*e*SLATE

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Problem Statement

To design an electronic slate, i.e. a board on which one can write

To be able to see the written pattern on a GLCD too.

Design Approach and Reasons for Choosing the Various Components

Basic idea for this experiment has been taken from the source:

http://www.fischtisch.de/uploads/Main/p287-hudson.pdf

We expanded on this concept and used a led as a light sensing device to create an electronic slate on which we can draw patterns. This drawing has been done using a laser. The shape in which the laser pointer is moved on the input device will then be on the shown GLCD.

During the initial stages of the project, we thought of using a photodiode matrix to create the input device. But photodiode matrix was not available in the lab. So we did some research through internet to find some alternatives for the photodiode matrix. So, ultimately we decided to go for another input device. Searching for that we came across the above mentioned paper which describes the usage of a led to sense the light falling on it.

This idea being new to us and innovative has been adopted for the future course of the project. Thus we obtained an input device, a led matrix, to serve this.

In this project, this led matrix served as the sensor matrix. Basically when a light ray is incident on a particular led the led will become on. When we shine the laser on the matrix in a particular shape the corresponding led's will be on. For safety reasons we used resistors in the circuit. The value of the resistances is 220 ohms

In the next step, we had to decide the number of leds that should be used in the input stage.

We finally settled for a 5X7 led matrix because going for any higher number of leds leads to increase in current that is needed to drive these leds. But the CPLD board limited us to use a 5X7 matrix. Thus the numbers of leds and output stages are determined.

So the basic hardware units were not that complicated. We kept them as simple as we can so that we don't face any problem later. The led matrix, resistors were assembled on a breadboard and the assembly is interfaced to a GLCD

As illustrated in following figure in its normal operation, light is emitted when current flows across the junction of an LED from its anode to its cathode. On the other hand, because it is a diode, it does not nominally conduct current in the opposite direction, when it is reverse biased by placing a positive charge on the cathode and a negative charge on the anode. However, small amounts of current do leak across the diode junction when it is reverse biased. The amount of such leakage is related to the incident light striking the LED, with higher light levels producing substantially larger leakage across the junction. It is possible to use the CPLD to exploit this property to measure incident light.

This is done as follows. First, both ends of the LED and current limiting resistor pair are wired to separate I/O pins. To sense light, the CPLD briefly reverse-biases the LED by setting pin A to logic 0 (ground or 0v) and pin B to logic 1 (typically +5v). This charges the small intrinsic capacitance found in the wire and diode. Pin B is then switched to high impedance input mode. At that point, the input value at the pin will read logic 1. Over a short period of time, the charge on the wire will leak past the reversed biased LED junction to the ground provided by pin A, with the input at pin B subsequently dropping far enough to register as a logic 0. By measuring the time it takes for this charge to drop below the logic 1 level, we can determine the rate of reverse bias leakage, and hence the level of incident light (again with higher light levels causing more leakage, and hence shorter times). As we're using CPLD, not microcontroller, pins can't be assigned as inputs and outputs dynamically. So, we connected two wires to pin B shown in figure below and configured one as input and other as output. This wouldn't change functioning of the circuit because input pins of CPLD are always at high-impedance state.

LED mode of working for the purpose of sensing light:

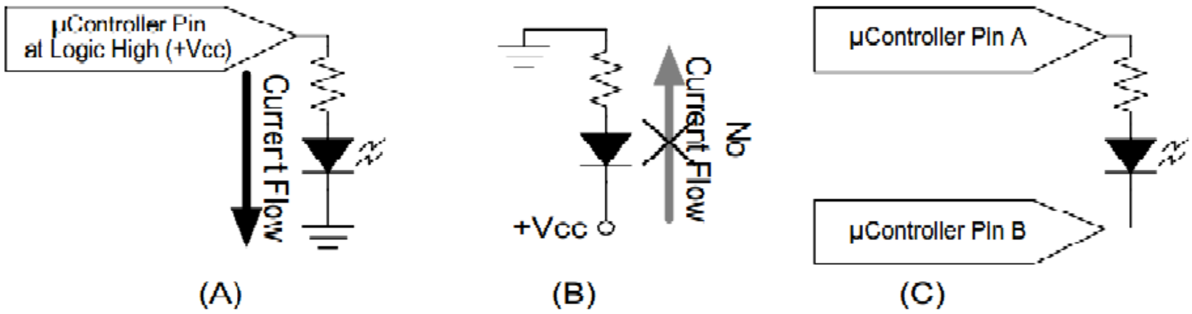
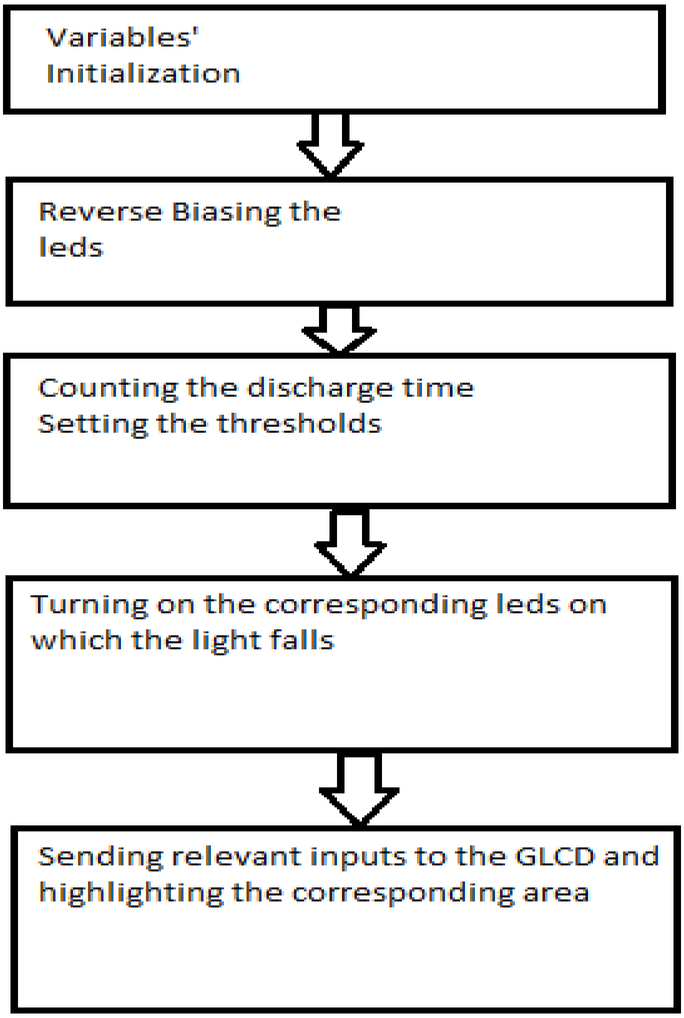


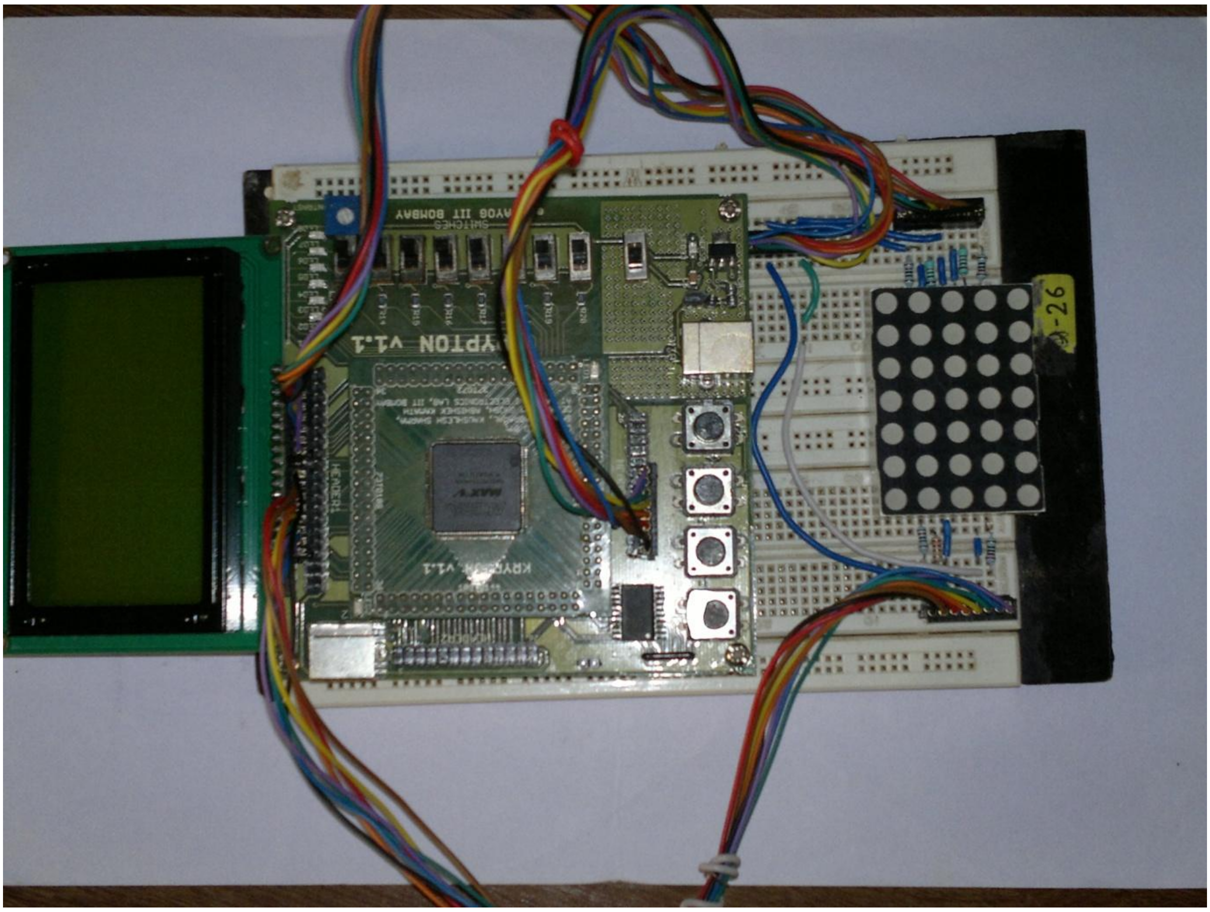
Figure 2. a) Normal use of an LED,
b) Reverse biased LED, c) Circuit for light sensing.

The algorithmic flow chart is as shown in the figure below



The above algorithmic flow chart describes the way in which our code has been written.

Below shown is our assembled circuit:



Conclusion and suggestions for further improvement:

- In the onset of the conclusion, we satisfactorily present the ***e*SLATE,** an electronic slate on which we managed to fairly produce the shapes drawn on it using a laser and output the shape on a GLCD too.

- As the laser is moved across the input pad, the leds on which the light falls turn on and also the corresponding part is highlighted in a partition of the GLCD.

- We did it on a miniature scale. This can be further improved to create larger version that can be of a much better use.

  Evidently, they have the potential to replace chalks, pens and pencils☺.

- A major suggestion is to use higher sensitivity leds and smaller ones.

The leds we used a large and hence the shape you desire, for example 3, may not be produced as might be desired.

Hence, increasing the number of leds and decreasing their size and gap between them can help produce output, that resembles the input more.

List of references:

1. http://www.fischtisch.de/uploads/Main/p287-hudson.pdf
2. ePrayog website.

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