UNIVERSITY OF JOHANNESBURG

SUBJECT: Computer Systems 3B (RKE3B)

TITLE: Practical Assessment 5B – Outcome C

DATE: 14 October 2014

MARKS: 30

Build a SOS signal Detector

1.) Introduction:

Space tourism is space travel with the purpose of recreation and leisure. There are a number of start-up companies such as Virgin Galactic and XCOR aerospace developing space shuttles for the purpose of enabling a space tourism industry. A space flight tickets from Earth to one of the orbiting Space Station hotels will cost approximately $250 000 per person. This will become a hobby for the rich and famous. An example of a space station hotel can be seen in Figure 1.

Figure 1: Space station hotel designed by Robert Bigalow

The company you work for develops technology to ensure safe space travel. You were tasked to develop a system that runs on the Altera DE0 FPGA development board that can detect an SOS signal from a serial source. This system will be cheap to produce and will act as a method of detecting stranded space tourists.

You are only developing the prototype allowing you to simulate the input signal using push-buttons. Your system will use 2 push-buttons $\boldsymbol{B_{on}}$ and $\boldsymbol{B_{off}}$ and 1 flip-switch $\boldsymbol{En}$.

- **BUTTON0** → Push-button $\mathrm{B_{on}}$ will provide an ON (1) input signal when $\boldsymbol{B_{on} = 1}$.
- **BUTTON1** → Push-button $\mathrm{B_{off}}$ will provide an OFF (0) input signal when $\boldsymbol{B_{off} = 1}$.
- **SW0** → Flip-switch $\boldsymbol{En}$ should reset the system when $\boldsymbol{En = 0}$ and allow SOS signals to be detected when $\boldsymbol{En = 1}$.

A compact form of the SOS Morse code message needs to be detected by your system, the message you need to detect is **110011**. When the compact SOS signal was detected the Light (**LEDG0**) needs to be turned ON.

Your SOS signal detector need to be implemented as a Mealy State Machine and you must use D flip-flops (**7474**).

2.) Tips:

- Remember that push-buttons work in reverse, the push-button returns **1** if released and **0** when pressed.
- You must derive the input signal $\boldsymbol{w}$ and the $\boldsymbol{clk}$ from the 2 input push-buttons $\boldsymbol{B_{on}}$ and $\boldsymbol{B_{off}}$. Every time one of the buttons are pressed the $\boldsymbol{clk = 1}$ else $\boldsymbol{clk = 0}$. The input signal $\boldsymbol{w = 1}$ when $\boldsymbol{B_{on}}$ is pressed and $\boldsymbol{w = 0}$ when $\boldsymbol{B_{off}}$ is pressed.

3.) Submission and Practical Notes:

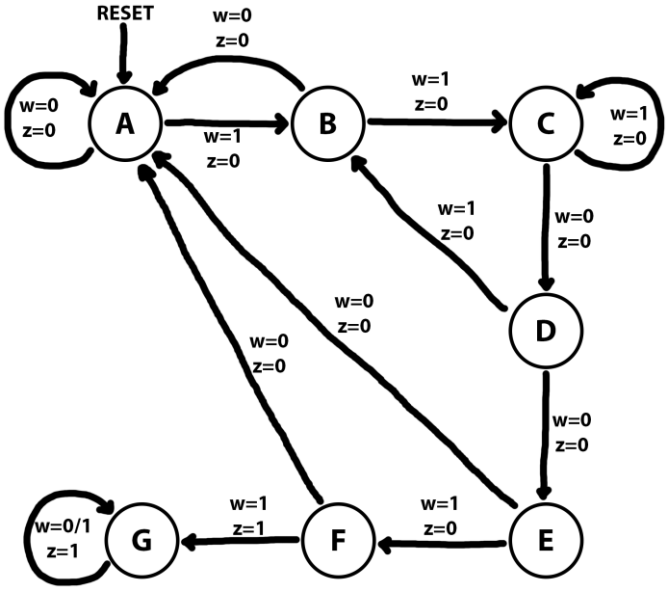
- Submit only the *.bdf - Block Diagram/Schematic file for the Practical on Edulink.
- Both group members need to submit the project design files on their blackboard accounts.
- Only groups of 2 allowed – Except when I have provided permission.
- Your submition will be tested for Plagiarism.
- **"No submission = No Mark"** – No extensions will be given.
- All work must be completed before 16:40 at the date of the practical session. If you have not yet completed your work by 16:40, a mark will be assigned based on your progress.
- Signed mark sheets (controlled by Demi's) are used as attendance.
- You need to show your calculations on paper or no marks (0%) will be awarded.

4.) Mark Distribution Guide:

Description	**Mark**
Question	**(30)**
Not present	Fail the course
Calculations Correct but not working	0/30 -> 18/30 (0%-60%) [18 Marks]
SOS detector working	18/30 -> 30/30 (60%-100%) [12 Marks]

5.) Solution:

State Diagram:



State Table:

Present State	Next State		Output z	
	$w = 0$	$w = 1$	$w = 0$	$w = 1$
A	A	B	0	0
B	A	C	0	0
C	D	C	0	0
D	E	B	0	0
E	A	F	0	0
F	A	G	0	1
G	G	G	1	1
-	dd	dd	dd	dd

State Assignment Table:

	Present State $x_3x_2x_1$	Next State $w=0$ $y_3y_2y_1$	Next State $w=1$ $y_3y_2y_1$	Output z $w=0$	Output z $w=1$
A	000	000	001	0	0
B	001	000	010	0	0
C	010	011	010	0	0
D	011	100	001	0	0
E	100	000	101	0	0
F	101	000	110	0	1
G	110	110	110	1	1
-	111	dd	dd	dd	dd

Karnaugh Maps:

x_3x_2 / x_1w	00	01	11	10
00	0	1	0	0
01	1	0	0	1
11	0	1	d	0
10	0	0	d	0

y_1

$y_1 = \overline{x_3}x_2\overline{x_1}\overline{w} + \overline{x_2}\overline{x_1}w + x_2x_1w$

x_3x_2 / x_1w	00	01	11	10
00	0	1	1	0
01	0	1	1	0
11	1	0	d	1
10	0	0	d	0

y_2

$y_2 = x_2\overline{x_1} + \overline{x_2}x_1w$

x_3x_2 / x_1w	00	01	11	10
00	0	0	1	0
01	0	0	1	1
11	0	0	d	1
10	0	1	d	0

y_3

$y_3 = x_3x_2 + x_3w + x_2x_1\overline{w}$

x_3x_2 / x_1w	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	0	d	1
10	0	0	d	0

z

$z = x_3x_2 + x_3x_1w$

Logic Circuit: