

Morse Code Display

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Description of the Project

This Project is a **Morse Code Display**, implemented using DE10-Lite FPGA Development board and an external circuit involving mechanical relay and red LED. The board displays English alphabets as their corresponding numbers (e.g., 1 represents A, 2 represents B, and so on, with Z represented by 26) and the system will translates these numbers into Morse code and visualizes the transmission through blinking LED patterns. Additionally, it provided an auditory feedback using a mechanical relay, which clicks for each dot and dash.

The combination of visual (LED), auditory (mechanical relay), and HEX displays feedback ensures a user-friendly experience.

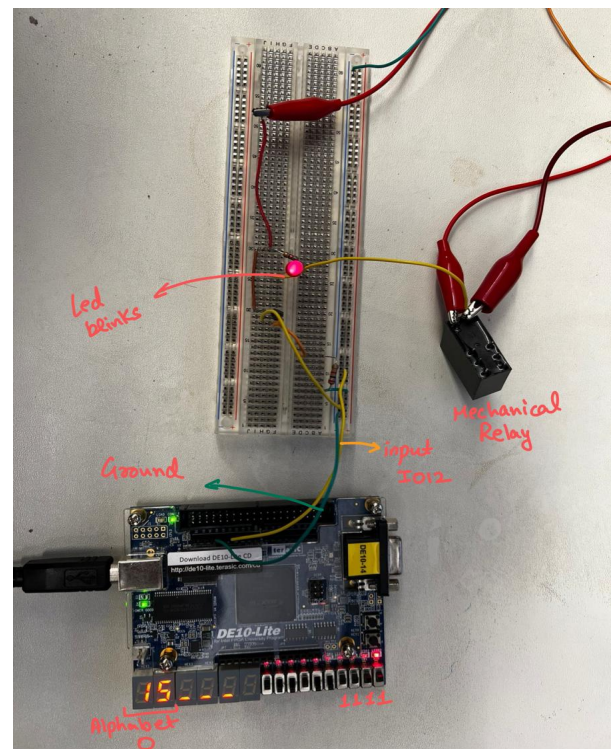
Features:

Alphabets(Numbers) to Morse Code Mapping: Switches on the FPGA board (SW[4:0]) allow the selection of any English letter (A-Z). Each letter corresponds to its position in the alphabet (e.g., A = 1, B = 2, ..., Z = 26).Morse code for the selected letter is displayed on the 7-segment HEX displays (HEX0 to HEX5).

An external **LED blinks** to represent Morse code dots (short blink(0.5 seconds)) and dashes (long blink(1.5seconds)).A **mechanical relay** provides a clicking sound for each dot and dash, enhancing the learning experience.

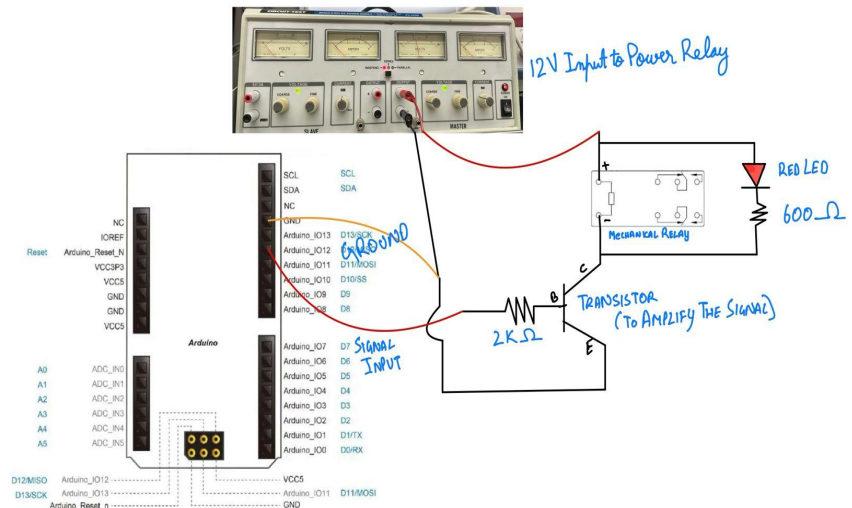
A custom clock module (clk_xx) reduces the FPGAs 50 MHz internal clock to a half-second pulse, ensuring precise control of LED blinking durations.

Key[1] and Key[0] to start and reset.



Approach In designing it

Module fsm: The FSM transitions through various states to control the blinking of the external LED and the activation of the relay; look at the current state of the fsm and then update the next step according to the morse message that needs to be transmitted. Each transition in states takes 0.5 seconds. So multiple transitions accumulate the time of signal.



Module clk_xx: The clk_xx module divides the 50 MHz clock signal to generate an enable signal every 0.5 seconds. This signal ensures accurate timing for the LED blinks.

External Components: The LED and relay are driven by a **transistor-based amplifier circuit**, ensuring sufficient current to operate the relay. The components are connected to the **Arduino_I012** pin. The relay provides tactile feedback for dots and dashes. It is triggered simultaneously with the LED, creating a synchronized sound pattern.

morse - 1's indicate a dash, 0's indicate a dot
len - number of 1's indicate the length of the message, or total number of beeps

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B: begin
(represent dot dash ...) morse = 4'b1000;
(Represent 4 elements/ 4 beeps) len = 4'b1111;
end

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Alphabet	Number	Morse Code	Binary Code (DE10-Lite)
A	1	. -	0001
B	2	- . . .	0010
C	3	- . - .	0011
D	4	- . .	0100
E	5	.	0101
F	6	. . - .	0110
G	7	- - .	0111
H	8		1000
I	9	. .	1001
J	10	. - - -	1010
K	11	- . -	1011
L	12	. - . .	1100
M	13	- -	1101
N	14	- .	1110
O	15	- - -	1111
P	16	. - - .	0001 0000
Q	17	- - . -	0001 0001
R	18	. - .	0001 0010
S	19	. . .	0001 0011
T	20	-	0001 0100
U	21	. . -	0001 0101
V	22	. . . -	0001 0110
W	23	. - -	0001 0111
X	24	- . . -	0001 1000
Y	25	- . - -	0001 1001
Z	26	- - . .	0001 1010

Sources we used:

Knowledge from Lab(01-05)

AI tool used: ChatGPT

The assistance provided by OpenAI ChatGPT was limited to enhancing understanding of the concepts.
