King Saud University
College of Engineering
Electrical Engineering Department *Semester:* **391**

Senior Design Project Proposal Form

Project #E1

Project Title: Design and cost estimation of a grid-connected rooftop photovoltaic (PV) system adhering to local regulations

Professor(s) Name(s): 1. Professor Abdulrahman M. Alamoud
2. Professor Abdullah M. AlShaalan

Number of Students: Two

Students Qualifications: EE404

Statement of Problem:
Saudi Arabia's large area and high concentration of solar energy makes it ideal for a vast number of applications such as generating electricity for home use, mobile phone towers, road signs, roads emergency phones, mobile military forces (army, national guard, and border guard), medical ambulances, and oil pipe lines cathodic protection to name but a few. However, in view of the rising cost of grid electricity, it has become attractive for house owners to install a grid-connected rooftop PV system to partially supply the household electric load and therefore lower the monthly electric bill.

Brief Description of the Project:
The project is intended to teach students how to design a grid-connected rooftop photovoltaic (PV) system and give them hands-on experience of constructing a mobile PV system for use in remote areas. The work will involve the disciplines of electronics, solar radiation, solar cells, and photovoltaic electric system design. A team of two students will work on the design and implementation of a small (3-5 kW) grid-connected rooftop PV system.

Objectives:
The design objectives are as follows:
(1) To put to use theory and tools the students acquired in previous electronic courses.
(2) To acquire experience in the design of a grid-connected rooftop PV electric system.
(3) To implement their design in practical rooftop PV electric generator.

Technical Approach and Expected Deliverables:
The work will involve two phases covering one semester each. In the first semester the students will learn the basic principles of solar energy such as solar radiation, p-n junction solar cell design and operation, PV modules, storage batteries, and other PV system components. The students will then learn PV system design techniques. They will then design a suitable rooftop grid-connected PV system. The students will take into account, in their PV design, the realistic constraints such as economic factors, safety, reliability, aesthetics, ethics, social impact and ECRA regulations.
In the second semester, the students will work on the implementation of a small-scale grid-connected PV system of their design. The PV system will be designed so that it may be installed on the rooftop of a house in Riyadh. Testing of the constructed PV system will commence to ensure a practical performance of their design. If the PV system performance is not found to be working properly, design fine tuning will be made. The expected deliverable is a small rooftop PV electric generator matching the available area and budget.

Project # E2

Project Title:

Design & Implementation of Smart Electric Vehicle Battery Charger

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

Number of Students: Two

Students Qualifications

EE401 + EE353

Statement of Problem

The new trends in vehicle instry are to replace the traditional petrol engine by electric one for so many advantages provided through using electric power sourse instead of burning liquide and gas fuels. Optimizing the vehicle prformance needs a good and robustic battery charger . The design of a smart EV (Electric Vehicle) charging system that provides maximum power delivery from electric source will be analyzed and optimized through the application of control strategies which ensure that system power converters are operated in regions of high efficiency. .

Brief Description of the Project

In this work we aim at developing a complete smart battery charger circuit based on microcontroller circuit . The algorithm that may be implemented using the microcontroller system will make use of all generated power from the available power source . Different power sources will be considered including solar power system and PV arrays . The algorithm is also suitable for Hybrid power sources that may include a grid connection and auxiliary batteries as storing element. The design of a smart EV charging system that provides maximum power delivery from Hybrid energy sources will be analyzed and optimized through the application of control strategies which ensure that system power converters are operated in regions of high efficiency. Using the proposed approach, system level models predict power efficiency improvement. The developed algorithm will take into consideration the battery type, the Battery State Of Charge (SOC) and the available power from different connected sources. The proposed algorithm will be developed tested using Matlab Simulink .

Project # E3

Project Title: Design and Implementation of Non-Invasive Blood Glucose Sensor

Professor(s) Name(s): 1. Prof. Mohamed Aboelela
2. Dr. Mohamed Abbas

Number of Students: Two

Students Qualifications

Capable of dealing with hardware and software

Statement of Problem

Worldwide, Saudi Arabia has one of the highest percentages of Diabetes, with an estimated number of 2,065,300 people diagnosed with the disease by 2010 [1]. The percentage the population suffering from the disease is 16.8%. (although some studies have shown this percentage to be higher). Comparing with other countries, The percentage in the United States is 10% of the population, 7.8% in India, and 4.2% in China. According to [2], WHO has reported that Saudi Arabia ranks the second highest in the Middle East, and is seventh in the world for the rate of diabetes. It is estimated that around 7 million of the population are diabetic and almost around 3 million have pre-diabetes. Even more worrying perhaps, is the increasing pattern of diabetes noted in Saudi Arabia in the recent past. In fact, diabetes has approximately registered a ten-fold increase in the past three eras in Saudi Arabia. The complications that can arise from diabetes kill more people every year, in addition to the many complications include: Heart Disease and Stroke, Kidney Damage, Eye Complications and Foot/Skin problems and Nerve damage. To properly manage the Diabetes in Saudi Arabia, a multidisciplinary approach is required.

Hyperglycemia in diabetes is the rises of blood sugar. If blood sugar rises high enough for a prolonged period of time, it can lead to two serious conditions. ultimately is can lead to can lead to life-threatening dehydration [3]. On the other hand , Hyperglycemia is the sever decrease of the blood sugar. untreated hypoglycemia can lead to Seizure, Loss of consciousness and eventually death

Brief Description of the Project

In this graduation project, within two phases, it is intended to develop a non-invasive device to detect the existence of Hyperglycemia/Hypoglycemia of the person under monitoring. In contrast with the existing blood glucose sensors which are classified invasive and hence cause pain to the patient, the intended device will utilize the red light source and detector to estimate the blood sugar level.

Objectives

The project will be run in two phases. By the end of the first phase the team should

(1) Capable of understanding the operation of non-invasive blood glucose sensors
(2) Set the block diagram and explain the operation of the detection and modeling the system.
(3) Present the simulation results and Write the required documents.
(4) Defend his work in front of examining committee

In the second phase, the project will be implemented and test and in vitro and in vivo results will be collected

Technical Approach and Expected Deliverables

The approach of the project is as follows:

1- the student will revise the characteristics of non-invasive Blood Glucose sensors.

2- Propose the system block and discuss the proposal with the supervisor.

3- Revise the utilization of Microcontroller .

4- Simulate the proposed circuit to check the correctness of the implementation.

5- Write the report thesis and defend the first stage

References:

[1] https://www.mtholyoke.edu/~cantl20a/classweb/rosewebsite/saudiarabia.html
[2] Al Dawish MA, et all, " Diabetes Mellitus in Saudi Arabia: A Review of the Recent Literature", Current Diabetes Reviews, VOLUME: 12 ISSUE: 4 Year: 2016 pp:359 - 368.
[3] http://www.mayoclinic.org/diseases-conditions/hyperglycemia/basics/complications/con-20034795

Project # E4

Project Title: Hyperglycemia/Hypoglycemia Detection and Warning System using Android and GSM.

Professor(s) Name(s): 1. Prof. Mohamed Alturaigi
2. Dr. Mohamed Abbas

Number of Students: Two

Students Qualifications

Capable of dealing with hardware and software

Statement of Problem

Worldwide, Saudi Arabia has one of the highest percentages of Diabetes, with an estimated number of 2,065,300 people diagnosed with the disease by 2010 [1]. The percentage the population suffering from the disease is 16.8%. (although some studies have shown this percentage to be higher). Comparing with other countries, The percentage in the United States is 10% of the population, 7.8% in India, and 4.2% in China. According to [2], WHO has reported that Saudi Arabia ranks the second highest in the Middle East, and is seventh in the world for the rate of diabetes. It is estimated that around 7 million of the population are diabetic and almost around 3 million have pre-diabetes. Even more worrying perhaps, is the increasing pattern of diabetes noted in Saudi Arabia in the recent past. In fact, diabetes has approximately registered a ten-fold increase in the past three eras in Saudi Arabia. The complications that can arise from diabetes kill more people every year, in addition to the many complications include: Heart Disease and Stroke, Kidney Damage, Eye Complications and Foot/Skin problems and Nerve damage. To properly manage the Diabetes in Saudi Arabia, a multidisciplinary approach is required.

Hyperglycemia in diabetes is the rises of blood sugar. If blood sugar rises high enough for a prolonged period of time, it can lead to two serious conditions. ultimately is can lead to can lead to life-threatening dehydration [3]. On the other hand , Hyperglycemia is the sever decrease of the blood sugar. untreated hypoglycemia can lead to Seizure, Loss of consciousness and eventually death

Brief Description of the Project

In this graduation project, within two phases, it is intended to develop a wearable device to detect the existence of Hyperglycemia/Hypoglycemia of the person under monitoring. Upon the detection of abnormality, the device will send a warning message to a responsible person, who can interfere and rescue the life of person under monitoring.

The device will be composed of blood glucose sensors. The sensor signals will be processed by an Arduino microcontroller to detect whether a problem exists. Up on the detection of a problem the system will send a message including the status and GPS

information of the person under monitoring to a nurse station/patient 'relative . The system will use GSM and Android technology.

Objectives

The project will be run in two phases. By the end of the first phase the team should

(1) Capable of understanding the operation of blood glucose sensors
(2) Set the block diagram and explain the operation of the detection system.
(3) Present the simulation results and Write the required documents.
(4) Defend his work in front of examining committee

In the second phase, the project will be implemented and test results will be collected

Technical Approach and Expected Deliverables

The approach of the project is as follows:

1- the student will revise the characteristics of Blood Glucose sensors.

2- Propose the system block and discuss the proposal with the supervisor.

3- Revise the utilization of Microcontroller .

4- Simulate the proposed circuit to check the correctness of the implementation.

5- Write the report thesis and defend the first stage

References:

[1] https://www.mtholyoke.edu/~cantl20a/classweb/rosewebsite/saudiarabia.html
[2] Al Dawish MA, et all, " Diabetes Mellitus in Saudi Arabia: A Review of the Recent Literature", Current Diabetes Reviews, VOLUME: 12 ISSUE: 4 Year: 2016 pp:359 - 368.
[3] http://www.mayoclinic.org/diseases-conditions/hyperglycemia/basics/complications/con-20034795

Project # E5

Project Title: Design and implementation of a Control System for an Apartment Complex.

Professor(s) Name(s): 1-Dr. Nacer Debbar
2- Dr. Mohamed Ramy Abdel-Rahman

Number of Students: Two

Students Qualifications:

1- Should have completed EE310 and EE401,
2- Certain knowledge of simulation packages for electronic circuits
3- Certain knowledge of logic design.

Statement of Problem

Often people travel and leave their homes unattended; they need many tasks to be performed during their absence: watering their garden, recording certain entertainment programs, etc. Also in fear of burglary, they want to show that their home is populated by turning on and off the lights the music, etc.
This electronic system will tackle such needs.

Brief Description of the Project

The project involves the design of a control system for the turn-on and turn-off functions needed in an apartment complex. The system is designed to activate the following:

1- Turn garden lights on at 18.0 h and off at 01.1 h
2- Turn on 10 possible sets of water sprinklers for 6 min each in sequence one at a time.
3- Turn a music system on at 9.0 h and off at 21.0 h.
4- Any other activity if necessary ….. .

In the first phase the team will identify the different tasks required by the system. They will then formulate the design problem in block diagram form. Using software packages they simulate the system and re-adjust the design as necessary until a working system that meets all requirements is achieved.

In the second phase, the team will work to implement a prototype of the system. They will shop for needed components and make a cost estimate of the system. The prototype will finally be tested to ensure that the desired results are achieved. In case, the performance is not found to be up to the mark, the design cycle will be repeated.

Project #E6

Project Title: Design, Manufacturing and Characterization of a low cost silicon pn junction solar cell

Professor(s) Name(s): Dr. Mohamed Ramy; Dr. Nacer Debbar

Number of Students: Two

Students Qualifications

1. Willing to get involved in extensive experimental work.
2. Should have completed EE310.

Statement of Problem

Solar cells are nowadays widely used for power generation. Saudi Arabia, being rich in solar energy, is now developing solar cells based on conventional manufacturing technologies. Development of low cost solar cells is vital for solar power to compete with traditional power generation methods. This project will deal with the design, manufacturing and characterization of a low cost pn junction solar cell using conventional silicon wafers.

Brief Description of the Project

The project involves designing, manufacturing, and testing a small size solar cell using conventional silicon wafers.

Objectives

1- To design and simulate a silicon pn junction solar cell.
2- To manufacture a silicon solar cell using microfabrication techniques.
3- To characterize the performance of the fabricated solar cell.
4- To compare the experimental and theoretical results

Technical Approach

- Literature review on device structures, operational concept and fabrication techniques of silicon pn junction solar cells.
- Design of the solar cell device structure. Proper choice of materials: silicon wafers, dopant material, and antireflection coating film.
- Simulation of the antireflection coating for the solar cell.
- Manufacturing the solar cell module using microfabricaiton techniques: spin/dip coating, dopant diffusion, etching and coating techniques. Low cost fabrication techniques will be favored.
- Characterizing the solar cell performance: current-voltage characteristics and efficiency.
- Comparing experimental and simulation results.

Expected Deliverables

- Simulation results.
- A working prototype of a pn junction solar cell.
- Solar cell characterization results.

Project # E7

Project Title: Design of Infrared Thermometer

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 object surface above zero degrees kelvin emits infrared radiation. This radiation is called 'heat'. It is usually required to measure the objects' temperature in degrees. However, in some applications it is preferred to measure it remotely without direct contact with the object, either because it is fragile or dangerous to become nearby. Some examples are measuring human body temperature out of eardrum, detecting hot spots by fire fighters, finding faulty electrical wires in a building, or measuring temperature of combustion engines.

In this project, we will design and built an infrared thermometer to remotely measure remotely an object's temperature. The thermometer consists of optical parts that collect infrared radiation and focus it to a sensor. The infrared sensor transforms incident radiation into electrical signal, which is converted to temperature (^{o}C / ^{o}F) and displayed on a digital screen. A laser is used to accurately direct the thermometer to the desired object's surface.

Objectives:

In this project the students will learn about:

1- Infrared collecting optics.
2- Semiconductor laser.
3- Programing of micro-controller.
4- Digital display.

Technical Approach and Expected Deliverables:

By the end of project, the students will :

1- Design and build an infrared thermometer.
2- Design infrared optics.
3- Program a micro-controller.
4- Write a technical report.