

# Final Project

## Long Exposure Photography

### Objective

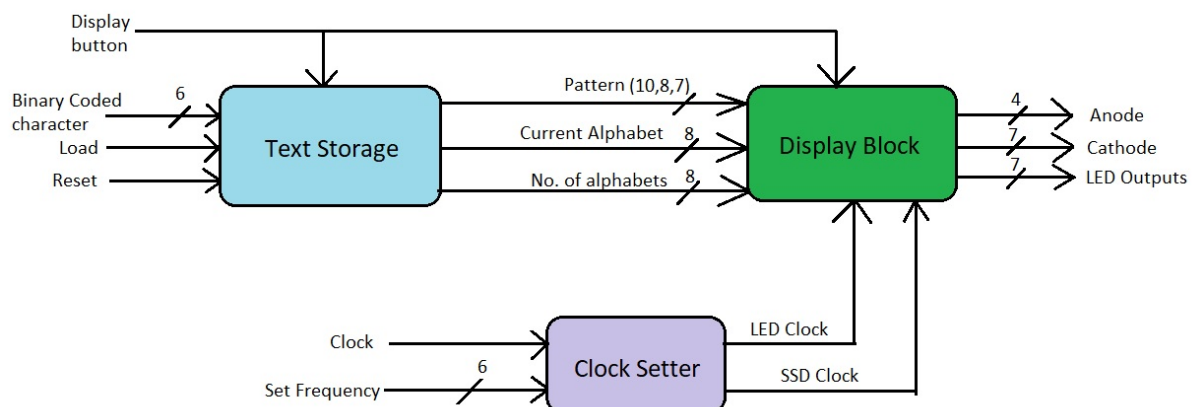
The aim is to print text in the air. Persistence of Vision enables us to see the trail of a light even after it has changed.

### Strategy

For each letter to be printed, a sequence of LED values were pre-decided such that scrolling the LEDs in a horizontal manner would generate text.

### Details of the Design

#### Block Diagram



#### Entity Description

##### 1. Text Storage (only works in loading mode)

- This block contains LED pattern for every binary coded character (A-Z).
- It takes **binary coded character** as input from user.
- When **Load** is pressed, it retrieves the corresponding LED pattern from memory and stores it in a separate memory named **Pattern**.
- It also keeps track of the **No. of alphabets** stored in **Pattern**.
- It also passes the **current alphabet** being loaded to the display block.
- **Display button** is used to toggle between loading mode and LED output mode.

## 2. Display Block

- This block has 2 modes : Loading mode and LED output mode.
- In loading mode, LEDs are kept off and it displays the **current alphabet** and total **No. of alphabets** on SSD (**anode & cathode**) using **SSD clock**.
- In LED output mode, the SSD is turned off and the LEDs start blinking according to the pattern provided by the text storage block, synchronized with **LED clock**.
- The signal **LED outputs** is mapped with 7 on-board LEDs.

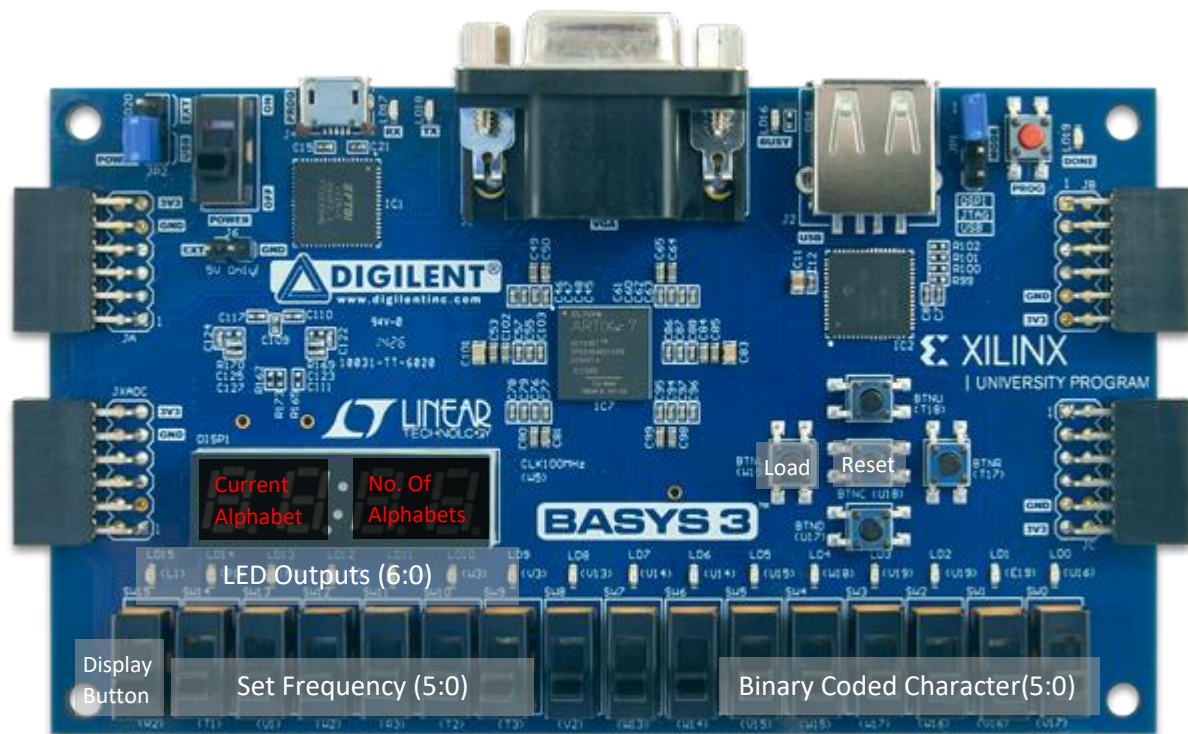
## 3. Clock setter

- This block uses the on-board **clock** and slows it down, using a counter, to produce 2 different clock, namely **LED clock** and **SSD clock**.
- **Set Frequency** is used to change the frequency of **LED clock**.

## Signal Description

Name	Type	Description
Display Button	Input	Used to toggle between loading mode and LED output mode ('0' is Loading mode and '1' is LED output mode)
Binary Coded character(5:0)	Input	6 bit vector encoding the position of character (A=1 & Z=26)
Load	Input	Pushbutton used to load the input character
Reset	Input	Pushbutton used to reset the whole system
Clock	Input	Clock to the system
Set Frequency(5:0)	Input	6 bit vector used to change the frequency of LED clock
Pattern(10,8,7)	Internal signal	2D array (10 x 8) of bit_vectors (6:0) storing LED pattern for each input character
Current Alphabet(7:0)	Internal signal	Binary Coded Decimal of position of last loaded character
No. of alphabets(7:0)	Internal signal	Binary coded Decimal of the total no. of alphabets loaded
LED clock	Internal signal	Clock used for blinking the LEDs
SSD clock	Internal signal	Clock used for Seven Segment Display
Anode(3:0)	Output	SSD anode output
Cathode(6:0)	Output	SSD cathode output
LED Outputs(6:0)	Output	Used to toggle the on-board LEDs

## Pin Mapping



## Validation Methodology

- Text storage block was tested by simulating in Vivado and storing different characters in the memory.
- Display block was tested in simulation as well as on board in 2 steps.

### **1) Testing of SSD display**

#### In simulation

Loaded different characters and verified the anode and cathode values.

#### On board

Loaded different characters and verified the SSD output.

### **2) Testing of LED output**

#### In simulation

Loaded different characters and verified the value of 'LED outputs' vector.

#### On board

Loaded different characters and then continuously rotated the board in an arc and observed the text printed in air.