CoE 115 Machine Exercise 1: Arithmetic Game

March 2019

Objective:

- To be able to use multiple peripherals in a single complex application

Hardware:

- LED
- Pushbutton
- LCD
- Potentiometer

Peripherals:

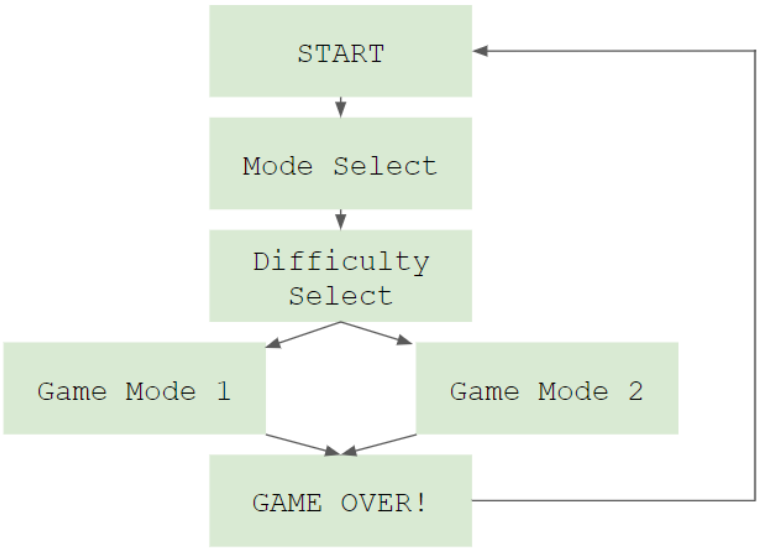
- GPIO
- Keypad
- A/D Converter
- Output Compare
- Timer*

A. Overview

You are to implement a quiz game that asks the player a simple arithmetic question (w/ single-digit operands only) that he/she must answer correctly. The questions are created randomly (both the operations used and the operands). The goal of the game is to answer as much questions as the player can, garnering the highest amount of points possible, before the game timer ends. When the timer expires, a "GAME OVER!" message is displayed along with the score, after which the game resets after 5 seconds.

B. Flowchart

The different states and flow of the program is shown below:

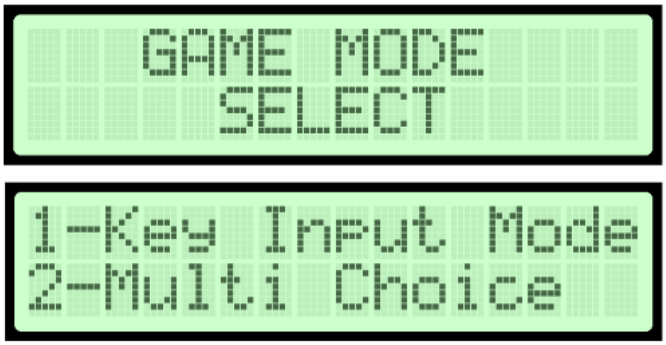


C. Game Start [5 pts]

After power-on/reset, a WELCOME message must be displayed with your name. Pressing the **pushbutton** proceeds to the next window.

D. Mode Select [10 pts]

The player must choose between two (2) game modes. A "GAME MODE SELECT" message is printed and then, after 1 second, the options are displayed.

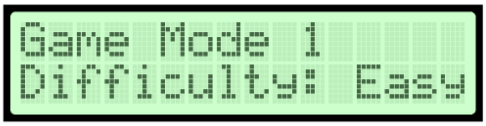


The player must press either the '1' key or the '2' key on the **keypad** to make their choice [**5pts**]. The first valid press is considered final. Pressing any other keys/buttons will not result in any response [**5pts**].

E. Difficulty Select [10 pts]

On the first line, the game mode the player selected is displayed. The player is then to choose the difficulty of the game. The difficulty affects which operations are used in the questions and the time limit for the game.

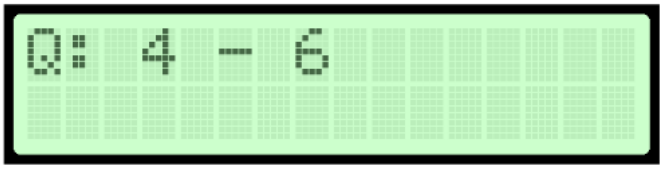
	Operations	Game Timer
Easy	Addition	5s
Average	Addition, Subtraction	8s
Hard	Addition, Subtraction, Multiplication	10s



To cycle through the three (2) difficulties, the player must turn the **potentiometer**. As the player turns the potentiometer, the LCD must display the current selection to either "EASY", "AVE", or "HARD" [**5pts**]. When he/she is happy with the current selection, they must press the **pushbutton** to start the game [**5pts**].

F. Game Proper [45 pts]

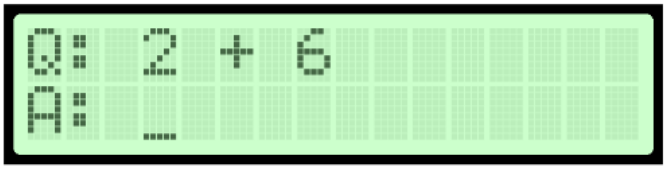
For any game mode, a question is displayed in the first line of the LCD. The question is a simple arithmetic expression with two single-digits operands. The operations allowed are dictated by the difficulty level that the player chose during the previous stage. The question, both the operation and the operands, must be generated **randomly**. You may get creative on how you intend to implement the randomness.

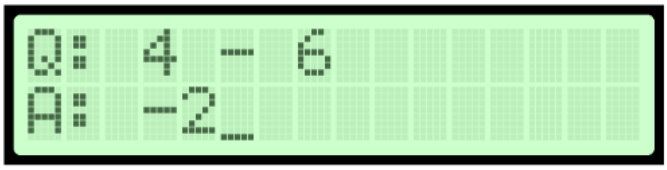


NOTE: Expressions resulting in negative numbers are allowed. Negative operands are also allowed.
After the game timer is up, the game ends and a GAME OVER message is displayed.

Game Mode 1: Key Input Mode [20 pts]

For this mode, the player needs to provide the answer by typing with the keypad. The # key is used as the dash (-) symbol to indicate negative numbers. The * key serves as the backspace button. [**15pts**]

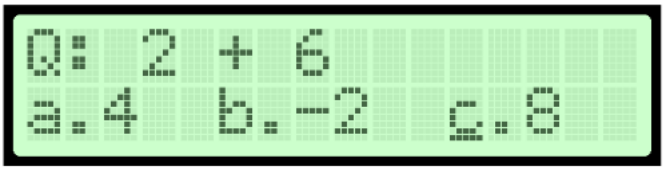




The player must press the **pushbutton** to submit their answer [5pts]. The game then provides a new question. This mode ends when the game timer is up, which is also determined by the difficulty selected.

Game Mode 2: Multiple Choice [25 pts]

For this mode, three options (a, b, and c) are presented to the player. Only one out of three options are correct. The incorrect options are generated randomly. The placement of the correct option (whether it's on a, b, or c) is also generated randomly. [**10pts**]



To select between the options, the player must turn the **potentiometer**. As they turn the potentiometer, the current selection is indicated by the cursor which moves (and snaps) under the 'a', 'b', or 'c' [**10pts**]. The **pushbutton** is also used to submit their answer [**5pts**]. This mode also ends when the game timer is up, which is also determined by the difficulty selected.

G. Game Timer [25 pts]

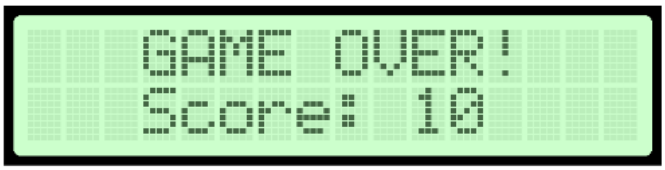
The game can only be played for the duration determined by the difficulty setting. After the game timer runs out, the game ends and moves to the GAME OVER window. [10 pts]

An LED is used to indicate how much game time is remaining. The LED gradually and periodically dims and brightens. The dimming and brightening speeds up as time passes such that the LED appears to be blinking rapidly just before the game ends (time is up). [15pts]

The LED must be OFF for Game Start, Mode Select, and Difficulty Select.
The LED must be ON for Game Over.

H. Game Over! [5 pts]

When the game ends, a GAME OVER! message is shown together with the player's score.



The player's score is the sum of all correct answer scores based on the table below. Incorrect answers will not affect the player score.

Question	Score equivalent
Addition	1pt
Subtraction	2pts
Multiplication	3pts

After 5 seconds, the game returns to the Game Start window.

Minimum Requirement

To avoid getting an automatic failing grade, you must be able to implement the Game Start, Mode Select, Difficulty Select, Game Timer, and Game Over windows.