King Saud University
College of Engineering
Electrical Engineering Department **Semester: 411**

Graduation Design Project Proposal Form

Project # E1

Project Title: Automotive Head-up Display

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.

Brief Description of the Project

A head-up display (HUD) is a transparent display that allows a user to monitor important information while keeping his head up, and without looking away from the viewing scene. It was initially developed for military aircraft pilots. They are now available for car drivers. The HUD can display important information for a car driver like driving information, navigation information, or warning signals.

In this project, the students will design and build an automotive HUD that can be connected wirelessly to the car or driver's mobile phone. It can display important information directly on car windshield in front of driver. The HUD consists of optical projector, imaging optics, optical combiner, and control unit.

Objectives

In this project the students will learn about:

1- Imaging optics.
2- Wireless connections.
3- Programing of micro-controller.
4- Digital displays.

Technical Approach and Expected Deliverables

By the end of project, the students will :

1- Design and build a head-up display system.
2- Design of imaging optics systems.
3- Program a micro-controller.
4- Write a technical report.

Project #E2

Project Title: Development of micro-textured silicon surfaces for BLACK SILICON solar cells

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. And preferably completed EE408.

Statement of Problem

Black silicon refers to modified silicon surface having micro/nano-textured structures which act to suppress reflection, and in the meantime enhance absorption of light into the silicon bulk. As a result, the silicon wafers appear black. This unique light-trapping effect caused by the micro/nano-textured surface morphology greatly enhances the absorption light in the silicon bulk leading to an enhanced photocurrent in solar cells and thus high efficiency. Different methods are utilized to produce black silicon surfaces such as: metal assisted chemical etching, laser treatment, reactive ion etching, and many others. Black silicon solar cells are already in production in several countries. Black silicon solar cell technology has not yet been developed in Saudi Arabia. The project would be a first effort towards the development of a black silicon solar cell in KSA.

Brief Description of the Project

The proposed project aims for developing an etching process that would yield a fully absorptive black silicon surface. Dry and wet etch processes and possibly silicon nanowires will be used to realize the micro-textured black silicon surfaces. Optical and electronic imaging techniques will be used for characterization.

Objectives

1- Understanding surface texturing methods for silicon solar cells.
2- Design and development of fabrication process for producing black silicon surfaces.
3- Characterization of the manufactured black silicon surfaces using Optical and electronic imaging techniques.

Technical Approach

- Background study on surface and bulk micromachining.
- Extensive literature review on surface texturing methods for silicon solar cells.
- Literature review on surface texturing methods for black silicon solar cells.
- Conducting laboratory experiments (using wet and/or dry etch approaches and/or silicon nanowire growth) aimed at developing fully black silicon surfaces.
- Optical characterization of the manufactured black silicon surfaces using a laser based setup and spectrophotometry.
- Optical simulation of black silicon surfaces (Pending software availability)
- Electronic imaging for the black silicon surfaces using scanning electron microscopy.

Expected Deliverables

- Block diagram for the developed fabrication process and the details of the process.
- Optical and electronic imaging characterization results.
- Fabricated and characterized silicon solar cell with black silicon surface (Time permitting).

Project #E3

Project Title: Water Bill Monitoring and Minimization System

Professor(s) Name(s): **Dr. Abdulhameed Al-**Sanie.
Dr. Mohamed Abbas

Number of Students: Two to three

Students Qualifications

Electronics and/or Communications group

Statement of Problem

After application of the new tariff of potable water in the Kingdom of Saudi Arabia, though it is the lowest worldwide, the consumers need to observe their water bills so that it does not became unnecessarily high. Since the price per cubic meter is increased as the amount of monthly consumption increases, one of the possible way to lower the bill is to set the monthly consumption to its minimum limit.

Brief Description of the Project

The kingdom of Saudi Arabia has a vast desert area with limited natural water resources represented by underground water and short rainy season. To cove the ever continuous needs for water, the Kingdom resort to desalination of sea water, and turn it into potable water, which cover around 70% of the Kingdom's water needs [1]. The high cost of producing fresh water is one of the reason that push the government to raise the price per cubic meter [2],[3], though it is the least worldwide. In turn , consumers water bill has been observably increased. Therefore , a method for rationalization of water consumption is required.

The aim of this capstone project is to design a system to help the customer minimizing his monthly water bill. According to the current billing system, the bill value is not linearly increased with number of consumed cubic meters. since the price per cubic meter is increased as the drawn quantity increased. The intended system will be designed to perform the following tasks ; (1) it monitors the status of water tank in a house by calculating the amount of stored water. (2) It calculates the average daily consumption. (3) It conveys this information to the owner (4) It automatically or manually controls the input to the water tank. (5) Optionally, the system observe the level of cleanness of the tank to help determining the tank cleaning necessity. The first four tasks will help the customer minimize his monthly consumption , hence , minimize the water bill.

The students will implement the system by integrating water level, impurities and parasitic sensors, water flow meter with a control unit , which will be interfaced by the customer through a communication link and android application.

Objectives

At the end of the two phases of the project, the student should

(1) understand the operation of water level sensor, Flow meter, Impurities and parasitic sensores, programming and utilizations of microcontrollers and system simulation.,

(2) design an integrated system to monitor the water level and cleanness of a water tank

(3) design an android application to interface the system in (2)
(4) Test and verify the operation of the full system including soft/hardware.

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Technical Approach

The project will be executed in two phases.

Phase one:

(1) Literature review of the required materials including (i) clarity of the problem and objectives (ii) understating theory of operation of the different items of the project.

(2) system simulation using one of the appropriate CAD tools.

(3) preparing list of components and/or equipments and placing a purchasing order.

(4) Writing the report of the first phase

Phase Two.

(1) Receiving and testing the project components.

(2) Preparing a sample tank equipped with the sensor, valves and meters

(3) Programming the microcontroller and connecting with the sensors , valve and meter

(4) Preparing an Android app to interface the system.

(5) Test the full system.

(6) Update the project report

Expected Deliverables

(1) Water tank monitoring and control system using Android and Internet

References:

[1] https://mawdoo3.com/ما_مصادر_المياه_في_المملكة_العربية_السعودية

[2] https://www.nwc.com.sa/Arabic/Pages/NewTarrifCalculator.aspx

[3] Omar K M Ouda, "Review of Saudi Arabia Municipal Water Tariff", World Environment 2013, 3(2): 66-70

Project #E4

Project Title: sEMG Controlled Prosthetic Hand for Amputees

Professor(s) Name(s): 1. Dr. Mohamed Abbas
2. Dr. Tariq Alshawi
3. Dr. Saleh Alshebeili

Number of Students: Four Students

Students Qualifications

Two students from Electronics Group and Two students from Communications Group. It is preferable that the students (or some of them) have studied signal processing related course(s).

Statement of Problem

The number of amputees is increasing worldwide due to road accidents, wars, etc... In many cases the removed part is replaced with just a passive prosthesis " decorative counterpart" to keep the outer look of the amputees. Developing an "easy to use" active prosthetic hand will definitely help amputees utilize the residue of the removed limb in an efficient way and , therefore, enhance their life quality.

Brief Description of the Project

Recently, there are many researches to develop an "active" prosthesis to help the amputees performing some of the lost functions. This project aims to design a prosthetic hand controlled by the surface Electromyography (sEMG) signal. The different actions of the targeted prosthetic hand will be controlled using the sEMG signals of the residual muscles in the removed limb. The work in this project includes (1) Sensing and amplifying the sEMG of designated muscles. (2) Processing the detected EMG signal to identify the intended movement. (3) Generation of the desired signal to control the prosthetic hand.

Objectives

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

(1) Understand the nature of EMG signal and the method(s) of its sensing,
(2) Implement a system to reliably sense the EMG signal of a target muscle.
(3) Classify the different fingers and hand movements by processing the related EMG signal.
(4) Integrate the subsystems implemented in (2) and (3). and produce the required signals to control an "off shelf" prosthetic hand.

Technical Approach

1. The student team will first make a comprehensive review about the topic and related subjects..
2. The team will be divided to two groups.
   - *Group one* will be involved in developing the sensing and amplification circuitries of EMG signal.

- *Group 2* will be involved in designing a signal classifier to detect the intended movement. Group 2 will depend on publically available signal databases. Then the system will be trained using real signals delivered by Group 1.

3. The team members will collaborate to generate the required control signals, with application to an off shelf prosthetic hand.
4. Each group will present their work to the other group and supervisors.

The work will be done in two phases:

Phase I

1.1 Literature review and comprehensive understating of the topic.

1.2 Sensing system design and simulation using an appropriate CAD tool.

1.3 Implementing the signal processing platform using Matlab or other tools.

1.4 Preparing the component list and placing the purchase order.

1.5 Writing the report of the first phase.

Phase II

2.1 Implementing the sensing system and exporting real EMG signals.

2.2 Training the classifier with real signals obtained in 2.1.

2.3 Design a circuit to produce the control signal using the results of 2.1 and 2.2

2.4 Apply the control signals to an off shelf prosthetic hand.

2.5 Test the full system on a real subject.

2.6 Update the report to its final form.

Expected Deliverables

1. EMG signal sensing system
2. EMG signal classifier
3. EMG-controlled Prosthetic hand

Project # E5

Project Title: Design and Prototyping of a Digital Tachometer.

Professor(s) Name(s): Dr. Nacer Debbar
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

In industrial machines using motors for their operation, it is usually required to monitor the revolution speed of the motor and its direction. This electronic system will tackle such a need to provide the direction of rotation and rpm of motors.

Brief Description of the Project

The project involves the design of a counter that will display the number of revolution per minute (rpm) of a mechanical shaft. Mounted on the shaft is a circular disk that has 60 holes around its edge. A light sensor is interrupted 60 times for each revolution of the disk. The output of the light sensor, a string of pulses, is fed to an electronic system that counts and displays the result. Mounted on the shaft is an analog tachometer that senses the direction of the rotation. The electronic system will also display the direction of rotation of the mechanical shaft.

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.

Objectives

The project is intended to:

1- give students a hands-on experience of designing complex electronic systems,

2- illustrate to students how to use state of the art techniques and technologies learned in the program to realize a working system

3- expose students to projects that are multi-disciplinary in nature: Electronics, mechanical engineering, optoelectronics, digital signal processing, etc.

Technical Approach and Expected Deliverables

System Requirements:

1) The system should use the 60 Hz, 110 power lines for power supply and timing.
2) The system count and display the speed in the range - 999 to +999 rpm.
3) The output display comprises five 7-segment LEDs: the first three LEDs show the rpm value and the second two LEDs show the direction of revolution: the letter C for clockwise or the letters CC for counterclockwise direction.

Deliverables:

- Block diagram of system design
- Simulation of all electronic circuits
- A working prototype

Technical Requirements:

- Good circuit design skills. Knowledge of digital circuits, logic levels, and interfacing of digital ICs is essential. This system requires also some analog design skills related to opamps and signal conditioning.
- Electronic circuit simulation using the available software.