Faculty of Media Engineering and Technology
Dept. of Computer Science and Engineering
Dr. Shereen Afifi

CSEN 605: Digital System Design
Winter 2022

You are going to develop a project based on FPGA using the board provided to you (or optionally your own) and writing VHDL code.

The material in the course does not fully exploit the capabilities of the FPGA board so you must do so yourself by consulting the user manual as well as the internet. Some examples include Arduino connector with ADC, push buttons, seven segment displays, an accelerometer and a VGA output.

Delivering your project by presenting a demo (A 2 to 3 min video in English that clearly shows the project and how does it work), as well as a small report that outlines the idea, the set of sensors and parts you used, the implementation (codes, circuits, pin assignment) and the results. Moreover, A real model representing your application as much as possible should be implemented and presented.

You can buy many of the external devices from the local market at:

- Future Electronics (https://store.fut-electronics.com/)
  - Address: El-Sarayat street, Abdo Basha, Abasia (in front of Faculty of Engineering, Ain Shams University)
- RAM (http://ram-e-shop.com/)
  - Address: 32 El Falaky St., Bab El Louk, El Tahrer, Cairo, Egypt.

You'll be divided into **Two Batches**:

Batch 1 : November 28 to December 12
Evaluations for Batch 1: December 13 and December 14
Batch 2 : December 15 to December 29
Evaluations for Batch 2: January 2 and January 3

Group formation: exactly 5 members per team or you'll be randomly assigned.

Submission Guideline:

1. Submit the whole project including all the source code files
2. Report documenting the whole project idea, inputs and outputs, pin assignment and explaining your code.
3. Video (2-3 min) showing a demo of the project running.
4. Notepad with your names, ids and emails.
5. Upload the material as a zip file to google drive and make the link shareable.
6. Rename your zip folder by the following format (TEAMNUMBER_BATCHNUMBER)
7. Submitting a drive link containing the zip folder to **csen605dsd@gmail.com**

NOTE THAT:

1. **NO EXTENSIONS BY ANY MEANS TO ANY BATCH UNDER ANY EXCUSE WILL BE POSSIBLE. KINDLY STICK TO THE DATES STATED ABOVE.**
2. **Sensors and actuators cannot be replaced by switch, button, buzzer, or LEDs, etc. It can only be used as additional devices; ie, the project shouldn't be built upon a button and LED for example. It should be a REAL SENSOR such (IR, proximity..etc) and the MOVING PARTS could be (motor, water pump..etc).**

Ideas

(You need to choose ONE of the following ideas)

A. PROJECT: "Take a break, take a cookie:"

Initially, you have a cookie jar in which you will define the initial number of cookies you're going to start selling (for example: it could be the maximum capacity of the jar).

You'll need to implement a cookie jar that will detect if a user placed his hand beneath the cookie jar and if there is enough cookie available in the cookie jar. If there are enough cookies, he/she should enter the amount of cookies they want through the keypad and if the amount is available the cookie jar should dispense the number of cookies requested and the **reduced** amount should be displayed on a screen.

Tasks:

1) You have to display the starting TOTAL number of cookies on the 7 SEGMENT DISPLAY. (This step should be done only once at the beginning)

2) The user must enter the number of cookies needed using an external input device.

3) Using your own choice of sensor, you should be able to detect if the user is asking for a cookie.

4) If it's detected that a user wants a cookie, you then need to check if there are available cookies

   a. If yes, a moving part should draw the cookie from the jar.

   b. If not, an "EMPTY" word should be displayed on the 7 segment display of the board.

5) The reduced amount of cookies available should be displayed on a 7 SEGMENT DISPLAY.

B. PROJECT: "برق بنزين Smart Car:"

You have a smart self-driving car that follows a straight lane, whenever it goes out of the lane a warning message should be displayed on the screen. The car should also stop when it detects an obstacle in front of it.

Tasks:

1) Initially, the car should be moving using a moving part.

2) The car should follow a lane using a sensor of your choice.

    a. If the car drifted outside its designated lane, a warning message "ALERT" should appear on the 7 SEGMENT DISPLAY.

3) Using your own choice of sensor, the car should detect if there is any obstacle in front of it.

    a. If the car detected an obstacle, the car should stop.

C. PROJECT: “ Walking Stick”

A walking stick to guide blind people walk with more ease.The stick gets activated and deactivated by the user. It also produces a vibration to tell the user if there's obstacles in front of him/her using the obstacle avoidance sensor and a warning sound is produced if the user drops the stick.

Tasks:

1) The stick gets activated and deactivated by the user through a switch/button (in FPGA/external button..etc).
2) Using your own choice for the obstacle avoidance sensor, whenever an obstacle is detected the stick should vibrate using a moving part of your choice.
3) Using a touch sensor or equivalent, the stick detects whether it is dropped or not and if it is dropped a warning sound should be produced using your own choice of sound device.

D. PROJECT: “Medication Scheduler”

A lot of people take medication on a daily basis where most of them forget to take their pills at the right time. Our FPGA controlled machine is here to automatically dispense the dosage of the prescribed medication at the right time. The patient will adjust the timers and the medications in their specific slots, thus at the exact time an alerting sound will go on, and when the patient approaches the machine it’ll detect him and will open the corresponding slot automatically through a moving device. We will use the clock embedded in the FPGA to simulate the time between one dosage and another.

Tasks:

1) When the exact time approaches the patient should be alerted using a sound device of your own choice.
2) When the patient approaches the dispenser he should be detected using a sensor of your own choice.
3) If it is the right time and the patient is detected the dispenser should be activated using a moving device of your choice.

E. PROJECT: “Washing machine”

You are required to implement a washing machine with 2 stages:

1. Stage 1 is for rinsing the water.
2. Stage 2 for spinning the clothes.

Tasks:

1) The user needs to start the washing machine using a button or any equivalent.
2) The washing machine should pump the water using a water pump for a specific amount of time from your choice and then the water pump stops after that time and this is marked as stage 1. Moreover, you should switch on a LED to determine that we are in stage 1.
3) The washing machine should spin the clothes using a motor after stage 1 is finished automatically. This should be indicated using another LED than that used in stage 1.
4) You should have a stop button to stop the washing machine.

F. PROJECT: “Smart Lecture Halls”

You need to implement a smart lecture hall that counts the number of students attending the lecture through a motion sensor and you must ensure that each student entering the hall gets his hands sanitized.

Tasks:

1) Using 2 different motion sensors one to detect students entering the hall and the other one to detect students exiting the hall:
    a) Whenever a student enters the hall the current number of students must increase by one and the number should be displayed on SEVEN SEGMENT.
    b) Whenever a student exits the hall the current number of students must decrease by one and the number should be displayed on SEVEN SEGMENT.
2) After the student enters the hall, his/her hands must be sanitized and this is done using a motion sensor or equivalent from your choice to detect the hands of the student, whenever it is detected a moving device from your choice will dispense the sanitizer.

“BONUS”

- If you added an extra feature using an ANALOG SENSOR which requires an extra microcontroller (for example: Arduino Board) connection it will be counted as a bonus to any of the ideas listed above.
- You must use the microcontroller for ONLY reading the sensor values; however, any output must be controlled through the FPGA.