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Design of Wireless DAQ System Using QAM Modulator

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Abstract-This paper discusses the design and implementation of digital acquisition system with wireless telemetry using QAM modulator. The chip is intended for wireless pressure measurement to analyse various pressure distribution during normal daily activities.This complementary metal-oxide-semiconductor (CMOS) IC consists of serial Analog to Digital Converter (ADC) and Voltage-Controlled Oscillator (VCO). The objective of this DAQ-IC is to be single chip which can be integrated with the ability of wireless transmission to an external on body receiver. Such device provides low power consumption, convenient and comfortable testing system simulating a range of normal daily life activities.

Keywords- QAM modulator, wireless system, SAR ADC

1. INTRODUCTION

The introduction of a wireless communication is essential to enhance the application of smart sensors. As there is growing need of biomedical wireless sensor systems, which can acquire biomedical signals from a patient and transmit the signals wirelessly to a remote location for further analysis. As compared to wired system, wireless system provides a number of benefits such as data collection of laboratories, freedom and higher patient mobility in daily routine. These systems entail severe technical challenges such as robustness of the wireless link and the need of a suitable data transmission band, coupled to low power dissipation and small size. A wireless sensor system typically demands a sensor node and a wireless transmission node.

2. SYSTEM ANALYSIS

Design of MEMS Biomedical Pressure Sensor for Gait Analysis [1] reports the analysis and optimization of a pressure sensor for foot pressure measurement. In this paper, the focus is directed towards total performance optimizations of the sensor output signal. This paper discusses the design and implementation of a wireless DAQ-IC for foot plantar pressure sensors. The IC is designed to interface with the fabricated sensor and to be implemented together with the sensor in the insole of a shoe.A Wireless System-on-Chip for Biomedical Plantar Pressure Sensor [2] discusses the design and implementation of a digital acquisition (DAQ) with wireless telemetry for foot plantar pressure sensors. The project targets wireless communication transmitter operating in the industrial, scientific and medical .The designed chip has low power consumption, less than 20mW in active mode when communication at 1.25Mbit/s, and using 1mm^2 of chip area when implemented in 0.35um CMOS technology. Design and Simulation of a Wireless DAQ-IC for Foot Plantar Pressure [3] presents the design and implementation of a wireless data acquisition (DAQ) integrated circuit (IC) for foot plantar pressure sensors. Block diagram consist of Successive approximation Analog to digital converter and voltage controlled oscillator(VCO).The analog signals from the MEMS pressure sensor is digitalize by 8-bit SAR- ADC then data is serialize by a PISO register which is then modulated by an FSK modulator. SAR-ADC permits low power high performance ADC to be packaged in miniature form. Finally the digitized signal is sent to 2.5GHz FSK wireless transmitter based on direct modulation of a voltage control oscillator enabling a 1.25Mbit/sec data rate. The wireless system has low power consumption, less than 20mW in active mode when communication at 1.25Mbit/s, and using 1mm^2 of chip area when implemented in 0.35um complementary metal oxide semiconductor (CMOS) technology. A wireless communication transmitter system operating in the 2.45GHz band. The sensors used in this system are MEMS sensor. The sensors used has many characteristics such as small in size, excellent linearity both at high and low pressure and negligible hysteresis. This paper describes the design consideration and simulation of wireless DAQ integrated circuit IC. (CMOS) IC consists of serial Analog to Digital Converter (ADC) and Voltage-Controlled Oscillator (VCO). The objective of this DAQ-IC is to be single chip which can be integrated into a shoe with the ability of wireless transmission to an external on body receiver. Information derived from such pressure is important for diagnosing lower limb problems, footwear design, sport biomechanics performance and injury prevention. An Ultra Low Power 9-bit I-MS/s Pipelined SAR ADC for Bio-

medical Applications [4] presents a pipelined successive approximation register analog-to-digital converter (SAR ADC) for bio-medical applications. The pipelined architecture can enhance the operation efficiency of the ADC and also save the digital power consumption in the SAR A 2-Bit, Power-DAC Cell for High-Efficiency, Fully Digital QAM Transmitters [5].A high-efficiency, large output-power, mm-wave digital transmitter architecture is proposed for high data rate QAM transmission. It operates entirely in digital mode, without any matching networks, it is scalable in frequency up to at least 50 GHz and portable to future generations of CMOS technologies.

3. PROPOSED WORK

The design and implementation of a wireless system on chip for sensor was used in pressure sensor. It showed that the power consumption is sufficient for system operation. The focus is on redesigning the system by replacing the FSK modulator by QAM modulator to increase the efficiency of the system [6]. It operates entirely in digital mode, without any matching networks, it is scalable and portable to future generations of CMOS technologies. QAM modulator has high-efficiency, large output-power,is proposed for high data rate QAM transmission.

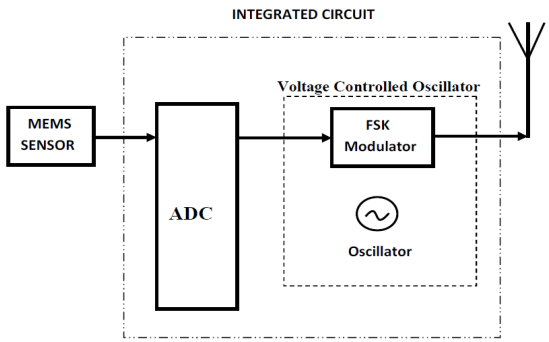

Fig. 1 The block diagram of DAQ system on chip

The introduction of a wireless communication is essential to enhance the application of smart sensors. Block diagram consist of Successive approximation Analog to digital converter and voltage controlled oscillator(VCO).The analog signals from the MEMS pressure sensor is digitalize by 8-bit SAR- ADC then data is serialize by a PISO register which is then modulated by an FSK modulator. SAR-ADC permits low power high performance ADC to be packaged in miniature form. Finally the digitized signal is sent to 2.5GHz FSK wireless transmitter based on direct modulation of a voltage control oscillator enabling a 1.25Mbit/sec data rate [7]. The wireless system has low power consumption, less than 20mW in active mode when communication at 1.25Mbit/s, and using 1mm^2 of chip area when implemented in 0.35um complementary metal oxide semiconductor (CMOS) technology.

4. METHODOLOGY

The signal processing of biomedical application typically requires low voltage, low noise analog interfaces which places a high demand for very low power consumption and low cost ADC [8]. Successive Approximation Register (SAR) ADC architecture are best suited for low power and small area application. The SAR ADC allows for high performance, low power ADCs to be packaged in small form factors for today's advanced biomedical applications. Fig. shows the schematic of the proposed 8-bit SAR ADC, which is similar to that of Hao-Chiao and Guo-Ming design [9]. The main building blocks of the design consist of a comparator, a SAR and a digital to analog converter (DAC). On the other hand, a VCO is an integral element of any wireless transceiver and other communication systems. In this system, a ring oscillator based VCO controlled by the output of the ADC is used as a quadrature amplitude (QAM) modulator. This is considered as the simplest integrated transmitter. In this design, the VCO acts as the carrier generator.

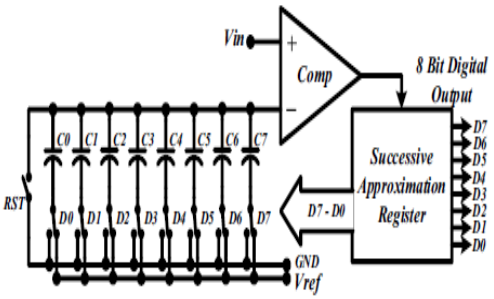

Fig. 2 Block diagram of designed 8 bit SAR ADC

5. CONCLUSION

The design and simulation of wireless system on chip for sensor is presented for use in pressure sensor. The analysis of simulation showed that the power consumption of this system is sufficient for system operation. These results show that the system is feasible for converting the sensor signals to digital signals, hence translate it to its frequency representation and ready for transmitting.

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