Bringing the Classics Back To the Classroom to Enhance Learning Experience

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This paper outlines the use of Matlab, a 7-segment display and an LED matrix to create a game that enhances students' hands-on experience in classroom. We hope that this new idea will make the class better and fun for students.

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Introduction/Background

At the University of Houston, we focus on hands-on learning in our curriculum. We begin by introducing Arduino and Matlab in our freshmen introductory level course, ECE 1331: Computer and Problem Solving. In spring 2016, students have the opportunity to program Arduino using Matlab in conjunction with an LED matrix to design a game as other institutions [1-4] have also used Arduino in their classrooms with great success. Although Dr. Marpaung has received a positive feedback in regards to using a Zumo bot in classroom [5], he believes that he can also enhance students' hands-on learning experience by offering them a different set of projects involving an LED matrix.

Lab Assignments

Laboratory assignments are designed systematically to guide students until their final project. We use Matlab on each lab assignment to program an Arduino Uno board.

In laboratory assignment 1, students use Matlab, Arduino and a 7-segment display to display letters using parallel communication.

In laboratory assignment 2, students learn how to send serial data using shift registers from Arduino to a 7-segment display to display letters.

In laboratory assignment 3, students learn how to send serial data using shift register to an LED matrix to turn on three LEDs at one time.

In laboratory assignment 4, students learn how to sequence LEDs in a row/column going back and forth.

In laboratory assignment 5, students learn how to sequence LEDs to form a snake and a Z shape.

In laboratory assignment 6, students learn how to turn on multiple LEDs sequentially to form a U-shape or a Z-shape.

In laboratory assignment 7, students will create a guessing game. In this game students need to create a code that will generate a random character to display using an LED matrix. A user needs to type the character back to Matlab and if he/she fails to answer correctly, the game stops. As the game progresses, a user will have more characters showing up on an LED matrix and less time to answer the question.

Figure 1 shows the overall setup using Arduino, shift registers and an LED matrix.
Figure 2 shows a character on an LED matrix using Arduino and shift registers.
Figure 3 shows the result of a correct user guess on an LED Matrix using Arduino and shift registers.
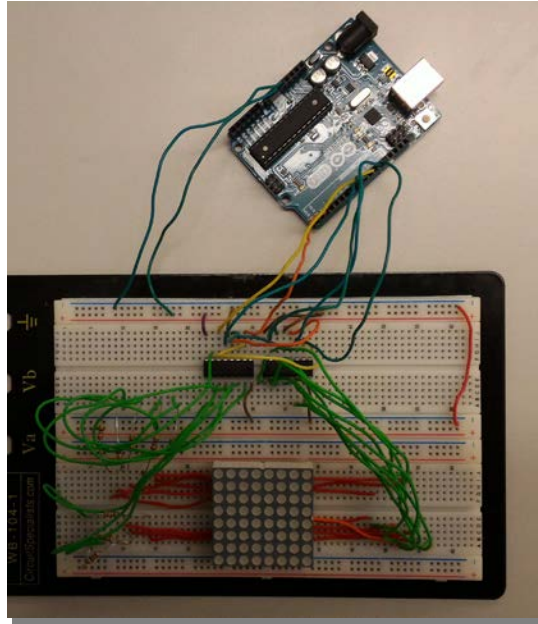Figure 4 shows the flowchart for Lab assignment #7.

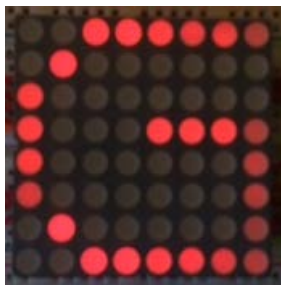Figure 1. Overall setup using Arduino, shift registers and an LED matrix

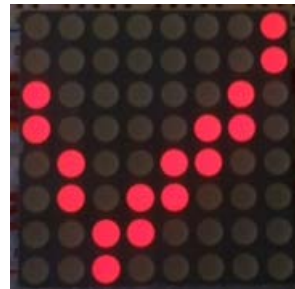Figure 2. A character on a LED matrix with Arduino

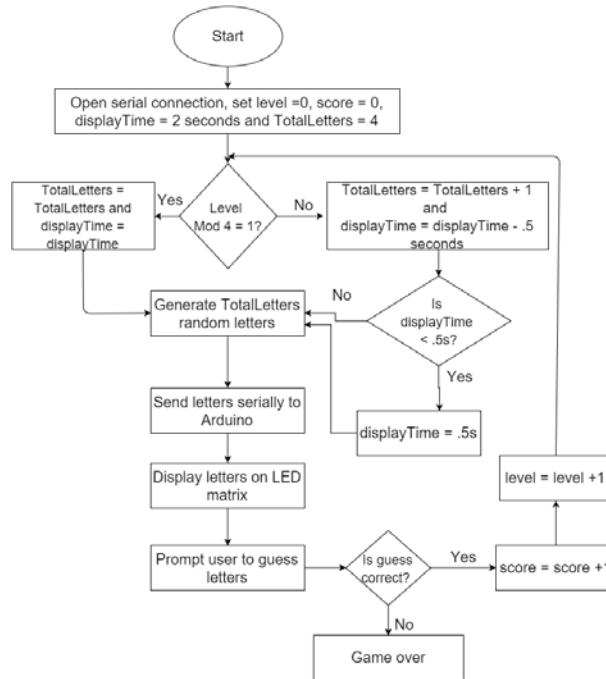Figure 3. The response to a correct guess

Figure 4. The flowchart for Lab Assignment 7

Lab Limitations

Due to the nature of the processing time of Matlab, we have not been able to come up with a game that is heavily timing dependent like Tetris. In general, it is advisable to have more than 60 Hz refresh rate for an LED matrix to display a symbol properly without a flicker and we have not been able to get such refresh rate using Arduino and Matlab. In fact, it was found that the process of shifting and displaying data to the LED matrix using only Matlab functions resulted in a processing time on the order of 1.2 seconds.

Future Work

We plan to add more multicolor LED matrices in order to come up with more games such as Battleship and add an MP3 shield to give it a sound.

Conclusions

The availability and affordability of a microprocessor such as Arduino have given educators a mean to push students to a new level. More and more engineering students want to have a hands-on experience in early classes and here at the University of Houston, we provide them with it. We hope that our work would inspire a lot of educators to bring more technologies to classroom.

References

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