# CSET Senior Design Specification

3D Lightcube: 3D Snake

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**Approval for Design**

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# ****Abstract****

The goal of this project is to create a game of snake that will be played in a 3D light cube. The Light cube controller, the user input controller, and game control will reside on a Spartan III FPGA. The user will control the game though a smart phone device using Bluetooth. The cube device will be given data to display via a 28 wire interface. The cube will support displaying multiple colors and will be usable for other applications in addition to the 3D snake game I will be producing for it, including music visualizer, or text display. To facilitate other control methods or other uses a pass through function from the rs232.

# Background

The light cube has been an interest for many tinkerers of electronics for some time, there are many good examples of 8x8x8 light cubes, but for the most part all have been controlled by small microcontrollers, like the ones in Aruduios. These displays allow for some very interesting patterns to be made because they are controlled through software. These devices are typically for entertainment purposes only, as they really serve no practical functionality. The ability to display patterns typically is through an onboard program or via a pass through functionality for control from a more power.

# Functional Description

## Project Definition

The led cube will be able to display simple 3 dimensional 8x8x8 images. The game itself will be a simple game of snake where the user controls the snake giving positive or negative pitch and yaw commands based on the current motion of the snake. The user will control the snake using a smart phone running android. A simple android app will be included to facilitate this. The smart phone will communicate with the device via a Bluetooth interface.

The device will also have a separate program for testing the device, in addition to the snake program.

## Objective

The objective is to create a game that puts a spin on an old classic, by adding in the factor of a third dimension to make things more complicated and interesting.

## Design Specifications

* The cube will be generic enough that it can display any image compatible with the display. (the cube controller will be autonomous)
* The softcore will run several programs including the snake game, as well as at least 1 demo program for testing the display.
* The test program will be able to test each led individually and together.
* The android phone app will send commands to the softcore to control the game via a Bluetooth.
* The LED refresh rate will be no less than 60hz
* Each color will have at least 16 brightness levels, including completely off.
* The device will be able to enter test mode or game mode via switches.
* The snake game will have no difficulty levels, but will continue until the snake crashes into itself.

## Deliverables

* LED Light cube
* Led Controller code
* Snake game code
* LED Light demo code
* Android Bluetooth Controller App
* User manual
* Final Report

## Constraints

* The Android Phone and the LED controller must be close enough to facilitate Bluetooth communication
* The cube must not be in turbulent environments.
* Environmental temperature is between -35°C and 25°C
* The light cube will be powered by 120V AC

# Strategy

## Technical Approach

The LED light cube will be constructed out of 512 RBG LEDs, the drivers of which are to be made of shift registers, 8 for each color and 1 more for multiplexing. These shift registers will drive 92 transistors, one for each shared anode, and 8 transistors of higher power constraints, one for each of the 8 multiplexed layer cathodes.

The control code, program code, softcore, and Bluetooth control unit will all be coded onto an Altera Spartan III, which is on a Terasic DE0. Additionally there will be the smart phone running Android to use as a controller for the game.

## Block Diagram

Figure 1 shows the basic structure of this project including all major design features. The specifics of each component including design hierarchy are yet to be determined.

Figure : Design Block Diagram



## Design Hierarchy

TBD

## Manufacturing

Once the FPGA design is done the core could be printed to silicon which would make game logic and LED control circuitry very cheap. The LED driving circuitry could very easily be translated to place and route designs, which would drive down the cost of this portion of the design.

The largest problem and most expensive component is the cube. Building the cube by hand is going to be an incredible ordeal taking many, many hours, and designing an automated process for this would take a lot of specialized hardware that would all need to be designed. The process of building the cube by hand is best facilitated by the use of a jig. As the design itself isn’t complicated, just incredibly repetitive, anyone could build such a device if they had the requisite tools and time. Designs for the jig I will be using will be included, as well as details to the correct use of the jig.