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The use of wearable technology in fashion has led to specialized exhibitions such as “Manus X Machina” at the Metropolitan Museum of Art (MET) and “On You: Wearing Technology” at the Museum of Design in Atlanta (MODA). The gap between wearable technology and aesthetic considerations is shrinking as designers develop garments that incorporate wearable technology and fashion. However, a gap still exists in the integration of traditional embellishment and construction techniques with wearable LED technology. Present literature discusses an ease that accompanies working with wearable LED technologies not requiring the designer to possess experience with computer coding (Kim, as cited in Bonnington, 2011, “Angiomatic Kits” section), however, the techniques used in this research did require the use of coding. The aim of this design research is to explore the integration of LED lighting technology using traditional couture sewing and beading techniques in women’s formal apparel and accessory design. This design research was conducted in a case study approach using research through design methodology.

Tacit knowledge in circus costuming using wearable LED technology for visual effect inspired a Ringmaster’s outfit consisting of a coatdress and a top hat. The tailored coatdress is designed with a single-breast front closure and created with metallic brocade fashion fabric and cotton twill interlining. Traditional tailoring techniques such as padstitching and hand sewing are employed. The high-low hem features a teal satin contrast lining. The top hat is handcrafted with a doubled layer of wired buckram covered in baby flannel, lined in teal satin and finished with an embroidered organza overlay on black cotton twill. The coatdress’s symmetrical appliqué is comprised of teal, silver, gold, and blue zircon beads hand-embellished in an ornate pattern on a layer of embroidered black organza. The traditional beading techniques for the ensemble include the use of the following stitches: running, couching, backstitches, lazy stitches, and sequins secured with glass seed beads of various shapes and sizes.

The appliqué is laid over a circuit made of NeoPixel LEDs and conductive thread connected to an Adafruit FLORA microprocessor programmed to emit a “twinkling” effect. Additionally, a “stage lighting” effect occurs through the application of NeoPixels to the underside-edge of the hat brim, casting programmed light patterns down onto the wearer’s face and shoulders. Overall, the beads’ original “sparkle” under normal lighting conditions is greatly enhanced by both the “twinkling” NeoPixels stitched underneath the appliqué and the “stage lighting” effect created by the beads’ reflection of light shining down from the underside of the hat brim. NeoPixel LEDs are “addressable” lights, which means that they can be isolated within the programming code to perform lighting commands independently of each other (Stern & Cooper, 2015). The circuits for both coatdress and hat are powered by AAA batteries in battery packs hidden in easy-to-reach protective pouches in the hat lining and coatdress appliqué backing, allowing for access to “on-off” switches.

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The Neopixels are programmed using modified code from Adafruit's "Learn" forums (Stern, n.d.). For the top hat, a "stage lighting" effect is created through the programming of a "color wipe" (LEDs light change color in a sequential order), "rainbow cycle" (colors fade through a rainbow spectrum simultaneously) and "theatre chase" (twinkling) coding taken from the Adafruit/Arduino "strand test". This piece of coding was originally designed for use in testing circuited NeoPixels, and has been selected for use in the ensemble due to its straightforward modification instructions. This makes it a relatively simple piece of code to alter, given the designer's beginner-level knowledge of computer programming and coding.

One core finding of this design research suggests that a steep learning curve exists in modifying programming code without prior knowledge of computer coding. Challenges include adapting foundational knowledge in electrical circuitry and LED programming, safety precautions for technical components, and the use of brocade fabric with metallic fibers due to its inherent conductivity. In an early circuitry sample, LEDs and conductive thread were applied directly to the metallic brocade, causing a lighting element to overheat and burn a hole in the fabric. To mitigate risk of short circuiting or electrocution, it is necessary to insulate the conductive thread and microprocessor from coming into contact with the brocade fabric. Thus, the aesthetics of the appliqué evolved from a delicately beaded piece into a rugged, reinforced patch.

This exploratory design research resulted in some notable challenges in integrating customized wearable LED technology through application to traditional construction and embellishment techniques in formal wear. Limitations of the design research include the researcher's experience in programming code for LED lighting. In the future, alternative fabrics may be considered in addition to the use of insulated layers to reduce risk of electrocution. Additionally, alternative orders of operation should be explored in applying beading and LED circuitry to ensure an efficient process in the construction and evaluation of aesthetic qualities in the overall design.

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Stern, B. (n.d.). *Pac Man pixel suspenders*. Retrieved from <https://learn.adafruit.com/pac-man-pixel-suspenders/overview?view=all>

Stern, B., & Cooper, T. (2015). *Getting started with Adafruit FLORA: Making wearables with an Arduino-compatible electronics platform*. Sebastopol, CA: Makermedia.

