



Designing An Innovative Technological Wearable Caftan By Arduni

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ABSTRACT

The emerging technologies and the resulting innovative material approaches give rise to new potentials in the field of textile and fashion design and allow the development of creative products through the formation of new perspectives. Intelligent textiles are materials that respond to these stimuli when they are interfered with external influences such as force, temperature, heat, light, chemical reactions, electricity, and magnetic. In the development of wearable systems, the integration of information and communication technologies into a garment or fabric is the most important goal. In this study, about design, engineering, science and technology interdisciplinary collaborative or interdisciplinary electronic textiles, smart textiles, clothes with nanotechnology codes; The concept of fashion intertwined with technology, original application project and current fashion design issues were mentioned. A flexible led and sensor caftan was designed within the scope of the study. The unique design of the kaftan, the grandeur of the selected fabrics and the motifs used for ornaments are highly effective. From this point of view, the T-shape in the Ottoman kaftans in terms of model kaftan, which the author designed from this point, is similar in terms of being brit in front and long-flashy arms. On the other hand, the modern line that the kaftan has to carry in order to conform to the ceremonies in which it is worn in today's conditions is seen in the original design. The product design, in which technology and design are applied together, is revealed.

Keywords : Smart textiles, fashion design, electronic textiles, wearable technology, caftan

1. INTRODUCTION

Since the existence of humanity, textile products have started to be used due to basic requirements such as covering and protection from environmental conditions. Over time, it turned out to be voluntary and fashion came to the fore. Fashion reflects all of the social, cultural, and environmental characters, so fashion describes the person's sense of life at a specific time and place. Fashion is nurtured by society and society adopts temporary innovations which are the necessity of fashion process.

In recent years, it has become popular to bring functionality to textile products depending on the developing technology. At the last point of our arrival, the design of functional and modern textile products has become a necessity for many fashion designers. The smart textiles produced for this purpose are groundbreaking for wearable technological textile products. The most commonly accepted definition of smart materials is that such materials can be activated by physical, chemical or mechanical environmental influences and react to their surroundings predictably and beneficially (Sun, 2015). Focuses on the field of digital fashion and its development by providing an overview regarding fashion design and culture (Nobile *et.al.* 2021). To give a few examples of smart textile application; to determine the influence of heat and printing substrate type on the colorimetric properties of the thermochromic ink printed on various textile materials while subjected to heating simulating realistic conditions of usage. The results of the research can be used as a recommendations for the development of a smart temperature indicators for textile packaging (Djurdjevic *et al.*, 2019).

The interest in fashion is for generations, leading designers to different quests. With the effect of developing technology, fashion is not only the aesthetics of the model, color or aesthetics of the fabric. In addition to visuality, smart textiles are needed to design products with multi-functional superior performance features. One of the first designers to combine technology and textiles is the German textile designer Irene VanVilet. In Copper / Nylon Stripes and Copper Satin Weave designs, the warp of the fabric is polyamide 6.6 and the weft is copper and polyamide. Flexible copper yarn is used on satin braided lines. Polyamide yarn is used in the textured lines with a cloth base. This creates a contrast and gives the surface a soft-radiant appearance. Australian fashion designer Helmut Land has designed an aesthetic-looking, simple silhouette of clothing for a protective garment that absorbs the harmful effects of sunlight and absorbs the light. Textile designer Sophie Roet designed the Wandering Lines-Red fabric. In the warp, she used a shimmering phosphorescent thread, like a brightly colored silk, and a polyolefin phosphorus. When the fabric is exposed to intense light, the phosphorescent-featured yarn absorbs light and shines in light (Ismal and Yuksel, 2016). Airmail dress by Hüseyin Çağlayan (1999), Çağlayan designed his Airmail dress to be folded into an envelope and sent through the mail. The dress—made from Tyvek, a nonwoven, paper-like textile-incorporates the blue and red markings of postage envelopes. His Airmail collection appropriates the actual materials

of global communication to create a streamlined wardrobe for the future". Electric Girls ballet performance is the pioneer of today's led floodlight. Illumination of ballerinas on the skirt of ballerinas is hidden (Yetmen, 2017). In Kinetic Dress design, interactive communication is provided between the clothes and the wearer's moods and mood. Depending on the movements of the wearer, there are patterns with flashing led lights (Rosella and Genz, 2004). In the interactive presentation that starts with heart, breath and trace, we see the garments consisting of technological designs produced by 3D printer technology. Wrapping clothes, colors and patterns create a whole new form of life (Kaprol, 2019). HugShirt was designed to meet the need for human bonding and closeness in 2002. It is the world's first wearable haptic telecommunication garment. This design creates a feeling of embracing and embracing each other away from each other. The temperature and pulse rate felt by a tight embrace through sensors placed inside; via cell phone or bluetooth. Rechargeable and washable. In 2004, he won the first prize in the design innovation category. In 2006, Time Magazine named it one of the best inventions of the year (Rosella and Genz, 2006). In the interactive presentation that starts with heart, breath and trace, we see the garments consisting of technological designs produced by 3D printer technology. Wrapping clothes, colors and patterns create a whole new form of life (Kaprol, 2019). HugShirt was designed to meet the need for human bonding and closeness in 2002. It is the world's first wearable haptic telecommunication garment. This design creates a feeling of embracing and embracing each other away from each other. The temperature and pulse rate felt by a tight embrace through sensors placed inside; via cell phone or bluetooth. Rechargeable and washable. In 2004, he won the first prize in the design innovation category. In 2006, Time Magazine named it one of the best inventions of the year (Rosella and Genz, 2004). This dress is constructed by laying 24.000 full-color micro leds on four layers of chiffon. Tiny micro leds make it possible to change patterns or colors instantly. It is depicted as the world's largest wearable screen. LEDs are 2x2 mm thick. With the Swarovski crystals on the dress, the dress offers a radiant and aesthetic appearance while the leds are not lit (Rosella and Genz, 2009). These T-shirts are customizable. It is the world's first IOS operating system applications. The application animates images, animations, photos, tweets on t-shirts through their applications (Rosella and Genz, 2012). U2 music group, on the 360 ° world tour, wore jackets that accompanied the rhythm of music by reflecting the flashing colors from the small holes on the jacket, thanks to over 5000 LEDs. Real-time wireless control (Rosella and Genz, 2009-2011).

The Italian Rock band wore Google-powered jackets designed by Cutecircuit. These jackets allowed fans to interact interactively with the stage show. The animations and images created by the fans were reflected on the jackets of the singers during the stage performances through mobile phones (Rosella and Genz, 2012).

2. EXPERIMENTAL DETAILS

2.1. Motivation of the Study

An innovative approach is added to textile design every day. Electronic products, sensors, textile products decorated with tools such as Bluetooth or infrared are more common in the market. On the other hand, no matter how advanced technology is, traditional products cannot be abandoned. In this study, it is to give an innovative perspective to traditional caftans, which are frequently preferred in ceremonies, with the help of sensors. By sensing the distance of the other person to the user and the arm movements of the person, the lights on the caftan are turned on in different ways. The selected light and sensor system creates the feeling of being furnished with crystal stone on satin fabric. Within the scope of the study, the theme, materials, application method, arduino principle for the caftan, which is the subject of the study, are explained in detail. The visuals of the product are given in detail and the story board of the study is presented in the last section.

The primary purpose of this study to make a comprehensive research on fashionable textile products, smart textiles, designers who design technological clothing and fashion. After the research, a sample application was made using fashion and technology together. This application focuses on electronic, textile and fashion trilogy. During the application of a sample garment designed, the most suitable materials for this garment were selected and the applicable electronic system planned for the product. In this way, a modern caftan design was realized by using led lights as a smart textile application with the Ottoman caftan from our traditions. It was modernized by combining the old with the new.

3. RESULTS AND DISCUSSION

3.1. Research

Electronic textiles (e-textiles) are derived from the combination of textile materials with electronic evenings to serve a particular purpose. The elements that make up the system are designed for each product, as invisible as possible and cannot be easily integrated into other systems. They are easy to adapt to issues such as e-textiles, measurement, power control response. It is thought that the clothes of the future can be controlled by computers. In this study, the latest developments in smart textile, materials and their production processes are mentioned. Each technique shows the advantages and disadvantages and our aim is to emphasize a possible balance between flexibility, ergonomics, low power consumption, integration and ultimately autonomy (Stoppa and Chiolerio, 2014).

The common feature of textile materials is protection from external factors and aesthetic features. Today, smart textiles are used to bring a new dimension to textiles to meet the rapidly changing needs of consumers. With the electronic measurement and storage features of these systems, new wearable electronic systems emerge. In this article, the concept of i-textile is presented together with building blocks for its realization (Park and Jayaraman, 2003).

As the subject of the study, the caftan from the Ottoman Empire to the present has been chosen. Women's caftans are also an indicator of existence and prestige goods from the Ottoman period to the present. It indicates the status of women with its fabric, embroidery, fur and accessories. Research covers product type, product accessibility, theme and story of the materials to be used in the product, user profile, budget and cost analysis.

- ✓ Type of caftan
- ✓ Trend forecast
- ✓ Material availability
- ✓ Theme and story line
- ✓ Clients profile
- ✓ Budgeting and costing

3.1.1. Theme and Story Line

The concept of the implementation project is determined as a nature event, the frost. Humidity that the air cannot carry turns into these crystals on plants, soil or leaves due to cold weather below zero degrees, which is called a frost. When a mother embraces her child, the drop falling on her cheeks from her pupil is called a frost too (Figure 1).



Figure 1. Frost and tears
(Designer: Vasily Koval, 2019)

In the scope of the study, it was decided to design the Ottoman Caftan which was developed with the application of led wearable technology as the original application project. The legacy of Turkish culture, the symbol of power and status, the Ottoman sultan caftans made the name of the whole world and inspired many artists and designers. Caftans, which are at the forefront of the Ottoman garments, have a unique beauty as a work of art with their excellent fabrics and patterns as well as hidden design elements such as mold features, hand stitches and decorative elements. The design process was based on Ottoman caftans for the shape of the caftans, and today's caftans for material selection and decoration.

The aim of the research is to combine the Ottoman caftans, which are adapted to modern life with their lines, with engineering applications. Therefore, in the focal point of the inspiration of the frost, beaded laces and flexible strip leds were used.

The color of the caftan is selected is green. Green is the color of nature. It symbolizes growth, balance, harmony, freshness, life and productivity. To simulate the ice crystals on the edges of the green leaf of the rime, the led is placed on the ends of the arm, body and skirt of the caftan. Just like crystals, LED lights show light from different angles. For this reason, sensors were placed and breaking effect of light was tried to be reflected.

The geography we live in is the design of a very popular garment and the transformation of traditional into an innovative garment by replacing the accessories used in the current versions of this garment with technological objects. This dress aims to be unique by the day it is worn. It is aimed to stand out from existing designs technology. It is planned to wear a young mother in the presence of a baby. The process of marriage in Turkey is quite colorful and comprehensive with conceptual ceremonies such as asking for the girl's hand in marriage, engagement, dowry, bridal bath, henna night, wedding, looking at the bride, bridal invitations. After the marriage is crowned with a child, a mevlid (a ceremony with praying) is arranged in order to the baby to be a good son for his family and nation. The mother wears a caftan. This caftan is one of the most ostentatious legacies of the Ottoman Empire. Caftans, which are at the forefront of Ottoman clothes, are the indicators of power and status for those around them despite their simple form. As in all societies, the baby is the greatest symbol of fertility, continuity and life. Mothers and babies are praised during prayers and are expected to make good wishes for the continuity of the family. Turkey is an example of a country that succeeds in conveying the traditions to the next generations. Since all the rituals were performed in a conceptualized way, the baby mevlid inspired this work.

In our study, the accessories used are;

- ✓ Woven satin fabric
- ✓ Lining fabric
- ✓ Wadding
- ✓ Ribbon leds
- ✓ Battery and switch
- ✓ Lace and beads for trimming

The choice of clothing in the Ottoman Empire was not based solely on functional or aesthetic criteria. Clothing was considered as a symbol of professional and social status (Özcan, 2009). During the Ottoman period, the caftans, which were a symbol of the power of the sultans, were used as outerwear by both men, women and children. Sultan caftans were not only political power; it was an indication of the rich taste of the Ottoman art and creativity. They had a T-shaped form and therefore had a very simple structure. Similar form, since the very old times that had the property. However, caftan, in Ottoman clothes, was a designer who was very important and seeking reputation and became one of the first terms that came to mind when the Ottoman Empire was mentioned. The caftans, which had a very large body size, were further extended with triangular pieces down the waist. The caftans were open from the front and usually had slits on either side of the skirt ends or in the rear center

(Ok, 2015).

In our special application project, the traditional forms and patterns of Ottoman caftans were set out. The caftans were designed from the front with an open, collarless and small upright collar. Front with ribbon or brit button.

In accordance with the aim of the study is to add bright lights to the Ottoman caftans which are adapted to modern conditions with modern lines and to make them remarkable; design knowledge, fabric knowledge and engineering applications were brought together. In the light of the caftan models examined, an original caftan design was made in accordance with the brand, modern, theme and geography to be used. The design started with the search for suitable fabric types. Since the product was intended to be used on a special night, woven satin fabric was decided.

This fabric was chosen because it had a natural, smooth and shiny surface. In addition, the fabric was rather pale and thin enough to allow light to pass through. A green hue is chosen to match the theme.

The design stages of the caftan, sewing and placement of electronic components were carried out as follows:

- ✓ In order to make the caftan to be designed commercially, the market analysis was done and the models and preferred fabric types that are frequently used in modern cafts were investigated.
- ✓ Green satin was chosen for caftan and gold satin was chosen for lining.
- ✓ After deciding on the choice of fabric, the necessary fabrics were taken for the design of caftan according to the measurements.
- ✓ Sample drawings of the planned caftan model were made. The location of the planned leds was decided (Figure 2 and 3).

Wearable technology for textile sample application; firstly, the fabric and leds required for caftan design were started by selecting. By bringing cultural materials and technology together, this exemplary application has emerged as a result of transforming the imagination into a fashion design process in a special design and application process. The exemplary application is carried out in all stages from the basic starting point to the sewing of garments and the integration of technology.

- ✓ Traditional materials and techniques were combined with advanced technology and new methods in the application project, which utilized the Ottoman caftans as output sources.
- ✓ With the help of the molds prepared according to the sample drawing, the lining of the caftan was cut and sewed.

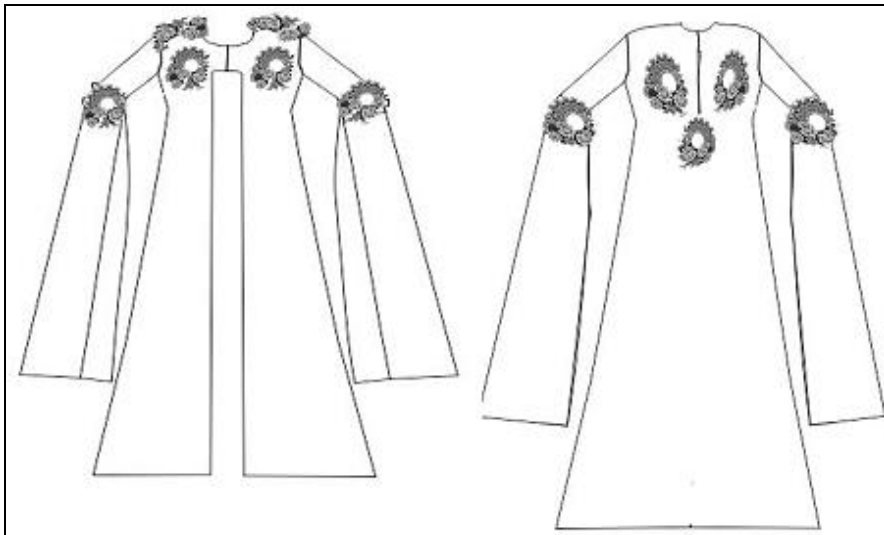


Figure 2. Sample drawing- face and back side of the caftan



Figure 3. Sample drawing- front of and back side of the caftan

Led garments give wearable technology a different field of application. These designs were visually captivating beyond functionality. Led products have been added to the hem, armhole and collar of the caftan designed within the scope of the study. The following factors have been considered for installation:

- ✓ Required ribbon length
- ✓ Power and voltage requirements
- ✓ Direction of LEDs on the strip
- ✓ Flexibility of LED strip lights
- ✓ Whether components such as connectors are required
- ✓ Whether the ribbon needs to be programmed

Strip Led: Thin conductor circuit bands consisting of small led bulbs. Small LED bulbs are arranged on a flexible and thin strip. It has been preferred in our original application project due to its wide usage area. It has self-adhesive structures.

Strip LEDs according to their light power; single chip led strip and three chip led strip. LED Strip is made up of SMD LED chips arranged on a flexible pcb. These SMD packages are white boxes on the strip LEDs. If there is 1 chip in these boxes, these strip LEDs are called single chip, and if there are 3 chips, they are called 3 chip strip LEDs.

Single color LED strip is available in many colors such as red, green, blue, amber, white and daylight.

According to usage area; Silicone and silicone-free models are available.

Silicone coated strip leds used for outdoor are preferred at the front and arm edges of the caftan (Figure 4). SMD packages on these leds have silicone coating. This coating was preferred because it protects the strip led. As it prevents oxidation, it also extends the life of the strip led.



Figure 4. Silicone single color led strip

At the skirt end of the caftan, analog strip leds were preferred to prevent visual disturbances during movement. It is preferred because there is no silicone coating on these leds and because the skirt is a moving area (Figure 5).

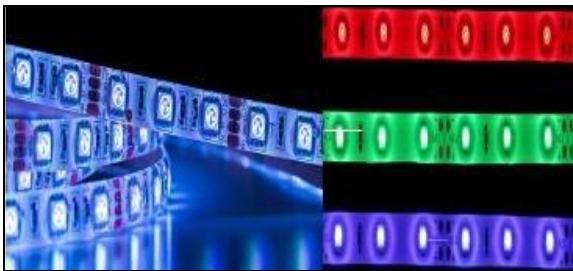


Figure 5. Analog single color led strip

3.2.Application

- ✓ For the caftan sewing, the lining was cut and sewed first.



Figure 6. Preparation of the inner dress and caftan

- ✓ Then cut the inner dress and caftan and sew.
- ✓ Arms mounted last.
- ✓ Led cables were cut according to the dimensions of the application areas (arm, body edges and skirt end).
- ✓ Sample fabrics for which led light is applicable were selected. Led lights were tested on satin, velvet, tulle and organza sample fabrics of different colors.

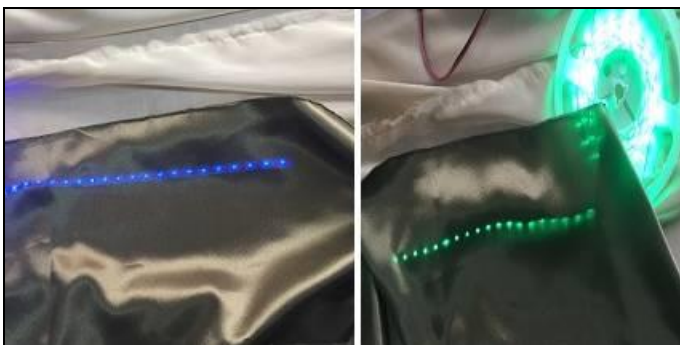


Figure 7. Testing of different color leds

- ✓ Self-adhesive flexible strip leds were placed on the lining. In addition to the bonding technique, the leds were sewn onto the fabric and secured.



Figure 8. Sewing flexible leds

- ✓ The leds integrated into the fabric were connected to the power supply by means of soldering process and are made operable. The lining was then stitched together with the lining itself, thus preventing the integrated leds from being damaged and distorting the aesthetic appearance. In order to reach the power sources to which the leds were connected and to make them operational, hidden eyes were created at certain points of the caftan. Thus, it was possible to replace the batteries and operate the leds with the control system. The batteries of the leds in the front of the caftan were hidden by creating a special area under the laps. In order to provide access to the batteries of the leds in the arms and the skirt of the caftan, hidden eyes were created in a way that would not disturb the visuality.



Figure 9. Integration of leds into the fabric

After the led system was integrated into the caftan, we can control the leds in front of the body by means of the added sensor. Sensor system; It consisted of arduino controller, light sensor, resistance, voltage amplifier, battery and led strips.



Figure 10. Placing sensor systems on the caftan

Finally, using different materials (lace and beads for trimming), the caftan was transformed into a different design. Thus, while the led lights do not light, it was intended to be a caftan with fascinating beauty. The motifs were carefully cut on the selected fabric. Then carefully placed on the front and back of the caftan.



Figure 11. Adding of accessories over the caftan

LEDs and sensors were placed on the caftan, which is sewn in accordance with the design. Sensor and led lamps worked with the help of batteries integrated into the caftan (Figure 12).



Figure 12. Batteries used inside caftan

The arduino coding system was used to activate the said leds according to the user's movement and other people's approach to the user. The electronic diagram and coding system of the sensors were given in Figures 13 and 14.

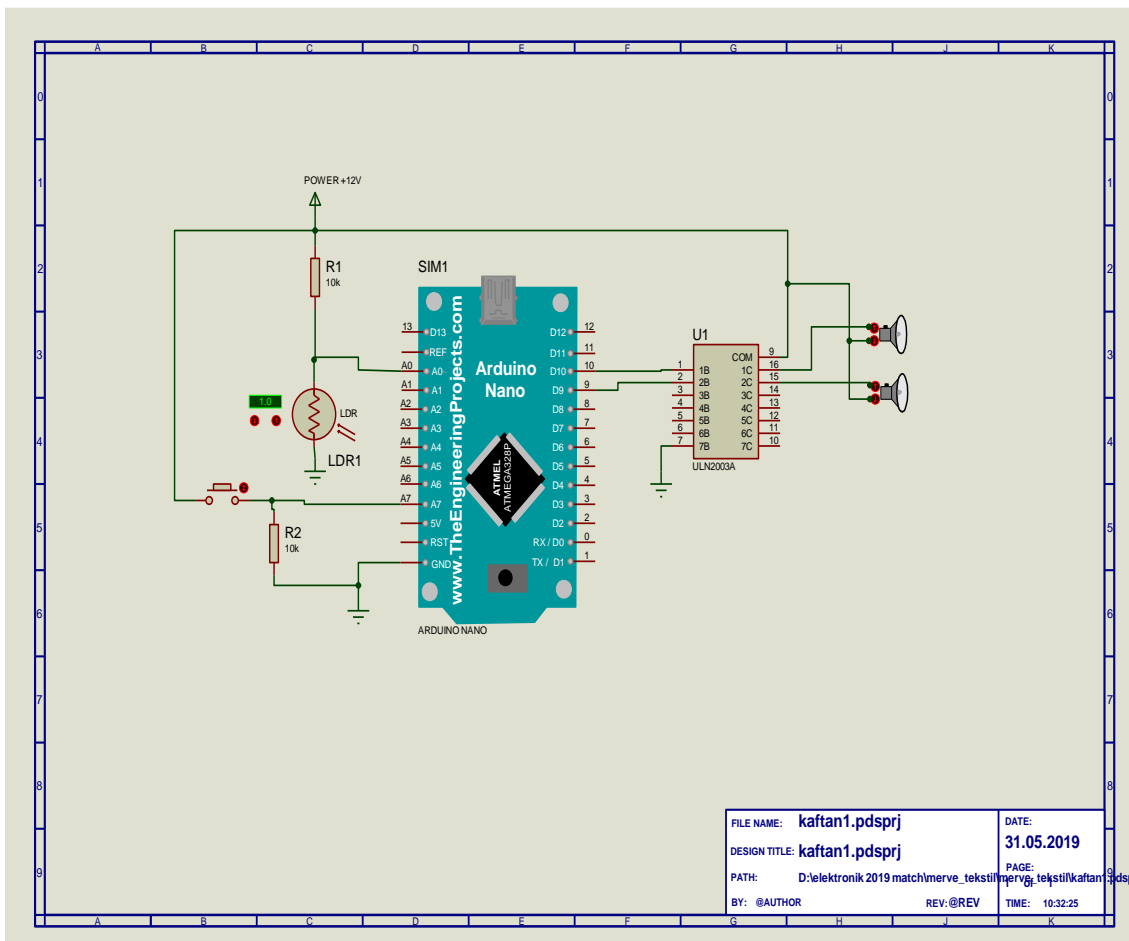


Figure 13. Electronic schematic of sensor system


```

const int ledPin = 2;
//const int button = 0;
const int ledPin5 = 5;
const int ldrPin = A1;
const int button = A0;
void setup() {
  Serial.begin(9600);
  pinMode(ledPin, OUTPUT);
  pinMode(ledPin5, OUTPUT);
  pinMode(ldrPin, INPUT);
  pinMode(button, INPUT);
}
void loop() {
  int ldrStatus = analogRead(ldrPin);
  int button = analogRead(button);
  if (button <= 20) {
    digitalWrite(ledPin, HIGH);
    digitalWrite(ledPin5, HIGH);
    Serial.println("button");
  }
  else if (ldrStatus >= 600) {
    digitalWrite(ledPin, HIGH);
    digitalWrite(ledPin5, LOW);
    delay(100); // wait for a second
    digitalWrite(ledPin, LOW);
    digitalWrite(ledPin5, HIGH);
    delay(100); // wait for a second
    digitalWrite(ledPin, HIGH);
    digitalWrite(ledPin5, LOW);
    Serial.print("Its DARK, Turn on the LED : ");
    Serial.println(ldrStatus);
    Serial.println(ldrStatus);
  }
  else {
    digitalWrite(ledPin, LOW);
    digitalWrite(ledPin5, LOW);
    //Serial.print("Its BRIGHT, Turn off the LED : ");
    Serial.println(button);
  }
}

```

Figure 14. Code for sensor system

The images of the caftan designed within the scope of the study are presented in Figure 15. In addition, a storyboard for the product was prepared and given in Figure 16.



Figure 15. Face and back side of the product

CAFTAN

The concept of the implementation project is determined as a nature zero, the frost. Humidity that the air cannot carry forms into these crystals on plants, soil or leaves due to cold weather below zero degrees, which is called a frost. When a mother embraces her child, the deep falling on her cheeks from her pupil is called a frost.



Figure 6.1 Frost and Tears

The aim of the project is to combine the Ottoman caftans, which are adapted to make a life with their lines, with engineering applications. For this purpose, in the final point of the inspiration

of the frost, beaded lines and flexible strip leads were used.

The color of the caftan is green.

Green is the color to nature. It symbolizes youth, balance, harmony, harmony, the clothes, life

and productivity. For this reason, green color was chosen for caftan design. To simulate the ice crystals on the edges of the green leaf of the rim, the cuff is placed on the ends of the arms, stem and

stem of the caftan. Just like crystal, LED lights show light from different angles. For this reason, sensors were placed and refraction effect of light was tried to be visible.



DESIGN THROUGH AND STAGES



NERVE UNCUOGLU

Figure 16. Mood board

4. CONCLUSIONS

With the developing technology, the expectations of the users are increasing day by day. Textile products also vary depending on the development of technology. The speed of our age also affects the textile sector. In particular, the fact that the manufactured products are susceptible to fashion causes the expectations to change and accelerate. This has led the concept of sustainability to come to the fore in fashion as in all other areas.

It is important for designers to make fashion forecasts and follow-up. However, with the effect of globalization, it has become more important for fashion designers to make different designs. To protect the sector, focus is on slow fashion. However, slow mode alone cannot provide sustainability. For this reason, textile manufacturers are trying to bring textile together with a different technology day by day.

Technological developments and emerging innovative material approaches give rise to new potentials in the field of textiles and fashion design and enable the development of innovative products through the emergence of new products. The use of intelligent wearable textiles is becoming widespread for this purpose. With smart textiles with superior performance features, technology has now become part of our body. And the future is beyond our imagination.

Designing a wearable technology differs from all other designs. Because this designed product should meet a need and be controlled by a wearable computer or other technological device. Furthermore, since this will be a textile product, it is very important that it is usable, fashionable, reproducible and easily applicable. Innovative wearable technological textile products, health, defense, security, communication and so on not only in areas but also in the fashion world. In this way, designers push the boundaries of creativity and innovation to produce products out of the ordinary. When the design processes are examined, it is seen that the concept of multi-discipline plays an important role. These products make life easier and improve the quality of life.

The use of information and communication technologies on garments and the integration of technology with textiles resulted in wearable technology products. These innovative products, which are no longer a product of imagination, are included in our lives, making life easier and improving the quality of life. Caftan, the subject of the study, has always symbolized strength and status for centuries. The unique design of the caftan, the grandeur of the selected fabrics and the motifs used for ornaments are highly effective. From this point of view, the T-shape in the Ottoman caftans in terms of model caftan, which the author designed from this point, is similar in terms of being brit in front and long-flashy arms. On the other hand, the modern line that the caftan has to carry in order to

conform to the ceremonies in which it is worn in today's conditions is seen in the original design. The main reason why the author made this application is to put together a multidisciplinary study by combining textile, technology with design and engineering applications.

The purpose of this application;

- ✓ To be able to design a caftan with modern lines starting from the design process, including theme and drawing elements. (Ottoman caftans and contemporary caftans have been studied in detail and a unique caftan has been designed in accordance with the purpose of both).
- ✓ To be able to choose fabric and accessories according to the product and theme. (Suitable for the selected frost as a theme, green color satin woven fabric and white color flexible led lights are combined in light of engineering information).
- ✓ To be able to add the bendable led lights to the designed caftan without disturbing the wearable form of the caftan. (The placement of the leds without disturbing the wearable form of the caftan is provided by lining, wadding and elastane bands).
- ✓ To control the LED lights with the help of a light sensor can be realised. (Led light is installed in 3 different areas including body, arm and skirt tip of the caftan. Each can be controlled separately. With the help of the light sensor used, the shape and level of the LED lights can be changed). Within the scope of the exemplary application, a caftan with flexible leds and sensor is designed.

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