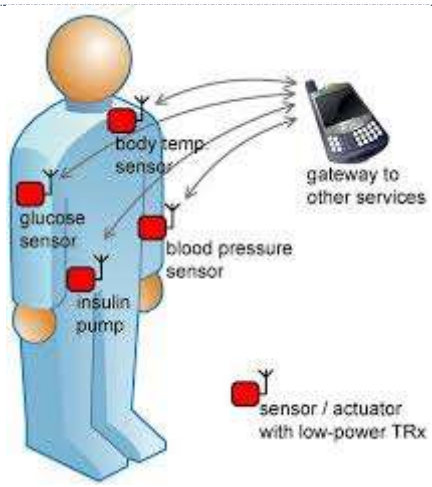

Fig 1: A typical WBAN setup.

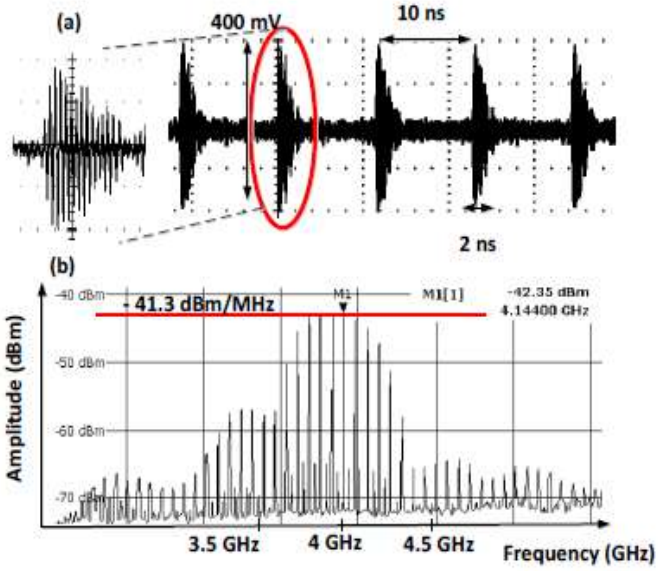

Fig 2: (a) Time domain IR-UWB signal (b) corresponding power spectrum.

Conveying the ADC near the receiving wire is not considered as a appropriate low-control method for UWB frameworks [2]. The completely advanced executions of the UWB beneficiaries require exact synchronization of nano-second scale limit UWB beats aside from information bit synchronization. IR-UWB recipients can be separated into two sorts; non-intelligible recipients and lucid recipients. Non-cognizant beneficiaries can be additionally subdivided into Energy Detection (ED) beneficiaries and Auto Connection (AC) recipients[3]. Execution of intelligent beneficiaries is contrasted and that of a non-intelligent recipient in, which demonstrates that better exactness can be gotten in intelligent collectors at the cost of high circuit unpredictability and high power utilization. It has been appeared in that a non-sound collector will perform superior to a lucid beneficiary for timing jitter values over 18 ps. It is appeared in that the ED recipient beats the AC beneficiary as far as BER for OOK and Binary Pulse Position Modulation (BPPM) plans. Brings about exhibits that the ED beneficiary is more control productive than the AC collector [4].

This paper depicts the usage of an IR-UWB facilitator hub that can be utilized as an off-body collector of IR-UWB based WBAN. Equipment usage of an ED beneficiary front-end is depicted in detail. The ED design is utilized for the most part because of the simplicity of execution utilizing off the- rack parts, capacity to work without the utilization of any timing control and resetting signals when contrasted with other recipient front-end

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topologies and little power utilization. The recipient front-end is produced utilizing off-the-rackparts: thus, it gives a simple to-actualize stage for IR-UWB test quaint little inns approval purposes. The IR-UWB front-end portrayed in this paper is fit for down changing over IR-UWB beats in the scope of 3.5-4.5 GHz into base band beats. The controller segment of the organizer hub is actualized utilizing Altera Stratix II FPGA module. The beat synchronization calculation is actualized utilizing the FPGA module. The organizer hub is prepared to do recognizing an IR-UWB beat stream with a greatest Pulse Reiteration Frequency (PRF) of 100 MHz Rest of the paper is sorted out as takes after; Section II depicts the equipment usage of the recipient frontend. Area III depicts the execution of IR-UWB beat synchronization, which is executed utilizing the FPGA module. Area IV displays the assessment of the organizer hub utilizing on-body to off-body tests. At long last, Section V finishes up the paper [5].

HARDWARE IMPLEMENTATION OF THE RECEIVER FRONT-END

Fig. 3 delineates the general piece graph of the IR-UWB collector front-end portrayed in this paper. The primary capacity of the IR-UWB collector front-end is to down-change over the high recurrence IR-UWB motions into base-band area and extending the beats.

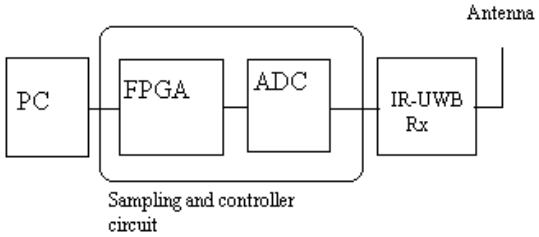

Fig 3: Block diagram of the IR-UWB coordinator node.

The time space waveform of the got base band flag after the simple enhancer organize for a flag transmitted at a 100 MHz PRF and a transmitter – beneficiary partition remove of 0.7 m is appeared in Fig.5 (a). Fig. 5 (b) delineates the measured recurrence area signs of the got motion for different areas of the IR-UWB collector front-end. The 0.7m transmitter – collector detachment separation is utilized as a part of the exhibition considering a short separation correspondence situation in a doctor's facility room condition.

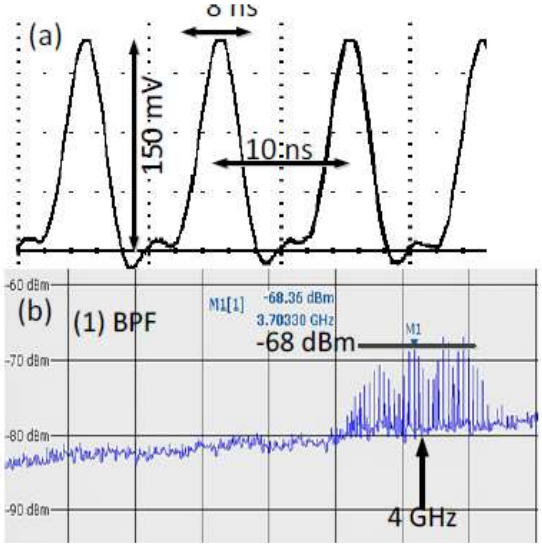

Fig 4: (a) Base band signal generated after the analog amplifier output, frequency spectrum at various locations of the IR-UWB receiver front-end (b) after BPF

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UWB PULSE SYNCHRONIZATION USING THE FPGA MODULE

Base band beats that are created after the simple intensifier stage are recognized utilizing the ADC and the FPGA of the organizer hub. Capacity of the beat synchronization calculation actualized in the FPGA module is to decide the ADC examining clock that specimens at the pinnacle of the gotten UWB beats. The pinnacle identification calculation utilized as a part of the FPGA module is delineated in Fig. 6. The UWB front-end produces a base band beat stream with beats that are 8 ns wide and 10 ns separated from each other for a transmit beat stream with a PRF of 100 MHz. With a specific end goal to recognize these heartbeats, the FPGA module creates six tickers having a recurrence of 100 MHz and a stage distinction of 60o. IR-UWB beat stream is successively examined utilizing these timekeepers. Ten successive UWB heartbeats are tested utilizing each clock and recorded heartbeat amplitudes are put away as a summation in an information exhibit. Utilization of ten specimen beats repays the impacts of time butterflies that may happen in the gotten UWB beat stream. Recorded heartbeat amplitudes are contrasted against each other all together with pick the ideal ADC testing clock for information location. This heartbeat synchronization can be actualized inside the synchronization part of an information parcel. FPGA program characterizes an underlying adequacy edge estimation of 10mV for distinguishing the nearness of a heartbeat. A heartbeat is identified if the beat adequacy identified by the ADC module surpasses the limit esteem.

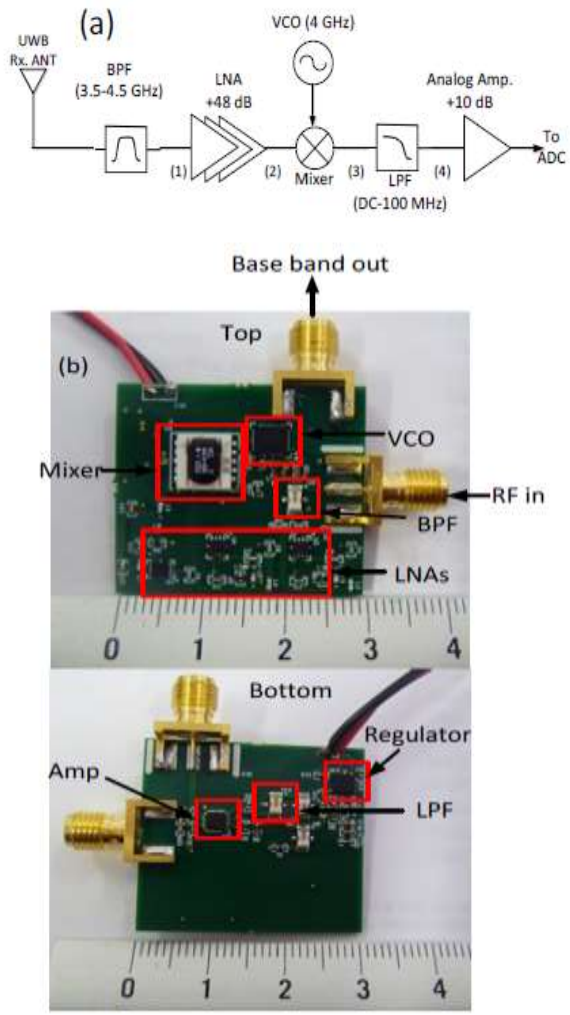

Fig 5: 4.IR-UWB receiver front-end (a) block diagram (b) PCB implementation.

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TABLE I
COMPONENTS USED IN THE IR-UWB FRONT-END DESIGN

Functional block	*Component name*
Mixer	MACA-63H+ [17]
BPF	BFCN-4440+ [17]
LPF	LFCN-1400+ [17]
VCO	HMC391LP4[18]
LNA	ZX60-5916M-S+ [17]
Analog amplifier	AD8000 [19]

Table 1: Components used in IR-UWB Front end design.

It was watched that this heartbeat synchronization technique gives attractive information correspondence to a short-run correspondence framework with a noteworthy nearness of a line-of locate part of the got flag. This down transformation construct beneficiary design centers with respect to distinguishing individual IRUWB beats that in the end prompts bit recognition. This strategy encourages high information rate correspondence rather than more traditional diode identifier based beneficiary designs, where the wrap of an IR-UWB beat burst is distinguished to decide information bits[6].

EXPERIMENTAL EVALUATION

The UWB facilitator hub is tentatively assessed utilizing a basic on-body to off-body correspondence situation for a solitary sensor correspondence framework. Amid the investigations, a solitary UWB transmitter hub is connected to the body and the facilitator hub is set outside the body. Information is regulated with IR-UWB heartbeats utilizing OOK tweak. At the point when facilitator hub gets information from the sensor hub, it exchanges they got information to a Matlab program that computes the Bit Error Rate (BER). BER is measured for shifting separations between the transmit and get radio wires. Fig.8 demonstrates the got UWB signals at the beneficiary receiving wire and comparing information bits recognized utilizing the FPGA executed calculation for a transmit-get partition of 0.7 m.

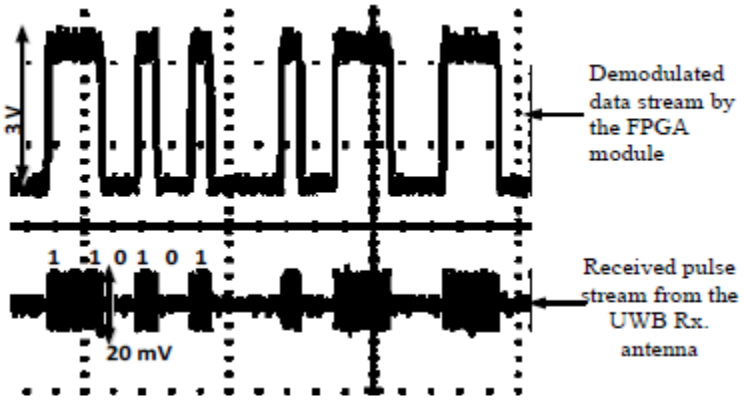

Fig 6: IR-UWB data reception.

Fig. 9 demonstrates the variety of BER with transmit-get partition. It can be seen from Fig. 9 that the recorded BER values take after a logarithmic rot as the transmit get partition increments. BER values for various transmit radio wire positions demonstrates a slight variety from each other for a similar detachment remove[7]. This framework can be additionally enhanced to encourage multi sensor correspondence [8].

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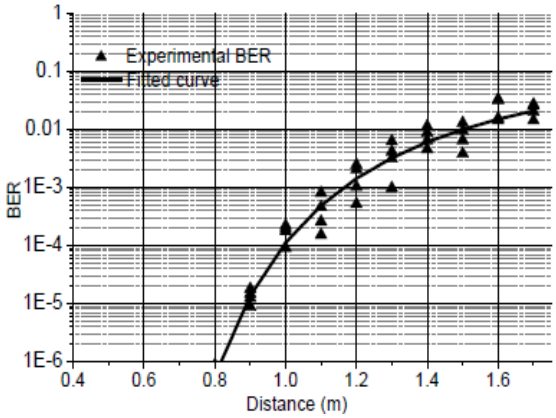

Fig 7: BER variation with transmit-receive distance.

CONCLUSION

This paper introduces the usage and trial assessment of an IR-UWB organizer hub that can be utilized for short-go WBAN applications. Full framework execution subtle elements of an IR-UWB recipient front-end that can be utilized to distinguish IR-UWB motions in the recurrence scope of 3.5 to 4.5 GHz is exhibited. An IR-UWB beat synchronization system executed utilizing a FPGA module is additionally introduced in this paper. The facilitator hub is tried utilizing an on-body to off-body correspondence situation and an information rate of 5 Mbps. The BER comes about acquired from the analyses demonstrate that the framework can work with a normal BER of 10-4 for a proliferation separation of 1m.

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