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Adv Programming & Electronics
10/17/16-11/6/16

Deconstruction 2: 1D Location Stair Lights
Final Project Documentation

Project Explicit Vision: Stair Aware (working brand project title) is a set of Internet connected smart stair lights. The general consumer does not have electrical engineering skills, but they do have a need for awesome lights in dark stairways. I submit that in a world of open source code, electrical components, and know how the barrier to knowledge entry can and should be lowered for the masses. Stair Aware is a take one of the more interesting light kit instructables, make it weather resistant, and add 2 point perspective to track a person walking on the stairs. Essentially, we are talking about doing what Sonos did for the home to stereo for the psychedelic professor style lighting on your stairs.

Process: The idea is to take one of the numerous many open source light projects for stairs out there and level down the knowledge base needed to buy such a thing. For bonus points feature development and future development I am going to try and program in other features that I am not 100% clear on yet, but I am doing proper design research with extreme users who have this use case. See below for interviews. However, I will most certainly be skinning up some low level industrial design to simplify and conjoin components, as they would ship to a user if this became a commercial good. Clearly one of those parameters would be to make modular components water resistant and the product somewhat easy to set up. I would say Nest a 10 on the complicated system and so we will target a 7 for set up.

----------Stage One----------

1. Research. Get some sense of the scope of the assignment and what resources are available. The goal is to answer the question "do I think I have a chance of success?" To answer this question you should research:

a. **How good is the documentation?**

   I have found a lot of good solid documentation and I feel confident on being able to build this. The only thing that will not be on my side given this project is time, components and battling scale. However, it seems that Kailen is interested and willing to build this with me so as a team I think we have a good chance.

b. **Who's tried this before?**

   1. Internet-enabled-interactive-stair-lights.pdf

2. Stair Lights - Alan Parekh's Electronic Projects.pdf
3. How Intelligent Lighting Is Ushering In The Internet Of Buildings | TechCrunch.pdf
4. HackerBoxes-0006-Internet-of-Things-IoT-Projects-F.pdf
5. Introduction to Hardware and IoT with Spark Core - Tech Knights.pdf
6. Particle has partnered with IFTTT for IoT.pdf
7. LED-Stair-Lighting.pdf
9. Interactive Internet enabled stairlights - YouTube.webarchive
10. Weekend Projects - Android-Arduino LED Strip Lights - YouTube.webarchive

c. **What have the outcomes been?**

The light aspect seems pretty straightforward and lots of people have built these. I am hoping to link this up to a particle photon, so it can be controlled by the phone, so that will be a tiny layer of difficulty but short of that I don't feel the light is going to be that hard.

Choosing the right kit and instructable, for components I would like some guidance on for sure. Then how to get them as fast as humanly possible.

d. What are some examples?

Stair lights with 2D position: The main one I have was the one we reviewed in class I sent in initially, which is the stairs with 2 point position used. I am just brain dumping right now, so I need to look at the exact components he used. I haven't done that yet.

- Arduino powered interactive handrail - YouTube.webarchive

- GitHub - Benn25/handrail/ interactive handrail with addressable LED strip.webarchive

2D position:

- Ideas to measure 2D position of an object constrained to X-Y plane
- Two-dimensional magnetic position sensor with digital coordinates output
- 2D POSITION SENSORS: Providing accurate position of parts with two degrees of freedom

- 2D Position Measurement with optical laser mouse sensor
- 2D + Multi-Axis Position Measurement
- Self-powered thin-film motion vector sensor

  Best Quality PIR Sensors Quick Look

  ****Don't know how hard it would be to link up to my boards
- Best Quality Motion PIR Sensors
- Sensor; Photoelectric; Fiber Optic Sensing Mode; Bipolar NPN/PNP; Infrared; 4

Internet Connected Board:

- particle documentationhttps://www.particle.io/products/development-tools/particle-local-ide
- Spark (3.3v) to Arduino (5v) Serial Communication
- An easy way to control your Arduino from Internet :)
- Arduino targets the Internet of Things with Primo board
- Eslov IOT invention kit
- Arduino PRIMO

  Arduino STAR - OTTO

e. How complicated do those examples look?

I don't feel like this undoable. In fact I am pretty confident. I just want to get on to which thing is the best and start buying so I can get it in fast.

f. Does it require exotic libraries, languages, hardware, or other items?

I don't know about the motion sensor yet, as I need to look at the one the guy used from the example code I have. I also need to look at the higher end consumer once I have found and what that would look like. At the moment that is where my work is, but all the other parts of the system are known and straightforward.

g. What parts do I need to acquire?

Good question. I don't have that decided on yet, that's my next round of work.

2. Once you've determined that it seems feasible to proceed, you should find a reasonable small study (example) to convince yourself that you really can do this. If this

were Arduino we could use the ?blink? example. You are not necessarily trying to do something useful, but to verify that you can make anything work at all.

a. Hopefully, you would find a simple existing, well-documented example (ideally a tutorial or similar)

I have listed a pile of these above. I need to choose one example that my partner and I feel is best. We might divide up the project a bit and try and figure out the photon too separately, so we have multiple component learning happening at different edges of the system in motion. Hopefully we can square this away today.

b. If you can't find an existing tutorial, you would have to design our own example to demonstrate the correct usage of the tool/library/device/concept.

I can find one, just let me get with my partner today and hack through all of this to decide what we want to do.

3. Design Research: This is presynthesis. What will come from the synthesis are the features of how we might connect this to the users existing data structures to provide value for their desired behavior change.

a. **Danielly Aldana**

1. DA_Tour Of Stairs
2. DA_Interview Part 1 of 2
3. DA_Interview Part 2 of 2
4. DA_Home After Tour
5. Still Images of the Front Of Her Place

b. **Jiggs**

1. Jiggs Full Interview (2nd half has more images)

2. Shots of the Whole Place

3. Stair Shots Stuff

----------Stage Two----------

** NOTE*** This is to document that has been done this week leading up to 10.22.16

1. **Kailen Early Stage Component Research:**
    a. **What I have learned So Far:** (Link)
2. **Parts List For Purchasing**
    a. **Final Parts List (Still Ordering) :** Editable Google Doc In Process (Link)
3. **Get A Photon Running**
    a. **Result: Success**
    b. **Documentation:** (Link)
    c. **Set Up Guide:** (Link)
    d. **Code Examples:** (Link)
    e. **Data Sheet** (Link)
    f. **If you need it for your photon:** Kailen@cca.edu pw: testing123
4. **Get a Photon Running the IR LED and get the IR LED sensor to receive a signal**
    a. **Result: Fail**
    b. **4 Color Resistor Calculator:** (Link)
    c. **5 Color Resistor Calculator:** (Link)
    d. **Resistor Color About:** (Link)
    e. **Code We Wrote: (Link to Code)** *put this in the photon editor*
        i. We basically worked of the blink tutorial and tried to do a print line of the sensor value to the console.
        ii. The console in photon is mad different from arduino so that was a weird thing to navigate.
        iii. We finally got some values coming through, but they didn't seem to make sense or actually real or working.
5. **Abandon the Photon**
    a. We don't know the board well enough.
    b. We just want to isolate the components and make sure we understand those.
    c. So we yanked everything and went to Uno.
6. **Move Over To Arduino Uno And Answer These Questions In The Test**
    a. What do the sensor values look like from this IR sensor?

b. At what distance can we get those values?

c. How many sensor would need in a 36inch stair to capture movement from a person walking up the stairs?

   i. This assumes that we are making 12inch modules with three modules going on a 39inch wide stair so the body of modules that house the lights is 36 inches by 1 inch wide.

7. Move to Arduino Results

a. **Quick Board Wire Up**- Complete

b. **IrReceiver Data Sheet**- tsop4838 (Link)

   i. **Search Results on Spark Fun**: tsop4838 (link)

c. **Code We Wrote**: 4. PhotoResistorTest2_v_2

d. **Hand Rail Guys Code**: (Ben 25/handrail) Look at that handrail code to see if he had good stuff in there about the ir sensor components and how we should call them out in the code.

   i. **Results**: We didn't find anything too remarkable or helpful there.

e. **IR Remote Examples We Found:**

   i. Arduino – Control LEDs with IR Remote Control (LINK)

   ii. Control LEDs ON/OFF with IR Remote and Arduino (LINK)

f. **We Worked With Second Ex "Control LEDs…"**

   i. **Library It Requires: (**Link**)**

   ii. **Result:** Library Had Some Errors When We Installed It

   iii. **How To Install Libraries Arduino:** N'case you want it (Link)

g. **Result:** At the moment we don't have the code or the basic components we have doing anything at all remarkable. The sensor values we were getting don't seem valid or real. We might be writing totally the wrong code with the wrong library. We need to get this checked and have some help. For now I am moving over to reviewing components for the whole system and purchasing, as I haven't finished that yet.

8. Images From Work Session 2

a. Photos: (LINK)

9. What is a Mux?:

a. **Definition:** (Link)

A multiplexer (MUX) is a device allowing one or more low-speed analog or digital input signals to be selected, combined and transmitted at a higher speed on a single shared medium or within a single shared device. Thus, several signals may share a single device or transmission conductor such as a copper wire or fiber optic cable. A MUX functions as a multiple-input, single-output switch.

In telecommunications the combined signals, analog or digital, are considered a single-output higher-speed signal transmitted on several communication channels by a particular multiplex method or technique. With two input signals and one output signal, the device is referred to as a 2-to-1 multiplexer; with four input signals it is a 4-to-1 multiplexer; etc.

b. **Example:** (Link)

c. **Spark Fun Part Kailen Found:** (Link)

10. **IR Communication Tutorials & Info:**

a. **Spark Fun Good Break Down:** (Link)

b. **How Do Infrared Receivers Work?** (Link)

c. **Why does this IR receiver not receiving some signals?** (Link)

d. **Arduino Infrared (IR) Remote:** (Link)

e. **Arduino Infrared Remote tutorial ****:** (Link)

If we can't do anything this Monday this might be worth doing. I think I have the parts.

---Stage Three---

***This is being written 11/6/16 at the conclusion of the project for final documentation purposes.

Final Stages of the Work:

1. **We Wired Up the Two Bread Boards:** with a 6 5mm infrared Led's and 6 Infrared Photo transistors
2. **Then We Wired Up The DotStar Led Lights and Got Them Working**

3. **We Downloaded The NeoPixel Code Library and Started Looking At Bunch of Examples for that:** Turns out that was the wrong library all together as we were not even working with neo pixels we were working with Dot Star Led's and that required another library all together.
4. **The Correct Library For Dot Star Is:** (Link)
5. **You Might Ask What is The Difference Between DotStar and NeoPixels:** (Link)
6. **So What Was the Final Code You Wrote?:** (Link)
7. **What Does That Code Actually do?:**
    a. Light up IR Led's
    b. Infrared Photo Transistors Reading Ir Light
    c. Console Printing Light Values
    d. If statement looking for A0 value above or below 21
    e. That A0 Statement is running the light or turning it off in its basic cycle
8. **Can you show me some images of the final product?:**
    a. Yeah sure but they aren't cleaned up yet
        i. **Link to Final Product Shots**
9. **Work Process Images:** (Link)
10. **Prototype Video Working: (Link)**
11. **Is there anything special about dotstar libraries?**
    a. Yeah they *aren't neo pixel libraries* and trying to force neopixel stuff into making them work is a total crap shoot.
    b. Working with them is a slight pain in the ass, but they are definitely better.
    c. You can try and get the FastLed Library installed and tweak it, but I wasn't able to get any of that to work
    d. Also this is cool: (http://www.tweaking4all.com/hardware/arduino/adruino-led-strip-effects/#running_lights)
        i. Totally couldn't get it to work
    e. I recommend you use the strand test code from the AdaFruit DotStar Examples and manipulate the code in there consistently compiling it to make sure it isn't broken
    f. Here is this nice PDF documentation Sheet Good Luck: (Link)
12. **If I were to continue working on this I would like to:**

a. Build out enough components to make 10 full stairs
b. Get a solid pricing structure if were to mfg decent quanities
c. Test lowering the number of lights in the strand I am using to get the price per unit down
d. Rework the component geometry to hold the connector plugs easily
e. Rework the component geometry to hold the led strip
f. Rework the component geometry to hold the ir Led's and Phototransistors
g. Come up with a clean wiring scheme for each individual component
h. Figure out 1D position on human location on 10 components and burst out water circles from each foot position like someone is walking on water.

13. Conclusions:

a. I don't really feel like we have gone deep enough with this project. I just barely got it working even though we accomplished a lot.
b. Pushing the animations with the light and playing with the sensors ability to capture motion are big, but the playing part is yet to happen and that is were all the magic is.
c. This project requires more magic.
d. Connecting a mobile app that can change the lights is huge to making this really cool as well.