King Saud University
College of Engineering
Electrical Engineering Department **Semester: 412**

Graduation Design Project Proposal Form

Project # E1

Project Title: Design and implementation of a power generation system using organic solar cells

Professor(s) Name(s): Dr. Mohamed Ramy; Dr. Ehab Awad

Number of Students: Two

Students Qualifications

1. Willing to get involved in extensive experimental work.
2. Willing to do hard work.

Statement of Problem

Organic solar cells are a class of photovoltaic devices that use organic semiconductor materials to produce electrical energy from sunlight by the virtue of the photovoltaic effect. Organic solar cells are lighter in weight and of lower manufacturing cost as compared to typical solar cells. Organic solar cells are flexible and potentially transparent and thus can be deployed in scenarios that are not possible for typical solar cells. On the other hand, organic solar cells are easily degradable and offer much lower efficiencies as compared to typical silicon solar cells. Organic solar cells are not being widely used in KSA and their performance at KSA's high temperature environment is not well studied. This project aims to design, implement and characterize a power generation system that uses organic solar cells.

Brief Description of the Project

The proposed project is concerned with developing power generation system that uses organic solar cells for solving a practical power generation problem relevant to KSA environment.

Objectives

1- Understand the physical working aspects of organic solar cells.
2- Design and implement a power generation system based on organic solar cells.
3- Characterize the implemented power generation system.

Technical Approach

- Background study on solar cell technologies and organic solar cells.
- Identify a technical problem relevant to the Saudi community that can benefit from organic solar cells.
- Conceptualize a power generation system that uses organic solar cells to solve the identified power generation problem.
- Power generation system design.
- Power generation system implementation and full characterization.
- In specific, the system will be characterized at KSA's high temperature conditions and the temperature coefficient of organic solar cells will be quantified. The suitability of using organic solar cells in KSA will be studied and assessed.

Expected Deliverables

- A power generation system based on organic solar cells.
- Electrical characterization results.
- Characterization results under high temperature conditions.

Project # E2

Project Title: On site testing of Large PV Systems

Professor(s) Name(s): Mohamed Abouelela and Mohammed Abbas

Number of Students: Two

Students Qualifications

Basic knowledge of electronics and communication and programming skills using C language

Statement of Problem

Photovoltaic power system applications and installations are experiencing rapid growth. The rating used to determine the incentive typically uses module nameplate rating (given at STC) and may not adequately consider system losses, components efficiencies and degradation from aging or corrosion. Customers are expecting their systems to produce according to the rating that the selection was based on. A certification On Site test protocol that delivers an accurate and credible estimate of component and system performance is needed. The project objective is to develop a microcontroller based equipment able to measure record and process the data needed perform a complete On site Testing for large PV systems and prepare the required evaluation report

Brief Description of the Project

The purpose of this paragraph is to give an overview of what the design need is and what design is being proposed to fill that need. (This section can be combined with the previous section)

The proposed project employs tools and techniques of modern sensing, processing, and networking to develop optimized energy usage solutions. The plan consists of development efforts across two major topics:

1. Development of distributed sensor-based techniques and embedded algorithmic processes to measure environmental parameters affecting the PV system performances
2. Development of IV curve plotter module and embedded algorithmic processes to measure the IV curve and return the curve to STC.
3. Development of local-area wireless communication and networking systems and adaptation of available protocols to enable remote access of collected data.
4. Define the procedure for reporting data to a localized data collection centers for further interaction.

Technical Approach and Expected Deliverables

A microcontroller based system will developed where the sensor reading can be acquired and proceed. The microcontroller will also provide an interfacing with the RF modules through its UART. A software will be developed to control the system functions and allow communication channel to transmit measurement data to a centralized data logger.

Project # E3

Project Title: Wireless Sensor Networks applications surveillance systems

Professor(s) Name(s): Mohamed Abouelela

Number of Students: Two

Students Qualifications

Basic knowledge of electronics and communication and programming skills using C language

Statement of Problem

Availability of low-cost sensing and processing modules as well as recently developed efficient wireless communication protocols for building automation applications provides the basic enabling tools for the application domain of smart control systems and other monitoring and reporting to overcome this problem . Example of such application is surveillance systems. Gas leakage, water folds, fire …etc are examples of problems that need urgent interaction. Sensing and reporting such problems may help in taking the right decision at the right time. The project addresses this problem through building a wireless network with the suitable attached sensors

Brief Description of the Project

The purpose of this paragraph is to give an overview of what the design need is and what design is being proposed to fill that need. (This section can be combined with the previous section)

The proposed project employs tools and techniques of modern microcontroller boards , data processing, and networking to develop a surveillance alerts system . The plan consists of development efforts across two major topics:

1. Development of distributed sensor-based techniques and embedded algorithmic processes to measure, detect, estimate, and manage surveillance alerts in a given building.
2. Development of local-area wireless communication and networking systems and adaptation of available protocols to enable the distributed sensing and processing devices to interact with each other.
3- Reporting data to a localized data collection centers for further interaction.

The Objectives are to:

1- Help users to get early warning
2- Increase safety in modern building by adding more smart features.
3- Realizing approximate a method of quick interaction in case of disaster during the 24 hours of the day.

Technical Approach and Expected Deliverables

A microcontroller based system will developed where the sensor reading can be acquired and proceed. The microcontroller will also provide an interfacing with the RF modules through its UART. A software will be developed to control the system functions and allow different communication channels for each sensor.

Project # E4

Project Title: Design of optical fiber communication link

Professor(s) Name(s): 1. Dr. Ehab Awad
2. Dr. Mohamed Ramy

Number of Students: Two

Students Qualifications: General knowledge in electronics and/ or communications

Description of the Project:

An optical fiber communication link can overcome the limited bandwidth of microwave wireless links. At the transmitter side, the data can be modulated on laser/ LED light. At the receiver end, a photodetector is used to convert optical data into electrical signal, which can be then demodulated. The optical fiber is used between the transmitter and the receiver to carry the data with a large bandwidth.

In this project, an optical fiber communication link will be designed and implemented. An input data will be modulated and transmitted over an optical fiber. The transmitted data will be then detected and demodulated at the receiver side using a photodiode to extract the original data.

Objectives:

In this project the students will learn about:

1- Optical communication links.
2- Optical fibers.
3- Semiconductor lasers and LED transmitters.
4- Photodetectors and optical receivers.

Technical Approach and Expected Deliverables:

By the end of project, the students will:

1- Design and build an optical fiber communication link.
2- Design and build optical transmitter.
3- Design and build optical receiver.
4- Write a technical report.

Project # E5

Project Title: Smart Traffic Light Controller

Professor(s) Name(s): 1. Adnan Nouh
2.

Number of Students: Two to three

Students Qualifications
EE 208, EE210, and 353

Statement of Problem
In today's generation we are facing a lot of traffic problems due to increased number of vehicles. People are unable to reach their destination on time due to traffic. Sometimes it happens although there is no traffic on other side but people have to wait till the timer runs and light turns green. A lot of time wasted just due this reason.

Brief Description of the Project
To overcome the traffic problem fuzzy logic can be used. We require sensor which can sense number of vehicles and rate at which vehicles are coming. Accordingly we can set the timer so that people have not to wait unnecessarily.

Objectives
(1) To design and implement an intelligent traffic control system,
(2) To develop a suitable algorithm to implement the design, and
(3) To provide the quickest possible clearance to vehicular traffic in all directions at a junction.

Technic Approach and Expected Deliverables

The technical approach that will be used in this project is employ IR sensors which can be mounted on either sides of a road. The traffic system will be controlled by micro controller or even PLC. The expected deliverables of the project is to implement the system and produce Control circuit for traffic system.

Project # E6

Project Title: Online Spike Sorting FPGA Accelerator for Real-time Animal Experiments

Professor(s) Name(s): 1- Dr. Ahmed Alzuhair 2- Dr. Saif Alsaif

Number of Students: 2

Students Qualifications

- HDL and MATLAB coding experience
- Familiarity with FPGA design (preferred)

Statement of Problem

Animal experiments, particularly in rodents continue to play a critical role in understanding brain function. Typical neuroscience experimental procedures consist of 1) simultaneous recording of brain electrical activity using surface or depth electrodes while performing the behavioral experiment 2) Offline signal analysis on the previously recorded datasets. The approach is limiting as it does not allow closed-loop experiments, where we may want to alter the experiment dynamically (i.e. with injected electrical stimulation pulses subject to the neuronal activity in closed-loop). This motivates designing online neural signal processing algorithms and hardware accelerators for latency-critical closed-loop experiments.

Brief Description of the Project

Action potentials (AP) or spikes, originating from neurons, are the fundamental processing unit in the brain with a period of around 1.5ms [1]. Implanted depth electrodes typically record action potentials from multiple neurons in their vicinity. The process of identifying the different firing neurons from the recorded APs is known as spike sorting. In this project, students will investigate spike sorting and will design a FPGA platform for online spike sorting experiments.

Objectives

Students will:

- explore previously recorded datasets of rodents' brain activity
- learn about animal experiments for brain science
- review existing algorithms and hardware for online spike sorting
- learn about hardware (FPGA) design and hardware-informed algorithm optimization
- learn about embedded platform verification and benchmarking

Technical Approach and Expected Deliverables

Phase I:

- Exploring publicly available rodent's neuronal activity dataset
- Literature review of spike sorting methods
- Studying and running the online model Osort[2]
- Designing a hardware equivalent architecture of Osort
- Verifying performance on rodents' neural signals

Phase II

- Extending the architecture to support multiple channels (multi-contact electrodes)
- HDL code design
- Implementation in an FPGA development board

- Simulated real-time performance evaluation on real neural signals

Stretch goals

- Micro/macro optimizing the hardware architecture while maintaining minimal performance degradation

References

[1] Gibson et al. 2012, Spike Sorting: The First Step in Decoding the Brain, IEEE Signal Processing Magazine

[2] Rutishauser et al. 2006, Online detection and sorting of extracellularly recorded action potentials in human medial temporal lobe recordings, in vivo, Journal of Neuroscience Methods, 2006, 154:204-224, 2006