Custom Laboratory Report

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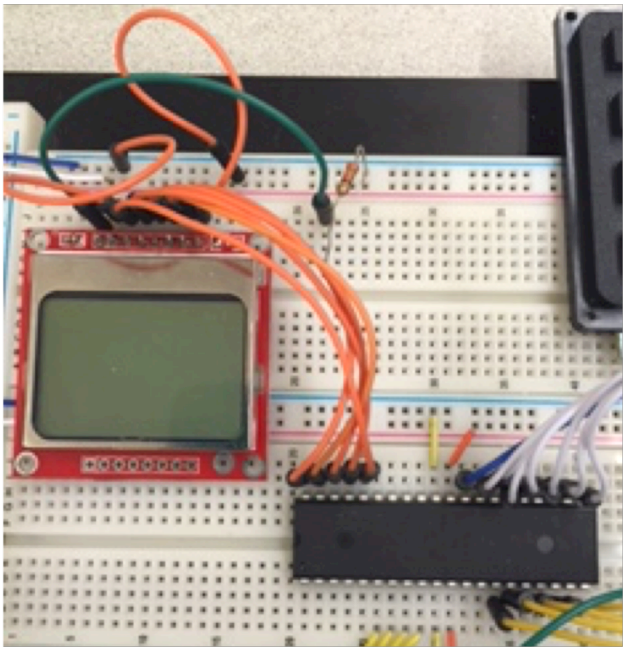
1 Description

For my final project I proposed to make my version of a tamagotchi toy. With this project, the user will be able to interact with a character, which is similar to having a pet or friend. I used a Nokia 5110 graphic LCD display in order to display my character. The user is able to choose between different buttons that controls the characters actions. The different actions include dancing to music, exercising, and sleeping. The user can also choose to play a coin tossing game where the character will flip a coin and the user can input their guess of heads or tails. If the user guesses correctly their score, which is displayed on a 7-segment display, will be incremented with a maximum of 9. The user can then reset their score whenever they would like by pressing the reset button.

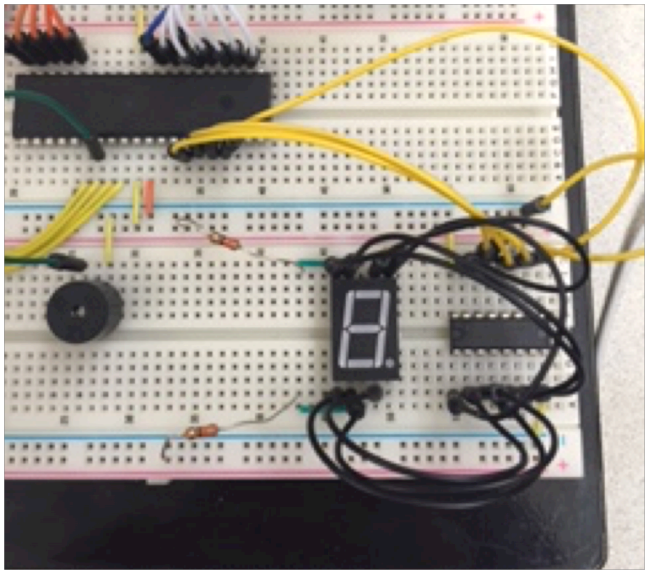
2 User Guide

The software used was Atmel Studio 6.2 using primarily C code. Some of the code I used was prewritten for us by the TA or was derived from outside online sources, which I credited on the files themselves. The period is set for 100ms. For hardware, we use the Atmega1284 microcontroller to connect our software with all of our different components. The 3 build upons I chose to use were the Nokia 5110 graphic LCD display screen, the 7-segment display, and a shift register. The other components used in my project are the keypad and the buzzer.

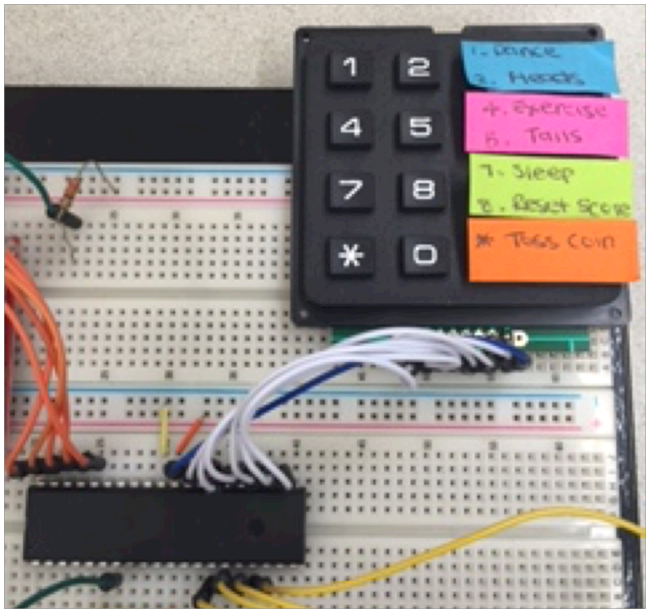
Nokia 5110 graphic LCD – This was used to display my character. The LCD is connected to PortA(pins 0-4). It requires a maximum of 3.3v of power so I changed the power to my breadboard from 5.0v to 3.3v. To get my pictures to display onto the screen, I used an online program to convert my bitmaps, which I drew, into data arrays. I then used my own function and the data arrays generated in order to display the graphics on the screen.



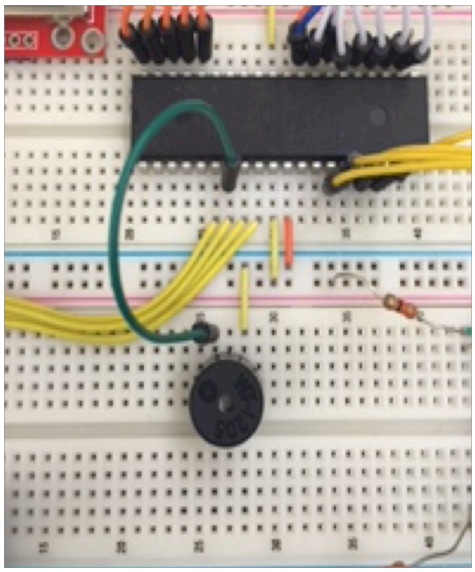
7-Segment Display – This was used to display the users score for the coin tossing game. The pins for the 7-segment display are connected to the pins of the shift register. When the user decides to play the coin toss game, the score displayed on the 7-segment will automatically increment up till 9 when the user's inputted guess matches with the results. The user can reset the score on the display to 0 by pressing the reset button at any time.
Shift Register – This was used to minimize the number of pins I would need to use for the 7-segment display. It is connected to PortD(pins 0-3).



Keypad – The keypad is used for user input. It is connected to PortC(pins 0-7). The input of the user dictates what happens to the character and everything else. Pressing "1" makes the character dance to a song. Pressing "4" has the character doing jumping jacks. Pressing "7" puts the character to sleep. Pressing "*" tosses the coin. Pressing "2" and "5" gets the user's choice where "2" represents heads and "5" represents tails. It also causes the coin to land.



Buzzer – The buzzer is used to play the notes for the song Twinkle Twinkle Little Star for when the character dances. It is connected to PortB(pin 6) and it must be disconnected from the microcontroller when the program is loaded to board. It must be reconnected before using the program.



3 State Machine Designs

I used 5 different state machines for this project. The 5 different SMs are called in the main function depending on various different conditions and user inputs. The 5 SMs I used are called Music_Tick(), Exer_Tick(), Dance_Tick(), Sleep_Tick(), and Score_Tick().

Music_Tick() – This SM plays the song while the character dances. It goes through 2 different arrays, 1 containing the notes of the song and the other containing the length of each note, and plays the note for the length associated with it. When it reaches the end of the arrays it will loop back to the beginning and restart playing the notes.

Exer_Tick() – This SM switches between displaying the 2 different graphic images that make the character look like it is doing jumping jacks. There are wait states between each time the graphic image is switched so that it does not switch too fast.

Dance_Tick() – Similar to the Exer_Tick(), this SM switches between displaying 2 different graphic images with wait states in between.

Sleep_Tick() – Similar to the Exer_Tick() and the Dance_Tick(), this SM switches between 3 different graphic images with wait states in between each switch.

Score_Tick() – This SM controls what value is displayed on the 7-segment display. It takes a variable that holds the users score and displays it on the 7-seg. Whenever the score is changed, this SM is called to change the value displayed.

4 Testing and Bugs

I started by testing each individual component on their own to ensure my wiring was correct and that I knew how to control it before putting everything together. When testing the keypad, I ran into a problem where the buttons were corresponding to the wrong values but I was able to fix this by rewiring my keypad. When putting all the components together I ran into multiple problems that caused my program to not be fully functional. I was able to fix the problems by testing my program with various different user inputs.

5 Appendix

Link to demo video: https://www.youtube.com/watch?v=QzVphR1q6qQ