King Saud University
College of Engineering
Electrical Engineering Department **Semester: 422**

Graduation Design Project Proposal Form

Project # E1

Project Title: Design and implementation of a power generation system using flexible silicon 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 simulation and experimental work.
2. Willing to do hard work.

Statement of Problem

Flexible silicon solar cells are photovoltaic devices that produce electrical energy from sunlight by the virtue of the photovoltaic effect. Flexible silicon solar cells are lighter in weight and of lower manufacturing cost as compared to typical solar cells. Flexible silicon 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, flexible solar cells offer much lower efficiencies as compared to typical silicon solar cells. This project aims to design, implement and characterize a power generation system that uses flexible silicon solar cells.

Brief Description of the Project

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

Objectives

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

Technical Approach

- Background study on solar cell technologies and flexible silicon solar cells.
- Semiconductor device simulation of flexible silicon solar cell using PC1D software. And circuit simulation using PSpice.
- Identify a technical problem relevant to the Saudi community that can benefit from flexible silicon solar cells.
- Conceptualize a power generation system that uses flexible silicon solar cells to solve the identified power generation problem.
- Power generation system design.
- Power generation system implementation and full characterization.

Expected Deliverables

- A power generation system based on flexible silicon solar cells.
- Simulation results.
- Electrical characterization results.

Project # E2

Project Title: Design of Li-Fi bidirectional data transmission link

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

Number of Students: Two

Students Qualifications: General knowledge in electronics and/ or communications

Description of the Project

Li-Fi (Light-Fidelity) is a free-space optical communication technology. The data can be transferred at high speeds over a visible or infrared light between a transmitter and a receiver. It has applications similar to that of Wi-Fi technology.

In this project, a bidirectional Li-Fi link will be designed and implemented. The data will be modulated onto LEDs visible and infrared light before transmitting to the receiver. At the receiver, a photosensitive element will detect modulated light and then demodulate data. The link will be designed to be full-duplex and high speed.

Objectives

In this project the students will learn about:

1- Visible and infrared LEDs.
2- Free-space optical communication.
3- Optical transmitters.
4- Optical receivers.

Technical Approach and Expected Deliverables

By the end of project, the students will:

1- Design and build a Li-Fi transmitter.
2- Design and build a Li-Fi receiver.
3- Transmit and receive bidirectional optical data at high speed.
4- Write a technical report.

Project # E3

Project Title: Design and Implemantaion of a CMOS-Based Radio Frequency Energy Harvesting System for Mobile Applications

Professor(s) Name(s): 1. Dr. Mohamed Abbas
2. Dr. Ahmed Al-Zuhair

Number of Students: Two Students

Students Qualifications
Candidate students are preferred to finish EE405.

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Statement of Problem

Performance of portable and implentable applications, especially biomedical applications, are strongly depend on battery life. Prolongations of battery life time is difinatly will be an added value for such application. Accompining these application with RF energy harvesting system to collect RF energy wirlessly will enhance the life quality of the end users of such product.

Brief Description of the Project

The number of people relying on portable and implantable biomedical devices are increasing. The dependability of implantable devices such as pacemakers, cochlea and recenely muscle stimulation devices, is largely depends on their battery life time. It very inconvenient for heart diseased people who are relying on pacemaker to have a frequent surgurical operation to change the pace maker because of the draining of its battery. Similarly for those who have an artificial cochlea. Therefor, providing such appliaction with an auxoliary source of enery is important to in prolong the battery life time and hence, decresae the number of changes of such devices.
With the ever icreasing number of mobile devices, the intensity of RF signal is also increasing. Therefore, this free source of energy can be utilized to foster the power supply of such protable applications.
In this graduation design project, in two phases, the students will design and implement a CMOS based energy harvesting system to either charge the battery of the tergetted mobile devices or even used as an auxoliary power supply.

Objectives

At the end of the project the students should be able to

(1) Understand the concepts of energy harvesting and the different techniques adopted for this purpose.
(2) Design and simulate a tuned circuit to capture a certain RF signal at a given frequency.
(3) Design and simulate a CMOS based circuit to level multiplication (signal clamping) to produce a suitable output voltage level from a weak input signal.
(4) Layout and post-layout simulate the designed circuit using the available technology file.

(5) Prototype the design using off shelf components.

Technical Approach

Phase I

1.1 Literature review and comprehensive understating of the topic.

1.2 Design and simulation of RF tuning circuit at the designated frequency.

1.3 Design and simulate a CMOS Based voltage level multiplier

1.4 Design and simulate a charging circuit for device battery

1.5 Preparing the component list and placing the purchase order.

1.4 Writing the report of the first phase.

Phase II

2.1 Using one of the layout CAD tools to layout the design circuit.

2.2 Design verifications.

2.3 Prototype preparing using of shelf components.

2.5 Test the full system on a real subject.

2.6 Update the report to its final form.

Expected Deliverables

1. Tape out of the intended circuit.
2. Prototype using of shelf components.

Project # E4

Project Title:
Design & Impelementation of UAV Detection and Identification System Using Soft Ware Defined Radio (SDR)

Professor(s) Name(s): 1. Prof. Mohamed Abouelela
2. Prof. Abdelfatah sheta

Number of Students: Two

Students Qualifications

EE401 + EE353

Statement of Problem : UAV (Unmanned Aerial Vehcile) systems are widely used in several applications like remote sensing , survillance and building security. A given UAV system uses wireless communication link with secured protocole to achieve its mission. Each model has its own operating frequency and communication protcole that is different from manufcturer to manufacturer. This project aims at developing a prototype of universal control unit that can detect and identify the type of a given UAV . This will enable the user to control multi types UAVs using single universal unit.

Brief Description of the Project

The main objective of this project is to design, build and test universal control unit that can detect , identify and control several types of UAVs. The problems associated with implementing the system are: Energy constraint, Unreliable communication, Unreliable RF sensors (antennas) , Ad hoc deployment , Limited computation power , and Distributed execution. Typical application of UAVs are Monitoring and Detecting fires indoor or outdoor, Detecting chemical or biological attacks, remote sensing , survillance and building security . UAVs can be also used on farm lands to monitor temperature, humidity, fertilizer and pesticide levels. The System will be build around a SDR and a microcontrollers . The function of SDR is to receive Rf signal from the UAVs antennas where we can identify its power level, carrier frequency, BW and Modulation Type. This information is fed to the microcontroller module to be processed in order to fix the type of the UAV and the appropriate signal needed to communicate with it .

Objectives

Often, the design has two to four specific objectives. You might consider listing them vertically as follows:

(1) Understanding different Types of UAVs and their remote control units
(2) Review several types of SDR modules , understand their operation and choose a suitable one for the project impelementation.
(3) Learning the principles of using μ- controller in embedded systems and the associated software tools.
(4) Use simulation tools (Matlab) for testing the propsed system connections

(4) Developing a driving software and GUI for the monitoring system

Technical Approach and Expected Deliverables

This section discusses how to achieve the objectives mentioned above and the expected end product (if any), etc.

(a) Practicing techniques foe attaching different types of data to a μ- controller boards.

(b) Developing the software needed to complete the system operation .
(c) Processing the collected data from UAVs and SDR suppliers concerning different types available in the market
(d) Design the circuit HW .
(e) Design the microcontroller interfac needed to control the wireless network .
(f) Integrating the above system components into one equipment that can be commercialized

Project # E5

Project Title: Design & Implementation of a wake-up algorithm for IoT wireless radios for health monitoring applications

Professor(s) Name(s): 1. Dr. Abdullah Alghaihab
2. Dr. Ahmed Alzuhair

Number of Students: Two

Students Qualifications

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

Statement of Problem

Remote health monitoring using wirelessly connected wearable devices is gaining significant attention lately as a potential area of technological revolution. One of the bottlenecks in such systems is the limited energy available, especially for wireless communications. In this project, a wake algorithm for wireless radios used for health applications is designed and implemented to help efficiently reduce the system energy requirements by turning off the main radio when it is not mostly needed.

Brief Description of the Project

The wake-up algorithm design depends on the type of physiological data been sensed and processed. In this project, students will analyze which type of sensed health data gives the best energy saving results and will design and implement the wake-up algorithm.

Objectives

(1) Literature review of published wake-up radios designs, and the algorithms implemented in such systems.

(2) Study the feasibility of applying wake-up algorithm on different kinds physiological data and analyzing the energy gain in applying wake-up algorithms in each type.

(3) Simulate the design in MATLAB.

(4) Verifying the performance in HDL.

Technical Approach and Expected Deliverables

- Literature review of existing wake-up radios designs, and the algorithms implemented in such systems.
- Analyze the impact of using wake-up radios on the overall energy requirements in health monitoring systems.
- Design and simulate an algorithm for wake-up.
- Implement the design on an FPGA development board.

Project # E6

Project Title: Design and Implementation of a Smart Home System

Professor(s) Name(s): 1. Dr. Ahmed Alzuhair
2. Dr. Abdullah Alghaihab

Number of Students: Two

Students Qualifications: Knowledge of basics in electronics and/or communications.

Statement of Problem and Brief Description of the Project

Smart home systems transform homes to be energy-efficient, comfortable, and safer. Although such systems can result in savings on the long run, they are unpopular due to the high installation costs. Students will build a smart home system that utilizes personal computing devices and inexpensive electronics for an affordable and flexible implementation. They will implement algorithms and hardware to monitor and control smart appliances, and integrate sensors/actuators for a safer and energy-efficient home.

Objectives

Students are expected to:

(1) Be familiar with state-of-the-art smart home systems
(2) Be able to identify opportunities for automation and smarter control
(3) Design a smart home management system
(4) Design and implement the system electronics and user interface

Technical Approach and Expected Deliverables

Phase I:

- Literature review and evaluation of smart home systems
- Identifying appliances and proposing opportunities for automation
- Design of smart home management system
- Design of a friendly user-interface
- Preparing and ordering electronics

Phase II:

- Assembling the system
- Implementation of the system and appliances control logic
- Testing and verifying the system performance