CpE 3151 – SP 2024

Final Project - 90 pts

For your final project in CpE 3151, you will implement the project specified below using Atmel Studio, Simon Board, and necessary peripherals.

Given this assignment is essentially an open book, you can use any resources you would like to complete the assignment. If external sources of information are used, please add them as references in your code's main block description. While working with others is fine any direct **plagiarism of code will be penalized heavily**. Ultimately, you will be submitting your own solution to the assignment and will be responsible for understanding how every part of it works.

SIMON game

Utilize the pushbuttons, LEDs, and USART on the Simon board to develop a compact version of the SIMON game. This game, known for its simplicity and engaging gameplay, involves the microcontroller generating a sequence by illuminating LEDs in a specific order. Players are then tasked with reproducing the sequence accurately using the pushbuttons. Interaction with the game is facilitated through the Serial port control panel on Microchip Studio, where the game's menu is displayed. Players make their selections via this menu, with their choices communicated back to the microcontroller through the USART, ensuring a seamless and interactive gameplay experience.

Menu and Selection

An example of a menu and making selections is given below in red.

Step 1:

SIMON GAME

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1. Start game.
2. Exit

Step 2: Option 1 selected

Start game: Select the start difficulty level.

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1) Easy
2) Moderate
3) Give me pain.

Difficulty levels:

Easy:

- Sequence Sets: Players will face 3 sets of sequences.
- Sequence Length: Each sequence will start with 3 elements, potentially increasing to a maximum of 5 elements throughout the level.
- Display Speed: Each element in the sequence will be displayed for a duration between 2 and 3 seconds.
- Response Time: Players are given a 5-second window to replicate each sequence correctly. Failing to respond within this timeframe will trigger an interruption, accompanied by a sound indicating the end of the current sequence. The game will then proceed to the next sequence.
- Scoring and Advancement: A player's performance is not judged on a per-sequence basis. Instead, scores are compiled across all 3 sequences, with a requirement to achieve an 80% cumulative score to automatically advance to the next difficulty level.

Moderate:

- Entry to Level: Players have the option to select this level at the start of the game or be automatically promoted to it from the previous level by achieving a cumulative score of 80% or higher.
- Sequence Sets: Players will face 4 sets of sequences, offering a more challenging experience than the Easy level.
- Sequence Length: Sequences will begin with 3 elements and may extend up to 10 elements, testing the player's memory retention and pattern recognition skills over longer sequences.
- Display Speed: Each element in the sequence will be illuminated for a duration between 1 and 2 seconds, requiring quicker observation and response from the player.
- Response Time: A 7-second window is allocated for players to replicate each sequence accurately. Failing to respond within this period will lead to an interruption, signaled by a sound denoting the end of the current sequence. Nonetheless, players are allowed to proceed to the subsequent sequence.
- Scoring and Advancement: Performance assessment does not hinge on individual sequence success. Rather, a player's overall performance across all 5 sequences is evaluated, with a necessity to achieve an 80% cumulative score to automatically advance to the next difficulty level.

Give Me Pain:

- Entry to Level: Players have the option to start the game at this challenging level or be automatically promoted to it if they achieve a cumulative score of 80% or higher in the preceding level.
- Sequence Sets: This level presents players with 5 sets of sequences, significantly testing their memory and reflexes.
- Sequence Length: The sequences start with 5 elements, expanding up to 15 elements, pushing the boundaries of the player's ability to recall and replicate longer sequences accurately.
- Display Speed: Each sequence element is displayed for a brisk 0.25 to 1 second, demanding quick observation and faster reaction times from the player.
- Response Time: Players are given a 10-second interval to respond correctly to each sequence. Failure to do so will result in an interruption, accompanied by an audio cue signaling the end of the current sequence. Nevertheless, players can proceed with the subsequent sequences.

Bonus:

Scoring and Advancement: Performance is evaluated across all 10 sequences collectively, not on an individual

basis. To progress, players must achieve an 80% cumulative score. Achieving this score under the "Give me pain" difficulty does not end the game; instead, it unlocks an even more challenging level. Beyond 'Give Me Pain': Upon conquering the "Give me pain" level, players advance to the hardest level, which retains the same settings but with a more demanding response time of just 3 seconds, further challenging the player's quick-thinking and reflexes

Winning and Losing Criteria: For All Selected Difficulty Levels:

Failure Condition: A player fails a sequence if an incorrect sequence is entered. Upon such a failure, the game will:

- Transmit a failure message to the serial port terminal.
- Generate a distinct sound indicating failure.
- Return the player to the start menu, allowing them to choose to try again or exit.

Success Condition: A player successfully completes a level by achieving an 80% score across all sequences within that level. Upon successful completion, the game will:

- Transmit a “Win” message to the serial port terminal.
- Play a celebratory sound signaling success.
- Return the player to the start menu for potential selection of a new difficulty level or to exit the game.

Interaction Feedback: During gameplay, every pushbutton press by the player will produce an auditory feedback sound. If a player presses an incorrect button, the game will:

- Emit a specific sound different from the correct entry sound, indicating an incorrect choice.
- Allow the player a single additional attempt to press the correct button for the current step in the sequence without altering the original response time limit.
- This chance aims to slightly mitigate the penalty for a single mistake, fostering a learning environment while maintaining the challenge.

Additional Specifications:

All sequences need to be random, please refer to the following link on working out how to do this.

https://www.nongnu.org/avr-libc/user-manual/group__avr__stdlib.html#gae23144bcbb8e3742b00eb687c36654d1

All the requirements (refer to rubric under Deliverables/Hardware verification) need to be implemented without errors to consider the project requirements fulfilled. You can make additions beyond the requirements and those will be considered for extra points (up to 15pts), but only if and after all completion requirements are met. Additions that would be considered would be those which use other peripherals on the microcontroller to inject interesting functionality to the project or extend the functionality of the project significantly. The points assigned for this extra work will be up to the TA.

Deliverables

You will need to submit the following items to be graded on this assignment:

- Verification (90 points)

- 35 points for a working Sequence generation
- 35 points for a working sequence detection
- 20 points for correct menu generation

Your Lab TA will need to see your implementation working and will check to make sure it works as per the requirements stated in the previous section. Your code may be tested to see if it handles certain edge cases.