GLOW GARMENTS

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2024

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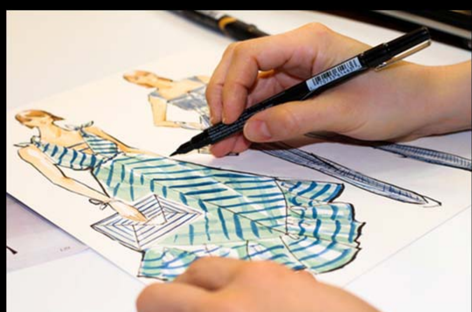
ADDRESSING THE NEED

We see the intersection of ENGINEERING x FASHION as an untapped opportunity—a new frontier in fashion that embraces technology to enhance individuality, functionality, and design.

PURPOSE

THOUGHT PROCESS

- ENGINEERING
- FASHION



OUR DESIGN

- We are redefining the intersection of fashion and engineering with our latest innovation: the illuminated sweatsuit.

- The illuminated sweatsuit is more than a garment; it’s a statement of how technology can illuminate (literally and figuratively) the path to the next era of fashion.

PRODUCT

BACKGROUND

- The fashion industry is increasingly exploring the integration of technology into clothing. Wearable technology is a growing sector, driven by consumer demand for creative and multi-functional garments.

- Flexible LED arrays, microcontrollers, and compact, rechargeable battery systems enable dynamic, programmable light patterns without compromising comfort and wearability. Advances in these technologies are paving the way for innovation in fashion-tech integration.

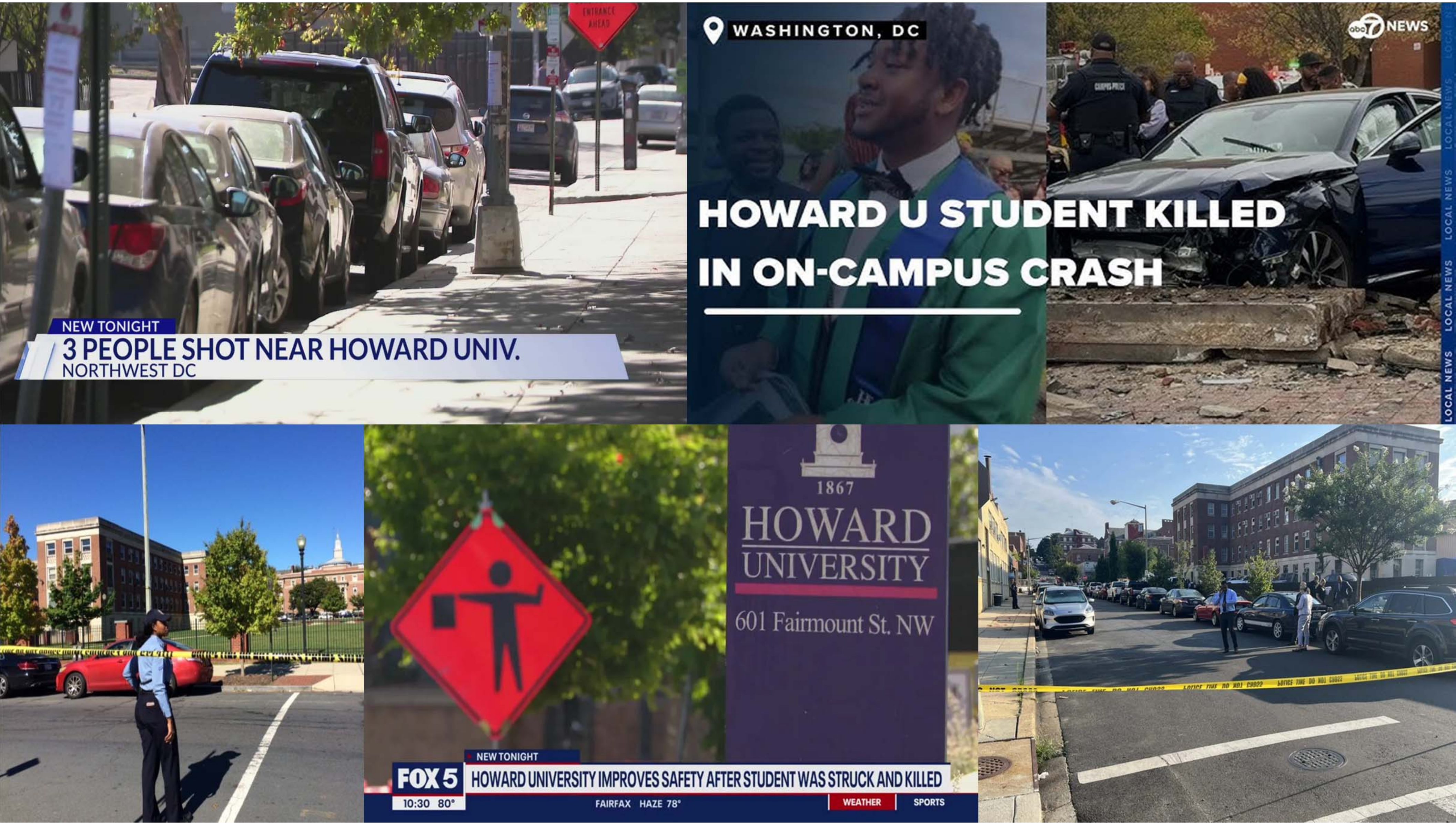
- Consumer insights include the desire for personalized and expressive fashion options, growing interest in wearable art that combines style with practical uses (e.g., safety and visibility), and the need for comfort, durability, and easy maintenance in tech-integrated garments.

Customer dissatisfaction:

- Lack of customizable, wearable light displays in mainstream fashion.
- Limited options for combining safety-focused designs with everyday wear.
- Challenges in integrating flexible, durable tech into fabric while ensuring comfort and ease of use.

Customer needs:

- Seamless Technology Integration
  Garments must balance technological innovation with comfort and wearability.
- Functionality & Expression
  Customers seek versatile clothing that facilitates both safety and artistic self-expression.
- Practical Design Features
  - Rechargeable, removable battery systems for easy maintenance.
  - Durable, flexible LED designs that withstand everyday wear and washing.


NEW TONIGHT
3 PEOPLE SHOT NEAR HOWARD UNIV.
NORTHWEST DC
WASHINGTON, DC
HOWARD U STUDENT KILLED
IN ON-CAMPUS CRASH
abc 7 NEWS
LOCAL NEWS
1867
HOWARD
UNIVERSITY
601 Fairmount St. NW
FOX 5
NEW TONIGHT
HOWARD UNIVERSITY IMPROVES SAFETY AFTER STUDENT WAS STRUCK AND KILLED
10:30 80°
FAIRFAX HAZE 78°
WEATHER
SPORTS

MISSION
(abstract)

At *GLOW GARMENTS*, our mission is to bridge the gap between traditional fashion and interactive technology by developing elegant, user-friendly LED-integrated garments. We aim to set new industry standards for wearable electronics through innovative engineering solutions that prioritize durability, simplicity, and artistic freedom, while making smart fashion accessible to everyday consumers.

VISION
(problem statement)

The fashion industry faces a pressing need to incorporate light art into costumes and clothing, facilitating explicit expression through message-delivering light patterns while enhancing consumer safety by merging technology with fashion. This approach involves the seamless integration of flexible LED arrays into fabric, maintaining comfort and wearability, alongside a small, rechargeable battery pack that is removable for washing, and a pre-programmed microcontroller for dynamic light displays. The innovation promises to elevate fashion to new creative heights, allow unique consumer self-expression in various projects, and open a new market at the intersection of technology and fashion.

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DESIGN REQUIREMENTS

Our project goal is to design and develop a sustainable fashion line incorporating LED technology to enhance **visibility** and **aesthetic appeal**. The garments will balance style, functionality, and eco-consciousness through innovative materials and energy-efficient lighting.

Project Objectives

- **Safety Enhancement**
  Improve wearer visibility in low-light conditions for activities like running, cycling, and walking.
- **Aesthetic Appeal**
  Design fashionable garments that seamlessly integrate LED lighting.
- **Sustainability**
  Utilize eco-friendly materials and energy-efficient technology to minimize environmental impact.
- **Functionality**
  Ensure the clothing is comfortable, durable, and easy to maintain.

Environmental Constraints

- **Material Sourcing**
  Use renewable or recyclable materials for fabric and LED components to reduce environmental impact.
- **Energy Efficiency**
  Incorporate low-power LED components and energy-efficient batteries to lower energy consumption and carbon footprint.

Socio-Cultural Constraints

- **Public Perception**
  Blend technology into the design to ensure garments remain approachable, stylish, and not intimidating to users.

Compliance Requirements

- **FCC Compliance**
  Electronic components must meet FCC standards (e.g., Part 15 of Title 47) to avoid harmful interference.
- **Textile Flammability Standards**
  Fabrics must comply with safety standards (e.g., ASTM D1230) to reduce fire risk.

SOLUTION GENERATION

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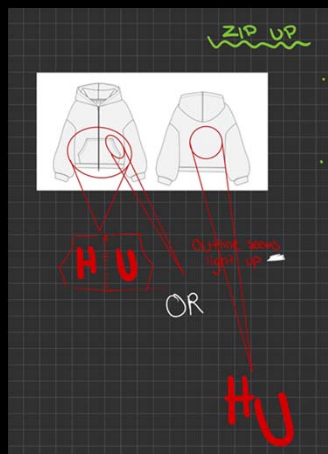
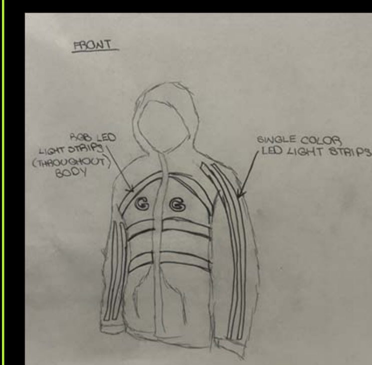
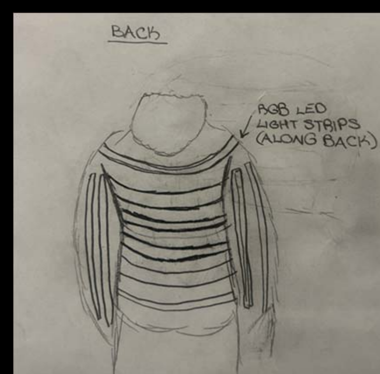
PROJECT ONE



PROJECT TWO

PROJECT THREE





SOLUTION

ADVANTAGES & DISADVANTAGES

1	2	3
Pros: - Targeting Howard University community could help with initial adoption - Hoodie provides ample surface area for design - Hoodies are comfortable and accepted as everyday wear Cons: - Limited market scope - Hoodie material might be too thick for comfortable LED integration - School branding might limit creative expression options	Pros: - Combination of 3M reflective material and LEDs enhances safety features - Lighter weight than a hoodie design - Can appeal to a broader market - 3M adds passive safety feature when LEDs aren't active Cons: - May be more challenging to integrate both 3M and LED technology. - Higher production costs - Less surface area	Pros: - Windbreaker Waterproof Material - With sensors, the jacket can respond to movement, creating lighting, enhancing user engagement. - In low-light conditions, jacket can increase visibility, - Brand identity built into the design (GG logo) Cons: - LED strips require a power source, which means carrying batteries that need regular charging or replacement, adding weight - Adding electronic components may affect the comfort and flexibility, potentially limiting its practicality for everyday use.

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SCHEMATICS

Component	Part Name	Web Link	Unit Price	Quantity	Total Price
Accelerometer & Gyroscope	Sunfounder GY-521 MPU-6050 6 DOF Gyro Accelerometer IMU	https://www.adafruit.com/product/3886?gad_source=5&gclid=EAIaIQobChMI9cWfubXkiQMVXl9HAR3-nS1ZEAQYASABEgJUz_D_BwE	$12.95	1	$12.95
LEDs	Adafruit NeoPixel Digital RGB LED Strip - White 30 LED 3m - WHITE - FULL ROLL	https://www.electromaker.io/shop/product/adafruit-neopixel-digital-rgb-led-strip-white-30-led-3m-white?gad_source=5&gclid=EAIaIQobChMIsu2gsrzkiQMVymNHAR2Ivw51EAQYAiABEgITtvD_BwE	$14.95	3	44.85
Microcontroller	Arduino Uno Rev3	https://store-usa.arduino.cc/products/arduino-uno-rev3?gad_source=5&gclid=EAIaIQobChMI1Y3d7bXxiQMVTmFHAR14ohlgEAQYASABEgKI7PD_BwE	$23.46	1	$23.46
Power Button (Jacket)	Rugged Metal On/Off Switch with Blue LED Ring - 16mm Blue On/Off	https://www.adafruit.com/product/915	$4.95	1	$4.95
Battery	Lithium-ion Battery 10000mAh 11.1 V	[illegible]	$54.00	1	$54.00
Voltage Regulator	LM2596 DC-DC DC Adjustable Buck Power Supply	https://www.ebay.com/itm/365206544809?chn=ps&norover=1&mkevt=1&mkrid=711-117182-37290-0&mkcid=2&mkscid=101&itemid=365206544809&targetid=2299003535955&device=c&mktype=pla&googleloc=9007525&poi=&campaignid=21214315381&mkgroupid=161363866036&rlsatarget=pla-2299003535955&abcId=9407526&merchantid=777306343&gad_source=5&gclid=EAIaIQobChMIm9KgsbbxiQMVtFFHAR1xdzi4EAQYBCABEgIWJ_D_BwE	$1.49	1	$1.49
Conductive Thread	Stainless Thin Conductive Thread - 2 ply - 23 meter/76 ft	https://www.adafruit.com/product/640	$6.95	3	$20.85
Waterproof Fabric & Sealant	Seam Grip Seam Sealer	https://www.rei.com/product/603034/gear-aid-seam-grip-seam-sealer	$9.95	2	$19.90
Total					$182.45

COMPONENTS

1. MICROCONTROLLER (ARDUINO UNO)
2. ACCELEROMETER & GYROSCOPE (MPU-6050)
3. FRONT AND BACK LEDs
4. RIGHT LEDs
5. LEFT LEDs
6. PUSH BUTTON
7. LITHIUM ION BATTERY (10000 mAh 11.1 V)
8. VOLTAGE REGULATOR (LM2596)
9. WATERPROOF SEALING
10. CONDUCTIVE THREAD
11. JACKET

DESIGN DESCRIPTION

The microcontroller 1 is positioned for centralized control of all components. The accelerometer and gyroscope 2 is connected to the microcontroller 1 and mounted at the center of the back of the jacket 11, detect motion and orientation accurately.

The front and back LED strips 3, left sleeve LED strip 4, and right sleeve LED strip 5 are sewn onto the jacket 11, connected to the microcontroller 1 and powered by the voltage regulator 8

When the left arm goes up, the left sleeve LED strip 4, flashes white five times as detected by the accelerometer 2 when arm raises 45 degrees. Similarly, when the right arm goes up, the right sleeve LED strip 5, flashes white five times.

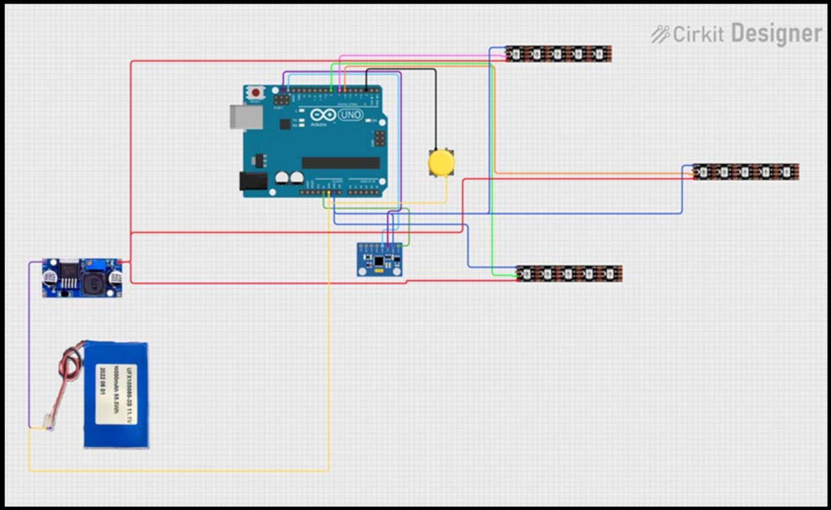
General acceleration detected by the accelerometer 2 illuminates the jacket green via the front and back LED strips 3. Deceleration detected by the accelerometer 2 transitions the jacket's illumination from green to red, indicating the intensity of the deceleration.

The pushbutton 6, powers on the system when pressed and held, completing the circuit between the microcontroller 1 and the battery 7. Subsequent presses turn the system off.

The rechargeable lithium-ion battery 7 powers the system, housed securely in a pocket or compartment within the jacket. The voltage regulator (LM2596) 8 steps up the battery output to provide a stable 12V supply to the LED strips.

A waterproof sealant, such as silicone conformal coating or liquid electrical tape 9, is applied to the LED strips, wiring, and exposed components to protect the electronics from environmental damage, ensuring durability and functionality in various conditions.

Conductive thread 10 is used to seamlessly integrate and connect all components throughout the apparel, maintaining flexibility and wearability.



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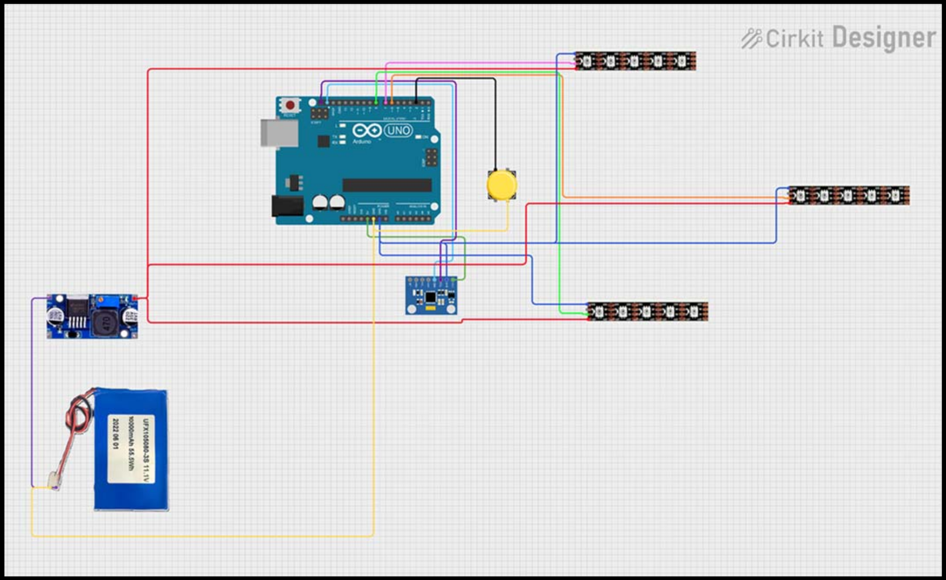
SAMPLE

ARDUINO CODE

```
#define PIN_FRONT_BACK_LED 6
#define PIN_RIGHT_SLEEVE_LED 7
#define PIN_LEFT_SLEEVE_LED 8
#define BUTTON_PIN 2

Adafruit_NeoPixel frontBackLEDs = Adafruit_NeoPixel(60, PIN_FRONT_BACK_LED, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel rightSleeveLEDs = Adafruit_NeoPixel(30, PIN_RIGHT_SLEEVE_LED, NEO_GRB + NEO_KHZ800);
Adafruit_NeoPixel leftSleeveLEDs = Adafruit_NeoPixel(30, PIN_LEFT_SLEEVE_LED, NEO_GRB + NEO_KHZ800);

void setup() {
  pinMode(BUTTON_PIN, INPUT_PULLUP);
  frontBackLEDs.begin();
  rightSleeveLEDs.begin();
  leftSleeveLEDs.begin();
  Wire.begin();
  mpu.begin();
}

void loop() {
  if (digitalRead(BUTTON_PIN) == LOW) {
    systemOn = !systemOn;
    delay(500); // Debounce delay
  }

  if (systemOn) {
    sensors_event_t event;
    mpu.getEvent(&event);

    // Detect upward movement of the left arm
    if (event.acceleration.y > 45) { // Adjust threshold as needed
      flashWhite(leftSleeveLEDs);
    }

    // Detect general acceleration
    if (event.acceleration.x > 3 || event.acceleration.y > 3 || event.acceleration.z > 3) {
      illuminateGreen(frontBackLEDs, rightSleeveLEDs, leftSleeveLEDs);
    }

    // Detect deceleration
    if (event.acceleration.x < -3 || event.acceleration.y < -3 || event.acceleration.z < -3) {
      transitionToRed(frontBackLEDs, rightSleeveLEDs, leftSleeveLEDs);
    }
  } else {
      frontBackLEDs.clear();
      rightSleeveLEDs.clear();
      leftSleeveLEDs.clear();
      frontBackLEDs.show();
      rightSleeveLEDs.show();
      leftSleeveLEDs.show();
  }
}

void flashWhite(Adafruit_NeoPixel &ledStrip) {
  for (int i = 0; i < 5; i++) {
    ledStrip.fill(ledStrip.Color(255, 255, 255), 0, ledStrip.numPixels());
    ledStrip.show();
    delay(100);
    ledStrip.clear();
    ledStrip.show();
    delay(100);
  }
}
```



FINAL EXPECTATIONS

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PROTO 1

PROTO 2

PROTO 3

PROTO 4

SPECIFICATIONS

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1. Power Consumption of LED Strips
   - LED Type: WS2812B (common individually addressable LEDs).
   - Power per LED:
     - At full brightness (all colors at maximum intensity): 0.06 W/LED
     - In real-world scenarios: average 0.04 - 0.05 W / LED
   - Number of LEDs:
     - Front and back LED strip: 60 LEDs.
     - Left arm LED strip: 30 LEDs.
     - Right arm LED strip: 30 LEDs.
     - Total LEDs: 60+30+30= 120 LEDS
   - Power Consumption of LEDs:
     - Assuming an average 0.05 W/LED = 120 LEDs × 0.05 W/LED = 6.0 W

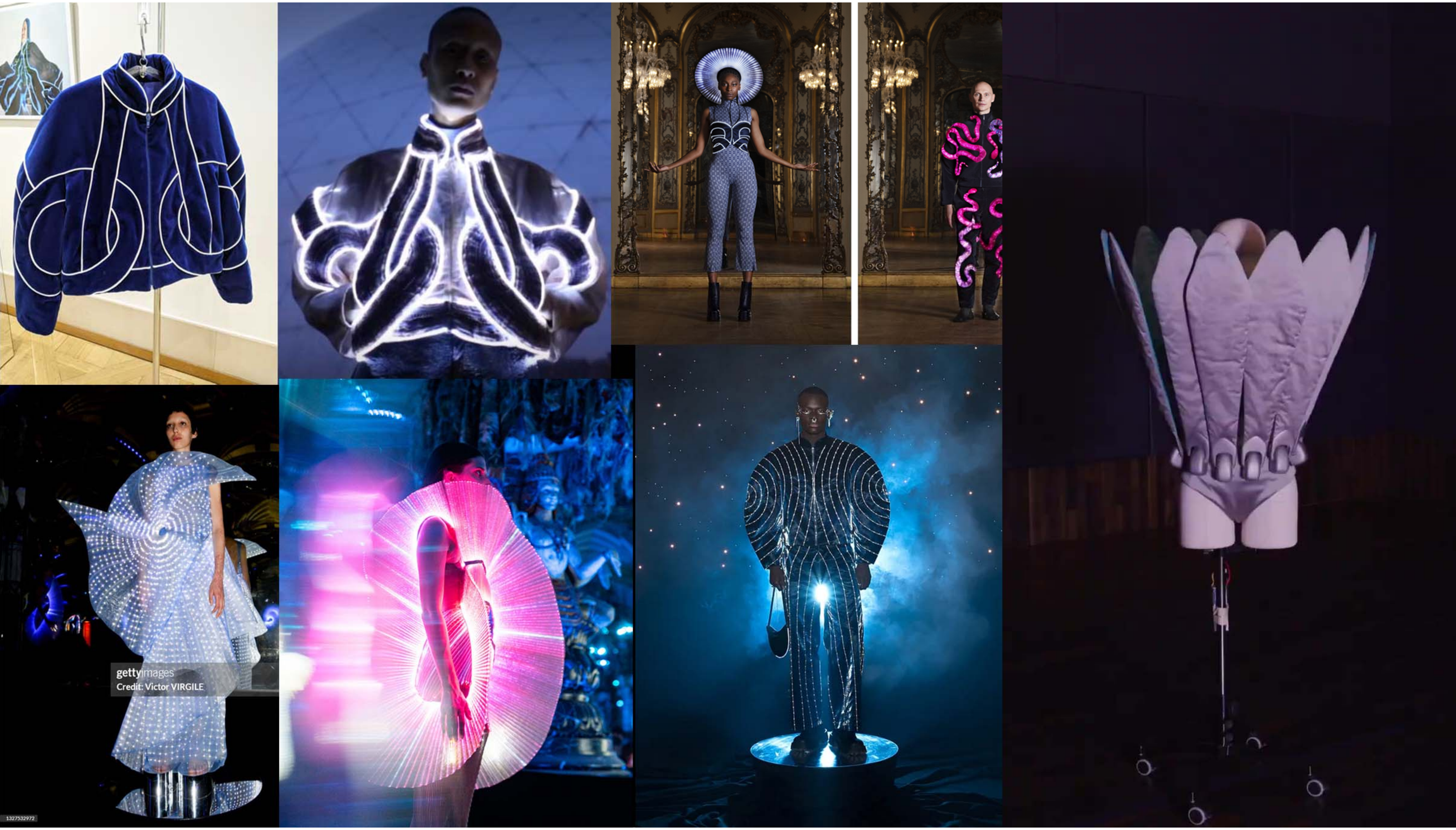
2. Power Consumption of Microcontroller (Arduino UNO)
   - Arduino UNO Power Draw:
     - Idle: 0.1 W (at 5 V and 20 mA).
     - Under load: 0.2 W

3. Power Consumption of MPU6050 (Accelerometer + Gyroscope)
   - Power Draw:
     - Typical operating current: 3.9 mA at 3.3
     - Power consumption = 3.3 V × 3.9 mA = 0.013 W

4. LM2596 Voltage Regulator Efficiency
   - Efficiency:
     - Assumed to be 85%
     - Total power: Power Loss = (Total Power Draw / Efficiency) - Total Power Draw
   - Total Power Consumption:
     - Direct Power Needs: Power(LEDs) + Power(Arduino) + Power (MPU6050) = 6.0 W + 0.2 W + 0.013 W ≈ 6.21 W
     - Incorporating Regulator Efficiency: Actual Power Consumption = Power Draw / Efficiency = 6.21 W / 0.85 ≈ 7.3 W

5. Runtime Estimate with a 10,000mAh, 11.1V Battery
   - Battery Energy:
     Energy = 11.1 V × 10 Ah = 111 Wh
   - Estimated Runtime:
     Runtime = Battery Energy / Power Consumption = 111/7.3 ≈ 15.2 hours

INSPO


gettyimages
Credit: Victor VIRGILE

THANK YOU

WE'LL TAKE ANY QUESTIONS !