EECE320 Project Report

Part 1

Dr. Mazen Saghir

Electrical and Computer Engineering Department

By

Antonio Makhoul (202500415)

Wassim Shams (202502112)

1. Module Listing (Verilog)

- Keypad Encoder:
    - keypad_encoder.v
    - tb_keypad_encoder.v
- Seven Segment Display Driver:
    - sevenseg_driver.v
    - tb_sevenseg_driver.v
- Verilog Header: team_params_202500415_202502112

2. Simulation Evidence

a) Keypad encoder evidence:

a. Icarus Verilog testbench output:

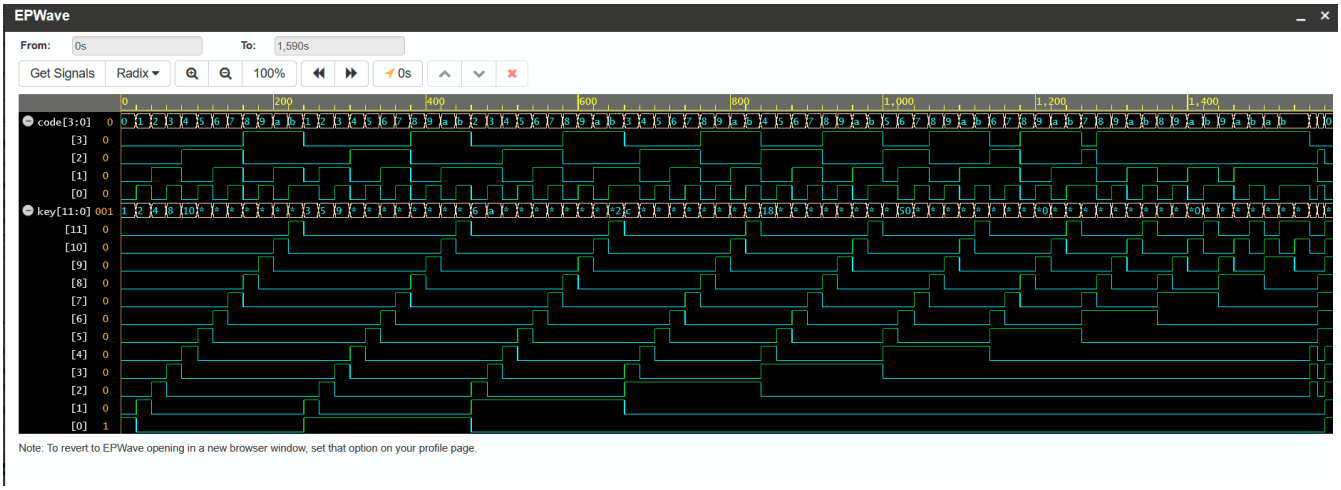
```
PS C:\Users\User\Desktop\AUB\Semesters\Semester 4\EECE320\Projects\Project 1> vvp a.out
Starting Keypad Encoder Testbench...
--- Pressing one key only ---
PASS: Key 0 -> Code 0000
PASS: Key 1 -> Code 0001
PASS: Key 2 -> Code 0010
PASS: Key 3 -> Code 0011
PASS: Key 4 -> Code 0100
PASS: Key 5 -> Code 0101
PASS: Key 6 -> Code 0110
PASS: Key 7 -> Code 0111
PASS: Key 8 -> Code 1000
PASS: Key 9 -> Code 1001
PASS: Key 10 -> Code 1010
PASS: Key 11 -> Code 1011
--- Pressing two keys ---
PASS: Keys: 0 and 1 -> Code 0001
PASS: Keys: 0 and 2 -> Code 0010
PASS: Keys: 0 and 3 -> Code 0011
PASS: Keys: 0 and 4 -> Code 0100
PASS: Keys: 0 and 5 -> Code 0101
PASS: Keys: 0 and 6 -> Code 0110
PASS: Keys: 0 and 7 -> Code 0111
PASS: Keys: 0 and 8 -> Code 1000
PASS: Keys: 0 and 9 -> Code 1001
PASS: Keys: 0 and 10 -> Code 1010
PASS: Keys: 0 and 11 -> Code 1011
PASS: Keys: 1 and 2 -> Code 0010
PASS: Keys: 1 and 3 -> Code 0011
PASS: Keys: 1 and 4 -> Code 0100
PASS: Keys: 1 and 5 -> Code 0101
PASS: Keys: 1 and 6 -> Code 0110
PASS: Keys: 1 and 7 -> Code 0111
PASS: Keys: 1 and 8 -> Code 1000
PASS: Keys: 1 and 9 -> Code 1001
PASS: Keys: 1 and 10 -> Code 1010
PASS: Keys: 1 and 11 -> Code 1011
```

```
PASS: Keys: 2 and 3 -> Code 0011
PASS: Keys: 2 and 4 -> Code 0100
PASS: Keys: 2 and 5 -> Code 0101
PASS: Keys: 2 and 6 -> Code 0110
PASS: Keys: 2 and 7 -> Code 0111
PASS: Keys: 2 and 8 -> Code 1000
PASS: Keys: 2 and 9 -> Code 1001
PASS: Keys: 2 and 10 -> Code 1010
PASS: Keys: 2 and 11 -> Code 1011
PASS: Keys: 3 and 4 -> Code 0100
PASS: Keys: 3 and 5 -> Code 0101
PASS: Keys: 3 and 6 -> Code 0110
PASS: Keys: 3 and 7 -> Code 0111
PASS: Keys: 3 and 8 -> Code 1000
PASS: Keys: 3 and 9 -> Code 1001
PASS: Keys: 3 and 10 -> Code 1010
PASS: Keys: 3 and 11 -> Code 1011
PASS: Keys: 4 and 5 -> Code 0101
PASS: Keys: 4 and 6 -> Code 0110
PASS: Keys: 4 and 7 -> Code 0111
PASS: Keys: 4 and 8 -> Code 1000
PASS: Keys: 4 and 9 -> Code 1001
PASS: Keys: 4 and 10 -> Code 1010
PASS: Keys: 4 and 11 -> Code 1011
PASS: Keys: 5 and 6 -> Code 0110
PASS: Keys: 5 and 7 -> Code 0111
PASS: Keys: 5 and 8 -> Code 1000
PASS: Keys: 5 and 9 -> Code 1001
PASS: Keys: 5 and 10 -> Code 1010
PASS: Keys: 5 and 11 -> Code 1011
PASS: Keys: 6 and 7 -> Code 0111
PASS: Keys: 6 and 8 -> Code 1000
PASS: Keys: 6 and 9 -> Code 1001
PASS: Keys: 6 and 10 -> Code 1010
PASS: Keys: 6 and 11 -> Code 1011
PASS: Keys: 7 and 8 -> Code 1000
```

```
PASS: Keys: 7 and 9 -> Code 1001
PASS: Keys: 7 and 10 -> Code 1010
PASS: Keys: 7 and 11 -> Code 1011
PASS: Keys: 8 and 9 -> Code 1001
PASS: Keys: 8 and 10 -> Code 1010
PASS: Keys: 8 and 11 -> Code 1011
PASS: Keys: 9 and 10 -> Code 1010
PASS: Keys: 9 and 11 -> Code 1011
PASS: Keys: 10 and 11 -> Code 1011
--- Pressing three keys ---
PASS: Keys: 2, 3, and 4 -> Code 0010
--- Pressing four keys ---
PASS: Keys: 5, 6, 7, 8 -> Code 0101
--- Pressing all keys ---
PASS: All keys pressed -> Code 0000

======= SUMMARY =======
Tests completed. Results:
Passed tests: 81 | Failed tests: 0
tb_keypad_encoder.v:132: $finish called at 1590 (1s)
```

b. Waveforms:



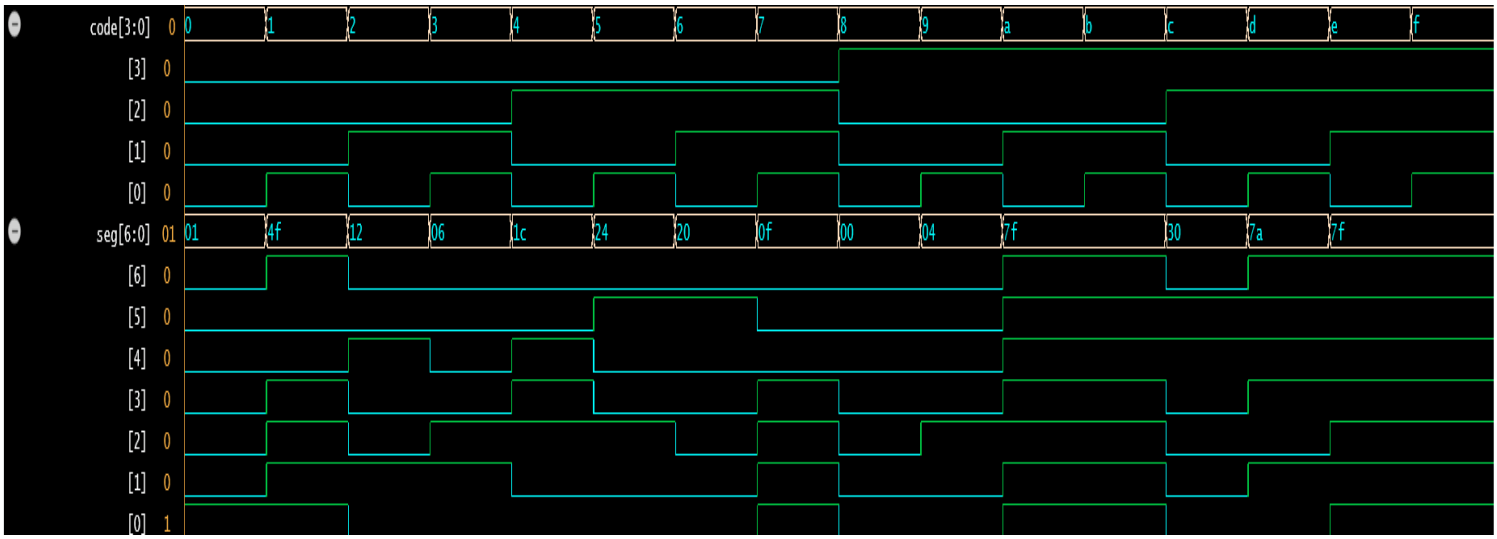
b) Seven Segment Display Driver

a. Icarus Verilog testbench output:

```
PS C:\Users\User\Desktop\AUB\Semesters\Semester 4\EECE320\Projects\Project 1> vvp a.out
Starting Seven Segment Display Testbench...
--- Testing all supported glyphs ---
PASS: Code 0000 -> Segments 0000001
PASS: Code 0001 -> Segments 1001111
PASS: Code 0010 -> Segments 0010010
PASS: Code 0011 -> Segments 0000110
PASS: Code 0100 -> Segments 0011100
PASS: Code 0101 -> Segments 0100100
PASS: Code 0110 -> Segments 0100000
PASS: Code 0111 -> Segments 0001111
PASS: Code 1000 -> Segments 0000000
PASS: Code 1001 -> Segments 0000100
PASS: Code 1010 -> Segments 1111111
PASS: Code 1011 -> Segments 1111111
PASS: Code 1100 -> Segments 0110000
PASS: Code 1101 -> Segments 1111010
PASS: Code 1110 -> Segments 1111111
PASS: Code 1111 -> Segments 1111111

======= SUMMARY =======
Tests completed. Results:
Passed tests: 16 | Failed tests: 0
tb_sevenseg_driver.v:59: $finish called at 320 (1s)
```

b. Waveforms:



3. How parameters affect behavior

The configuration parameters defined in the header file control how the keypad encoder and seven-segment display modules behave under different input conditions.

The PRIORITY_DIR parameter determines which key takes priority when three or more keys are pressed simultaneously. Here, a value of 1'b0 means the system prioritizes the lowest-index key.

For dual-key inputs, DUAL_KEY_POL specifies the policy to follow. In this setup, a value of 2'd2 indicates that the encoder will select the higher-index key when exactly two are pressed.

The POLARITY parameter, set to 1'b1, defines that the seven-segment display is common-anode, meaning the output signals must be inverted before display.

Additionally, GLYPH_TARGET identifies which digit pattern should be modified (in this case, digit 4), while GLYPH_MASK provides the pattern we must XOR our output with before displaying the segments associated with digit 4.