Date: 03/31/2015

Senior design project: turtle

Theme: summary on the progress so far

1. Programmable Flashlight: we decided to use hexagon as main body at very beginning which is also the shape of upper shell of the turtle. Hence, our idea changes from hexagon to make a turtle. As an extra feature for this flashlight is asked and we have a large body filled with LEDs which is perfectly for a game screen, we embed the famous and classic "Snake Game" inside.
2. Flashlight LED: The basic function of our product is flashlight. Hence, we put 8 small LEDs in the front of turtle head to illuminate everything ahead as a normal flashlight does. All the flashlights are driven by the battery with a transistor working as their switch that is controlled by an output pin from MSP430G2452.
3. Main body LED matrix: Though the screen made of LEDs is an interesting idea, it's hard for micro-controller to drive large number of LEDs and give each of them coordinates. With the help of our instructor, Vladimir Goncharoff, we use a technique invented by Charlie Allen in 1995, Charlieplexing, to drive 61 LEDs only using 9 I/O pins of MSP4302452 (this micro-controller is assigned by Dr.Goncharoff).When using Charlieplexing, n drive pins can drive  LEDs with every two pins connecting two LEDs forward and reverse.

Thus 9 pins are able to control 72 LEDs, and we only make use of 61 LEDs of total 72 possible LEDs arranged in shape of hexagon consisting of 9 columns and 9 lines. If we need to light one specific LED, the only thing we need to do is output a high voltage at its anode and low voltage at cathode, which is assigned with coordinates we designed especially for this hexagon matrix.

1. User interface: This flashlight has 4 buttons. Three of them are used for snake game and the rest one is for flashlight. The game buttons are: left button (make the snake turn left), right button (make the snake turn right) and game power switch (On/Off). The flashlight button turns 8 flashlight LEDs on and off. Normally, the voltage of all four buttons is high pulled up the built-in pull-up resistors. Once the voltage is detected to be low, it means the button is pressed.
2. Snake game: Here is the procedure of our snake game. After player pressing the game power switch, the game will start. A warm-up phase will be the first step to give player enough preparing time. During this phase, the outermost LEDs on the LED matrix will be lighted one by one with a fixed starting LED and the same one as ending LED. When the warm-up phase is finished, a snake and the first target will be shown at the LED matrix with random position and won't move until player presses the left or right button. Now the game officially begins, the snake will follow the direction given by player pressing different button. Once the snake gets a target, the speed of snake will increases and one new target will show up still randomly. As the player gets more and more targets, the speed will increase but won't go beyond a limitation. The game will end only in two situations: 1. the player presses the game power switch to shut it down; 2. the snake hits one of the six edges of our hexagon LED matrix. A feedback of how many targets this player gets will be displayed by means of a snake running from the top LED along the outermost circle to some point which is determined by player's score. The higher score the player gets, the longer the snake runs at feedback. And the player can choose to show his score to other people if he/she doesn't press left or right button after the feedback. If he/she presses, whole game will restart and run from the warm-up phase again.
3. Appearance: The turtle is made up with 6 3D-printed pieces: one top hexagon LED screen case (TOP), one middle supporting body (MID), one bottom base (BAS), two turtle libs (LIB) and one turtle head (HED). Two LIB and one HED are glued on the top surface of the MID. TOP is inserted into MID. And BAS is glued on the bottom surface of the MID.