

Desarrollo. Procedure.

Recuerde MOSTRAR sus circuitos funcionando a su profesor para la valoración del trabajo de laboratorio (TL4).

1. *Implement in Top Level Design a **10 leds gradual intensity control** (5 internal and 5 externals: **red, green, blue, yellow** and **white**) with 10 switches, as indicated by the pre-report. Respect the different on and off times (i.e. $t1 = 4 \text{ sec}$, $t2 = 2 \text{ sec}$) and place a speaker with power stage in one of the outputs. Report a PWM simulation, the codes used (HDL & UCF) and include photos with text that show the result of at least two of your tests, as well as a video (sent to the mail, on disk or putting the link in the report) explaining what is shows when the LEDs go on and off.*

Challenge 1 (substitute point 1).

Implement a dimmer for a cluster of 6 white leds high intensity using a rotary encoder. If the encoder turns CW (clockwise) the light up and if it turns CCW (counter clockwise) the light off. If the encoder's push is pressed the cluster turn on in a middle intensity. Report codes (HDL & UCF), video and photos.

VHDL

2. *Implement with the language requested by the teacher (VHDL or Verilog) (a) an on-off control (on-off) and (b) a S1-S2-S3-off speed control (low, medium, maximum and off), of two gearmotors (3-24 V) with a single push for each motor with load. In (a) if the button is pressed once, the motor must be turned on, if pressed once more, it will turn off. In (b) the motor is off, when the button is pressed, the motor is started at low speed, when pressing again it changes at medium speed, if it is pressed again it turns at maximum speed and if it is pressed again the motor is turned off, add an **RGB** led to indicate the speed changes, as well as two voice messages that indicates two states of the motors ("motor on", "maximum speed", etc.). It is necessary to put a mechanism or charge for each indent with reference to a celebration (day of the dead, Christmas, etc.) or any commercial, industrial, mining, automotive, etc. (see figure 4.19) This must be done with an debounce circuit programmed in the FPGA as well as with a power stage for the 2 gear motors. Report your debounce simulation, the code used (HDL & UCF) and include edited photos with explanatory text that show the result of switching on-off. **Note:** If the push button is mechanical, implement the debounce system to avoid the noise generated by the mechanical rebound. Both paragraphs are reviewed at the same time.*

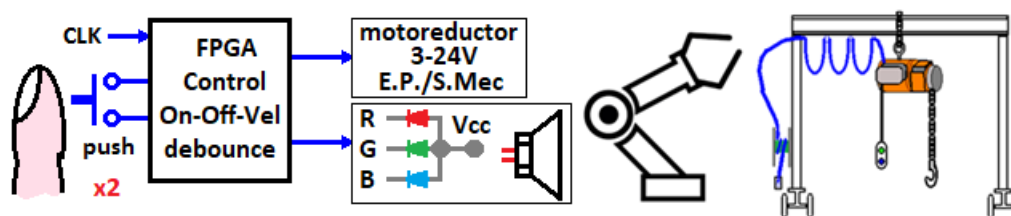


Figure 4.19. Diagrama del control on-off y velocidad con botón push y antirrebotes.

VERILOG

- Implement the code to program 2 images in a **matrix display**, one image is fixed and the other image must have movement (examples: happy face, arrows, numbers, letters, symbols, animals, sine signals, etc.) with a sensor activation and a voice message giving some indication (examples: “going up”, “going down”, “laughing”, etc.), illustrated in figure 4.20. An 8x8 or bigger matrix display will be used, energize with external source with or without power transistors or use a serial matrix display IC (i.e. MAX7219). The change between images is by means of a **magnetic sensor**. Report the codes (HDL & UCF) and several photos of fixed and moving images with explanatory text. Make a video (sent to the mail or put the link) explaining what is shown in the fixed image and the moving image.

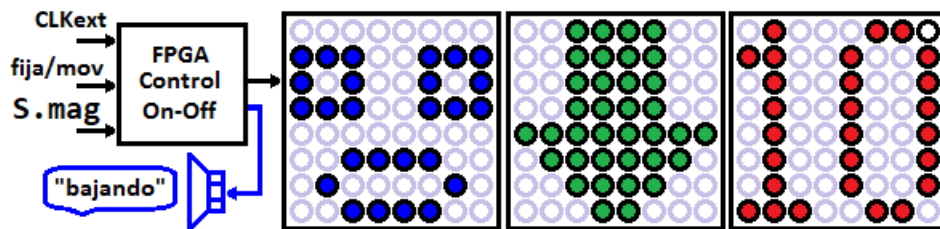


Figura 4.20. Figuras del display matricial.

- Implement a **marquee** to send two messages on 7-segment display (i.e. HOLA, CIAO for 4 displays using Nexys 2 or 3, and larger words if there are more displays on the development board, i.e. Nexys 4 DDR, DE2, etc.), and a message when appear complete in all displays the word, as shown in Figure 4.21. The movement is from right to left and the change between both messages is controlled by the **flex sensor**. The control clock has to be external with any oscillator designed. Report the codes (HDL & UCF) used and include photos with explanatory text that show the result of the motion sequence, at least in one sense, also put the schematic, photo of the oscillator used and a video (sent to the mail, on disk or putting the link in the report) explaining what is shown by moving information from the marquee.

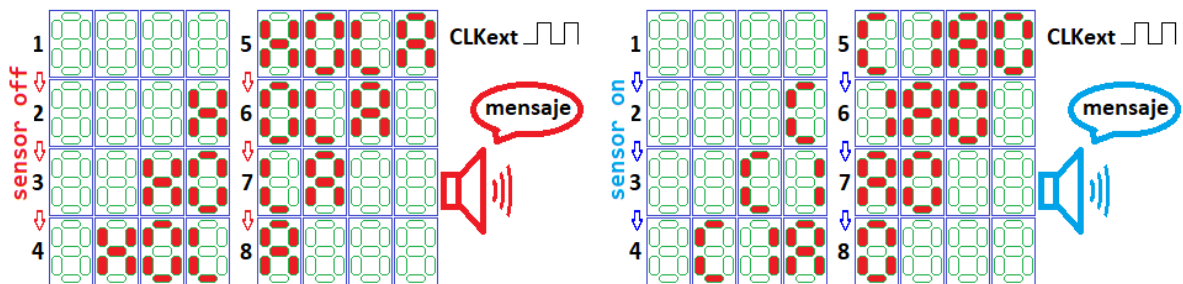


Figura 4.21. Marquesina para los mensajes “HOLA” y “CIAO” activados por sensor de toque.

Challenge 2 (substitute points 3 and 4).

Implement a marquee using a matrix display (at least $8 \times 24 = 3(8 \times 8)$) to send a message. The design includes a voice message and 2 speeds that change with a sensor. Report codes (HDL & UCF), video and photos.

VHDL

5. Implement in the language indicated by the teacher (VHDL or Verilog) the codes to display on the **LCD**: (i) a fixed message (i.e. name of your team-company-members); (ii) a marquee with movement control and (iii) a fixed message with variable data input (i.e. numbers from 0 to 63 controlled by the 6 switches (or one encoder) or temperature with LM35 sensor and ADC, etc.). It is possible to work with parallel LCD (i.e. Pmod CLP) and work with bytes or nibbles or use a serial LCD (i.e. Pmod CLS). Report the codes (HDL & UCF) used and photos of its operation, remembering that all codes always carry comments, as well as at least 3 photos with explanatory text.

Challenge 3 (substitute point 5).

Implement a programmable timer of minutes and seconds (99:59) on an LCD display, in which the data is entered with a matrix keyboard and initialized with the hashtag (#) and delete the data with the asterisk (*) symbol. At the same time as the countdown is initiated, a focus is switched on and when the time is finished or the data is erased, the focus is switched off. Put a button that pauses the count and turn off the load, but do not erase the data and continue if you press the hashtag (#) again. Report codes (HDL & UCF), video and photos.

VERILOG

6. Implement (i) a digital temperature meter with the LM35 and position in degrees with a potentiometer with output to display using a **discrete ADC** (parallel or serial) and a swith to change the measuremen; (ii) an ECG signal generator with a **discrete DAC** (parallel or serial), a buzzer and an external clock to vary the ECG signal (see the block diagrams in figures 4.22 and 4.23). In figure 4.24 you can see the commercial serial ADC. Bring standard meters for comparison. Report codes (HDL & UCF) and photos.

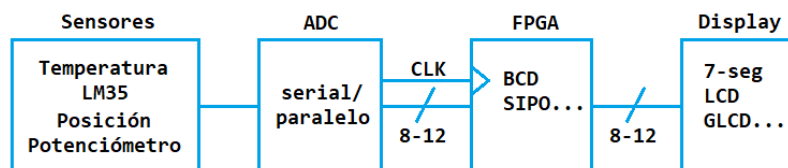


Figura 4.22. Diagrama de bloques de los medidores de temperatura y posición.

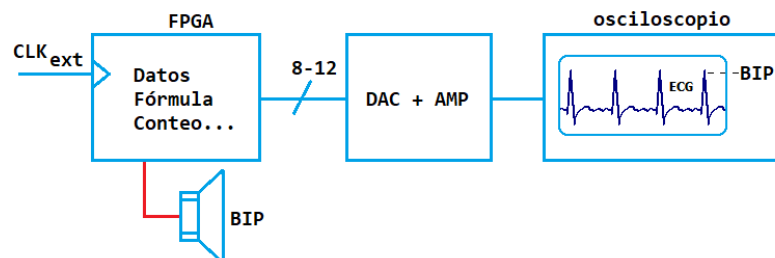


Figura 4.23. Diagrama de bloques del generador de señal ECG.

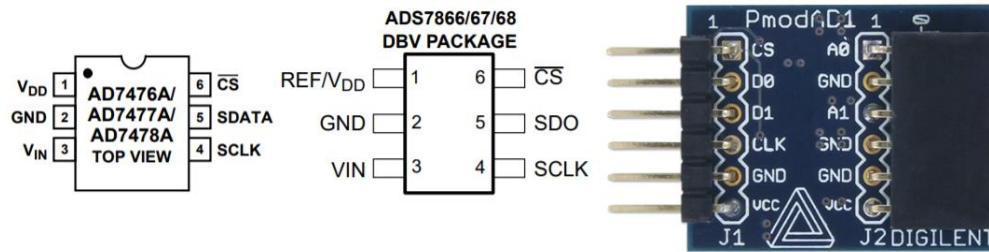


Figura 4.24. ADC seriales comerciales con comunicación SPI.

7. Realizar sus comentarios y conclusiones (incluir en por lo menos un párrafo Gracias “Gracias a esta práctica...”). Todos los códigos van en una sola columna con comentarios.

Write your comments and conclusions (include “Thank you” in at least one paragraph, “Thanks to this practice ...”). All the codes are presented in only one column with comments by line or blocks.

NOTA: Respetar la numeración de cada punto de este formato en el reporte escrito [**máximo 25 cuartillas** si se entrega impreso (Letra Times New Roman de 12ptos, interlineado sencillo)].

Proyectos opcionales utilizando PLDs y HDL.

Diseñar (a) un visualizador matricial RGB de 200 x 20 para mandar mensajes que se programen al conectar un teclado al el puerto PS2, (b) un sistema de control de un brazo con tres grados de libertad controlados a través de un joystick, cuyos movimientos x-y mueven dos motoreductores del brazo, y un solo botón sirve para abrir y cerrar el motor del gripper.

Design (a) a 200 x 20 RGB matrix display to send messages that are programmed when connecting a keyboard to the PS2 port, (b) an arm control system with three degrees of freedom controlled through a joystick, whose movements x-y move two arm gearmotors, and a single button serves to open and close the motor of the gripper.

Diseñar y construir un sistema de control de apertura y cierre para:

- (i) una ventana deslizante
- (ii) una puerta abatible
- (iii) unas persianas verticales corredizas

Design and build an opening and closing control system for:

- (i) a sliding window
- (ii) a folding door
- (iii) vertical sliding shutters

Diseñar y construir un sistema de lavado de tapetes.

Design and build a carpet washing system.