2018-07-04

Dervish Sound Dress; a development of a musical interface garment which explores wearable technology using sound and haptic feedback for performance and interaction

Hurban, H

10.5281/zenodo.1408596
Proceedings for the SMC 2018 Sound and Music Computing Conference

Dervish Sound Dress; a development of a musical interface garment which explores wearable technology using sound and haptic feedback for performance and interaction

Hedy Hurban
ICCMR
Plymouth University
hedy.hurban@plymouth.ac.uk

Prof. Eduardo Miranda
ICCMR
Plymouth University
eduardo.miranda@plymouth.ac.uk

Dr. Edward Braund
ICCMR
Plymouth University
edward.braund@plymouth.ac.uk

ABSTRACT

Dervish Sound Dress is a wearable piece of technology; a garment that is inspired by the sacred experience of the Whirling Dervishes or the Mevlevi Sufi order in Turkey. The garment functions as an instrument when it is worn and changes depending on how the wearer moves. The cultural traditions of the Mevlevi Sufis and their metaphysical experience during the turning ritual of the '*sema*' performance is the inspiration behind the creation of a garment that emulates sounds by using body movement. *Dervish Sound Dress* is outfitted with sensors that emit musical sounds with every movement that the wearer makes. The movement triggers sensations through haptic feedback like when a musician plays an instrument. The project seeks to explore how technology can be integrated into a garment as an expressive body instrument to amplify contemporary sonic performance. *Dervish Sound Dress* explores how through performance, sound and sound vibrations that are used in a garment can generate an emotive response in the wearer by creating sonic expression. This dress is accessible to anyone wishing to embark on a unique musical journey.

Keywords: Dervish, sound design, haptics, wearable technology

1. INTRODUCTION

Dervish Sound Dress draws upon the sacred turning ritual of the *sema* which means 'to hear' or to 'listen'. It symbolically expresses the formation of the universe and man's transition of love and respect to the Creator.[1] Often referred to as the 'Whirling Dervishes' in the West, it is a practice that originated in Turkey in the early 13th century by renowned poet and Sufi mystic Celaluddin Rumi otherwise known as Mevlana in Turkey. The *sema* originated as a practice that was established as a supplement to regular obligatory Islamic prayers as a way to create a direct connection to the divine using music, body movement and contemplative prayer. Although still in existence today, the practice was banned in the 1920's by Mustafa Kemal Ataturk as a means to 'modernize' or 'Westernize' Turkey. Many Dervish *tekke*[2] were closed and Dervishes were forced to practice the *sema* underground. Nowadays the practice is a dwindled tourist attraction in Turkey, however authentic *tekke* and dervish performances still exist and have been revived. *Dervish Sound Dress* is a commentary on the past, present and the future of Turkish culture that uses a sophisticated ideal of technology by taking the sacred experience and Islamic tradition and creating artistic expression from it. The thrust of this research is to implement new technologies within garments to explore new performance practices. This is explored through designing a garment that uses a wide range of sounds, melodies and rhythms and utilizing active haptic[3] mechanisms and proprioception for the wearer. By combining the areas of wearable technology, costume design, computer music and performance, a musical journey which is felt and created by the performer can also be experienced by the viewing/listening audience immersing them into a unique sound experiment.

1.1 A Performative Wearable

The differing layers of *Dervish Sound Dress* establish it as a unique piece of performance art that combines fashion design aesthetics with sound design, wearable technology and cultural traditions. It is a performative wearable that

[1] http://www.semazen.net

[2] The 'tekke' refers to the gathering place or 'lodge' in which dervishes practice the *sema* and gather for prayer and training.

[3] The term 'haptic' is derived from the Greek word meaning 'touch', from Greek *haptikos* "able to come into contact with," Harper, D. 2018. Available at: https://www.etymonline.com/word/haptic [Accessed: February 2, 2018].

can be worn by a dancer, a Dervish or the public. The initial experiments of the dress will be the catalysts for developing garments that generate musical sounds to formulate compositions using body movement. Seamlessly integrating technology and textiles to create a streamlined, intuitive interface which is performer controlled is the core of this project. Based on these observations, the research for creating contemporary performance inspired by the *sema* using intelligent garments will be explored.

The intention is to analyze whether the dress could potentially enhance the interactive aspect of what a dervish may encounter during a *sema* by allowing the wearer to be immersed in a more interactive experience. This is done by implementing haptics which act as sensory indicators on the dress itself. When sound is emitted, the haptic vibration is triggered on the bodice of the dress allowing the wearer to 'feel' the sound vibrations. Introducing haptics as a tool for stimulating and enhancing the sensory experience of the wearer can lead to an effective and tangible output. Haptic technology can assist the wearer by providing cues that are given by gestural recognition. Essentially, the garment is a wearable instrument which is a programmable interface that is controlled by the wearer.

1.2 Background and design inspiration

The inspiration is derived from the *sema* and is also influenced by the playing of instruments that are situated close to the body, such as a stringed instrument. One of the essential elements to a performance is the music and rhythm which propels the Dervishes into a trance-like state or meditation through movement. Mevlevi or Sufi music can also be described as religious or classical music which is essential to the mystical component of the *sema* (Friedlander, 1975). Sufism can be described as the "mystical experience in, and the ecstatic and emotional realization of, the presence and power of God" (Lifchez, 1992). The 'Whirling Dervish' performance is a spiritual expression of love and devotion to God. The music that is used during the *sema* enhances the Dervish's experience of striving to attain a higher level of consciousness and connection to his faith.

The *sema* ideally involves the use of poems and music to focus the listener's concentration on God and perhaps even induce a trance-like state of contemplative ecstasy (Lewis, 2000). During a *sema* performance, the Dervish begin their 'turning' very slowly; almost as though they are undetected. The hands start to spread out as one faces the heavens, the other points down to the earth, and the turning begins as though their skirts reflect the orbital patterns of the planets.

Although *Dervish Sound Dress* is not meant to be a 'fashion' garment per se, the textiles used are influenced by Ottoman Turkish garments of the 15th to 16th centuries which are rich in embroidery and colorful fabrics. The lush, vibrant and contrasting colors of the textiles were commonly worn during this period. Many *entaris*[4] that were worn by the Ottoman Sultans were also appropriated by the Dervish orders in Turkey although their garments were far less ornate and detailed. The different layers of cloth are an important characteristic of the diversity of Turkish traditional clothing (Koç, 2011). The traditional garments worn by the Mevlevi are an ensemble of a white jacket that is tied around the waist, a belt or sash and a large white circular skirt with long trousers underneath. As the skirt opens during a 'turning' performance, the more magnificent the silhouette becomes. *Dervish Sound Dress* resembles the silhouette of the *tenurre*[5] worn by the Mevlevi Dervishes, using a pale blue jacquard fabric and a red contrasting lining and is exposed when the dress becomes fully 'turned' during the performance. It is constructed in two pieces; a bodice and a skirt with a belt that stores a microcontroller unit.

A design that can combine these elements into a singular technologically sound user interface will allow for the overlapping of different disciplines, whilst respecting a venerable cultural tradition to be used in a contemporary art performance practice.

The project strives to emphasize the intersection between digital art, biometrics, music, performance, costume design, culture and wearable technology.

2. WEARABLE TECHNOLOGY

Wearable technology can be defined as the use of technological interfaces that are interlinked with textiles for fashion or practical functionality. Humans have had a desire to develop technology that extends the functionality of the human body (Olsson, 2008). Wearable tech also falls under the umbrella of 'smart' accessories such as wristwatches, headgear, eyewear and footwear. Wearable fashion technologies are in fact 'designed' garments accessories, or jewelry that bring together aesthetics and style with functional technology.

Fashion designers who are using smart textiles or integrating fashion and technology in some way require collaboration with electrical engineers and programming professionals.

2.1 Innovations in wearables

The changing landscape of technology and how societal and economic pressures of using technology in varying ways to suit consumer interest and demand is what the future beholds. Thus, commercial interest in fashionable wearables is increasing, as seen in clothing using embedded technologies that are becoming more evident in the areas of sport, healthcare, rescue services and security (Seymour, 2010). The possibilities of exploring emotive textiles and garments can change the shape of the capabilities

[4] The *entari* is a traditional garment composed of layered robes worn in Turkey dating back to before the Seljuk period (10th Century).

[5] The *tenurre* is the skirt portion of the attire worn by Dervishes (Lifchez, 1992 pp. 270).

that wearable technology can provide. The scope for creating textile interfaces that engage a global audience should be intuitive, and compatible with emotional adapters (Quinn, 2010).

Where fashionable technology refers more directly to the sense of style that a person reflects while wearing a garment that is designed with a mode of conveying an amplified fantasy, wearable technology deals with wearing objects that have been electrically engineered or programmed in such a way that the wearer can interact with the garment. Berzowska (2005) remarks that a 'wearable' garment should be constructed in a way that makes sense to the wearer; that it is practical for use on the body and doesn't interfere with functionality. Moreover, it should be attractive and a seamless integration in the cloth so that the wearable computer is less fragile. The explorations of the intersections between wearable technology and fashion are inevitable. Fashion designers who are using smart textiles or integrating fashion and technology in some way require collaboration with electrical engineers and programming professionals.

Technological innovations have made it possible to allow for processing power to double, components to become miniaturized, and alternative energies to become viable options (Seymour, 2009). Fashionable wearables require new offerings from computational technology where innovation is much more advanced than in clothing design technology (Zhang, 2016). Technological advancements in using smart or conductive threads and textiles as well as biomimicry, chemical, Nano, and bacterial textiles are breaking ground in the research for new implementations of wearable tech.

2.2 Fashion designers using Wearable Technology

Many fashion designers are collaborating with electrical and software engineers to develop products that are becoming more accessible to people. Moon Berlin[6] is a design company that uses a unique light technique in their high fashion garments creating a dynamic between light and shadow effects (Berglin, 2013).

Hövding is a Swedish company that developed a collar made for cyclists that uses accelerometers and gyroscopes that are triggered by abnormal movements in the wearer and inflates in the case of an accident to protect the head (Berglin, 2013).

Integrating technologies seamlessly with the body poses numerous challenges, including the intuitive nature of computing. Humans are increasingly demanding that their bodies become outfitted in the latest technologies. Fashion designers are collaborating with engineers and scientists to create groundbreaking designs and technological advancements. Seymour (2009) discusses the importance of collaboration between designers and engineers as key to developing technology and wearable garments. Designers such as Ying Gao use interactive garments such as the '(No)Where (Now)Where' dresses which use photo luminescent thread and imbedded eye-tracking technology so that the viewer's gaze changes the shape of the dress.

Many designers are using technology combined with fashion design incorporating the significance of using sound as a tool for creating a more emotional and interactive experience within a garment. Ziya Azazi is a Turkish performance artist whose 'Dervish in Progress' is an exploration of dance and performance without the use of technology, yet his performance of turning and design of a garment which resembles a dervish dress reveals a unique possibility for interlacing the disciplines.

Imogen Heap is a musician/performer whose work with the Mi. Mu gloves is changing how electronic music is performed live. The gloves are designed using numerous flex sensors and can handle gestural movements by implementing conductive textiles connected to a computer using a wireless interface. The gloves have the capability to perform a variety of sounds by changing the movement of the fingers.

CuteCircuit is a company that has developed several garments using haptic mechanisms embedded in textiles. The 'Sound Shirt' has made headway in the development of using haptic vibrations in clothing to emulate a live orchestral performance that is 'felt' rather than heard by the wearer. The importance of how music can be felt as a sensory experience is evident in their work.

Fashion designers are embracing the demand for commercializing their products, making them accessible for the mass market. Integrating software interfaces into clothing is becoming more streamlined and less gadget-like.

Fashion designers using technology and wearables in their designs need to be more concerned with creating new experiences of human to computer interactions for benefits other than for superficial or commercial uses. Exploring these relationships with embodiment through multi-sensory engagement can have effective appeal (Cranny et al, 2008).

The scope of the research for *Dervish Sound Dress* is to implement new technologies within garments to explore new performance practices. This is examined through designing a garment that utilizes a wide range of sounds, melodies and rhythms and active haptic mechanisms and proprioception for the wearer.

3. MUSICAL COMPOSITION AND PROCESS OF *DERVISH SOUND DRESS*

The principles of the dervish *sema* resonate with the design of the costume. It embodies the enduring custom of mystical 'turning' while taking a leap in an abstract exercise using technological innovations and honoring the cultural belief system of the Islamic practice. For this, the sonic essence of the dress is one of the key elements of the dress.

[6] www.moonberlin.com

The infusion of musical composition into the garment itself provides a unique platform for performance possibilities. Using authentic traditional Turkish instruments for the sound element of the dress strengthens the aesthetic of the design by enabling the genuine nature of the musical aspect of the *sema*.

3.1 Traditional Turkish classical music

The traditional composition of a *sema* can take several hours, the first of which is spent in prayer and preparation. The Dervish must fully brace themselves for the rigors of turning for a considerable length of time. A practice which takes copious months of training comes to fruition in the magical turning spectacle of the *sema*.

Traditionally, several instruments are used during a performance; most notably the *ney* (a flute-like instrument), a *khudum* which is a percussive instrument and the *tambur* (a classic stringed instrument). Historically, these instruments and the genre of *Klasik Türk Muzigi*[7] or Classical Turkish Music were instrumental in compositions created for the *sema*. *Dervish Sound Dress* draws upon the sounds of the *tambur* and the rhythms that are created by it. The motive is to emulate the vibrations that are felt while a musician plays an instrument, and the emotional response that the musician and a performer such as a Dervish feels. According to Eryaman, (2012) the *sema* consists of listening to music and participating in whirling movements and chanting to reinforce ecstasy and attain a mystical state. In traditional performances, the musicians improvised melodic compositions called 'taksim' and determined the direction of the *sema* based on their mystical feelings (Friedlander, 1974). For the ceremony to be validated, three important elements must exist including music, dance and oneness with Mevlana (Friedlander, 1974). Therefore a timed composition is key to coordinating the body movement with the sounds that are initiated by the performer. The goal is to allow space for interpretation in terms of sound combinations however for the initial performance, the aim is to explore how the movement coordinates with the melodies and sound compositions in the pre-programmed sensors.

3.1 Compositional elements using haptics

Using haptics can result in a much more expressive experience for the wearer in that the vibrations felt while sounds are being emitted enhances the progression. Leman (2008) remarks that research on haptic feedback is often linked with research on musical expression and performer nuances. Not only are vibrations important because of how they explain the instrument's reverberation, but also during the performance the sounds can heighten this experience as the performer moves in the dress. "Implementation of haptic feedback technology within wearables will lead us into a new era, where we will be able to carry virtual world and feel it" (Demidenko, 2017).

The dress design features haptic vibration as a sensory reverberation so that the experience of wearing and performing in the dress is more immersive and interactive. The haptic vibrating motors will be triggered when sound is activated by the wearer touching the conductive thread 'buttons' sewn onto the bodice. Haptic feedback can be described as a sensory vibration that is felt when a sensor is triggered on a garment or an electronic device. Haptic or tactile feedback communicates information to the wearer by using vibrations through tactile touch. Touch sensation uses in a garment have several implications. A feature of using tactile touch or haptics enables the discrete sensory communication of vibrations from the device to the wearer. If reverberations are sensed on the body, the wearer can interact with the enabling design, much like a musician interacts with an instrument that is played in close contact to the body emitting similar haptic vibrations. Haptics can contribute to imparting a more powerful and tactile experience.

3.1.1 *The interactive sonic space and haptic feedback*

During a *sema*, the Dervish is focused on many sensory applications that are initiated in the space that is created by both the performer, the musicians and the audience. Notably, the act of turning is a mode for transmitting vibrations as is the constant and rhythmic rotation of the body and the tempo of the music which drives the movement. This mechanism of repetitive motion inherently provides tactile sensations between the performer and the interactive space as "musical performance depends on bodily movement that goes beyond the auditory and the sense of hearing" (Rebelo, 2006).

3.2 Turkish *Tambur*

The sensors are programmed with synthesized sound samples of the traditional Turkish *tambur* which is an instrument that is sometimes used during a *sema* performance. Keeping the integrity of the instrument is a fundamental component of the design and overall output of the sounds. The *tambur* is a stringed instrument with a high frequency of vibrations which reverberate for a longer period, creating a droning ambience. The sound design component relies on using organic sound samples of the classic Turkish *tambur*. The samples have been recorded by a classical *tambur* musician and manipulated in computer music design software creating ambient tones, drawn out melodic arrangements and rhythms that resemble the classic instrument. This gives the garment a unique edge by functioning as a computer digitized representation of a stringed instrument that is activated by motions of the body.

4. TECHNICAL ELEMENTS

The proposed composition is a performance that is initiated by the wearer and output to a speaker system, whereby

[7] Bates, E. 2011. *Music in Turkey: experiencing music, expressing culture*. New York: Oxford University Press.

the audience can also become involved in an audio/visual event.

The construction of the dress is done by enabling a variety of sensors that perform according to how the sound is triggered by movement of the wearer. These determine the output based on the rotation of the dress using a gyroscopes/accelerometers/compass sensor which will measure the speed of the dress as it is turning. Flex sensors are placed in the sleeves close to the inner elbow and trigger sound when the arms are in certain positions based on a threshold of values. The flex sensors efficiently detect the angle of movement in the sleeves and are placed there to emphasize the gestures made by the arms which release sound.
The progression of the dress corresponds to how the sound elements evolve. A key component to the technical element of the dress is the composition and choreography. The performer must comprehend the operating functions of the dress whilst following a planned composition with a notated score and set of movements. Although the dress provides the opportunity to create a scored musical composition, the sounds can also be interpreted by the wearer as they experience the dress.

4.1 Sensor Placement and choreographed body movement

Capturing the movement and energy of the Dervish is the inspiration for how the dress initiates sound depending on its position. In a performance setting, the starting position of the dress begins with the performer's arms crossed at the chest and the body is standing still. As one arm unfolds and then the other, sounds are triggered until the performer begins to turn. As the speed of turning increases, more sounds are triggered until the dress is fully opened allowing for a cacophony of sounds to be emitted. The conductive thread button is sewn in a circular pattern on the bodice of the dress and attached to a capacitive touch sensor. When the performer touches the button, haptic vibrations are released along with pre-programmed sounds of the synthesized *tambur*. Other buttons are used and when touched these will also activate ambient sounds to accompany the melodic sounds output from the turning of the dress and the arm movements.

The overall placement of the sensors tracks the various movements, positions and gestures of the performer (see Table 1). Analyzing the form of the dress from starting position to when the dress is fully rotating is done by testing the speed and momentum of the rotation. Aesthetically, the conical shape that the skirt forms while in a fully turned position is what makes the performance mesmerizing. Maintaining the shape of the dress while in a continuous state of 'whirling' is the driving force behind how the sensors are placed and how the musical composition evolves over time (see Figure 2).

The accelerometer/gyroscope/compass determines the increase and decrease in volume of the melodic sound sample based on the rotation of the dress. The performer as well as the audience can anticipate the progression of sound. This bonds the relationship between the performer and the audience by offering a direct link to how the sound evolves during the performance.

The dress is programmed using the Arduino microcontroller system which is attached to the belt section of the dress. The thresholds are determined using algorithms created with Max by Cycling '74 and Arduino software. The sensor data is preprocessed by mapping the sound samples to each individual sensor and analyzing the data created from it. The dress functions wirelessly enabling the performer in free, unrestrictive movement. All wiring and components are concealed within the lining of the dress.

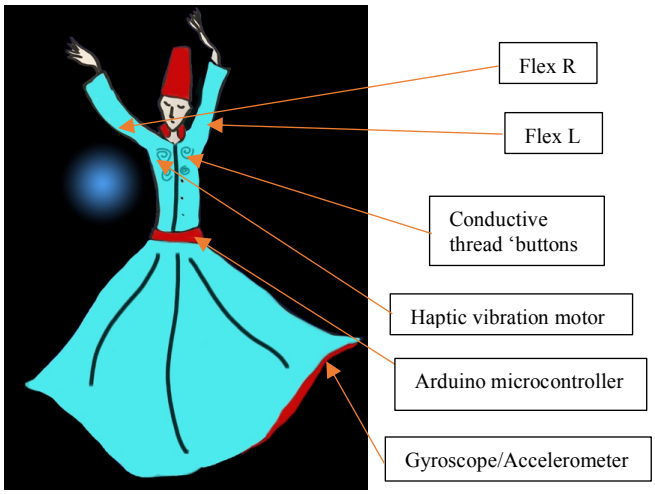

Figure 1. Design concept and sensor placement for *Dervish Sound Dress*

Sensor/hardware component	**Description of Function**
Flex Sensor Right(R) and Left (L)	Flex sensors in sleeves detect movement and produce sound when sensor value reaches a certain threshold.
Conductive thread 'buttons'	Attached to capacitive touch sensors, the buttons are programmed with synthesized musical tones and melodies.
Haptic vibration motor	When buttons are touch, vibrations are released.
Arduino microcontroller	Stored in the belt of the dress and programmed wirelessly.
Accelerometer/gyroscope	Detects both speed and velocity of the dress. Based on a defined threshold of movement, sound is triggered.

Table 1. Description of sensor placement and function.

5. OBSERVATIONS

A prototype using the previously mentioned sensors and conductive thread has been produced with promising results (see Figure 2). The implementation of sound samples which are allocated to the sensors provide a variety of sound possibilities and compositions.

The next phase will be coordinating a performance in a theatre setting with a skilled dancer. After these initial tests *Dervish Sound Dress* will be constructed from the blue jacquard and red satin textiles. The goal of the design is to make it comfortable to wear, practical to put on and off and perform in. The sleeves will need to fit closer to the skin to allow for accurate data flow from the flex sensors.

Figure 2. Prototype of Dervish Sound Dress displaying touch pad buttons on bodice

6. FINAL REMARKS

The essential features that enable *Dervish Sound Dress* to perform use haptic feedback, computer music sound and design. Combining these elements needs further exploration in the realm of wearable and fashionable technologies and in performance. The dress is influenced by the classic Ottoman Turkish textiles and layers of fabric and appropriates the sacred *sema* experience of the Mevlevi Dervishes. It is a commentary on how wearable technology can be seamlessly integrated for a meaningful interactive experience for the wearer that expresses sound through gestural movement and performance.

Based on conclusions of experiements conducted in the first performance, the aim will be to analyze the options for using smart fabrics rather than attaching sensors to the garment. This result will be a less restrictive design from the reduction of bulk of hardware units for easier flow of movement of the performer, and a more streamlined, intuitive interface of the garment which is performer controlled. Feedback from performers will be essential in refining how the dress will work against the body and movement.

The future of fashionable garments or costumes that use wearable technology such as *Dervish Sound Dress* can be built with much more enhanced technological capabilities. These innovations could further explore how the garment would function as an extension of the body; as an instrument, capable of autonomously making musical compositions by using gestures. The design of clothing seamlessly integrating with technology could be used in a variety of art and performance practices including dance, theatre, and opera to augment the wearer and audience experience.

7. REFERENCES

[1] Berglin, L. (2013) Smart Textiles and Wearable Technology - A study of smart textiles in fashion and clothing. A report within the Baltic Fashion Project, published by the Swedish School of Textiles, University of Borås.

[2] Berzowska, J. (2005). *Electronic textiles: Wearable computers, reactive fashion and soft computation, Textile: Cloth and Culture,* 3(1), doi: 10.2752/147597505778052639

[3] Cranny-Francis, A. & Hawkins, C. (2008) *Wearable technology.* Vis. Commun., 7, 267-270.

[4] CuteCircuit. (2017) Available at: http://cutecircuit.com/soundshirt/ [Accessed: January 18, 2018]

[5] Demidenko, A. (2017) *What is Haptic Feedback? (Haptics).* Available at: https://teslasuit.io/blog/haptic-feedback/haptic_feedback [Accessed: February 4, 2018]

[6] Eryaman, M. Y. (2012) *From Whirling to Trembling: A Montage of Dervishes' Performative Inquiries*. Qualitative Inquiry, 18, 55-62.

[7] Friedlander, S. (1975) *The Whirling Dervishes: being an account of the Sufi order known as the Mevlevis and its founder, the poet and mystic Mevlana Jalaluddin Rumi*. Wildwood House

[8] Koç, F., Koca, E. (2011) *The Clothing Culture of the Turks, and the Entari (Part 1: History).* Folk Life: Journal of Ethological Studies, Vol. 49 No. 1. 2011, 10-29.

[9] Lifchez, R. (1992) *The Dervish lodge: architecture, art, and Sufism in Ottoman Turkey*, Berkeley; Oxford, University of California Press.

[10] Loschek, I. (2009) *When clothes become fashion: Design and innovation systems*. Berlin, Germany: Berg Publishers.

[11] Olsson, T. (2008) *Open Software; Fashionable Prototyping and Wearable Computing using the Arduino,* Malmö; Blushing Boy Publishing.

[12] Quinn, B. (2010) *Textile Futures; fashion, design and technology*. New York, Berg.

[13] Rebelo, P. (2006) *Haptic sensation and instrumental transgression*, Contemporary Music Review, 25:1-2, 27-35, DOI: 10.1080/07494460600647402

[14] Seymour, S. (2009) *Fashionable technology: the intersection of design, fashion, science, and technology*, Wien; London, Springer.

[15] Stening, B. (2007) *A Blushing dress and an Excitable body suit*. Available at: http://www.curvelive.com/Magazine/Archives/eighteen/A-blushing-dress-and-an-excitable-body-suit. [Accessed: February 14, 2018]

[16] Zhang, Y. (2016) *Tech Fashion; Fashion Institutionalization in Digital Technology*. Malmö, Stockholm University.