INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	**Ph.D.**
Thesis Title	:	**Design of IR-UWB Transmitter and Receiver for IEEE 802.15.6 Wireless Body Area Network System**
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Thesis Submitted to the Department/ Center	:	**Electronics and Electrical Engineering**
Date of completion of Thesis Viva-Voce Exam	:	**11/04/2019**
Key words for description of Thesis Work	:	**Mixed-Signal VLSI Circuit Design, IEEE 802.15.6, Wireless Body Area Network, Transmitter, Receiver**

SHORT ABSTRACT

The need for health-care systems using the technological advancements in wireless communications has witnessed the design of low power, intelligent and miniaturized invasive/non-invasive medical devices to be used on or around the human body or implanted in the human body for constant health monitoring and advice. This special type of wireless sensor networks (WSN) is referred to as Wireless Body Area Networks (WBAN). This thesis attempts to devise an implementation architecture that enables the design of an energy-efficient and low-complexity 15.6 IR-UWB transceiver system for BANs. A brief description of the work is as follows:

IR-UWB Transmitter using SRRC Signaling Pulse: This work considers a method for approximation of an arbitrary signaling pulse by a piecewise linear approximation (PWLA) approach and details its practical implementation in simple mixed-signal circuits. The proposed PWLA approach has the potential to approximate a signaling waveform with a high degree of accuracy. Various PWLA approximations of the SRRC pulse are considered and compared in terms of cross-correlation (with the ideal pulse), power spectral density and implementation complexity. Using a six-segment PWLA SRRC pulse, a complete design of a 15.6 compliant IR-UWB transmitter operating at a carrier frequency f_c = 3.9936 GHz and a data rate of 0.4875 Mbps using PPM signaling is given. The transmitter is designed for both 2-ary and 16-ary PPM signaling.

IR-UWB Non-coherent Energy Detection based Receiver: This work considers a design of an energy-efficient, non-coherent, energy-detection based receiver that uses a windowed integrator and a single-ended SAR ADC for “integration" and “digitization" followed by a new digital back-end for information extraction. The windowed integrator uses a new digital switching technique. The proposed single-ended SAR ADC uses a modified merged capacitor switching scheme for a capacitive reference DAC and works using a novel counter based SAR controller. The RF front-end is implemented using a single-to-differential LNA followed by a cascade of switchable inverter based gain stages feeding a squarer and an integrator for energy computation. BER performance of digital back-end is also carried out to validate the proposed energy detection based receiver. The receiver is designed for detection of information from the transmitter.

DAC Switching Technique for Single-ended SAR ADCs: This work deals with developing an energy-efficient SAR ADC and proposes a new switching technique for the capacitive reference DAC employed in the SAR ADC. This technique brings down the switching energy in the first few comparison cycles where the switching energy consumption is the highest among the `N' comparison cycles. Simulations are carried out to validate the proposed DAC switching technique and results are compared with the existing state-of-the-art DAC techniques.

Design Methodology for Event-driven PWLA Waveform Generator: The final part of the thesis focuses on providing a more accurate piece-wise linear approximation of a (signaling) waveform. To this end, an event-driven approach for PWLA pulse generator is considered and its performance evaluated. A set of “events" are generated at the break-points of a suitably chosen piece-wise linear approximations and these events in turn drives the PWLA segment generator to realize an arbitrary signaling waveform with a high degree of accuracy. Results show improved performance as compared to those in clock-driven approach. This study of the event-driven PWLA approach shows promising potential for applicability of the proposed pulse generator methodology in transceiver design.

In summary, it may be stated that this thesis has introduced a few circuit techniques along with an investigative study for design of energy-efficient and low power transceivers for IEEE 802.15.6 Wireless BANs.