Tie Design using Electrical Conductive Fabrics

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Abstract

One of the clothing requirements, especially for men, is the tie that was initially used by the ancient Iranians. The designing of ties without an Iranian design on them, despite the fact that they are originated out of Eastern traditions, is one of weaknesses of fabric and clothes design. One of the new methods to create designs on textiles is the use of new technology; in this research light was used for tie design. Due to the replica tie designs on the market, this study attempts to use original Iranian designs, through conductive fabrics, to produce light and to create a new design. This study uses graphene oxide for the production of conductive fabrics. Finally, the tie design by passing electric current through the tie has been simulated and a set of tie designs are provided.

1. Introduction

Originally, ties were used by ancient Iranians, and after that they were used by the European countries. The word 'tie' is taken from the word 'Croix', which means connecting two things together. After surfing the internet, and searching through dictionaries and English Encyclopedias, it was concluded that in Dehkhoda dictionary the tie is stated as tying two things together. Tie in English is known as either 'Cravat' or 'tie'. According to Webster dictionary, the word is taken from the French word 'Cravate', originated about 1656 years ago, which refers to a scarf that is tied around the neck. In Oxford dictionary, tie is defined as a short and narrow strap used by men, which is tied with a knot around the neck. The word was first mentioned in the Oxford dictionary, and it came into existence in the 17th century, in France. Tie is taken from the word 'Croat', because for

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the first time it was used by Croatian soldiers (Croat ethnic) who served in the French army (Mohaghaghi, 2005: 1). According to the above documentation, a great similarity exists in the meaning between the word 'tie' in Persia and 'tie' in England, but there is no common roots for the two words. Therefore, this issue should not be discussed without close examination.

In British and French cultures, it has been said that the term 'tie' started to spread from the mid-17th century. They state that Croatian soldiers (from Croatia) in Hong Kingdom, also called 'Croate' during the era of Louis XIV, tied scarves around their necks, and that this custom began since that era. Perhaps the people of France in the 17th century learnt from the Croatian soldiers to tie scarves around the neck, and even if we accept that the neck scarf is named 'tie', there is no reason to deny this issue, because the origin of this term is from Persia, and relevant document evidence supporting that exists. In the beginning, Avesta was studied, which is a book that dates back to thousands of years ago; it mentioned twelve things that are needed by a man in war, the eighth word of which is 'Coeres' taken from the word 'Coerat' (a tie or bow tie), and it is said that Coerat was tied to the armor. Figure 1 shows the image of 'Shapur I', the son of Ardeshir Papkan, carved on stone in Naqsh-e-Rajab, and a tie or something similar can be seen (Mohammad Moghaddam, 1935: 30).
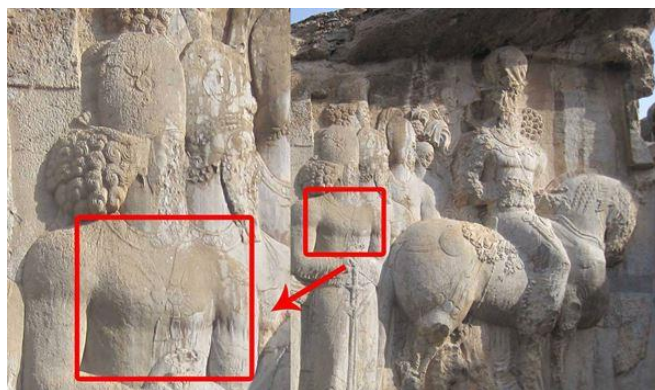
Fig 1 Shapur I son of Ardeshir Papkan in Naqsh-e-Rajab written on stone (Moghaddam, 1935: 30)

Previously, the tie was wider and was tied on the front of the chest, and as seen in the figure, the kings and noble guards wore it. This phenomenon can also be seen in many figures engraved on the stone in Taq-e-Bostan, as well as on ancient coins. One can say that bow-tie came to existence with a slight change in the tie. This front chest was seen as an ethic until the Safavid period. Some images on the stone walls of Persepolis museum and the coronation ceremony of Ardeshir II depicted on the stones in Taq-e-Bostan, along with images of the kings of ancient times prove these claims (Moghaddam, 1935: 30).

Noel Malcolm, an English scholar, in his book entitled, 'A brief history of Bosnia', believes that tie for the first time was brought to Europe from Iran. The Iranians, in order to be different from others, used to tie a fabric on the front of their shirts. However, according to contemporary history, tie was brought to France by the Croatians (Moghaddam, 1935: 31). The origin of tie is from Iranian people, although it has gone around the world through France, and was used in 1656 by Louis XIV. It is interesting to know that Croatians (Croatia) in south-east Europe were actually the ancient khoravats (khooravat) or (khoorabad) that had migrated to Balkan Peninsula. They hung beautiful cloths for aesthetic purposes (Moghaddam, 1935: 31). Noel Malcolm has named this term as 'friendly' (khoorabad). This term is still used among the people of Kermanshah and Illam as 'khoorava'.
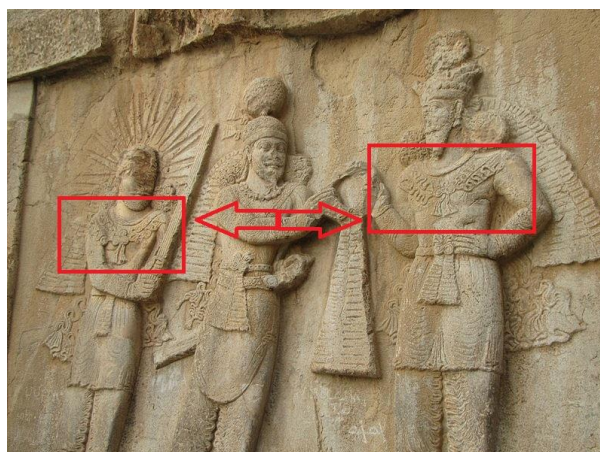
Fig 2 Ardeshir II in middle, Ahura Mazda right and Zoroast at the left (Moghaddam, 1935: 30)

Noel Malcolm has conducted a research in his book on the Iranian connection to the past of Yugoslavia. He believes the term 'tie' or 'Hravat' does not have any roots in the Serbian language. This term is similar to the Iranian name which has been found on stone plates in the area of Greece, in southern Russia. The root of the name is khravat, which in Avesta means 'friendly'. Historical research shows that the Croatian race from 3000 years ago migrated from Iran, to Croatia, Serbia and Bosnia. Perhaps, the great peak of migration to these nations was 1700 years ago. The reason of this migration was the suppression of Manaviyan in Sasanian period. Based on the research conducted by Noel Malcolm, the term 'Serb' is taken from the Persian term 'Charv', which means flock. According to old documents, Serbian and Croatian people include people with Persian roots who later joined the Slavic people. Noel Malcolm believes that the new theories in this context are consistent with historical evidence. Some Croat theorists prefer their common heritage to be Iranians, rather than Slavic. Such theories, especially during World War II, were strengthened when the Iranian race were classified higher than the Slavic races, according to the Germans. As stated by Malcolm, Croats and Serbs were refugees from Iran who migrated at the same time to Balkans. The early migrators, in order to be distinguished from other nations called themselves 'khravat' or 'Croat'. These immigrants tied beautiful scarves around their necks that later were popularly known as 'tie' worldwide.

In 1656, Louis XIV formed the Croatian regiment of volunteers in his army. Members of the regiment, according to their predecessors, tied a silk handkerchief around their necks with a knot at the end. This handkerchief was also tied around the injuries of the soldiers. Since then, the silk handkerchief was accepted as a part of the military ornament in the French army, and the term 'a lacroate' entered the French language. After 170 years, neck-tie became official worldwide (Moghaddam, 1935: 31). Hence, the French people wore neck handkerchiefs which had originated from the soldiers, and named it 'Tie'. The term 'tie', and the way to tie it does not have a classical background because the Europeans made a 'national origin' and associated it with the Croat soldiers (Moghaddam, 1935: 32). With regard to the picture carved in Naqsh-e-Rajab (3 km north of Persepolis) (fig 3), and according to 'Hearthsfield', Papak is the father of Ardeshir who is wearing (med) clothes, and it is quite clear that 'koeret' and the term 'tie' is taken from there.

This tie is wider, and was tied by the kings and high-ranking military men. It is seen in the figures carved on stone and ancient on coins. For example, the stone carving in Tagh-e-Bostan (fig 4).

Fig 3 Picture in Naqsh-e-Rajab (3 km north of Persepolis) (Moghaddam, 1935: 32)

Fig 4 Stone carving at Tagh-e-Bastan (Moghaddam, 1935: 32)

This background, until the Safavid period and later, was the custom seen on Shah Abbas's figure (fig 5). In French language, it is 'Cuirasse' which is taken from the Italian word 'Corazza', and its origin is 'kuress', from Avesta.

Fig 5 Cuirasses (Moghaddam, 1935: 32)

According to the Europeans, 'Cuirasse' has been used since the 15th century in Europe and since it had no classical background, it came up with the original term 'Corocea' which originates from 'Coriaceus', meaning 'leather' and from the Latin word 'Corium', meaning 'leather'.

In Mazandaran, people wear local costumes, and the custom that the groom wears on the wedding night includes a red or green scarf which is worn around the neck. It symbolises close attachment to someone, just like wearing a ring on the ring finger. In author's opinion, tie in ancient Iran was like 'kosti', a religious symbol relating to a place. Kosti is a rope tied to the waist, and tie was worn around the neck (Moghaddam, 1935: 33). However, tie in Persian dictionary is a light and delicate fabric which is knotted around the neck in a special way and hung in front of the chest (Moghaddam, 1935: 33).

2. Tie Psychology

Scientifically, what thoroughly reflects the changes in the body appearance, and all the materials added as a supplement to the body are called clothes. These changes can be permanent such as plastic surgery, or temporary like using perfumes. However, the changes and extension in the body can be one, several, or can even affect all the human senses. But what we consider as things to wear are in fact supplements, used for different purposes such as beauty, protection from the cold and heat, chastity, piety, etc. Fashion design researchers Higgins and Eicher have considered two basic functions for clothes; one as the modifier component of the body, and the other as the medium for communication (Higgins and Eicher, 1992).

The design of cloth is mostly made up of colors, textures, lines, and shapes that come from the engagement of body with the changes (Delong, 1998). According to the definition, the shape of

clothes includes all the details of the appearance, such as the outline, shape of buttons, and the cutting of sleeves and collars. Every piece of clothing and apparel requires thinking and thoughts which forms the motivation of its production and design. The message present in the clothes may be functional or esthetic or it may be a collection of signs, including social, cultural, political and mythical messages (Mosavi and Tavanaei, 2005:1).

Clothes serve as an interface that protects the human body from the effects of the physical environment and psychology. People may wear necklaces and amulets or in some cases clothes for luck, good fortune, and to repel evil spirits, which shows that clothing items can be considered to hold powers, in the minds of people. Social psychology is the study of people in social contexts, and with respect to the important role of clothing in the society, it also investigates the beliefs, attitudes, emotions and different behaviors of individuals regarding clothing. Nowadays, clothes are an important part of cultural studies in the science of anthropology. Scientists believe that the clothes of each person have a direct effect on the recognition process. Most of us believe that the way of wearing clothes plays an important role in communicating with others, and in our individual attractiveness. Scientists have written a number of texts in order to study the effects of clothes on people's psychological processes, and with their interactions with the environment. As a result of these studies, they found out that clothes stimulate the body and the brain, and that the clothes which people wear put them in different psychological states.

In addition to the effects of clothes on the individuals wearing clothes, they also create feelings and emotions in people who see them on others. These feelings are different with respect to characteristics such as gender, age, talent, skill, knowledge, experience, and interest. These individual characteristics are highly effective in individual interaction (Delong, 1998). Therefore, the person wearing clothes should be aware of the consequences and effects of clothes worn, and to know that others will judge them what one is wearing. For example, sometimes the clothes with light or dark textures, and with shapes and curved lines create an impression of subtlety and femininity, and in other cases, for an older person, it creates the feeling of nostalgia and association with the experiences of adolescence. Therefore, time, location, values, past purposes, and present society has a huge impact on the viewer of clothes.

The emergence of 'fashion' plays an important role in the change in people's attitude in relation to the type of clothing and lifestyles. Fashion is an innovative look that has constantly changed and evolved over time and in response to the cultural values of the society. Fashion as a model accepted by the society usually means 'up-to-date' and 'novel', and it leads to the creation of new and innovative products. This innovation is due to new technology, cultural events, or designers' creativity. Fashion is a social phenomenon, which on the one hand the person is accompanied by the community, and on the other hand it distinguishes the person from others (Javadi and Sayedal, 2007: 3). This phenomenon provides suitable ground for economic growth in a way that is in harmony with the cultural values and social arts. In today's fashion world, designers try to change the public taste by encouraging people to wear the latest fashion clothing, shoes, jewelry, and other items. Recently, fashion has become one of the important criteria in evaluation and aesthetic of costumes.

3. Aesthetic and Coordinating Costumes

The aesthetic of clothing includes science that helps to improve the quality of people's lives and provides human satisfaction. In general terms, aesthetic is the satisfaction that is achieved after experiencing with the five senses of humans, namely sight, smell, touch, hearing, and taste. This pleasure may be generated in the person wearing the clothes by recognizing the values and benefits

of a good design. The study of aesthetics of clothing is devoted to the types of clothes, effects of clothes on people or on the person who is wearing the clothes, and the attitude generated by them at a particular place and time. In simple words, aesthetic of clothes argues about how people can choose; so that their attire looks better in the eyes of others. Also, aesthetic includes the discovery of the nature of fashion. Understanding aesthetic is the response to the viewer or the person wearing the clothes, through awareness of the form of clothes, the physical and cultural environment, and the interaction between them (Delong, 1998).

Every day, most people before leaving home come across the question of 'what to wear?' and spend a lot of time to choose the clothes to wear. This is because they intend to choose the best clothes according to their choice and sense of fashion so as to create the maximum impact on their social relationships. The concern of people in the selection of clothes is their coordination. Coordination is an English word made of two Latin words (co) and (order) which means 'sort the order'. Being well dressed, like a painting or a photograph is the combination of beauty and harmony. The question is how one can put together various pieces of clothes such as suits, shirts, ties, belts, shoes, socks, and sweaters to create a positive image? Research has shown that there is a simple answer to this question, and it is the fashion industry at the time, as well as the different cultures. In fact, there are four important elements in the choice of clothes regarding harmony, and by focusing on them one can create a fundamental change in their image. These four elements are design, color, weight, and texture. Selection of types of designs or motifs of fabric can lead to the clothes being viewed as cool or ridiculous by others. Color has a major impact on the person wearing clothes according to the psychological properties of colors, which convey messages such as trust, vitality, etc. The texture and weight of fabric is in direct relation with the different times of day or year (Javadi and Sayedal, 2007: 3).
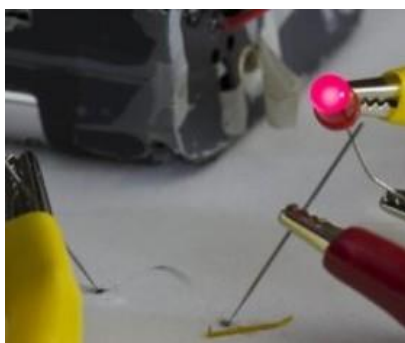
4. Conductive Fabrics

4.1. World's First Electronic Textile Production

An international team of researchers have succeeded in producing the world's first electronic fabric using graphene.

Researchers in the system and computer engineering institute of the University of Exeter, as well as the micro systems and Nano-technology in Lisbon, Lisbon University, Aveiro Company in Portugal, and textile research center in Belgium have developed a new method for merging the flexible and transparent electrodes in the fiber of fabrics. This discovery could produce a wearable, lightweight, durable, and portable electronic device such as a piece clothing containing computers, mobile phone and mp3. Graphene, with a thickness of one atom is the thinnest material with the capability of electrical conductivity. This material is flexible and is known as the strongest material around. In recent years, scientists and engineers have been trying to use graphene in wearable electronic devices. New research has shown that a single layer graphene has electrical, mechanical, and optical properties. This has given an attractive offer as a transparent electrode to be used in wearable electronics. In this way, graphene is manufactured by a method known as 'Chemical Vapor Deposition' (CVD) on copper coils, using a new system called 'Nano-CVD'.

The researchers have invented a new method to convert graphene from copper coils to polypropylene fibers, which have been used in the textile industry. According to the scientists, this achievement can be of great help in wide sectors of health care and hygiene. The result of this study is published in the journal of Scientific Reports.

Fig 6 World's first electronic textile production using graphene

5. Methods for Conductive Fabric to Produce Tie

5.1. Materials and Goods used:

Polyester fabric, and the specification of chemical used is shown in table 1 and 2.

Table 1 Cloth properties in use

Type of weave	Manufacturer	Thread type wrap and weft	Weight (g/m2)	Warp density (1/cm)	Weft density (1/cm)	Description
Wreathy	Yazd Bafth	Warp polyester viscose and weft 100% polyester	145	30	36	-

Table 2 Specification of chemical material used

Material name	Name of Manufacturing company	Chemical formula
Graphite	Merck Germany	C
Sulfuric acid	Merck Germany	H_2SO_4
Potassium Permanganate	Merck Germany	$KMNO_4$
Hydrogen Peroxide	Merck Germany	H_2O_2
Hydrochloric acid	Merck Germany	HCL
Aniline	Merck Germany	C_6H_7N
Hydrogen Sulfide	Merck Germany	H_2S

5.2. Instrument and Equipment

Specification of the instruments and equipments used in this research is summarized in table 3

Table 3 Specification of the equipment used

Name of the Instrument	Manufacturing company	Description
Aven	Shimi fan Germany	-
Magnetic stirrer	BANTE MS300 Magnetic stirrer	-
Digital scale	KERN Germany	Accuracy 0.0001 gram
Ultrasonic	VICNZA Italia	-
FTIR	BRNKER Germany	-
Centrifuge	KOKNSAN Japan	-
Ohm meter	MIOKI Japan	-

6. Methodology

6.1. Fabric Preparation and Surface Modification

Polyester, which has a broad application in various fields was of interest for researchers, and an attempt is made to modify it in order to develop a new application for polyester. Over the past few decades, studies have been conducted on the alkaline hydrolysis of yarn and polyester fabric to improve their physical properties. Polyester alkaline hydrolysis with caustic soda is the reaction of surface degradation that causes shortening of the polymer chain, and consequently the thinning and the cavity on the surface of the fiber. Also, alkaline hydrolysis of polyester fibers has less staining, water absorption, air permeability, abrasion resistance, dirt release, static load generation, and hardness.

6.2. Graphite Oxide Synthesis

Initially, graphite sulfuric acid is added and placed in an environment of magnetic stirrer for 24 hours. Then potassium permanganate is added and kept for 2 hours at a temperature of $50^{\circ}C$ to be stirred. After this step, 140 ml of distilled water with 10 ml hydrogen peroxide is added to the solution and stirred for 50 minutes, and then the solution is separated by a centrifuge device. In the next step, hydrochloric acid is added to the solution for washing, which remains in the solution for 50 minutes. Later the solution is centrifuged again, and washed with distilled water and centrifuged once more. After the centrifuge, the solution is mixed with 50 ml of distilled water and is kept in an ultrasonic device for 1 hour. Then the cloth is put into the solution for 45 minutes, at a temperature of $100^{\circ}C$, and is kept on the magnetic stirrer. Then the cloth is kept in an oven at $70^{\circ}C$ for 2 hours, untill the cloth is dried. After this step, hydrogen sulfide is mixed with 50 ml distilled water and placed on the heater to reach boiling point; the cloth is put into the solution for 45 minutes. Then the fabric is placed in the oven for 1 hour at $70^{\circ}C$ for it to dry. In this part, the distilled water solution and hydro-chloric oxide is prepared so that the pH value is between 3 and 4. 100 ml of distilled water is added along with one drop of hydro-chloric acid to the solution, the fabric is then placed inside the solution and the container is kept in an ice bath and is stirred for 30 minutes with a magnetic stirrer. Afterwards, 8 grams of $FeCl_4$ and 4 to 5 ml hydrochloric acid is dissolved in 50 ml of distilled water. This is later added drop by drop into the container with the fabric. Then it is stirred for 4 hours in the ice bath. Later, the fabric is washed in 5% hydrochloric solution (14 ml of hydrochloric acid and 86 ml distilled water). Finally, the fabric is kept in the oven at $70^{\circ}C$ for 2 hours for it to dry.

6.3. Process and Implementation of the Design

These designs have been inspired by stencils of Iranian designs (Qajar period). Designs are printed on satin fabric by digital printing, and afterwards one can see its implementation.

Fig 7 Painting of the husband and wife of the court during Fathali Shah Qajar

Fig 8 Portrait during Zand and early Qajar in Fathali Shah Dynasty

Fig 9 Painting of the husband and wife with hand on the shoulders with glass of wine during Qajar period

Fig 10 Portrait during Zand and early Qajar in Fathali Shah Dynasty

Fig 11 Painting of Fathali Shah by famous painter Mehrali in 1810 at Negarest, Tehran

Fig 12 Painting of wedding ceremony at the background integrated with husband and wife image in Qajar period

7. Conclusion

According to the stated issue, and implementing ancient Iranian designs on ties, creating a design using light along with a conductive fabric of carbon material, provides us with the ability to use technology for designing. In this study, fabrics are manufactured using conductive carbon material, and the design is distinguished by light. Therefore, the main aim of the study was to make fabric conductive for designing on clothes, especially ties. Also, using Iranian design on the tie has been achieved.

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