Mandy Rosengren
Undergraduate Research

Some Common Fate: Developing A Play Incorporating Wearable Tech Costumes

Mandy Rosengren

Context

This project evolved over the course of two semesters at Tufts University. During Fall 2019, the student theater troupe, Untrue To Form, approached Mandy Rosengren, a Costume Designer and Engineer, to participate in a writing experiment with student writer, Elisa Sturkie, to develop a play based on Mandy's costume ideas. The play was scheduled to be performed in Spring 2020.

The play focuses on technology's impact on people's lives. The show opens with a monologue by Eris, the Goddess of Chaos and Technology, in the play. The show then follows three storylines: one following two ninth grade students who start to drift apart due to technology, one following an unlikely connection between two people who begin to fall in love (thanks to technology), and one that follows a man's dark spiral fostered by technology and how these stories can come together.

The process started with Moment Work to inspire the plot of the play, featuring Mandy Rosengren's costumes, Elisa Sturkie's writing, found props and six actors, and this was led by Director Megan Rivkin and Assistant Director Abi Steinberg. From the scenes developed in Moment Work, Elisa Sturkie and Mandy Rosengren wrote the play, *Some Common Fate*. During Spring 2020, Elisa continued editing the play, as actors and production staff joined the team; meanwhile, Mandy Rosengren and her Costume Design Assistant developed wearable tech costumes to incorporate in the play through undergraduate research in the Mechanical Engineering Department. Student musician, Jake Zaslov, developed original music for the play. Unfortunately, due to Covid 19, the play could not be performed in April, but the next few pages feature Mandy's designs and the costumes that would have been in the show.

3D-Printed Inspired Moment Work

Before the play was written, different props and costumes were developed for Moment Work. To the left are some of the 3D-modeled and printed pieces created for the actors to use in Moment Work. Along with engineered pieces, different costumes from trash were also used as shown on the next page. From the work by the actors, Elisa Sturkie and Mandy Rosengren developed the play, *Some Common Fate*.

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Figure 1,5

Figure 1 is the Moment Work inspiration for the character Eris, who narrates the show, plays many of the technology roles and shapes many of the characters' lives. Figure 5 shows the sketch for Eris in the opening and closing monologue as well as her two sidekicks named the "Silent Ones."

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Figure 2,6

Figure 2 shows the Moment Work scene that inspired the plot that focuses on two high schoolers and how technology starts to drive them apart. The sketches for the characters in this storyline are shown in Figure 6.

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Figure 3,7

Figure 3 shows the inspiration from Moment Work for the characters in the show who come from very different worlds to fall in love -- with the help of technology. The sketches for many of the costumes in this storyline are shown in Figure 7.

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Figure 4,8

Figure 8 shows the Moment Work that inspired a storyline in the show that follows a character's dark turn heightened by technology. The costumes for this character and the characters who play technology are shown in Figure 8.

Undergraduate Research

In Spring 2020, Mandy Rosengren and her Costume Design Assistant, Lydia Vignale, develped wearable technology for select costumes in *Some Common Fate*. Shown below are the different costumes designed to include sensors, motors, and LEDs. The next few pages show some of the costumes developed for this undergraduate research project in the Mechanical Engineering Department at Tufts University.

Figure 1 Figure 1 is a sketch of the the voice-responsive cloak and can be found on pages 8 and 9.

Figure 2 Figure 2 is a sketch of the motion-responsive "Sassy" Serpent Hat and can be found on pages 10 and 11.

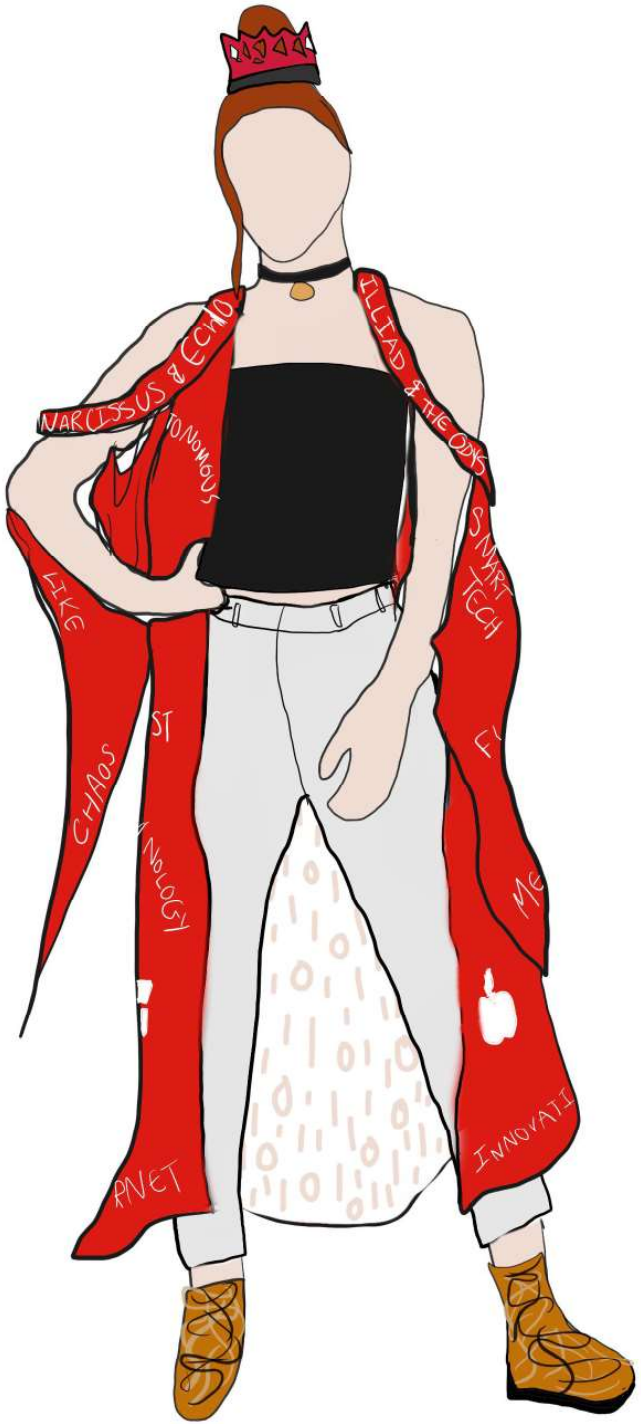
Figure 3 Figure 3 is a sketch of the "Mood Changing" Jacket which is currently in development. The jacket is worn by a popular student at the private high school in one of the storylines and uses heat sensors to determine the user's mood (similar to a mood ring). When the temperature changes, the optic fibers and Neopixel LEDs change color.

Figure 4 Figure 4 is a sketch of a drone hat which is currently in development. The hat is worn by one of the characters that plays different forms of technology. The drone hat has a touch sensor that will start the rotation of the blades when placed on the actor's head.

Figure 5 Figure 5 is a sketch of the laptop costume which is currently in development. The jacket is worn by one of the characters that plays technology. There is a laser-cut symbol of the Apple logo sewn onto the back, and the apple lights up with sewable LEDs when the actor presses a button in the jacket pocket.

Figure 6 Figure 6 is a sketch of an Amazon Alexa costume which was developed by Lydia Vignale. The costume is worn by the main character, Eris, who plays a character similar to the Amazon Alexa throughout the show. When the actor presses a button, blue EL wire lights in a pattern that resembles the waking pattern of lights for an Amazon Alexa.

Figure 7 Figure 7 is a sketch of the breath-responsive skirt and can be found on pages 12 and 13.



Voice-Responsive Cloak

This cloak was developed for main character of the show to wear during her opening and closing monologue. The cloak would have laser-cut images and words from the monologue that would light up during parts of the monologue. An Amazon Alexa and Arduino Nano were used for the voice recognition of the monologue to light different parts of the cloak. Unfortunately, due to Covid 19, the monologue cloak has yet to be completed.

Materials

- Red Fabric
- White Fabric
- Conductive Thread
- Conductive Fabric
- HeatnBond
- Arduino Nano
- Solderable Breadboard
- Amazon Alexa
- Rechargable Battery

Figure 1 Figure 1 displays the sketch of the voice-responsive cloak.

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Figure 2

Figure 2 shows the sketch of the placement of the different symbols and words on the cloak. The monologues both focus on the impact that technology has upon our lives, so many tech symbols are included. The play contains many references to Greek Mythology, and the cloak references these as welll in the laser-cut designs.

Figure 3

Figure 3 displays the design of the circuitry for the cloak. Each symbol or phrase on the cloak is lit by at least two white sewable LEDs in parallel and connect to other pieces of the cloak, such as the like symbol and the Facebook logo. The maroon on the cloak represents the nonconductive fabric that allows for some of the circuitry to overlap with other sections without creating a short circuit. All of the LEDs connect to the Arduino Nano that would be sewn into the cloak with a rechargeable battery and pocket.

Figure 4

Figure 4 displays the working circuit for the cloak using 19 LEDs and a test patch of a laser-cut Instagram logo. When the user says Echo and the programmed phrase of the monologue, different LEDs light.

Figure 5

Figure 5 displays the sewed parallel circuit with conductive thread that lights the Instagram logo shown in Figure 4. Both the Instagram Logo and the sewn circuitry in Figure 5 were created by the Costume Design Assistant, Lydia Vignale.

Motion-Responsive "Sassy" Serpent Hat

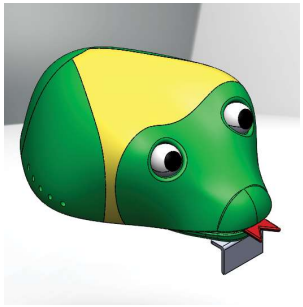
This hat was developed for a character in the play *Some Common Fate* who plays the serpent mascot at the private high school in the play. To make the snake "sassy," the eyes of the head roll, and the tongue moves in and out, while the actor retorts a sassy comment to one of the character. This action occurs when a person moves within fifty centimeters of the ultrasonic sensor that is underneath the mouth and sewn into the black hat that holds the snake head onto the actor's head.

Materials

Green, white, red and black PLA filament
2 Servo motors
1 Continous Servo Motor
Green fabric
Plastic bags (for stuffing)
Wires
9V Battery
Arduino Uno

Figure 1

Figure 1 displays the finished serpent hat.



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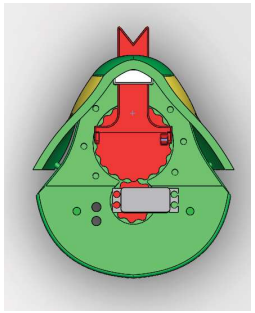

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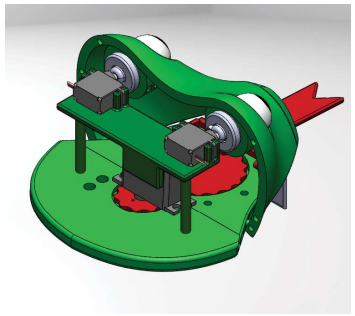

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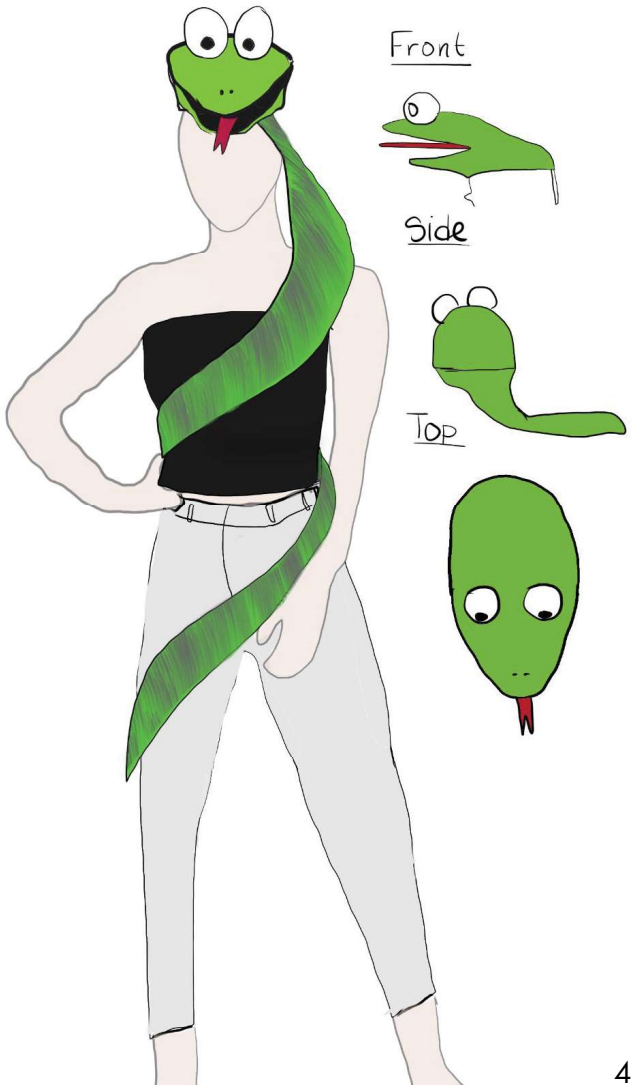

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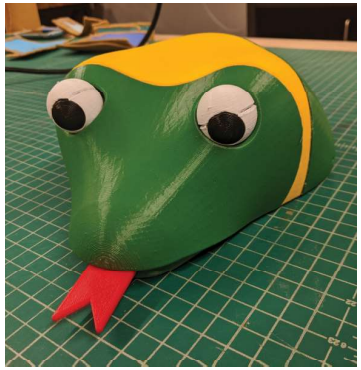

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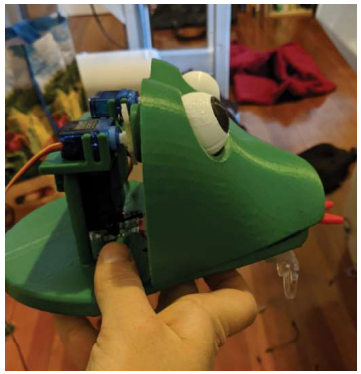

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Figure 2 ,6

Figure 2 shows the SolidWorks assembly of the snake head. The outer layer of the head consists of five parts that connect with pegs. The outer layer was modeled using surfacing. Figure 6 displays the 3D-printed result.

Figures 3,8

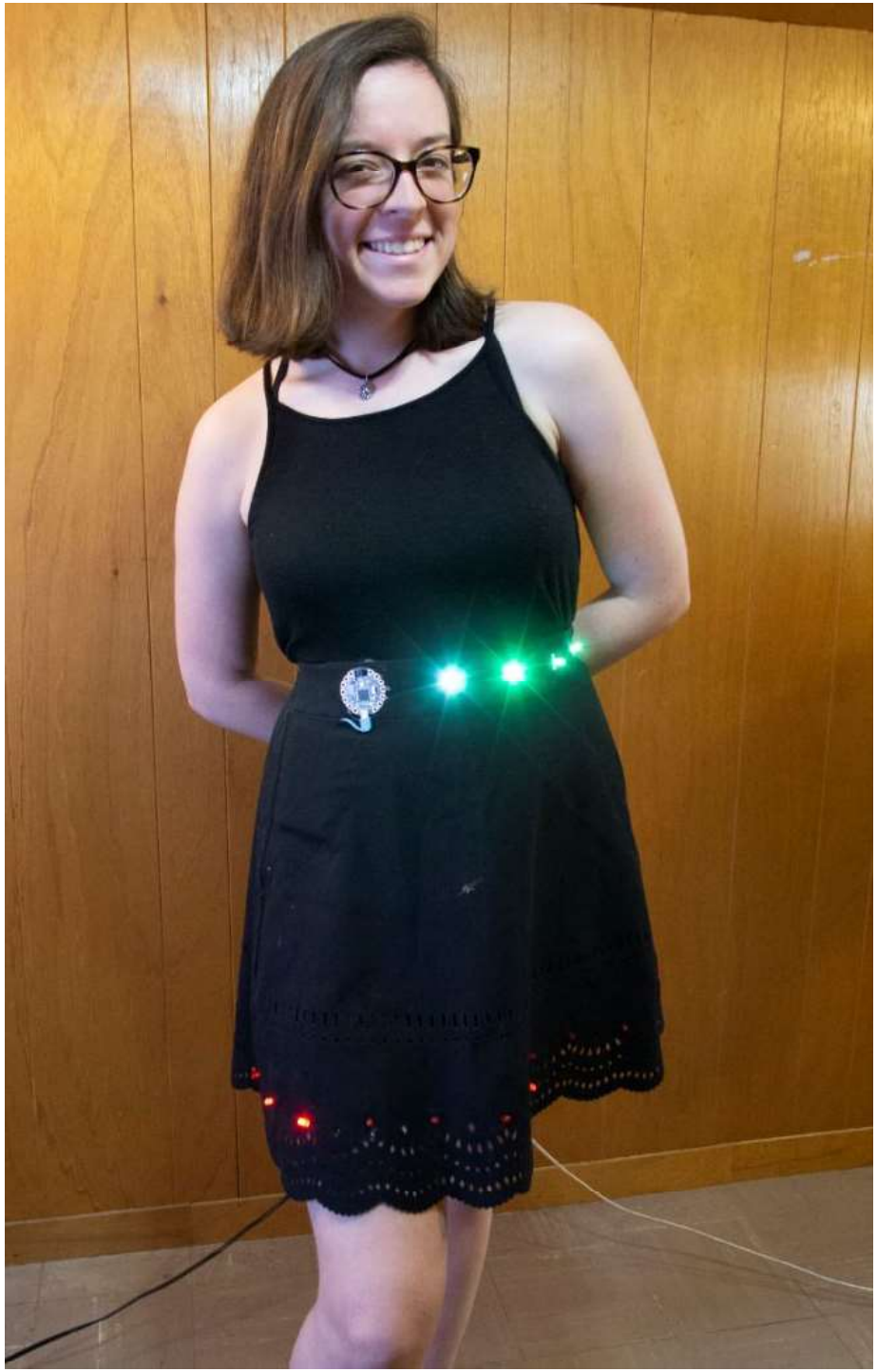
Figure 3 displays the SolidWorks model of the top view of the assembly to move the tongue in and out of the snake's mouth, and Figure 8 displays the 3D-printed version. A 360 Continuous Servo Motor rotates the gear that moves a peg that connects to the 3D-printed tongue. The peg moves left and right of the laser-cut rectangular prism, and the white "teeth" for the snake ensure that the tongue moves only in one direction.

Figure 4

Figure 4 is the sketch for the Serpent hat and how it would be worn by the actor.

Figures 5,7

Figure 5 displays the 3D modeled assembly of the mechanisms to roll the eyes and hold all of the motors in place. Figure 8 displays the finished version. A Servo Motor is attached to each eye and is held in place by a 3D-printed piece connected to the bottom of the head and lies on top of the Continuous Servo Motor used to move the tongue.



Breath-Responsive Skirt

The breath-responsive skirt was created for the play *Some Common Fate*, worn by the character Netty who 'created' the skirt to fit in with the popular students in her new private school. This skirt contains two circuits: one follows the rim of the skirt and lights red LEDs, and the second circuit consists of four RGB LEDs that change color based on the user's breathing. Behind the Adafruit Flora there is a felt sensor composed of conductive and nonconductive wool. When the actor breathes, the stomach presses the sensor and lowers the resistance of the sensor, changing the color of the skirt. When the actor inhales, the LEDs change from red to green, and the reverse occurs when the actor exhales.

Materials

- Black Skirt
- White Thread
- Green Fabric
- HeatnBond
- 24 Red LEDs
- 4 RGB LEDs
- Felt
- 150 Ohm Resistor
- Conductive Thread
- Conductive Fabric
- Conductive and Nonconductive Wool
- Adafruit Flora

Figure 1 Figure 1 displays the completed breath responsive skirt.

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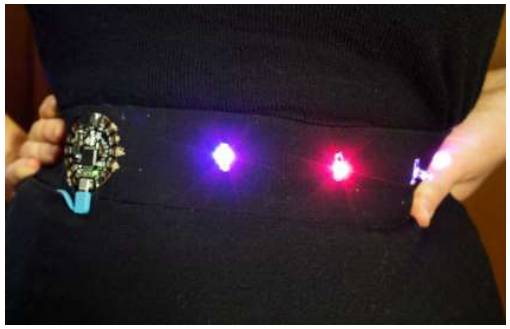

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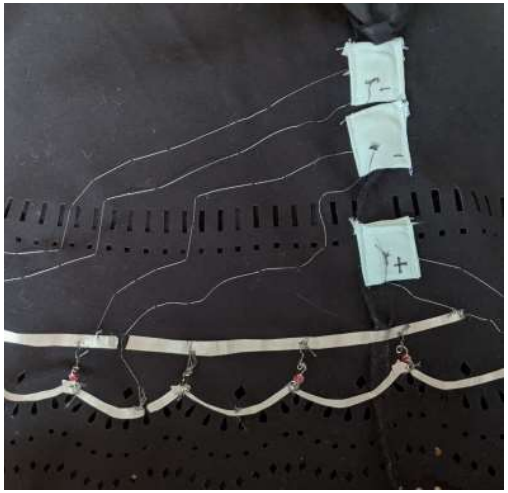

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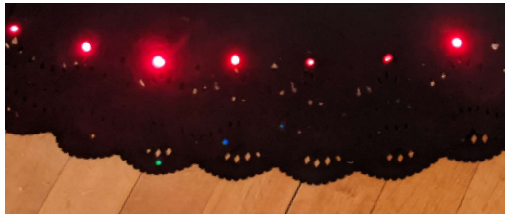

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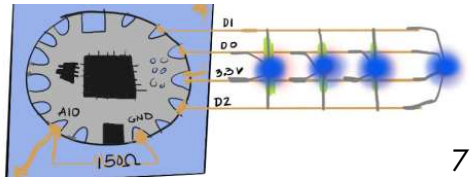

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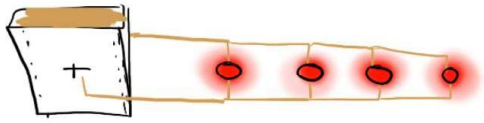

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Figure 2, 3

Figure 2 displays the working circuit found on the waistline of the skirt. Four RGB LEDs go through four created button holes. There are three green cotton fabric rectangles that sandwich between the conductive fabric and the pins, so they can overlap without creating a short circuit. This circuit is covered by green cotton fabric to protect the user.

Figure 4

Figure 4 displays the color-changing LEDs on the waistline of the skirt. The rechargeable battery lies in a pocket underneath the waistline. This figure displays the LED color when the actor exhales.

Figure 5

Figure 5 displays the circuit for the hem of the skirt. There are six 3V coin batteries that light four red LEDs each. The coin battery pocket consists of conductive and nonconductive fabric, and the circuitry is composed of conductive fabric and thread.

Figure 6

Figure 6 displays the outside of the hem of the skirt with the red LEDs. The LEDs poke out of the laser-cut designs in the skirt and were sewn in using conductive thread.

Figure 7

Figure 7 displays the sketch of the circuitry for the waist of the skirt. A 150 Ohm resistor is used to create a voltage divider with the felt sensor, allowing the LEDs to change color based on the pressure on the sensor.

Figure 8

Figure 8 displays the original sketch for the skirt with both circuits.

Figure 9

Figure 9 displays the sketch for the circuit at the bottom of the skirt with four LEDs in parallel that are connected to the battery pack.

Special Thanks

Thank you to Untrue to Form, the Tufts Theater Faculty, the Tufts Mechanical Engineering Faculty, the Center for Engineering Outreach at Tufts University, Bray Labs, Nolop Makerspace, the cast and crew of *Some Common Fate* and the many collaborators and mentors in this project including Linda Ross Girard, Chris Rogers, Elisa Sturkie, Lydia Vignale, Abi Steinberg, Meghan Rivkin, Jake Zaslov and everyone who helped make this project possible.

For more Wearable Tech Clothing, Engineering and Costume Designs, be sure to look at mandyrosengren.com