

ASHLEY WHITEHEAD

DIEGO ROMERO

# INNER LIGHT

PRESENTED BY BRENDAN LANE, ANDREW TSO, CHRISTIE WONG, AND KEN CALDER



**IAT 320 FINAL PROJECT DOCUMENTATION**

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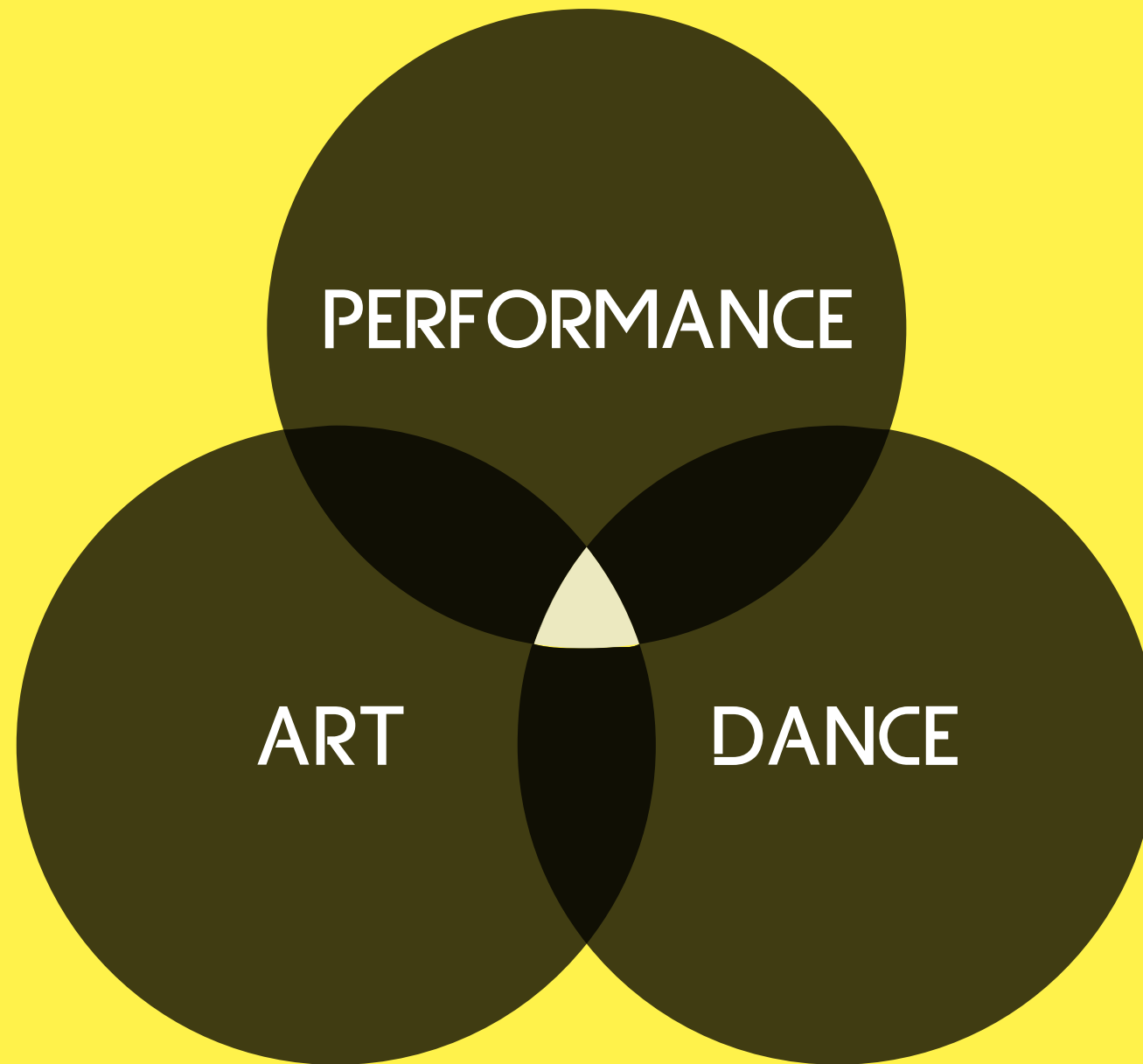
FINAL ARTIFACT





# PROJECT DESCRIPTION

Inner Light is a modern dance performance for two performers that chronicles the emotional journey of two people missing their other halves as they physically and socially interact with each other, explore their differences through contact and movement, and then find harmony with one another.



# PROJECT CHANGES

CONCEPT	EMOTIONAL JOURNEY OF ONE LONELY MAN	EMOTIONAL JOURNEY OF TWO PEOPLE MISSING THEIR OTHER HALVES	
INTERACTION	LEDS ON THE OUTFIT(S) WILL LIGHT UP BASED UPON THE DANCERS' PHYSICAL CONTACT WITH ONE ANOTHER		
TECHNOLOGY	EL WIRE EL SHIELD 1 ARDUINO LILYPAD	6 RGB ADDRESSABLE LEDES 2 ARDUINO LILYPADS 2 3.7 LITHIUM ION BATTERIES	
SENSORS	FORCE SENSORS	CONDUCTIVE FABRIC	6 FORCE SENSORS
TEXTILES	CONDUCTIVE THREAD, REGULAR THREAD, DANCE SUITS		
SETTING	BLACK BOX	GREEN SCREEN ROOM & STUDIO A	
LIGHTING	NONE	SHORT THROW PROJECTOR	SPOTLIGHTS
	IDEATION	PROTOTYPE	FINAL



# JOURNEY MAP



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graph LR; A[DISCOVERY] --> B[IDEATION]; B --> C[PROTOTYPE]; C --> D[FINAL]
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DISCOVERY

IDEATION

PROTOTYPE

FINAL

# DISCOVERY

Our group, during the discovery phase, discovered that we were strong conceptually and that we were interested in the poetic and creative aspects of body interface. We began to explore concepts for our project in this stage and felt that topics such as love, emotion, and reality allowed us to explore a more artistic side of body interface.





# ART/PERFORMANCE/DANCE

Due to our artistic and conceptual capabilities, we chose the art/performance/dance stream because we felt it afforded us a great amount of creative freedom to explore our areas of interest in art, music, and dance. Below are some of the areas within art, performance and dance that we initially considered.





# IDEATION

Within our ideation phase, we began to ideate key concepts for our project and sought to marry those with some of the specific areas of art/performance/dance to create a definitive project idea.

EXPLORATION OF PROJECT CONCEPTS

IDEATION SKETCHES

IDEATION CONCEPT

USER EXPERIENCE

SETTING

SKETCHES

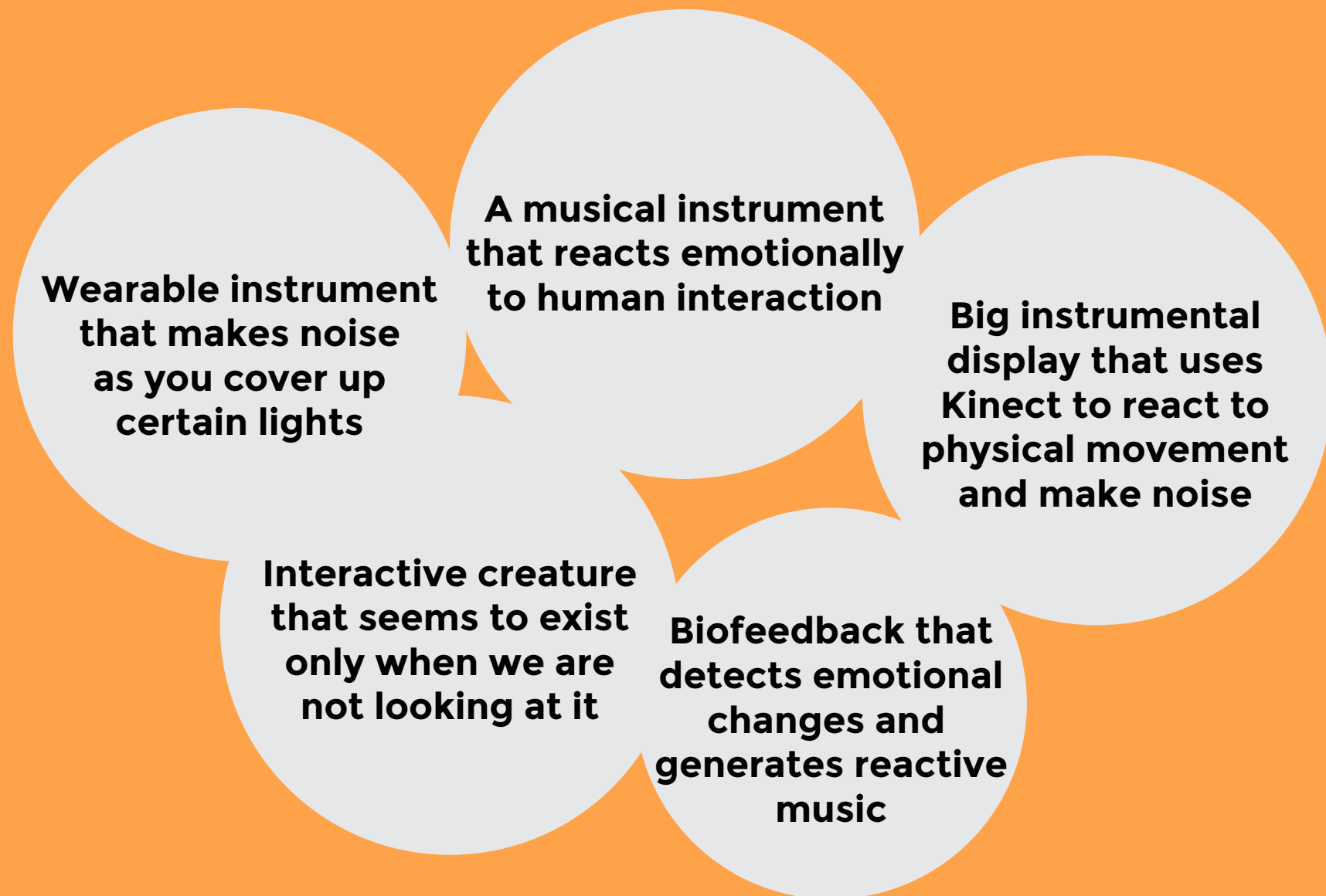
NECESSARY EQUIPMENT + SKILLS

KEY QUESTIONS



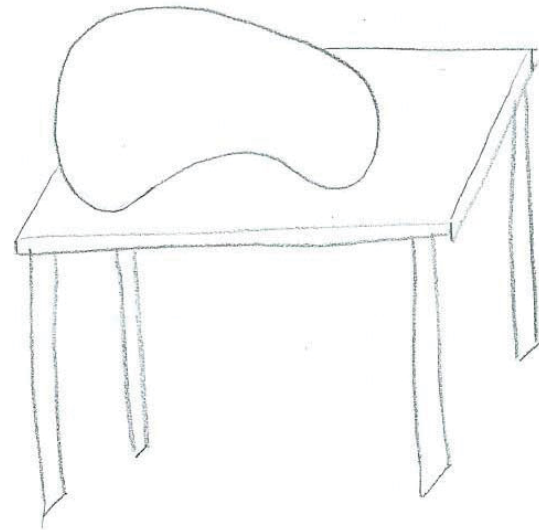
# EXPLORATION OF PROJECT CONCEPTS

After deciding on the key themes of emotion and reality, we began to develop project ideas based on those concepts. Below are some of the concepts we initially considered.

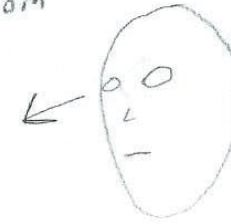
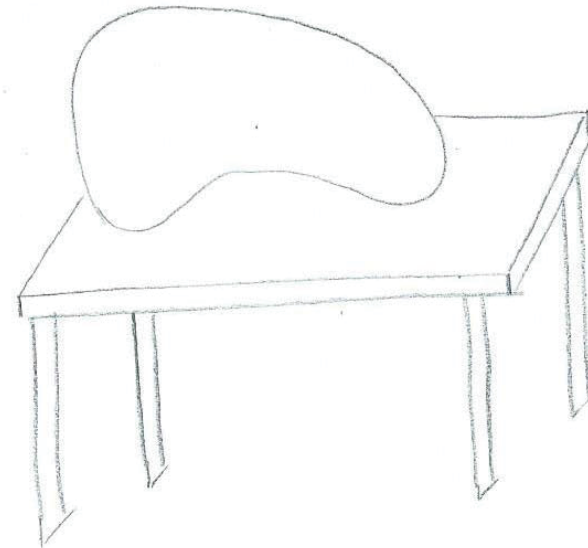


# IDEATION SKETCHES

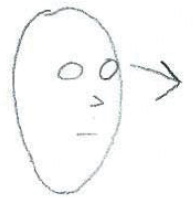
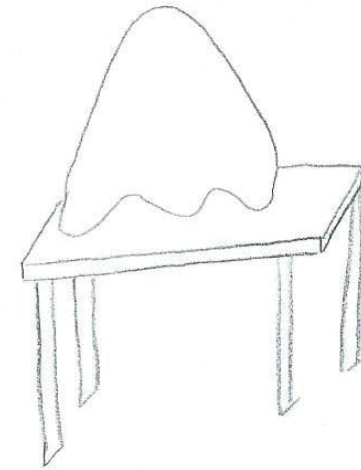
Object that can change into many shapes



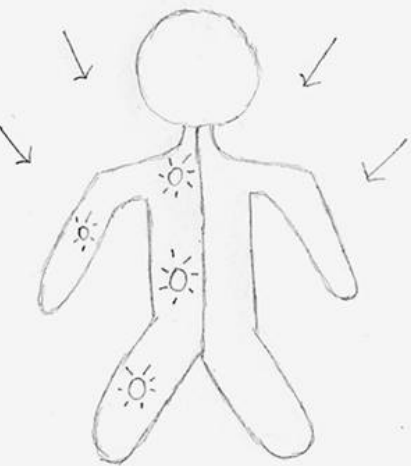
Doesn't change when it detects people in the room



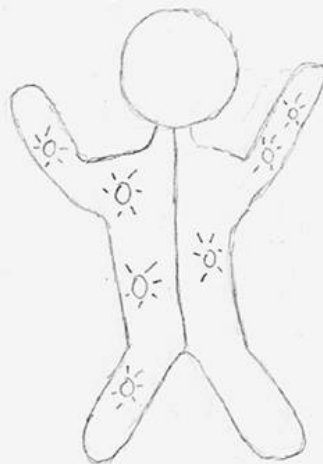
changes slightly when no one is looking



LEDs on half the suit light up based on the changing environment



Participant tries to duplicate output with gestures



The environment is constantly changing. Output cannot be duplicated



when petted makes pleasant music



when treated badly makes noises and screams



when not played with plays sad drones





# IDEATION CONCEPT

Our initial concept for Inner Light was an explorative, modern dance performance for two performers that chronicles the emotional journey of one lonely man as he physically and socially interacts with someone else for the very first time.



DISCOVERY IDEATION PROTOTYPE FINAL

# EXPERIENCE

The primary users are the dancers - one of the dancers will be contacting the other, and the physical contact in different areas will cause the other dancer's suit to light up in various ways depending on the area and duration of contact.

The dancers also provide a kinesthetic and visually interesting performance to the audience, our second 'users'. We want to create an emotional and intimate experience for the audience, one that is unique and visually stimulating.

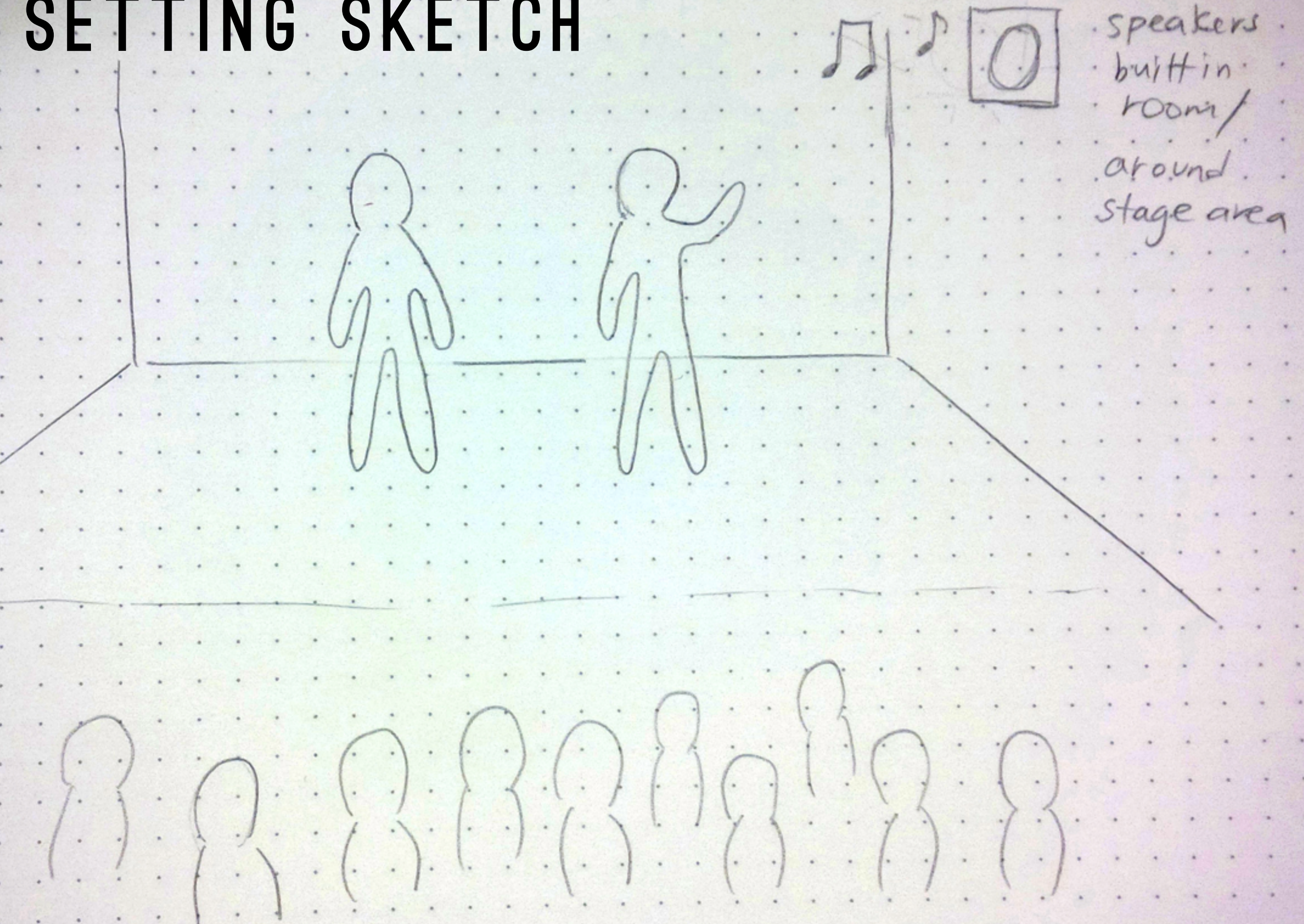


# INITIAL SETTING

Originally, the performance was to take place in SFU's Black Box, a small dark room. The room is equipped with a dance floor and controllable ambient lighting, allowing us to set the stage. The small size helps us to capture an intimate setting, and speakers allow us to play ambient music in the background. Because the room is dark, both performers will wear lit bodysuits to communicate to each other and to the audience. The performance will be under ten minutes long to avoid losing the audience's attention.



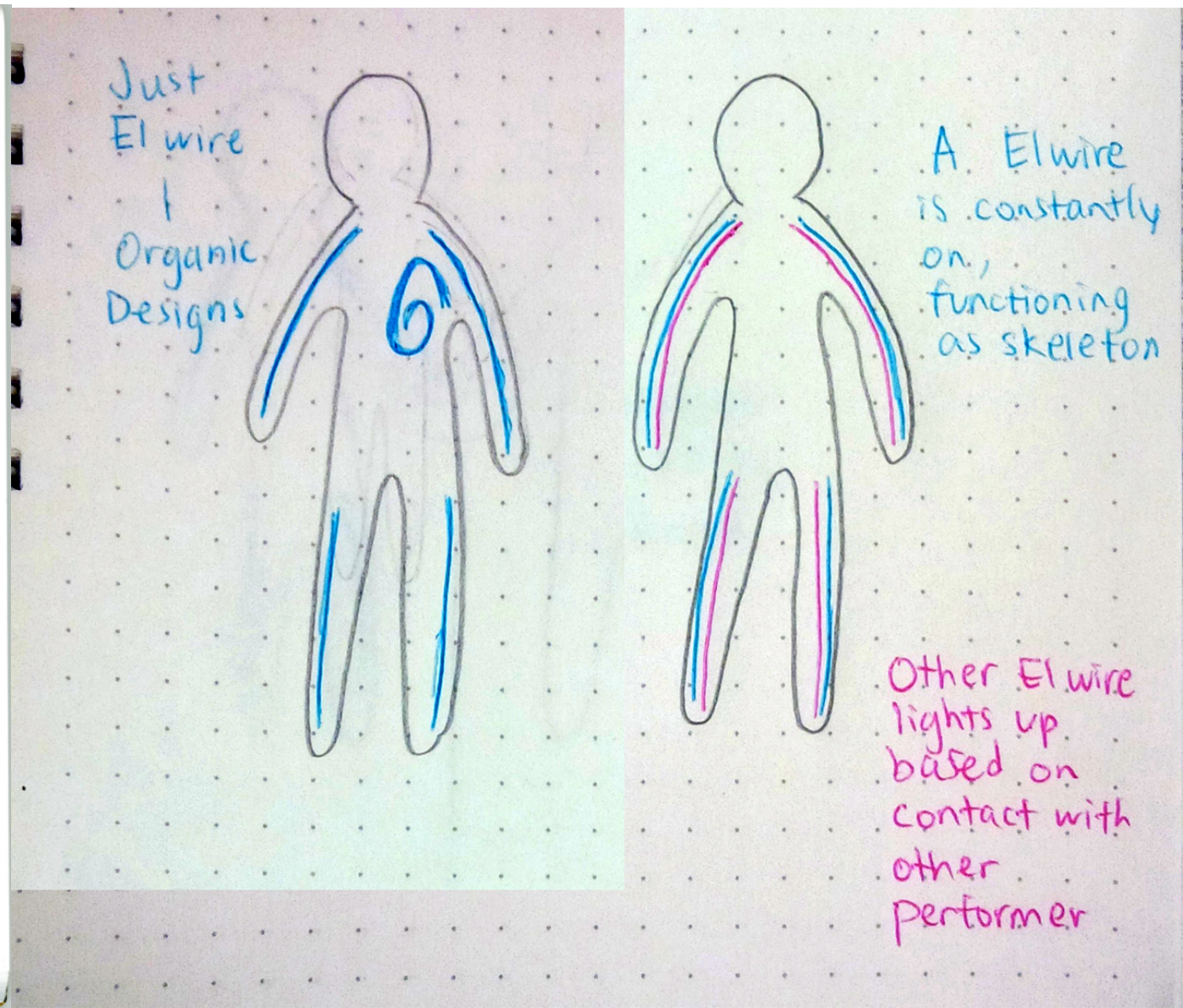
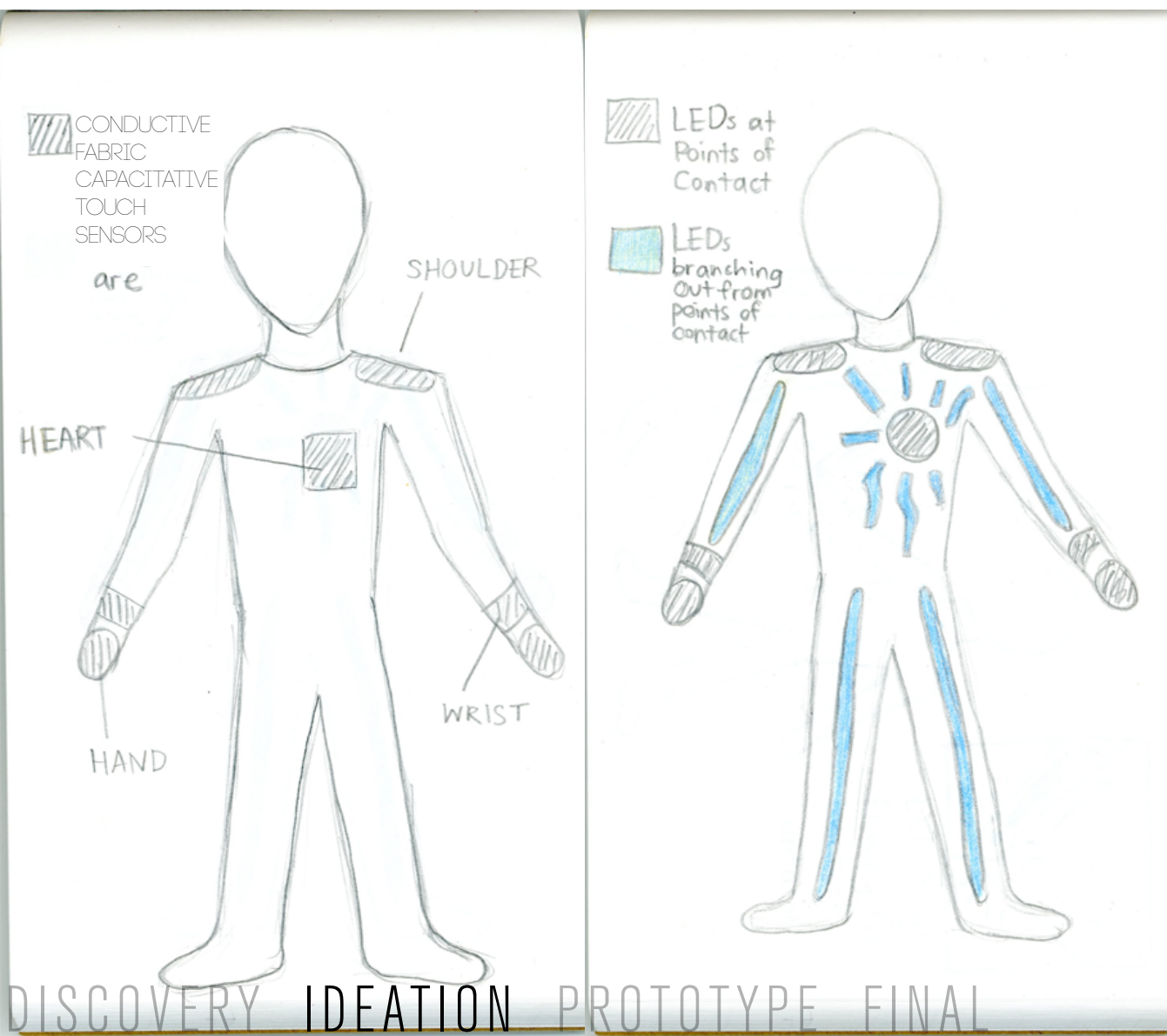
# SETTING SKETCH





# INITIAL SKETCHES

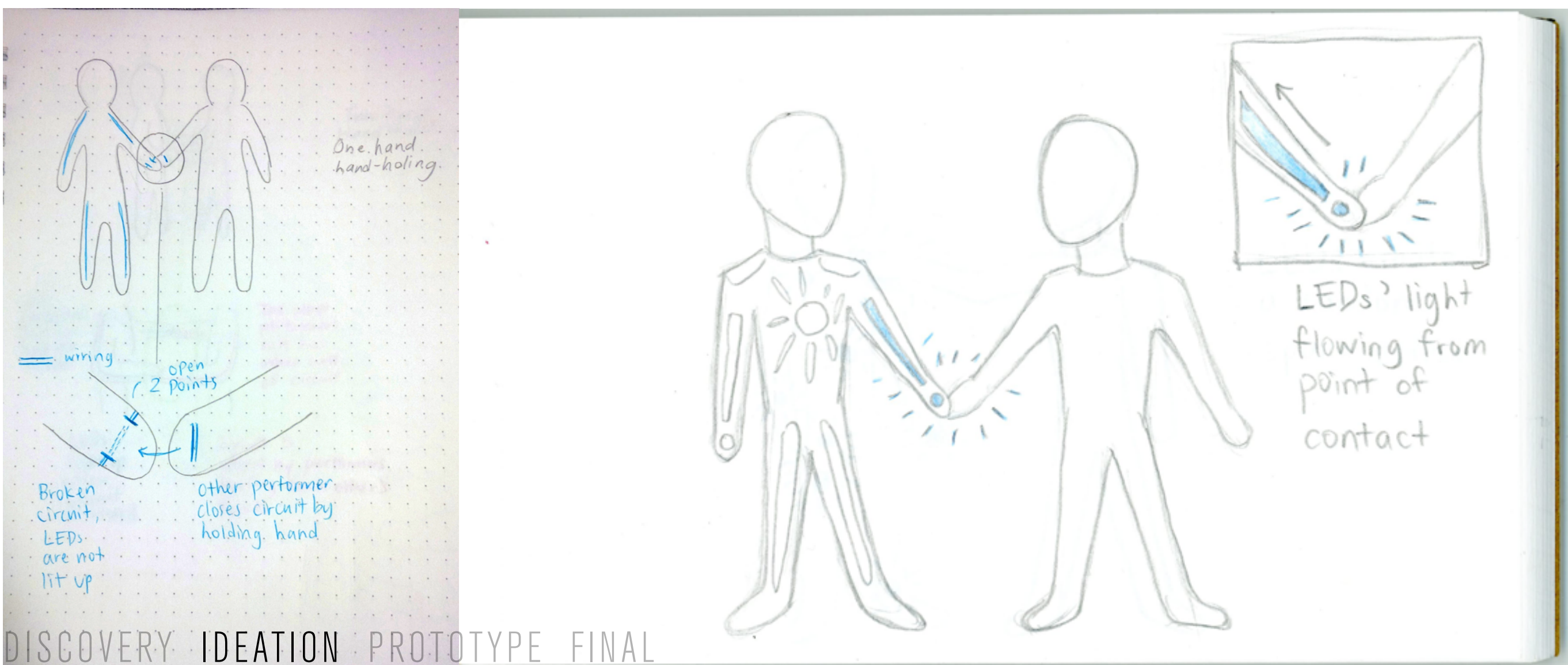
In our initial sketches, one dancer would touch various points on the lonely dancer's body to introduce them to physical contact. By altering the duration and location of touch, the other dancer would cause the light on the lonely dancer's body to alter in various ways, representing changes in his emotional state. The lonely dancer wears a bodysuit covered in segments of coloured el-wire. Some of this wire is always on to display their body form, but other segments light up in response to them being touched by the other dancer.





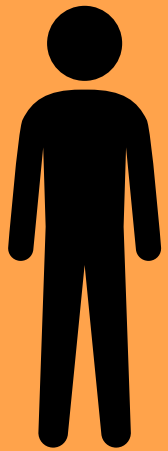
# INITIAL SKETCHES

The touch points will involve either two pieces of conductive fabric at the ends of a broken circuit, or a conductive fabric capacitive touch sensor. The sensors are activated when the second dancer touches specific touch points on the first dancer's body. When the touch point is activated, the segment of el-wire closest to that touch point is lit up, and the other segments of el-wire also flicker to simulate a wave of emotion radiating from the point of contact.

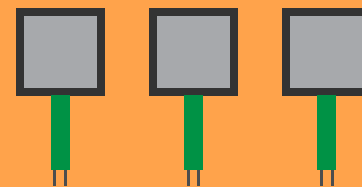


# EQUIPMENT

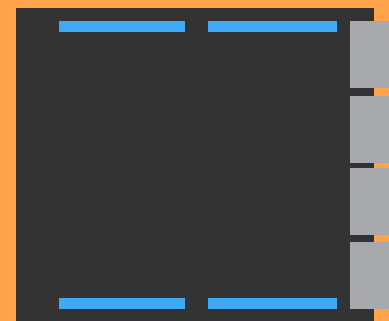
The original design for our suit contained force sensors at each of the touch points to detect touch and pressure. Light was emitted by coloured el-wire. Wiring will be done with conductive thread to ensure ease of movement, and the system will be controlled by an Arduino microcontroller in conjunction with Max/MSP or Processing.



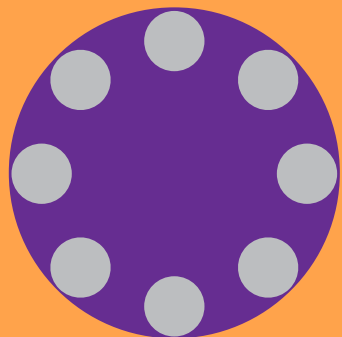
**DANCE SUIT**



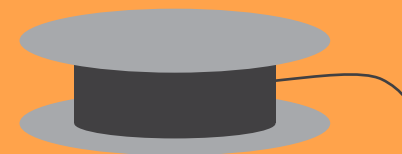
**FORCE SENSITIVE RESISTORS**



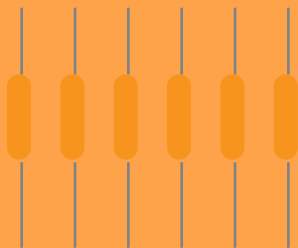
**EL-SHIELD**



**LILYPAD ARDUINO**



**CONDUCTIVE THREAD**



**RESISTORS**



**EL-WIRE**



# NECESSARY SKILLS

We will need to improve our Arduino coding skills and learn how to use Max/MSP, as well as develop skills in textiles, sewing, and circuitry in a wearable form. We will lastly need to gain insight from real dancers and study their movement as we seek to make the performance as poetic and believable as possible.

**CODE** + **SEWING** + **CIRCUITRY** + **DANCE**

# KEY QUESTIONS

We must consider how the light can be shown on all sides of the dancers and be visible to the audience, as they will be moving and be in contact, and we don't want the light feedback to be hidden from the audience

We must think about how to make the suit flexible for dancers - comfortable and durable

We must think about more advanced electrical concepts - how do we solder? How do we change the current or voltage of a circuit?

We must consider the fabric and materials - does conductive fabric work with a flexible bodysuit? How do we sew a flexible material? Should we use a flexible material at all?

Will the light be a fresh experience or will it prove to be a distraction for the dancers?

Will the dancers be able to see and effectively communicate with and be in contact with each other?

Will the audience understand that the light is being controlled by touch? Will this have the desired effect of inciting emotional empathy from them?

# PROTOTYPE



After developing our concept , we began to build a prototype for our dance suits while streamlining the design. We moved from el-wire to RGB LED strips, allowing us to play with flowing light. We also decided that both dancers deserved to have a reactive dance suit, as this would create a more interesting performance.

PROTOTYPE DESIGN

PROTOTYPE PROCESS

PROTOTYPE SKETCHES

INTERACTION

TECHNICAL DIAGRAM

TECHNOLOGY

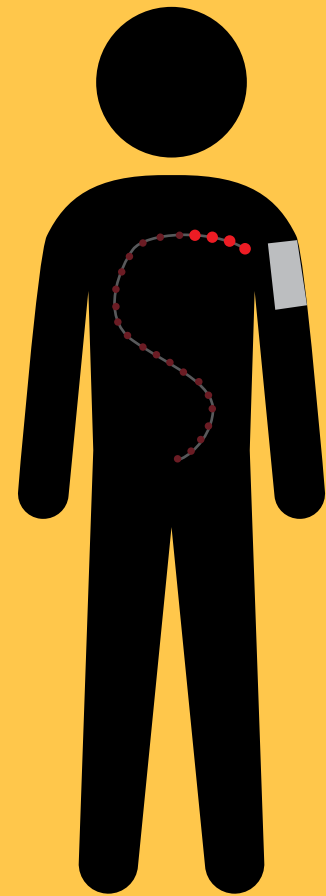
EXPERIENCE DIAGRAM

EQUIPMENT + SETTING

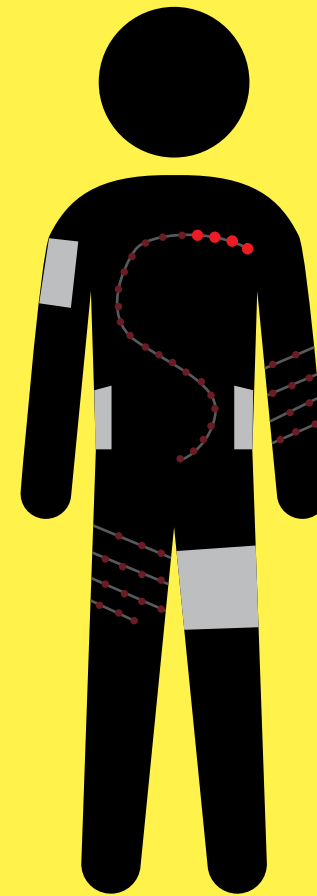


# PROTOTYPE DESIGN

Our final artifact was to contain two dance suits and many sensors and lights, but our prototype was a single shirt using a single sensor to activate a single light strip.

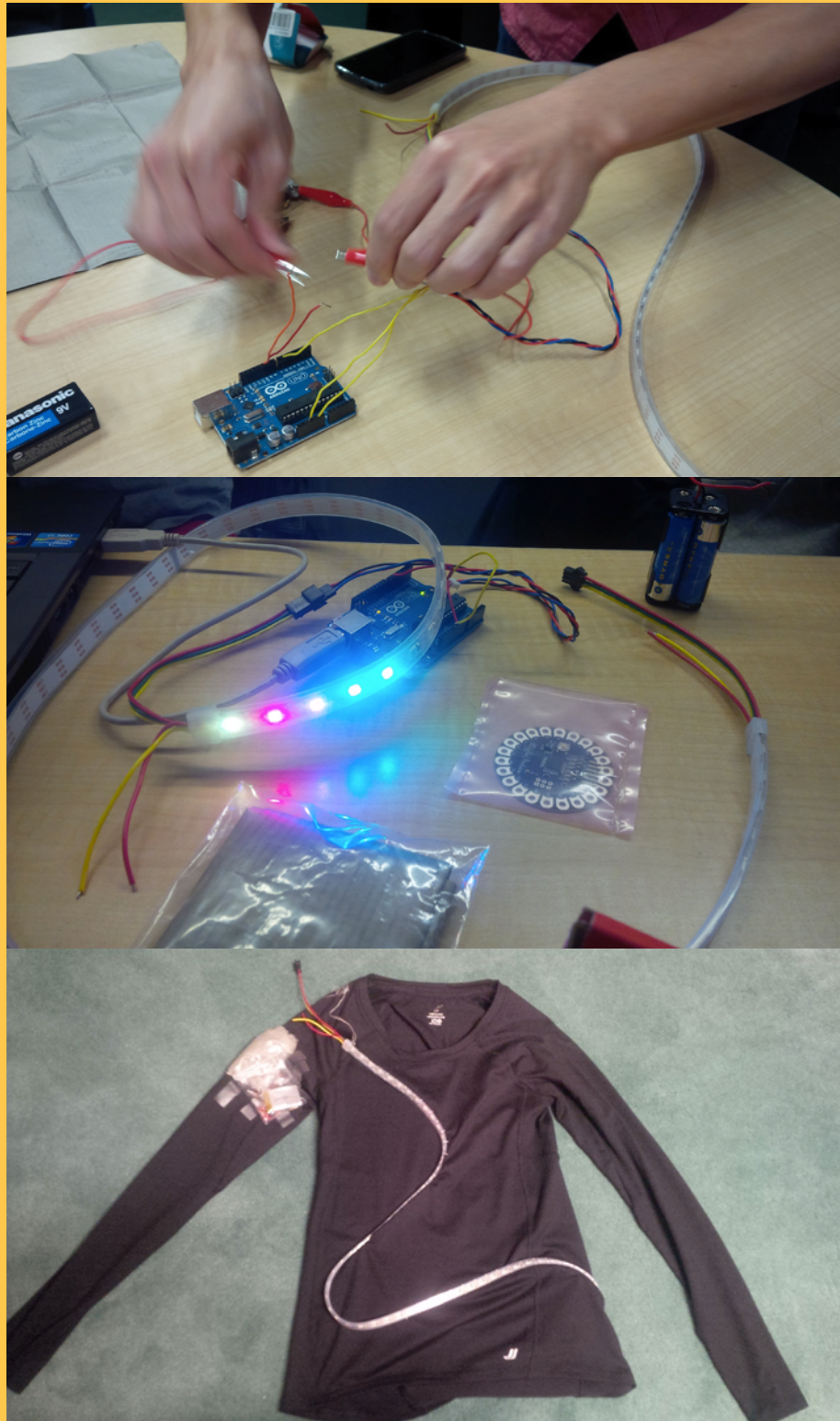


INTENDED  
PROTOTYPE



INTENDED FINAL  
PRODUCT

# PROTOTYPE PROCESS



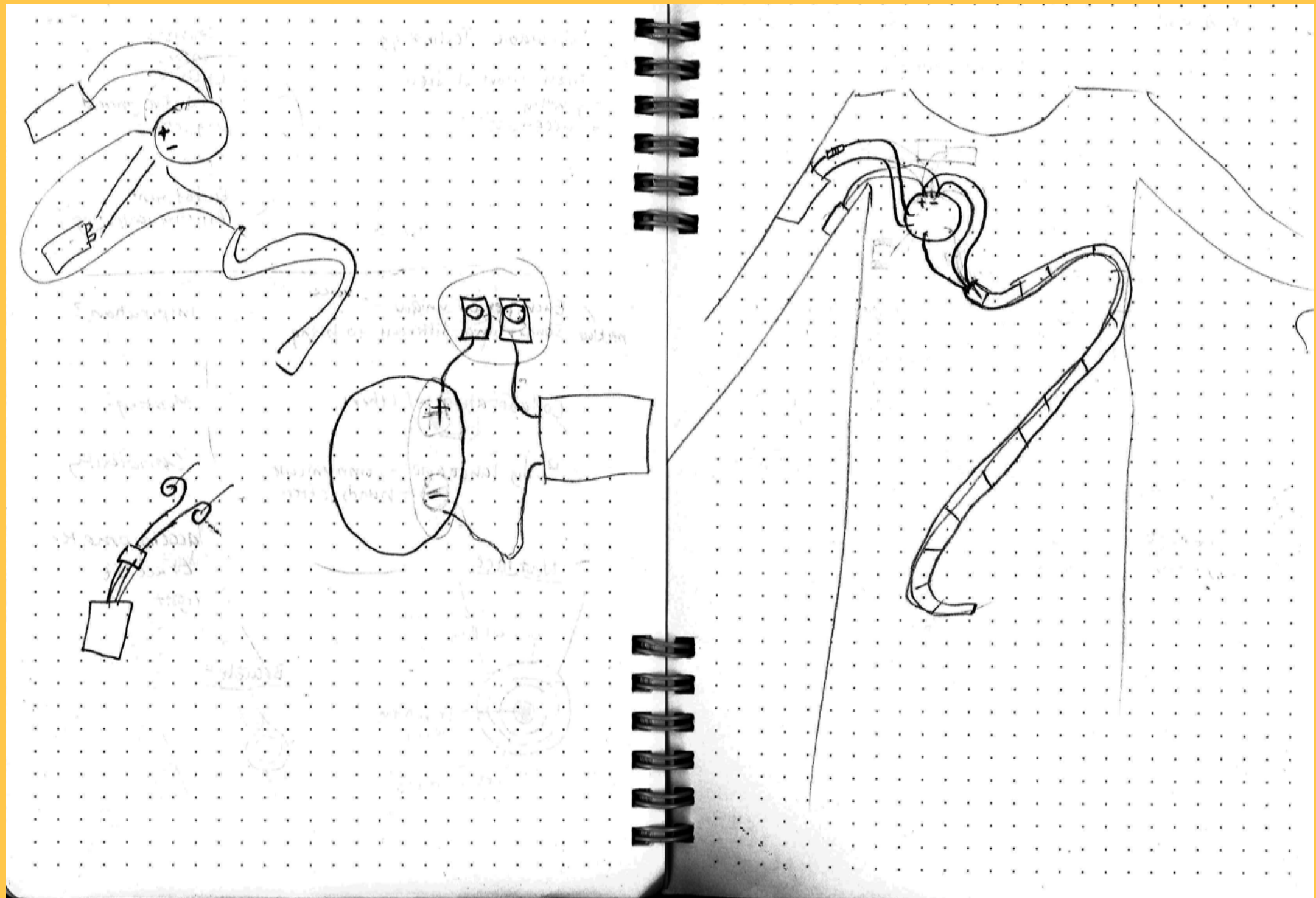
DISCOVERY IDEATION PROTOTYPE FINAL







# PROTOTYPE SKETCHES



DISCOVERY IDEATION PROTOTYPE FINAL

# INTERACTION

The touch sensor on Dancer 1's shoulder detects this touch and outputs a numerical value.

Dancer 2 makes physical contact with Dancer 1.

The RGB strip reads this value and begins to light up in a predetermined pattern.

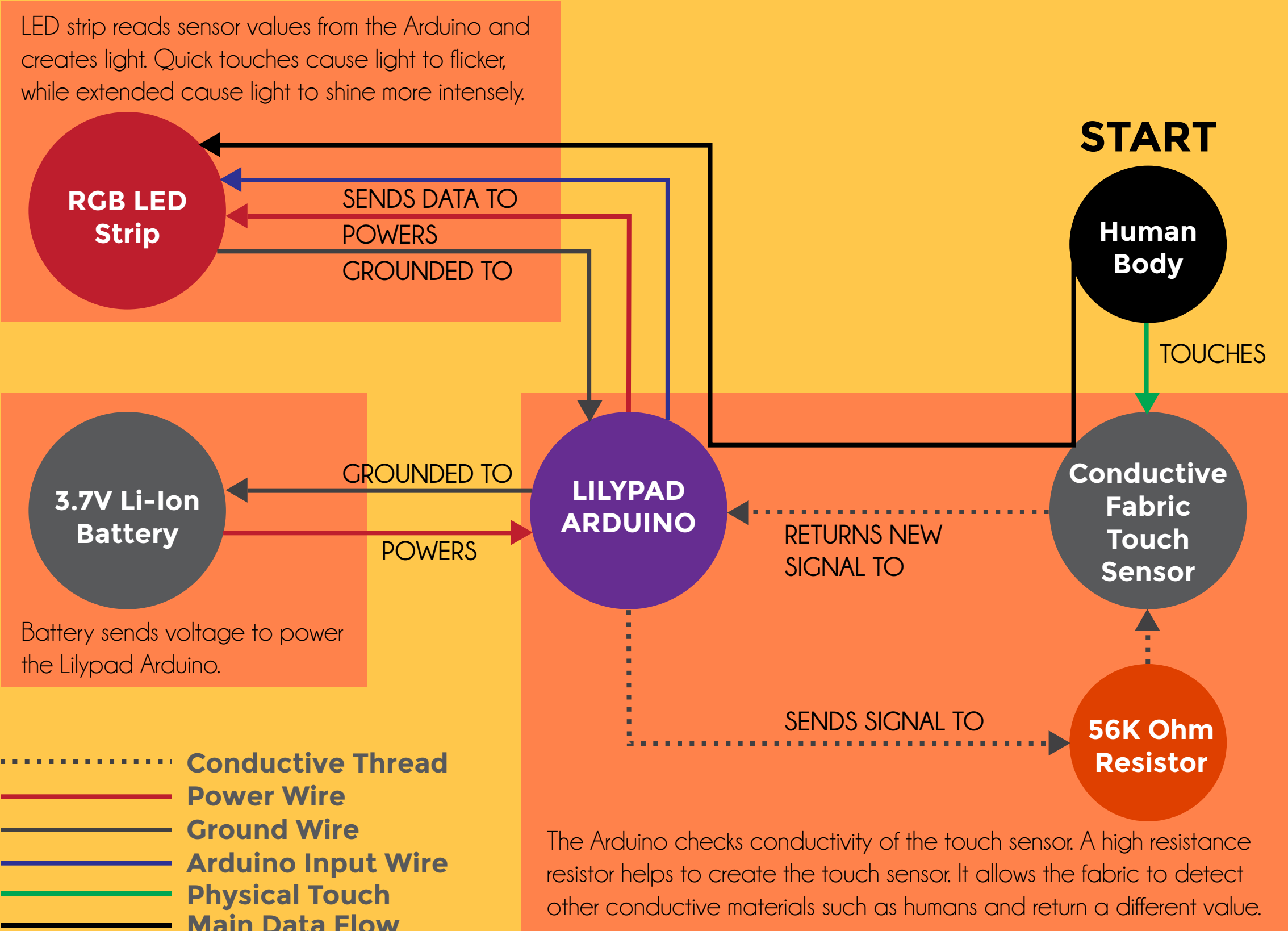
RGB strip ceases to light up if it is not physically contacted - the light is a physical sign that the dancer is being touched.

DANCER 1

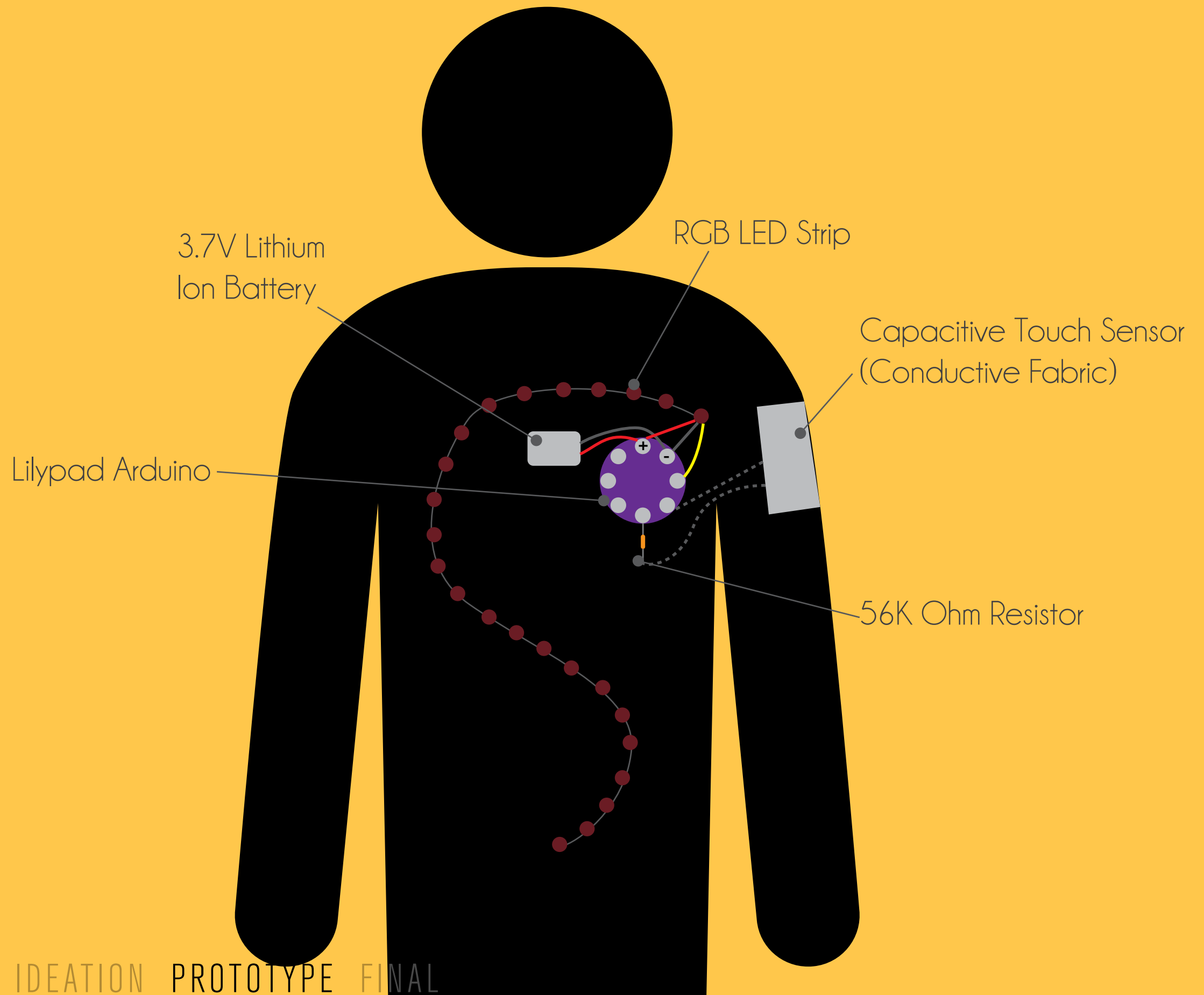
DANCER 2



# TECHNICAL DIAGRAM

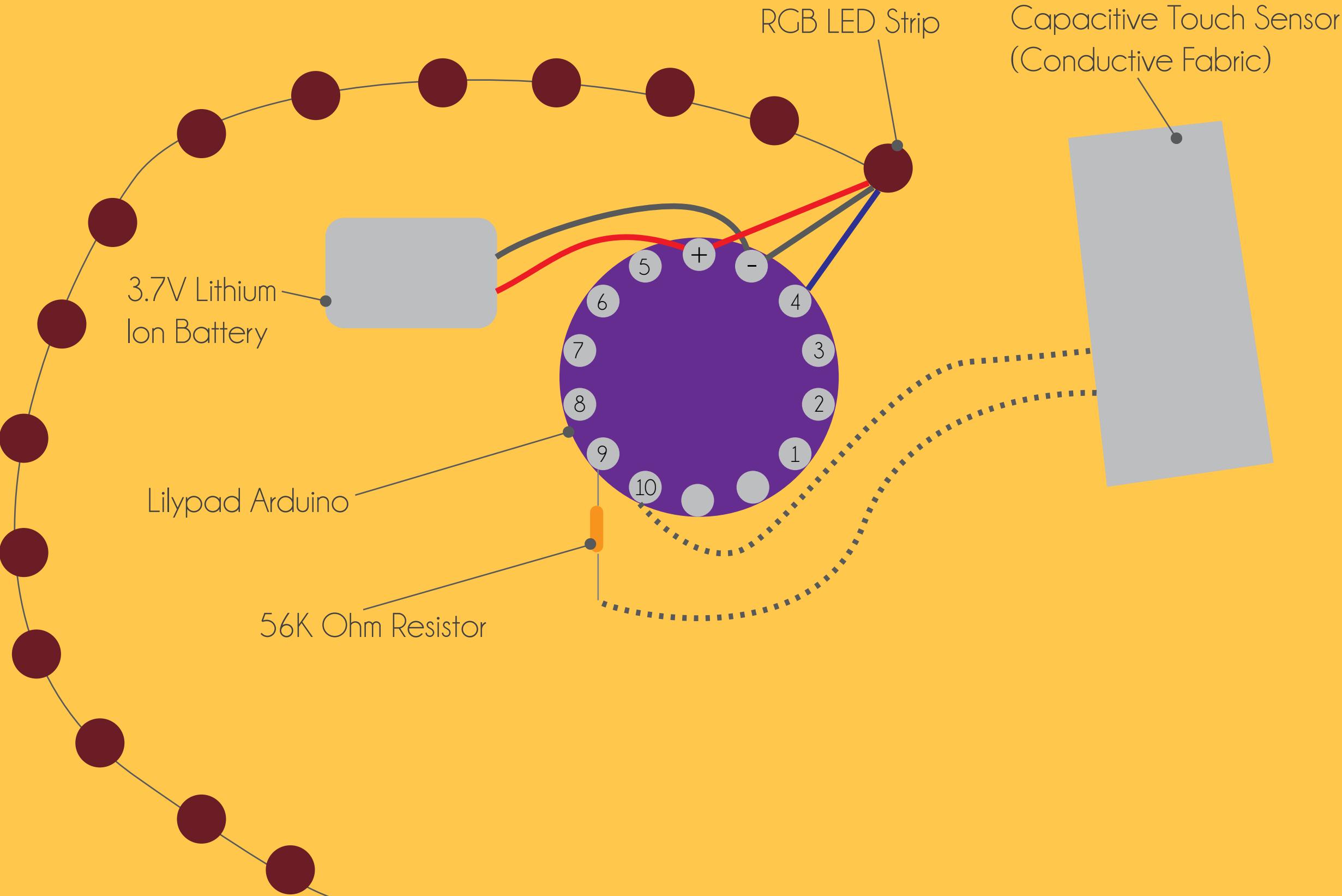


# TECHNOLOGY

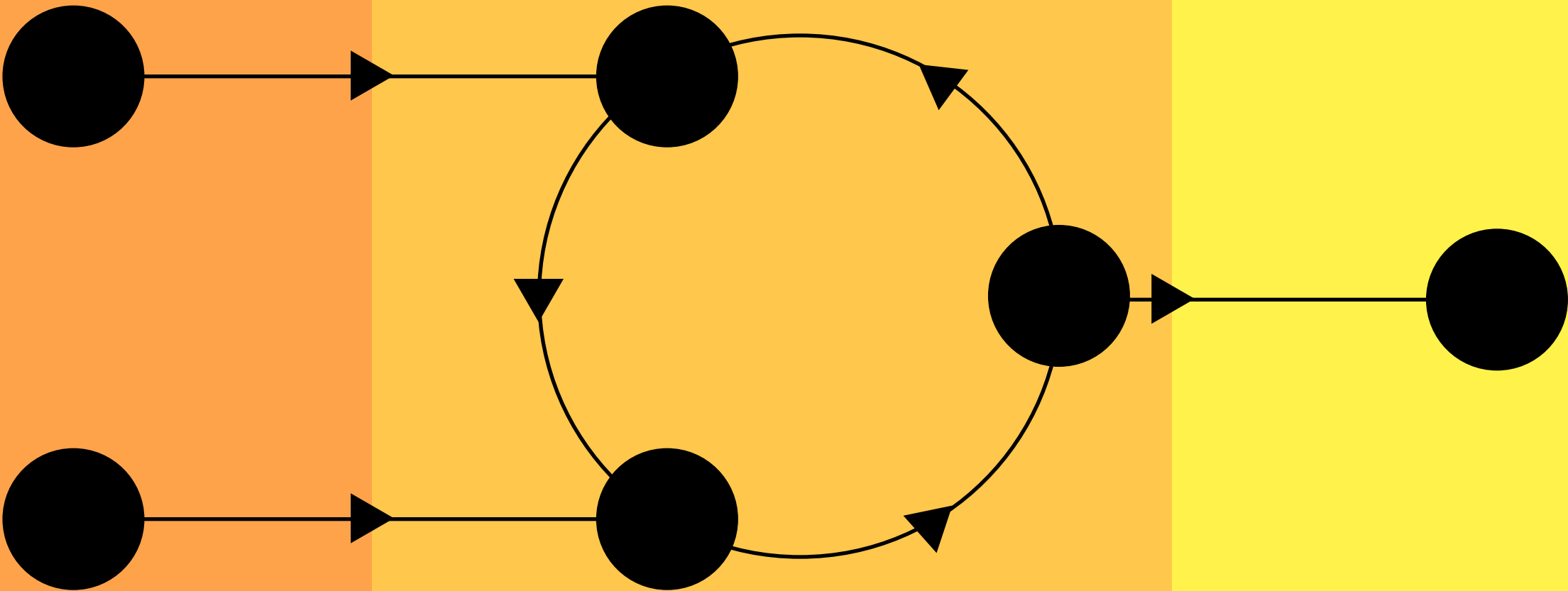




# TECHNOLOGY



# EXPERIENCE DIAGRAM



LONELINESS

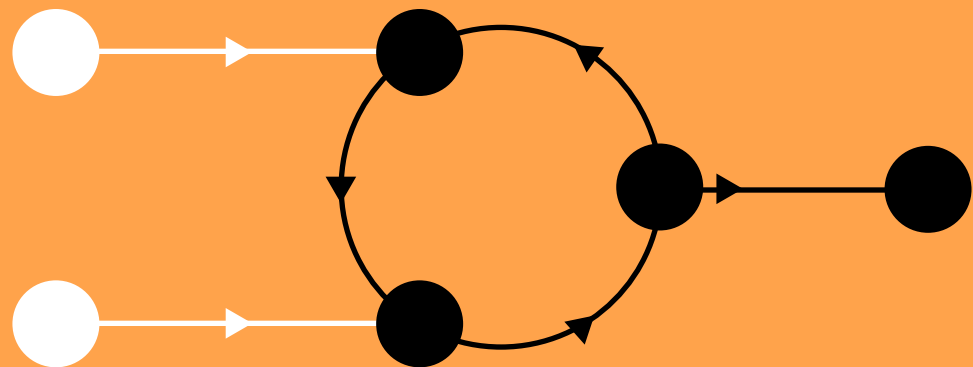
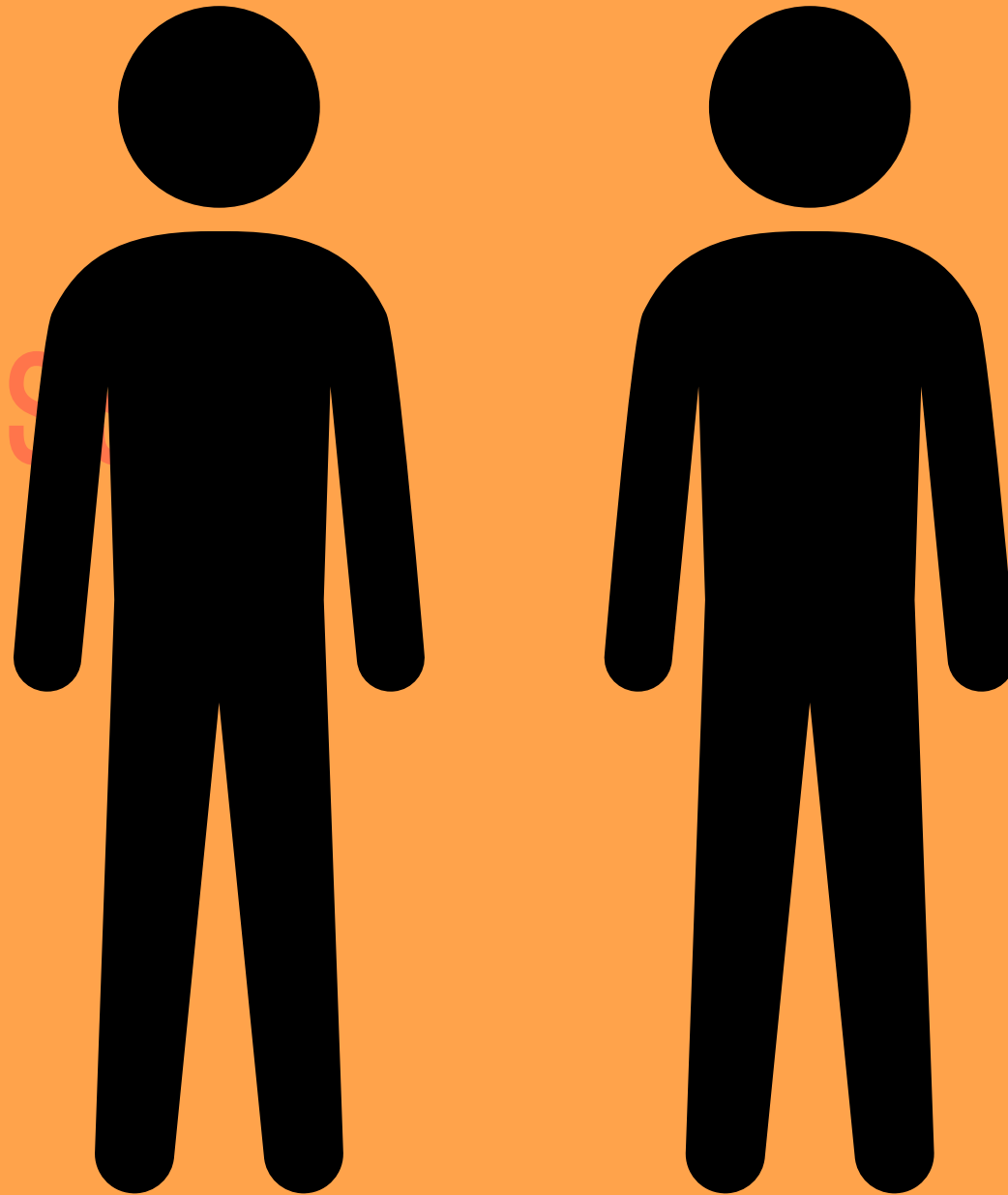
EXPLORATION

HARMONY



# LONELINESS

ISOLATION  
DARKNESS  
EMPTINESS  
NOTHINGNESS  
FEAR

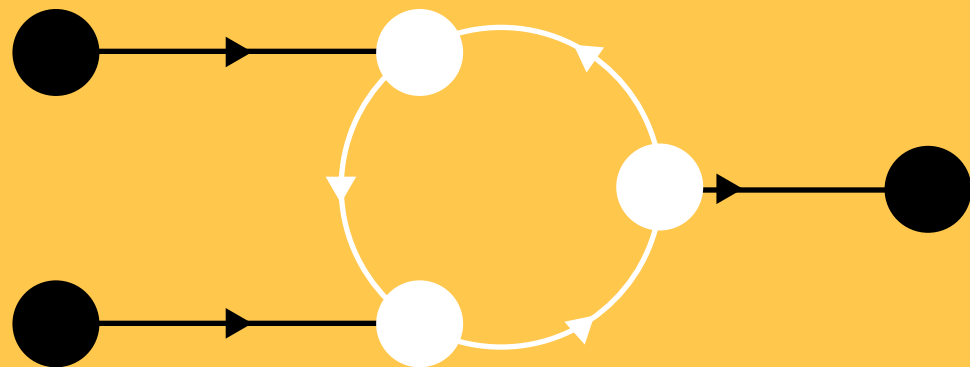
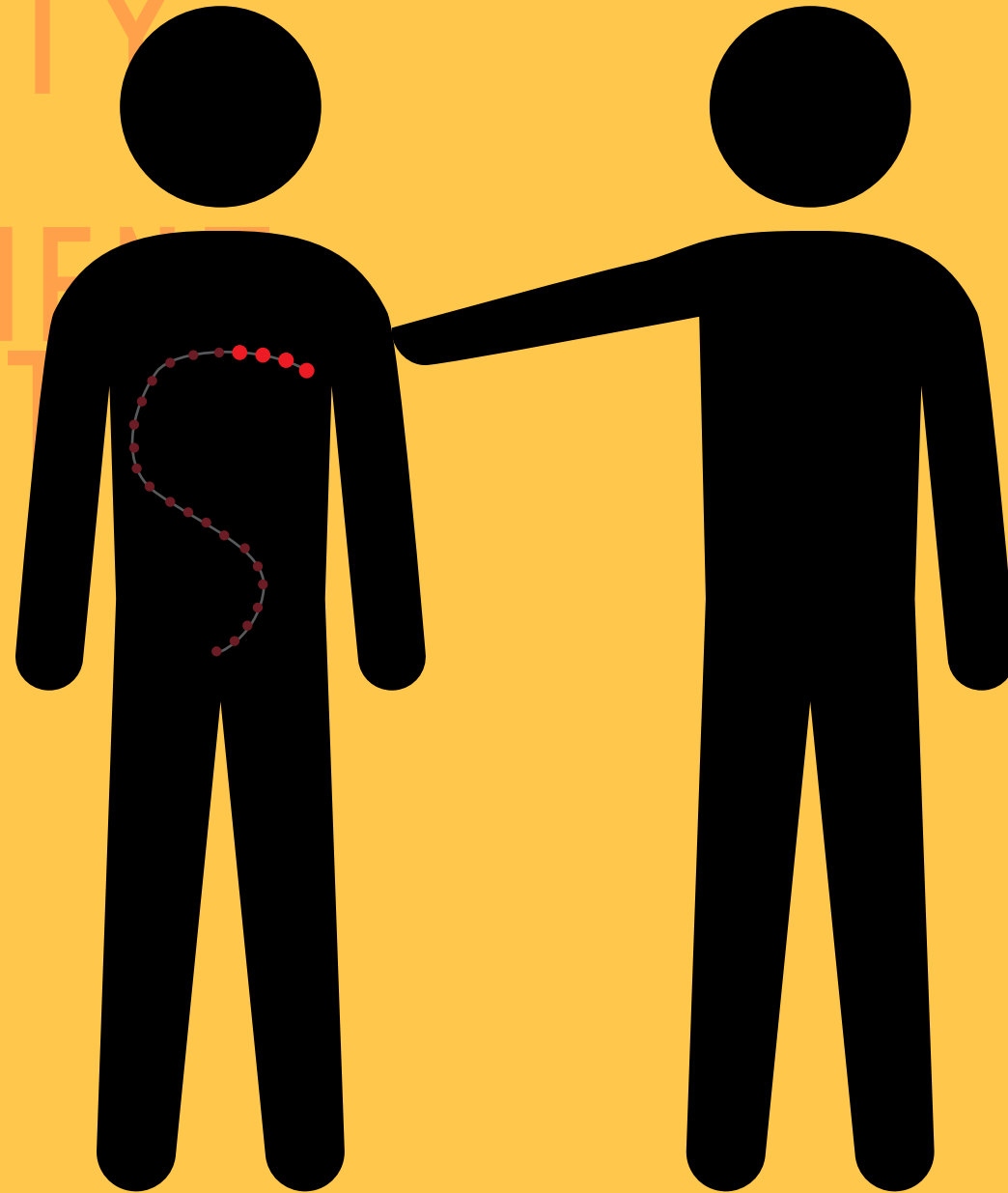


In the loneliness stage, dancers are physically separated. The room remains dark and their bodies do not light up. Both the dancers and the audience feel a sense of emptiness and isolation because of the pure darkness in the room. Slow, pensive music will cue the performance to start.

DISCOVERY IDEATION PROTOTYPE FINAL

# EXPLORATION

UNCERTAINTY  
CURIOSITY  
BEWILDERMENT  
DISCOMFORT  
GROWTH



In the exploration stage, the dancers begin to explore one another through physical contact, which in turn will light up their bodies. Dancers will feel the passion in the physicality of the dance, while the audience will be mesmerized by the lights. The music will escalate to echo these changing emotions.



# HARMONY

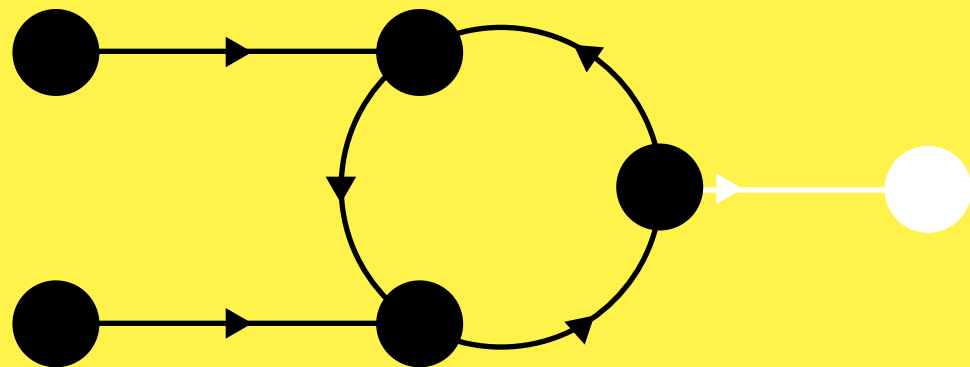
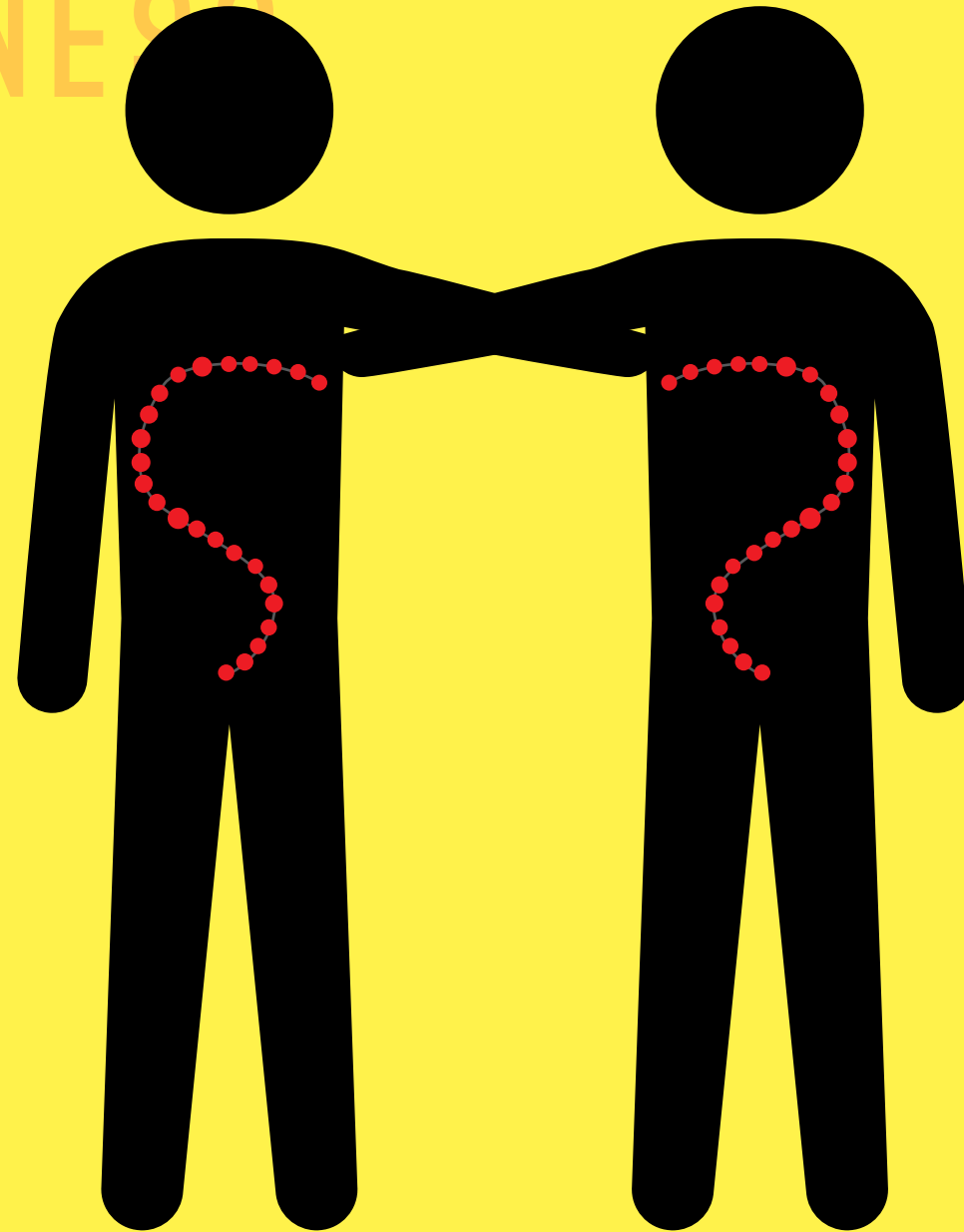
CONNECTEDNESS

ECSTASY

HAPPINESS

WARMTH

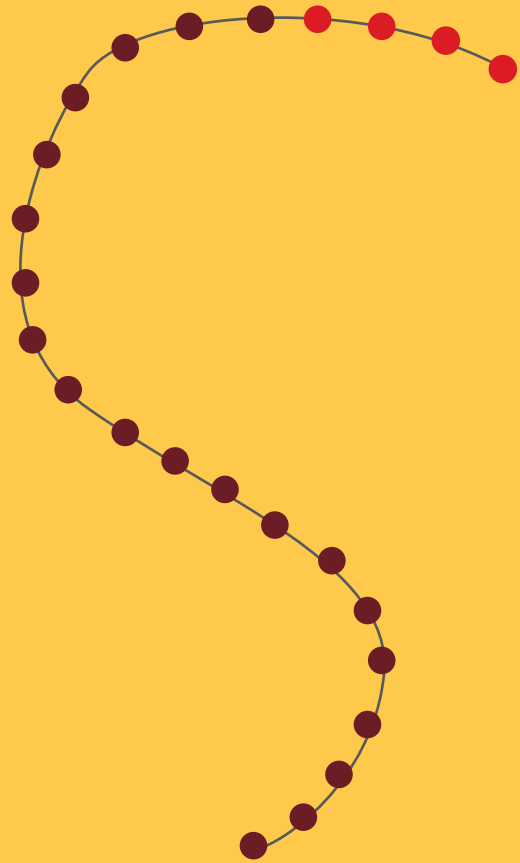
LOVE



At the end of the piece, the dancers find harmony and completeness and the lights on their bodies will glow with fierce intensity. The dancers will find warmth and joy in contact, while the audience will see and feel their love and connectedness. The music concludes to bring finality to the performance.

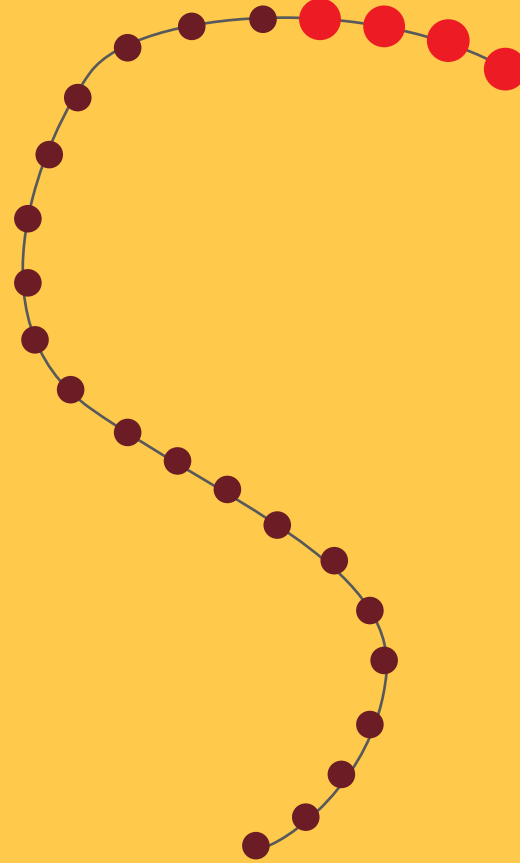
DISCOVERY IDEATION PROTOTYPE FINAL

# INTERACTION



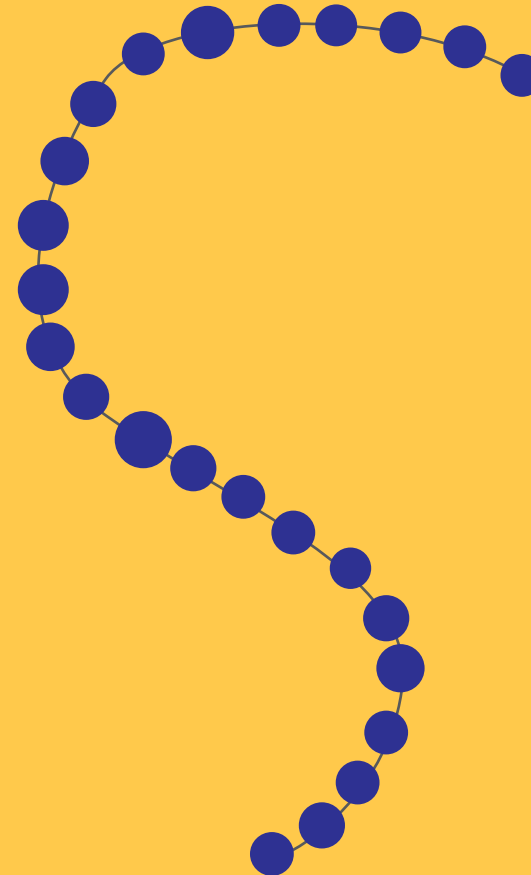
## TAP

A quick tap on a contact point will cause the lights to flicker briefly and dimly.



## HOLD

Extended contact on the contact point will cause the lights to shine more brightly and intensely.



## EARLY

Because the two dancers are lonely at the beginning of the dance, their lights will be blue to symbolize their loneliness and fear.

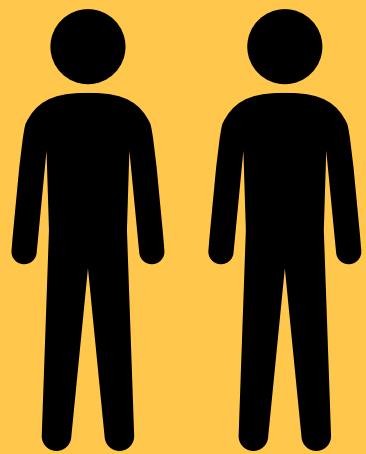


## LATE

By the end of the dance the dancers will have found harmony with each other and their lights will shine warm colours like red.



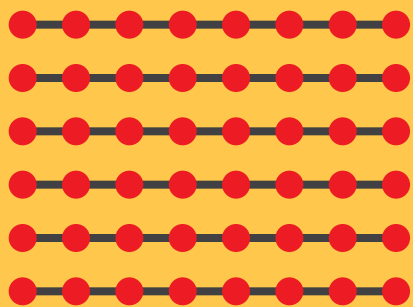
# EQUIPMENT



**2** DANCE SUITS  
(COTTON/SPANDEX)



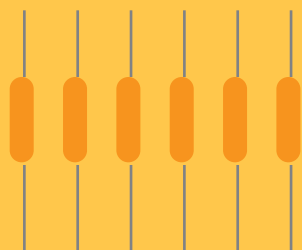
**1** SHORT THROW  
PROJECTOR



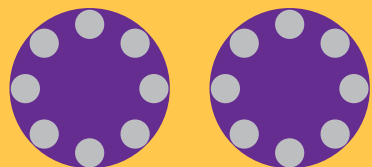
**6** RGB LED STRIPS



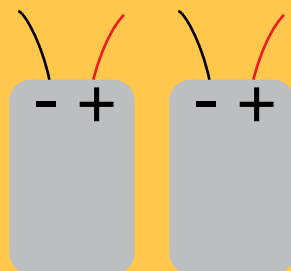
**6** PIECES OF  
CONDUCTIVE  
FABRIC



**6** 56K OHM  
RESISTORS



**2** LILYPAD  
ARDUINOS



**2** 3.7V LI-ION  
BATTERIES



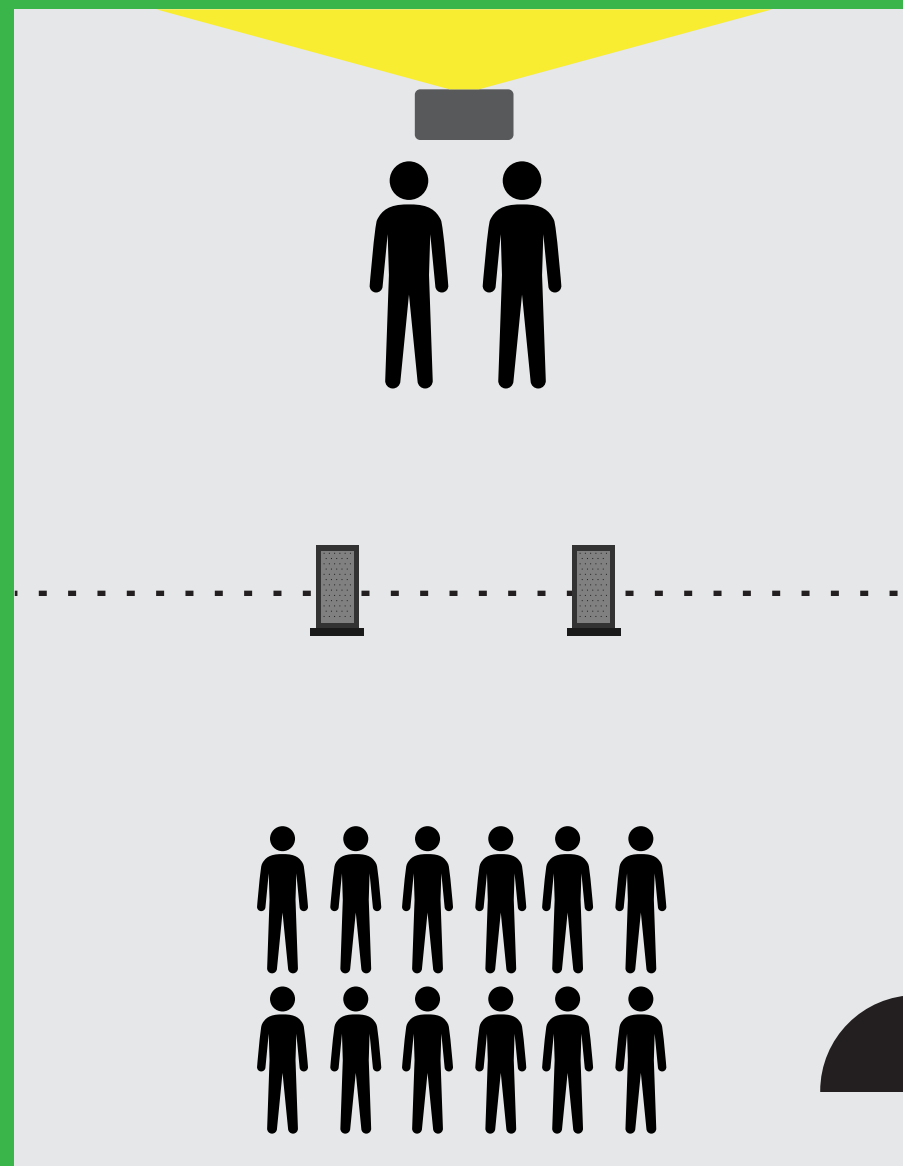
CONDUCTIVE  
THREAD



REGULAR  
THREAD

# SETTING

During the prototype phase, Inner Light takes place in SFU's green screen room. The two dancers will perform in the back half of the room, while the audience will sit and watch from other the side of the room. The lights will be turned off to create a sense of isolation in the room, but a short-throw projector mounted on the ceiling will shoot dim light against the back wall to provide enough light for the dancers to operate.



# FINAL ARTIFACT

Despite a strong foundation for our project, we began to encounter problems while building our prototype. Our conductive fabric sensors did not give us accurate data, and our poor sewing skills made working with conductive thread difficult. Our final artifact underwent numerous changes, but stays true to the original concept.

PROJECT DESCRIPTION

SKETCHES + PROCESS

EQUIPMENT + SETTING

FINAL SUIT DESIGN

CIRCUITRY + TECHNOLOGY

INTERACTION + AFFECT

CODE

PERFORMANCE + FEEDBACK



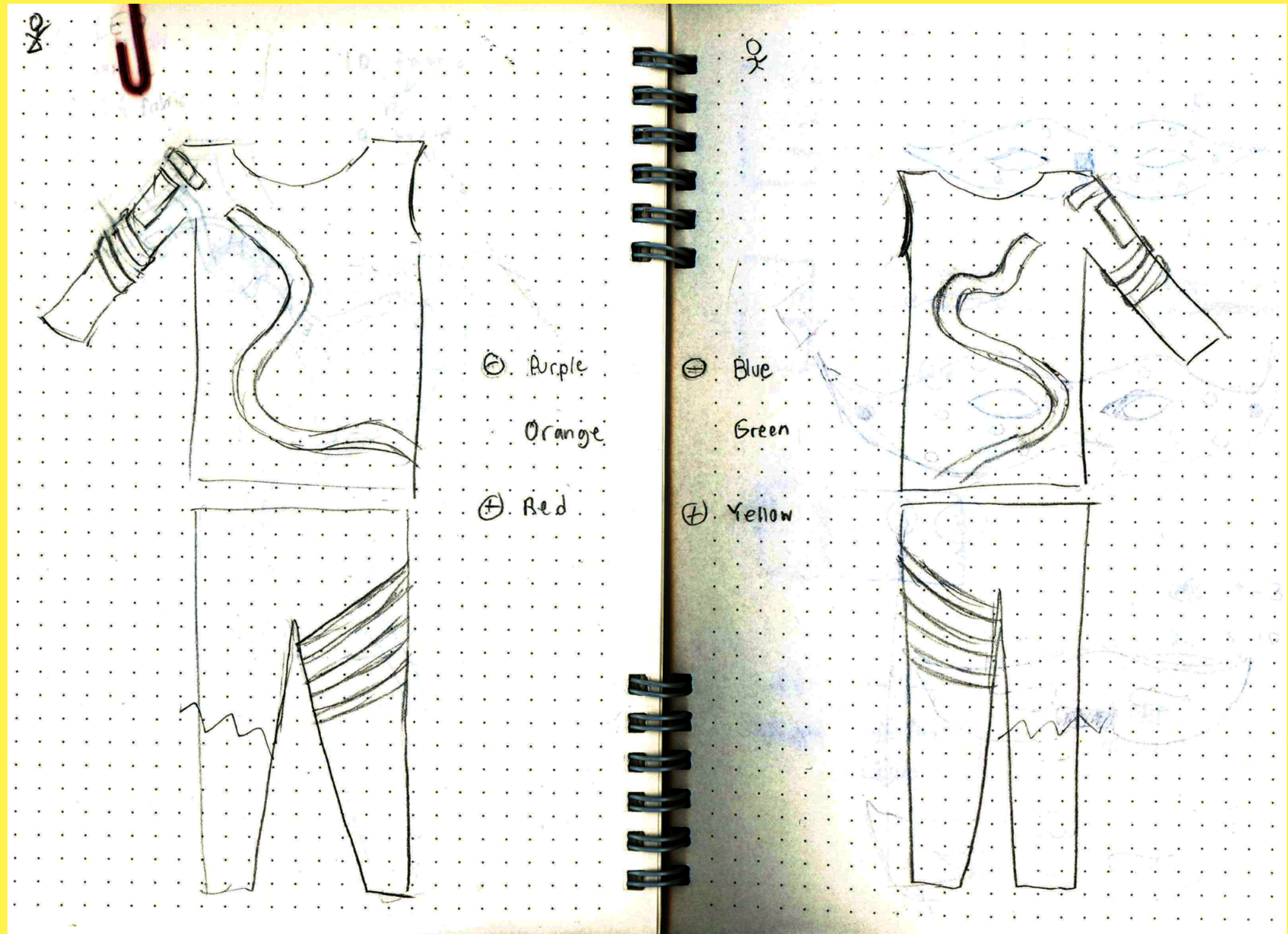


# PROJECT DESCRIPTION

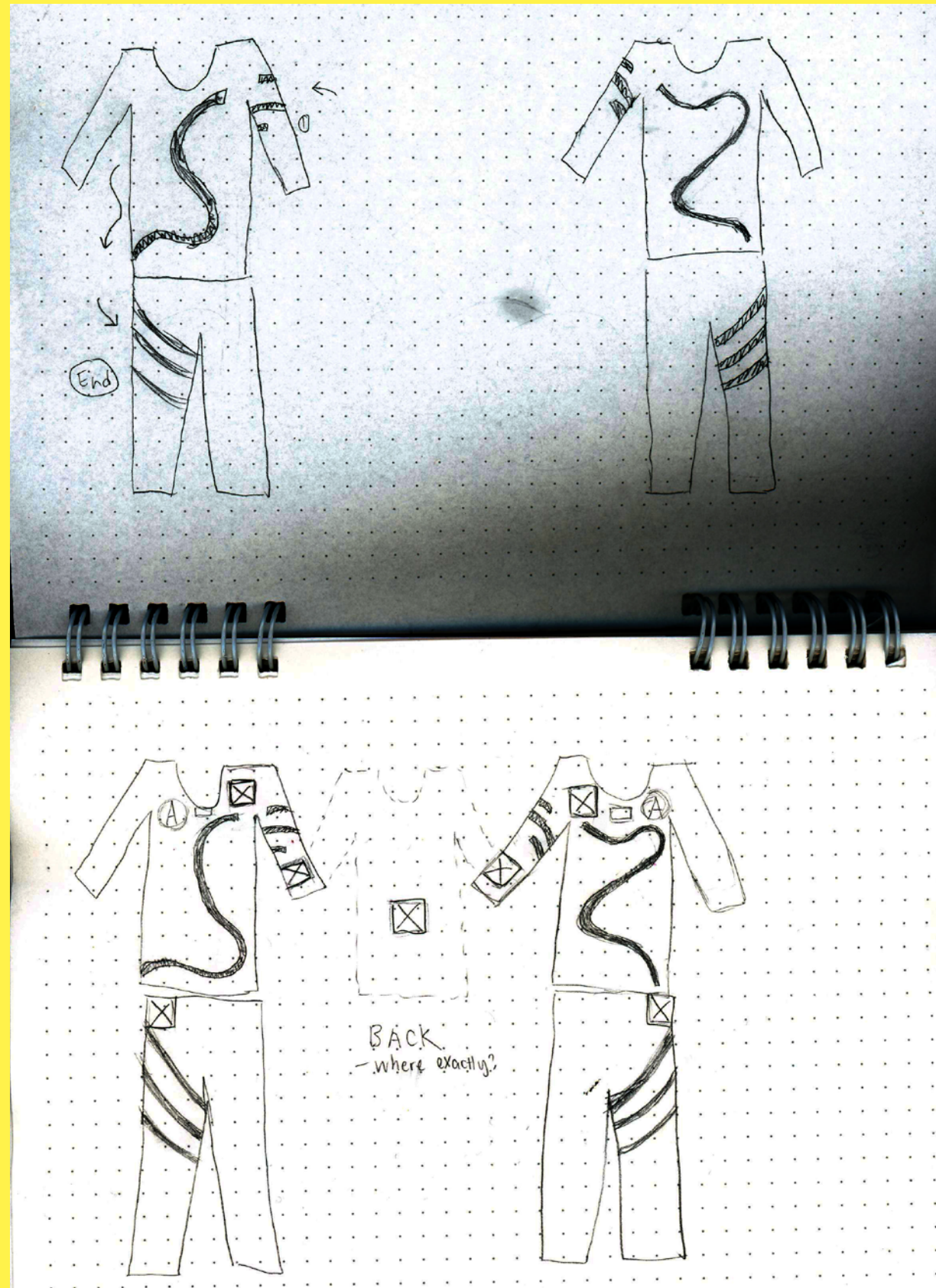
Inner Light is a modern, five minute dance performance that chronicles the emotional journey of two incomplete people interacting through physical and social contact. Lights illuminate on the dancers' bodies as an emotional response to their physical interaction. Professional dancers Ashley Whitehead and Diego Romero are the two performers in this dance.



# FINAL SKETCHES



# FINAL SKETCHES



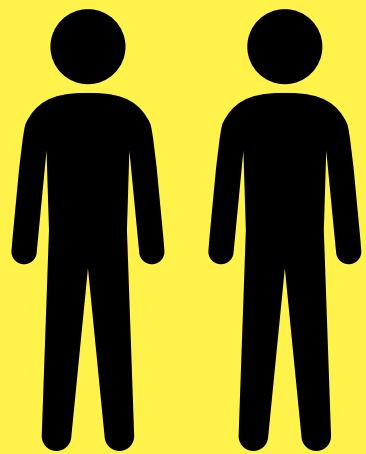


# TESTING THE FINAL ARTIFACT

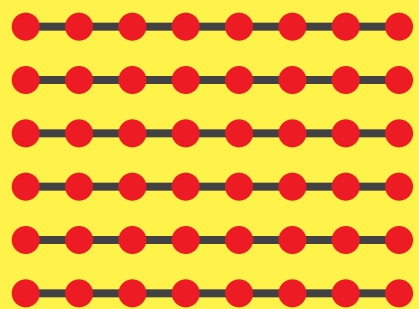
DISCOVERY IDEATION PROTOTYPE FINAL



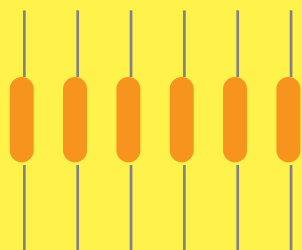
# EQUIPMENT



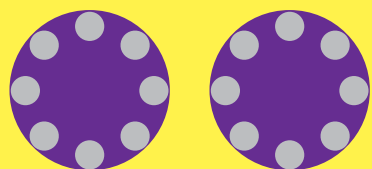
**2** DANCE SUITS  
(SHIRT + PANTS)



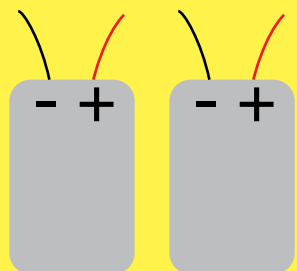
**6** RGB LED STRIPS



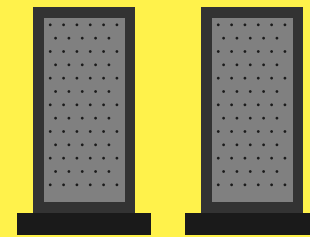
**6** 56K OHM  
RESISTORS



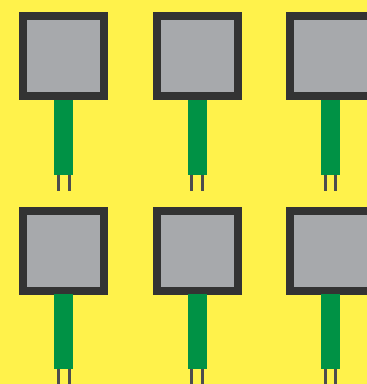
**2** LILYPAD  
ARDUINOS



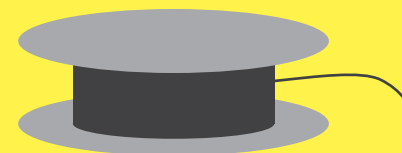
**2** 3.7V LI-ION  
BATTERIES



**2** SPEAKERS



**6** FORCE SENSITIVE  
RESISTORS



CONDUCTIVE  
THREAD



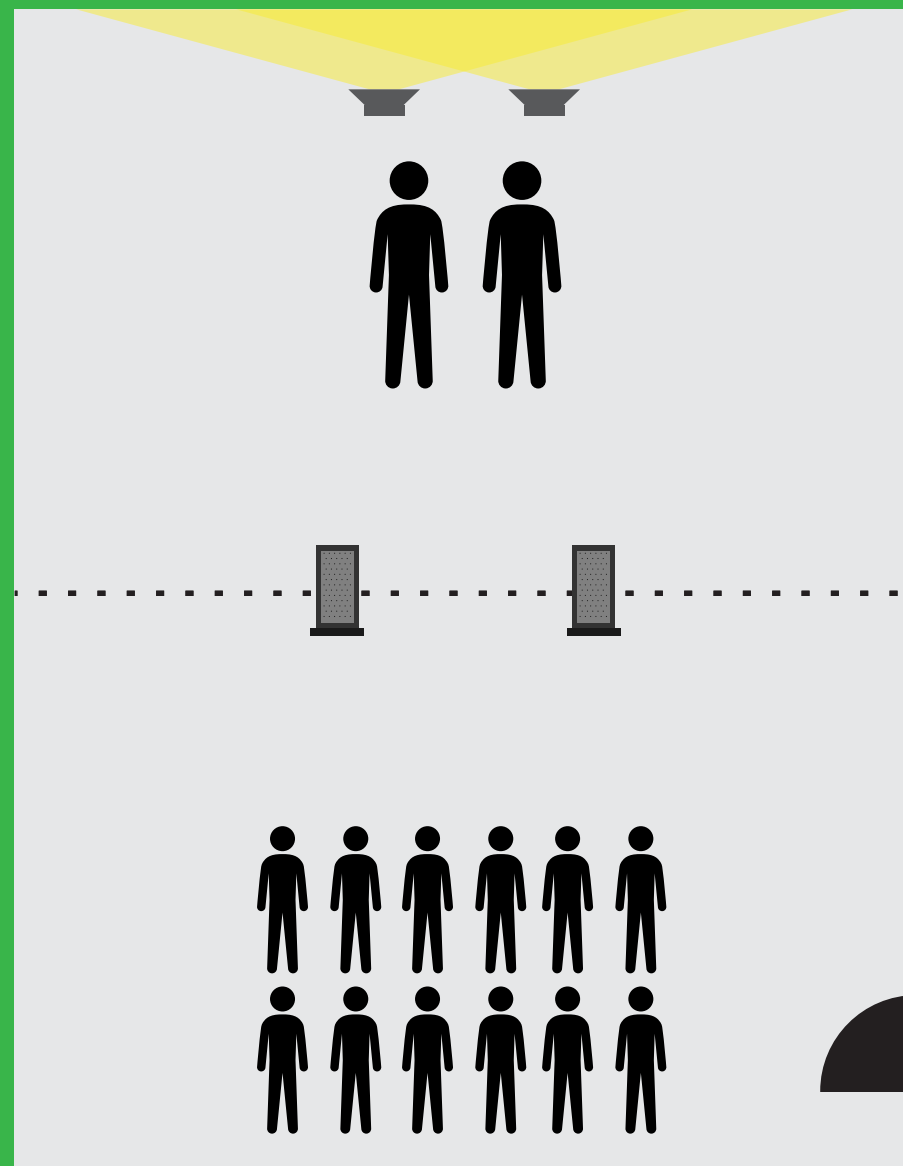
REGULAR THREAD



HOOKUP WIRE

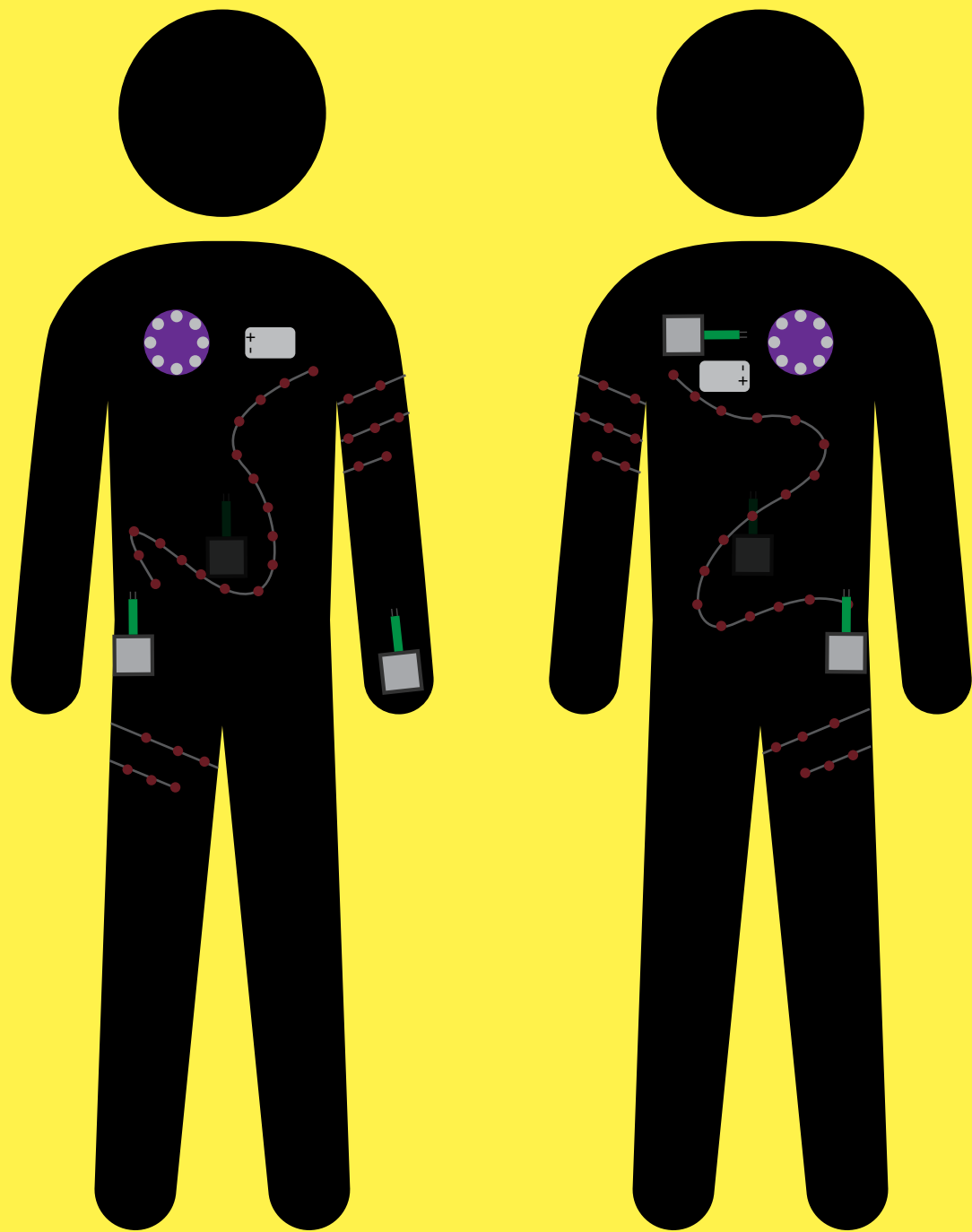
# SETTING

The final presentation took place in SFU's green screen room. The two dancers performed in the back half of the room, while the audience watched from the other side of the room. Dim spotlights provided just enough light for the dancers to operate while keeping the room dark, and speakers were placed near the centre of the room to provide sound for both the audience and the dancers.

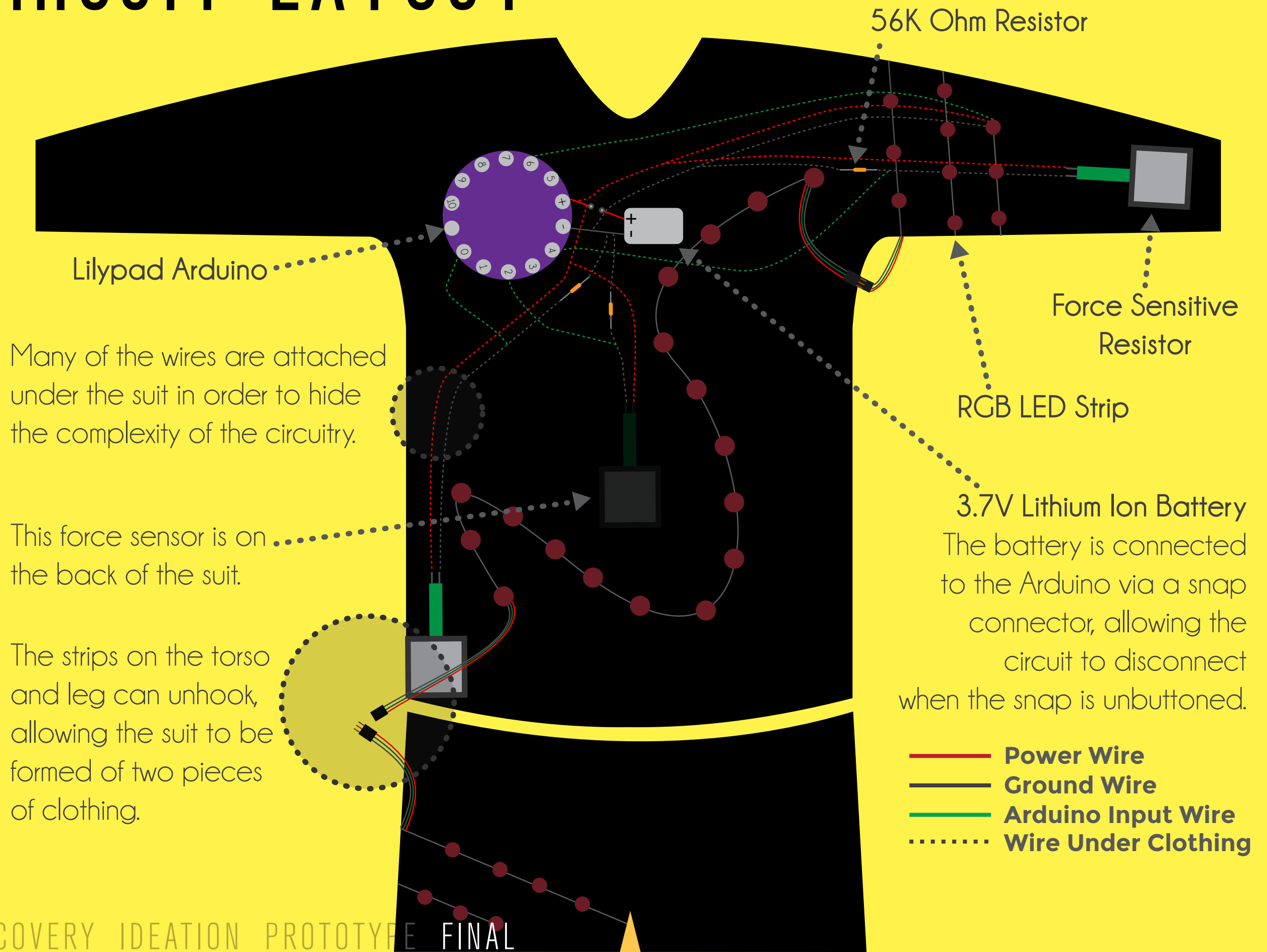




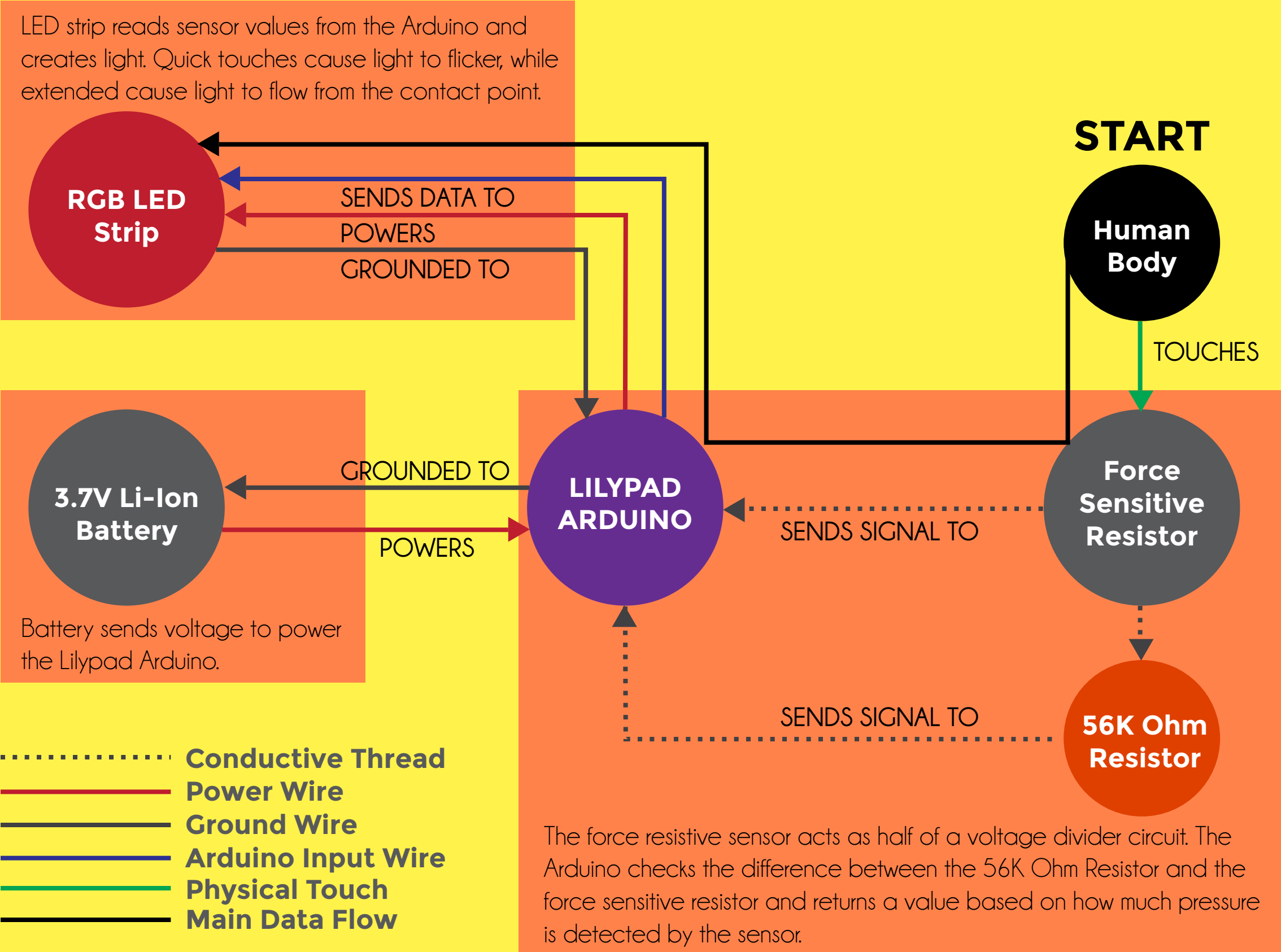
# FINAL SUIT DESIGN



# CIRCUIT LAYOUT



# TECHNICAL DIAGRAM

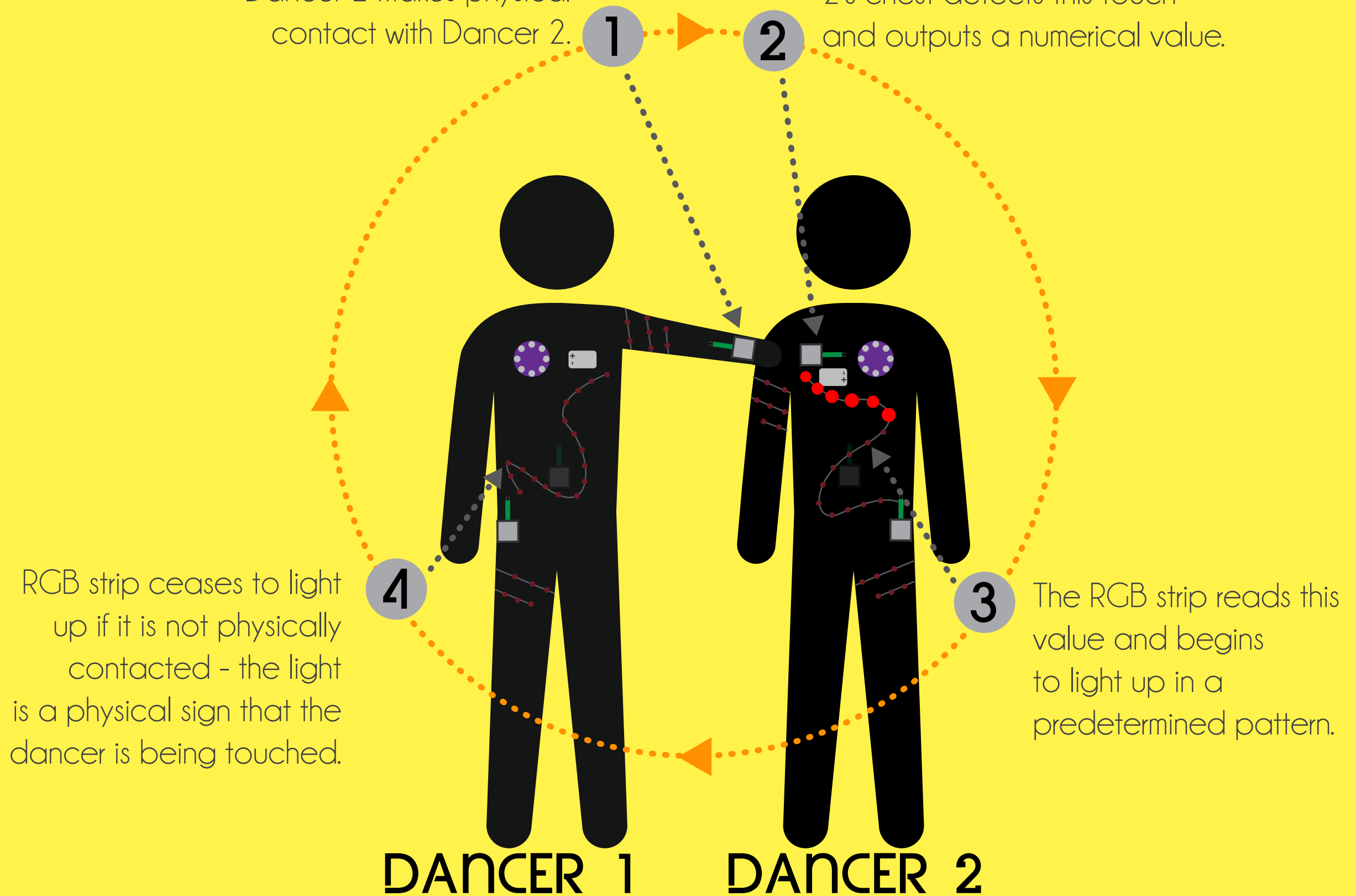




# INTERACTION

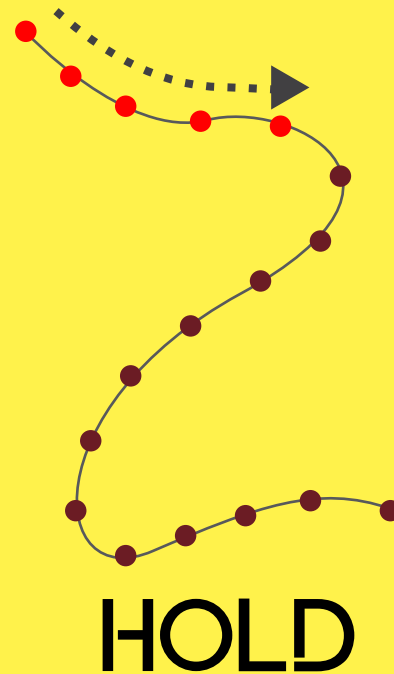
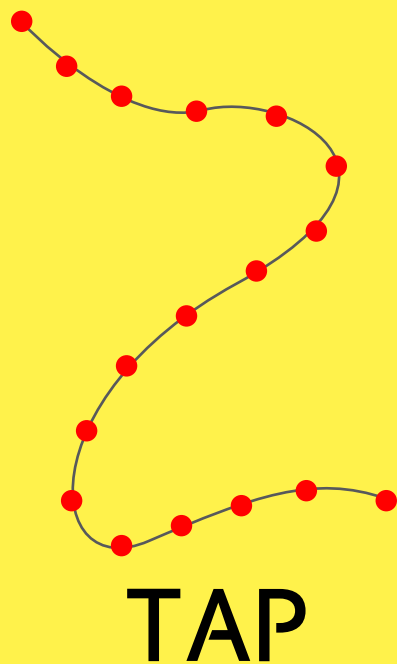
Dancer 1 makes physical contact with Dancer 2.

The force sensor on Dancer 2's chest detects this touch and outputs a numerical value.

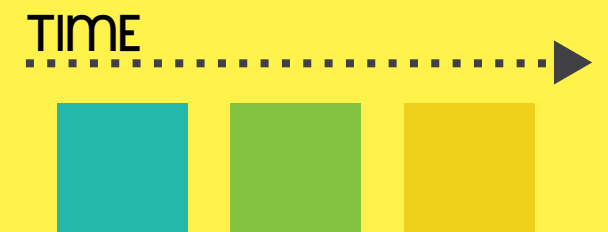


# INTERACTION

A light tap on a force sensor will cause the lights in the area of the contact point to flicker briefly, while sustained pressure will cause light to flow outward from the point of contact. As the dance wears on, the colours on the dancers' outfits will change, moving from colder colours to warmer ones.



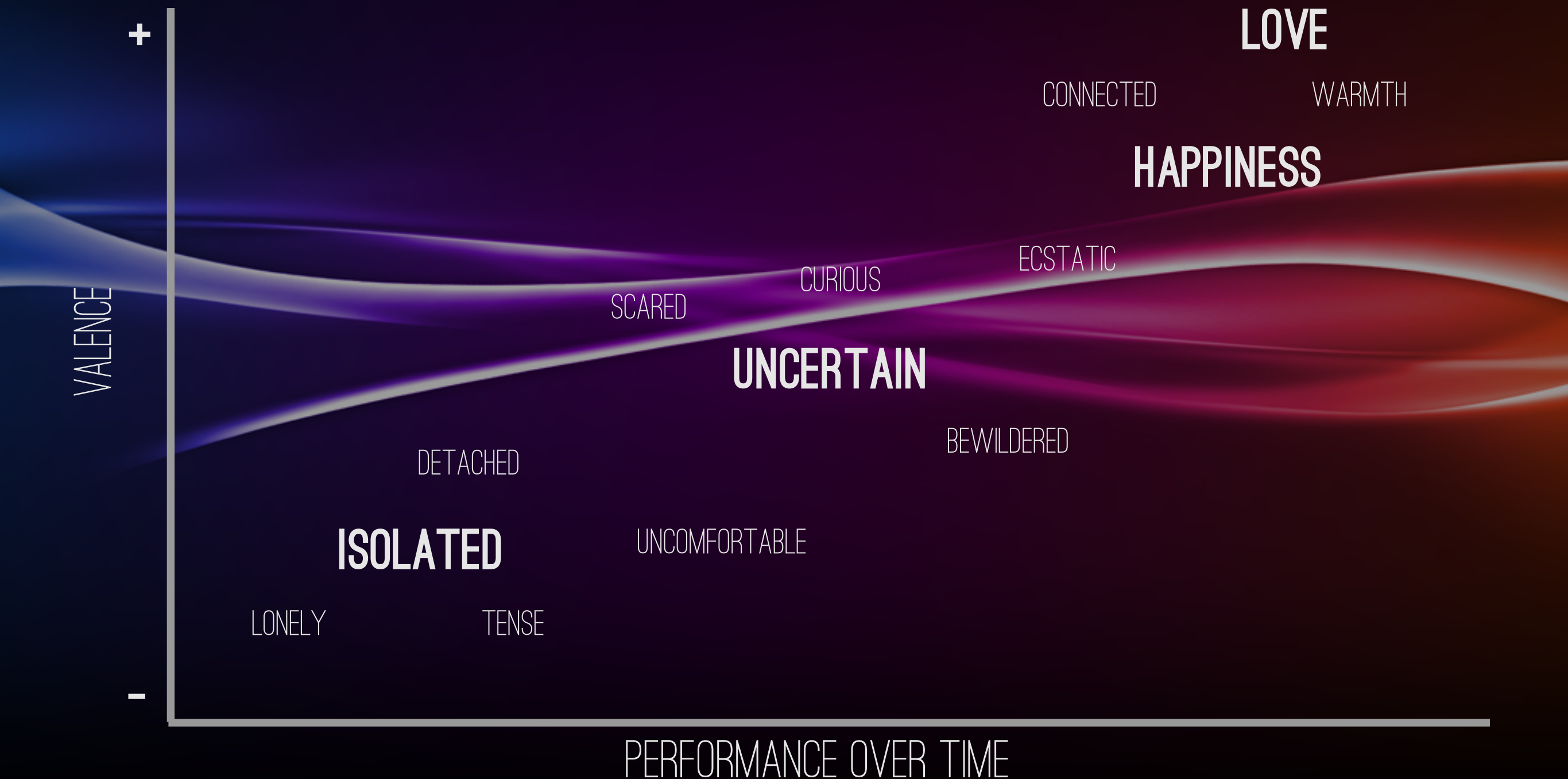
DANCER 1



DANCER 2

# AFFECT

The affective qualities of Inner Light change over time in conjunction with the narrative. Below is a chart that shows how the emotional impact of the performance moves from negative to positive as the performance wears on.



DISCOVERY IDEATION PROTOTYPE FINAL



# ARDUINO CODE

Inner Light uses a large amount of Arduino code to achieve its lighting effects. To view the code in its entirety, go to <http://www.sfu.ca/~blane/Final%20Project%20Code/>

```
}
} else if (fsr1IsTouched && fsr1 < 256) {
  (fsr1Count < armStripLength) {
    spark(0, armStripLength);
    clearNext = true;
  }
  toClear = true;
  fsr1IsTouched = false;
  fsr1Count = 0;
}

//Hip Sensor//

if (fsr2 > 512) {
  if (fsr2IsTouched) {
    if (fsr2TorsoCount > -torsoStripLength+2) {
      //randomFlash(armStripLength, totalStripLength);
      //Up torso
      fsr2TorsoCount--;
      ledsStatus[legStart-1+fsr2TorsoCount] = true;

      if (fsr2LegCount < legStripLength) {
        //Down leg
        fsr2LegCount++;
        ledsStatus[fsr2LegCount+legStart-1] = true;
      }
    } else {
      ledPulse();
    }
  } else {

    ledsStatus[legStart-1-fsr2TorsoCount] = true;
    ledsStatus[fsr2LegCount+legStart-1] = true;
    fsr2IsTouched = true;
  }
} else if (fsr2IsTouched && fsr2 < 256) {
  if (fsr2TorsoCount > -torsoStripLength) {
    spark(armStripLength, totalStripLength);
    clearNext = true;
  }
}

toClear = true;
fsr2IsTouched = false;
fsr2TorsoCount = 0;
fsr2LegCount = 0;
```

```
for (int i=0; i<sizeof(ledsStatus); i++) {
  if (ledsStatus[i]) {
    strip.setPixelColor(i,r,g,b);
  }
}

void checkSensors() {
  fsr1 = analogRead(fsrlPin);
  fsr2 = analogRead(fsr2Pin);
  fsr3 = analogRead(fsr3Pin);
  //fsr3 = 513;
  //Serial.println(fsr1);
}

void changeColor() {
  currentStep = millis();

  if ((currentStep - lastStep) > stepLength) {

    if (millis() < danceLength/3) {
      red += firstRed;
      green += firstGreen;
      blue += firstBlue;
    } else if (millis() >= danceLength/3 && millis() < 2*(danceLength/3)) {
      red += secondRed;
      green += secondGreen;
      blue += secondBlue;
    } else {
      // Serial.println(millis());
      // Serial.print(red);
      // Serial.print(' ');
      // Serial.print(green);
      // Serial.print(' ');
      // Serial.println(blue);
    }

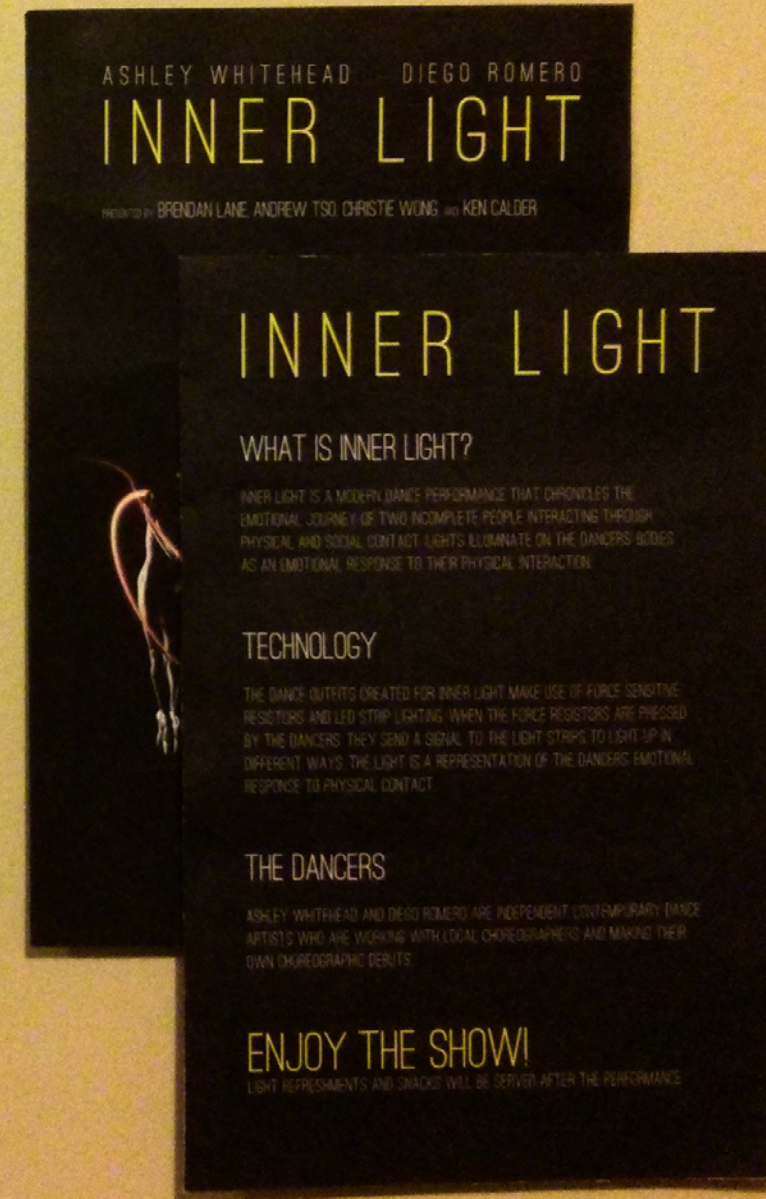
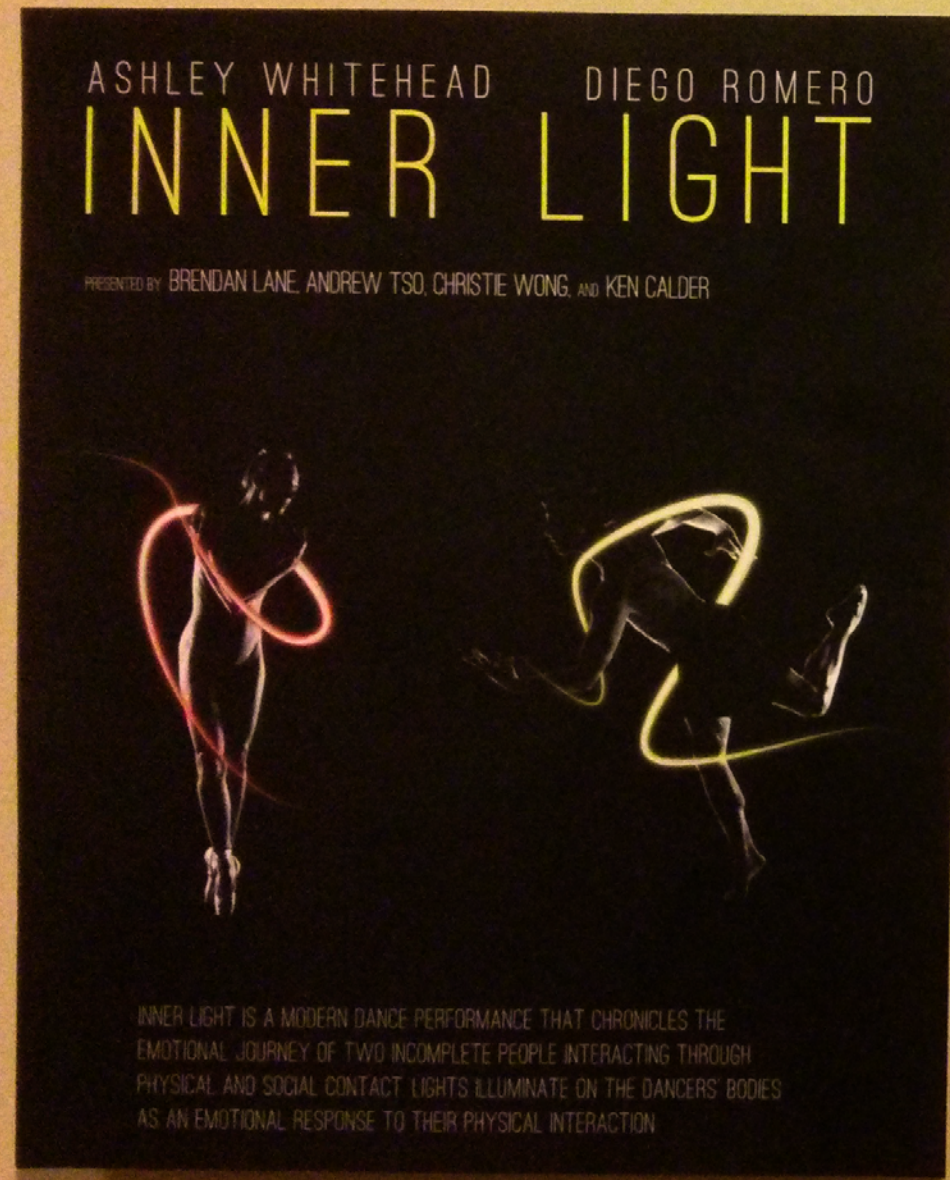
    lastStep = currentStep;
  }

  r = red;
  g = green;
  b = blue;
}
```



# ACTUAL PERFORMANCE

To give our performance a cinematic feel, we designed a promotional poster and handouts for audience members. The unified branding impressed the audience members and lent the performance a sense of legitimacy and professionalism. A video of the dance can be found at <http://vimeo.com/81780932>





# PERFORMANCE



DISCOVERY IDEATION PROTOTYPE FINAL



# PERFORMANCE



DISCOVERY IDEATION PROTOTYPE FINAL



# PERFORMANCE



DISCOVERY IDEATION PROTOTYPE FINAL



# PERFORMANCE

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# PERFORMANCE

DISCOVERY IDEATION PROTOTYPE FINAL



# PERFORMANCE



DISCOVERY IDEATION PROTOTYPE FINAL



# FEEDBACK FROM DANCERS

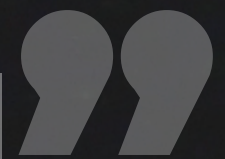


FUN PROJECT TO WORK ON!

LIKED THE FORCE SENSORS MORE THAN THE CONDUCTIVE FABRIC AS IT COULD LIGHT UP THE SUIT WITH OTHER THINGS (BESIDES HUMAN CONTACT)

WASN'T USED TO HAVING THE FRONT OF THE TORSO "OFF-BOUNDS" FOR CONTACT DUE TO THE LIGHT STRIPS

SUITS WERE AT FIRST STRANGE TO WEAR BECAUSE OF ALL THE WIRES





# FEEDBACK FROM AUDIENCE

“

AMAZING INTENSE LIGHT SHOW!

REALLY LIKED HOW THE DANCERS "SENT" LIGHT  
TO ONE ANOTHER

STAGE SHOULD BE ELEVATED - COULDN'T SEE DANCERS  
WHEN THEY WERE ROLLING ON THE FLOOR

CURIOUS ABOUT HOW TECHNOLOGY WORKED

WASN'T SURE WHEN THE DANCERS WERE "COMFORTABLE"  
WITH ONE ANOTHER IN THE NARRATIVE

”

**THE END.**