

List of Projects

Advisor: Dr. M. R. Haider

Project 1:

Design and implementation of an Industrial Scientific and Medical (ISM) frequency band Phase-Locked Loop (PLL) circuit

Description:

ISM frequency band is widely used for wireless communication such as cell phone, cordless, remote control, sensor network, modulation/demodulation, etc. To support multi-channel operation, communication device needs to generate multiple carriers or channel frequencies. Therefore in almost all radio frequency (RF) communication modules, a PLL circuit is used to generate multiple frequencies from a fixed frequency crystal oscillator. It provides a compact and programmable circuit solution. The main purpose of the project will be to implement such a PLL circuit for ISM band applications. Design specifications for the PLL circuit will be provided. Project phases include design and simulation using Design_Architect_IC, chip layout using IC_Station, chip fabrication and final testing to verify the design.

PLL building blocks are phase frequency detector, low-pass filter, voltage controlled oscillator and frequency divider.

Project 2:

Low-power and area efficient analog-to-digital converter (ADC) using all-inverter approach

Description:

Analog-to-digital converter (ADC) is an essential circuit block which is found in almost all electronic systems. It converts the real world analog signal to a digital data and makes it possible for digital processing. ADC blocks are found at the front-ends of modern voice/video processing units, digital modulators, portable devices, sensor units, etc. The main goal of this project will be to design an analog-to-digital converter. Low-power and less area consumption are two crucial needs for modern VLSI design. Conventional circuit architectures are most of the time power hungry and take a large amount of silicon area. An inverter is a simple circuit which can be configured for both analog (amplifier) and digital (logic gate) circuit applications. The prominent features of inverter are relatively low-power consumption, highly area efficient and moderate amplifier gain. Therefore in this project an ADC will be designed using only inverters. Project phases include design and simulation using Design_Architect_IC, chip layout using IC_Station, chip fabrication and final testing to verify the design. Design challenges include charge injection, clock feed-through, offset, mismatch, noise and speed.

Project 3:***Inductive-power link and backward telemetry for battery-less operation of sensor unit*****Description:**

In this project two loosely coupled inductors or coils will be used to transfer power to a sensor unit. The sensor unit will be energized by the received power, process any sensor signal and finally use the same coil setup to transmit the data through wireless media. Project phases include design and simulation using PSPICE, printed circuit board (PCB) design and testing. Building blocks are inductors or coils, power amplifier, trap network, modulators, regulators, energy receiver circuit, etc. Design challenges include establish the inductive link, recover the energy using resonant circuit and separation of data and power signals.

Project 4:***Implementation of a CMOS image sensor*****Description:**

Image sensor is used in a wide variety of ways such as in PET scanner for medical diagnostics, for optical monitoring of air or water pollutants, optical pattern recognition, etc. CMOS photodiode and data generation block will be implemented in this design. Building blocks are photodiode, opamp, bandgap reference, comparator, flip-flop, charge amplifier, modulator, etc.

Project 5:***Internet-based smart Home-Care Services*****Description:**

Different types of sensors will be placed inside the home or close to human body (wearable sensors). Sensors data will be processed and transmitted to a local base station. From the local base station data will be transmitted to distant location using internet.

Project 6:***Wireless Speed and Position control of an Electric Motor*****Description:**

Used for Robot control, toys, etc.

Building blocks are wireless transmitter, receiver, bandpass filter, mixers, low-pass filter, encoder, decoder, pulse shaper, etc.

Project 7:***Capacitance-to-Digital Converter with wireless Telemetry*****Description:**

Capacitive sensor is a well known type of sensor for better noise immunity and sensor resolution. The goal of this project will be to design a read-out circuit for the capacitance measurement of a capacitive sensor, convert the sensor signal to a digital data, transmit the signal using wireless media and monitor the data from a remote station.

Building blocks are charge amplifier, mixer, instrumentation amplifier, analog-to-digital converter, digital modulator, power amplifier, low-noise amplifier, demodulator, data representation, etc.

Project 8:***Optical pattern recognition for high speed Target detection*****Description:**

Compared to digital signal processing optical signal processing provides faster operation and supports a huge amount of data bandwidth. Optical pattern recognition has a lot of applications in military for surveillance or enemy target detection such as warship, missile, fighter planes, tanks, etc. The idea of the project will be to modify an algorithm that is suitable for optical signal processing. Background in linear analysis, signal processing and familiarization with MATLAB are needed.

Project 9:***Low-power and high data rate UWB communication system for Wireless Sensor Network*****Project 10:*****Precise Bias-Voltage Generation (Potentiostat) for Sensor Application*****Project 11:*****Low-Noise Amplifier Design for Radio Frequency Application*****Project 12:*****Class-E High Efficiency Power Amplifier Design*****Project 13:*****Floating-Gate based Mixer Circuit Design*****Project 14:*****Inductor-less Low-Noise Amplifier Design*****Project 15:*****Low-Noise High Resolution Sigma-Delta Modulator Design for Sensor Application***