Dynamic Animation Cube
Initial Design Document

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Project Description:

The goal of the Dynamic Animation Cube project to design an array of light emitting diode (LED) in a cube formation that will turn on and off at predetermined times in order to simulate 3-dimensional animation.

Motivation for project:

The concept of this project, for our group to fabricate a 3-Dimensional LED cube, came originally from an article posted on the Boston University website and was further enhanced by watching online videos of both larger and smaller projects, similar to the ones that we have set out to produce. Through our continued research, we were able to find many cube models, varying in color, size, and complexity. Our all-encompassing goal with this project is to provide a visually pleasing object, not made to have any functional purpose. The initial goal for our senior design project was for a design that would have a functional purpose and perform a specific task. However, after an initial exploratory phase on a previous concept, we came to the conclusion that the desired concept would not be possible under our current design and would not be able to complete it under our current specifications, time, and budgetary concerns. With our previous project scrapped, we returned to the research phase to select a new project. After individual research was completed, the group reconvened and after witnessing the LED cube we were convinced that we must head in the artistic direction.

Once we had selected our project, we began to seek funding in order to supplement our own monetary contributions to the project. Through the course of our search, we were able to secure $800 in funding from the ECE department at UCF. A contingency on the funding that the ECE department requested is that the completed project will become UCF property and go on permanent display in one of the engineering buildings on the UCF main campus. The concept of having our senior design project permanently displayed as a piece of art is very well worth the time and effort. Projects come and go, but our legacy will remain with UCF for years to come. We also feel that the expectation and chance of such a contribution will motivate us to work with a high level of discipline and keep us ahead of schedule of any deadlines that we need to meet. While many groups will be motivated to finish their project because it is necessary to graduate, we feel that the potential for public display of our work will motivate us to work harder, more skillfully, and with better results for the final project. Our team consists of two electrical

engineering students and two computer engineering students. We feel that this dynamic and this project will allow us to fully utilize all of the skills that we have been developing over the entirety of our college careers. There will be an equal amount of software and hardware design, so every member will have an equal amount of work and tasks to complete.

Goals and objectives:

We hope to not only craft a 3-Dimensional LED cube that will be sufficient enough for us to graduate, but also one that we will be proud to display for all future and present students and faculty at UCF. We intend to create a cube that will be impressively sized, but also while retaining the concept that we only have two semesters to accomplish this. With our limited time allocation, we simply cannot implement a design that fills an entire room or one that displays an extremely complex visual moving image. However, within the two allotted semesters that we have to implement the cube, our group feels that we can design, fabricate, and get a working cube of respectable size that will fulfill and hopefully exceed both our own and the ECE department's expectations.

During the process of design and construction of our project, we will set weekly deadlines and have numerous group meetings to ensure that we are working progressively towards our desired goals in an extremely timely manner. An established goal of this group is to coordinate our time wisely in order to avoid time related stress. In our time here at UCF within the electrical engineering program, we have all heard stories from senior design students who have preceded us and a common feature of the stories regarding senior design involves lack of sleep, stressful environments, and rushing to assemble their paperwork and/or their actual project. We would rather spend the final weeks/days of our senior year improving our design and making it more impressive, rather than just getting it to work at minimum standards.

Function of the project:

The LED cube will use multiple micro-controllers to control the LED diodes. These diodes will turn on and off, as well as change colors according to what shape they will be making as a whole.As previously mentioned, it will have no functional use and is intended to be strictly a visually pleasing piece of art.

Our group hopes to create a cube that displays still images, moving images, and perhaps even some sort of animation. The still and moving images will not be hard to display, and will consist of letters, numbers, and various objects that will be able to "move" around the cube, change colors of the object, and scale between different sizes. We foresee animation taking a little more time to master due to the fact that we will be using multiple micro-controllers to control different portions of the cube, so getting them all to work in a synchronized fashion will take some time and effort. We have seen animations that range from a rain-drop effect where the pixels "rain" down through the cube, explosions/implosions of a sphere, and even a flying phoenix on a larger scale model.

Even though we are using LED diodes which are low heat and energy efficient, we will be using a large amount of them, so we must take into consideration the power consumption. We are intending to keep it simple and run it off a simple DC outlet, but we will continue to monitor our design and adapt to whatever changes might occur.

Specifications and Requirements:

- Cube size: 3 x 3 x 3 ft (LWH)
- Visible sides: 5 sides
- LED type: RGB
- Pixel resolution: 16 x 16 x 16 = 4096
- Case construction: Transparent acrylic
- Communication: USB/ SD card controller
- Working temperature: 50-104 F
- Working Humidity: 10-80%
- Working Voltage: AC 110V-230V
- Number of animations: 100

The animations will be set up as a selection of 100 pre-designed animations that saved on a SD card that will run in a preloaded order. Animations will be able to added to the cube via a USB connection to the SD. We expect every single LED functional and working under operable conditions. Each animation will be able to display multicolored objects, figures, and effects.

Budget and Financing:
Budget: $800

Sponsors:

- TI providing some micro controllers
- Sponsor ECE Division: $800

Expenses:

- LEDs: $420.00
    - $0.10 an LED for 4000
- Base: $10
- Rods(Acrylic)
    - 16*16 = 256 Rods
    - 3 feet * 256 = 768 feet of rod
    - $1 per 6 feet; 768/6 = $128.00
    - http://www.tapplastics.com/shop/product.php?pid=150&
- Wires: $20
- Assorted Cables: $10
- Soldering Stuff: $20
- Board to mount the micro controllers to: $20
- SD Card: Free (Provided by Joseph)

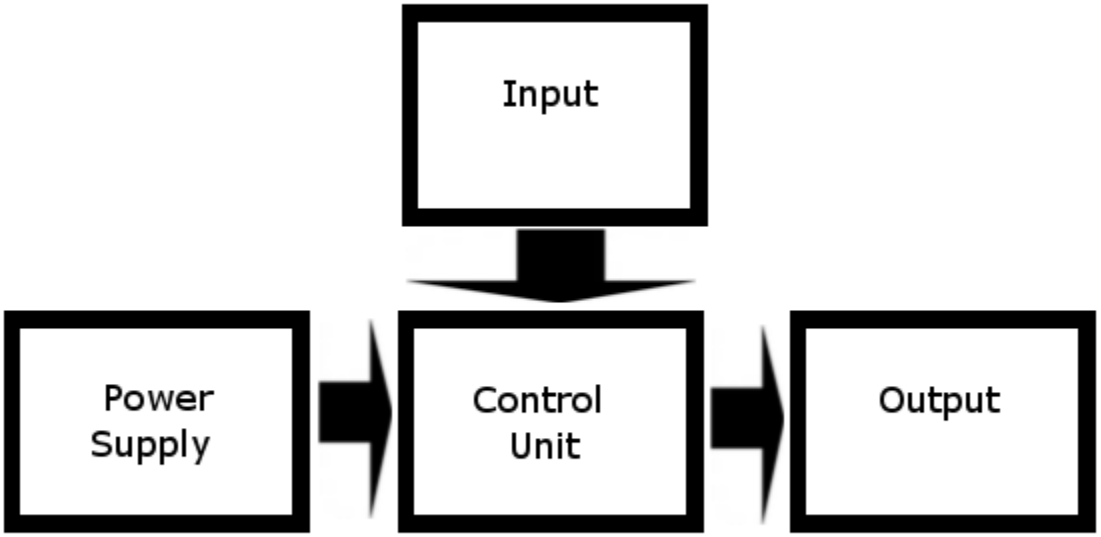
Total: $628

Milestones:

- First Semester
    - Prototyping done
    - Getting Materials
    - Create Schematic
    - Research Paper
    - Start building LED Cube
    - Begin Programming
    - Initial mock up built and tested
- Second Semester
    - Finish the cube
    - Testing LEDs in the cube
    - Testing the code
    - Fixing the code
    - Adding animations and secondary features

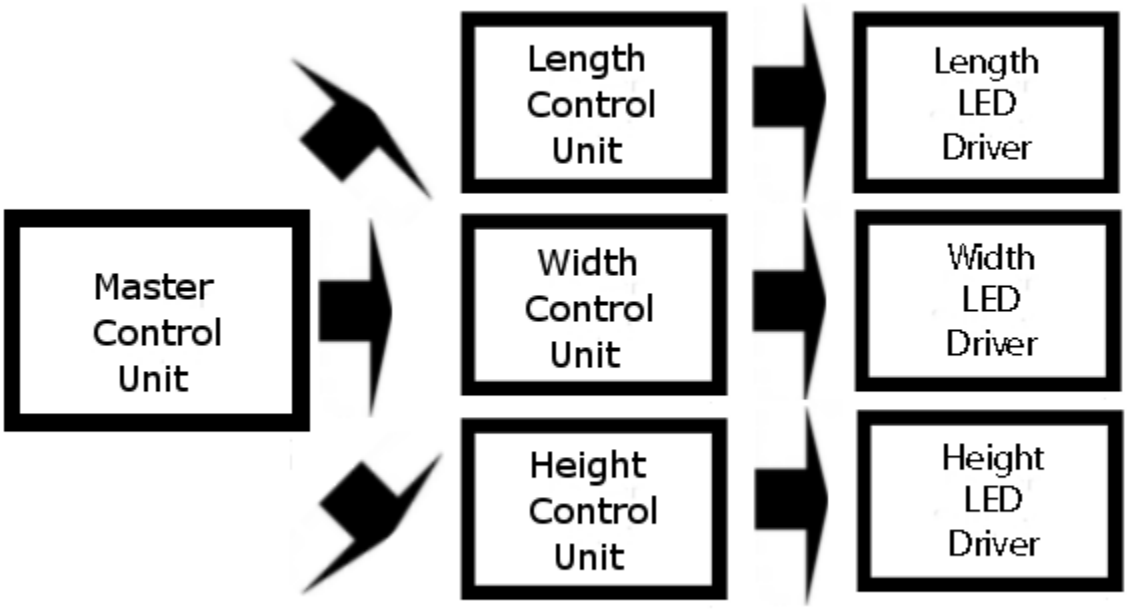
Block Diagrams:

Top level:



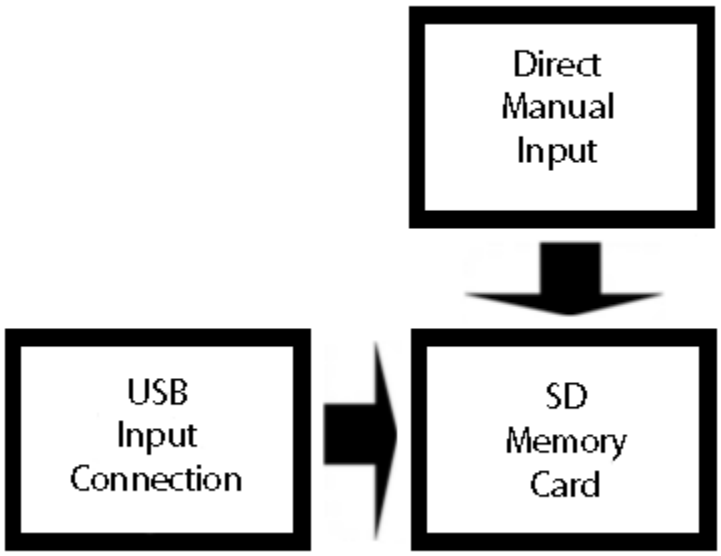
The top level diagram gives a visual description of our project in it's most basic form. A standard AC current will be derived from a wall outlet and fed into the power supply of our device. From the power will be distributed to the control unit which will be in charge of deciding which LEDs to t turn on and off. The control unit at first will fetch from memory the desired LEDs to turn on then communicate to the desired LEDs when to turn on and off. For the purposes of this project we will more than likely purchase the power supply so it will not be detailed any further in future block diagrams.

Control Unit:



The control unit will be the heart of the processing for this senior design project. The master control unit will most likely be a Stellaris micro controller that will be used to read in directions from memory and than pass on the desired patterns to each of the control units, one covering the length , one covering the width, and one covering the height dimensions of the cube. The dimension control units will take in the incoming data from the master control unit and use the information to tell the LED drivers which LEDs to turn on. For the purposes of this design we have decided to use the TI TLC5941. The TLC5941 carries many benefits however, two main reasons we are using them are the come with built in 16 channels providing us with the exact number of channels we desire to use for each dimension the also allow for dot correction which will allow us to keep all LEDs at a constant brightness independent of the current necessary to create the different colors desired from the LEDs.

Input Unit:



The input unit will be our path way to interaction with the LED cube. Here animations can be loaded into a dedicated SD memory card either through a provided USB connection or by directly installing the animations on the SD card. The SD card will hold all of the desired animation that will be fetched by the control unit for processing and future display.

Output:

The output of the system will be the only indication to the end user that the design is working. Using a system of LEDs set up in a 16 x 16 x 16 array the desired LEDs will turn on and off in a prescribed order providing the illusion of animated movement.