

## **Design Explorations of Personalizable Electronic Sound and Perfume Accessories**

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### **Abstract**

*It has been common since ancient times to use fashion accessories to make a positive impression on others and develop personal brands. For this manuscript, I've designed a range of personalized electronic sounds and perfume accessories that use personalized scents and sounds to create memorable experiences. These have built-in auditory and olfactory actuators that can generate unique sound and fragrance signatures from the wearer and the other party. Based on the design explorations, I also discussed the issues of design and implementation of personalized electronic sound and fragrance accessories, as well as issues and additional business opportunities for the use of these personalized electronic sound and odor accessories in everyday life.*

**Keywords:** *Electronic Accessory, Fashion Media, Sound and Smell, Interaction*

### **1. INTRODUCTION**

Our brains form connections between sounds, smells, and emotional experiences. For example, the ringing of a bicycle bell can take us back to our joyful childhood, and the smell of perfume can remind us of a loved one in the past. Sound and smell can trigger strong memories of our past experiences. That is, when we meet the same sound and smell again, our memories and emotions are already connected with the existing memories and emotions. [1][2].

Thus, emotional and memorable experiences associated with certain sounds and smells influence people's mood, judgment, work performance, and relationships. And it can be used for more emotional and memorable personal impressions and brands of products [3].

In previous research, I developed "Sound Perfume" to help people become more memorable through auditory and olfactory stimulations during face-to-face communications. This system is a wearable device in the form of glasses, which transmits and reproduces subtle sound and smell stimuli through data communication to deliver personalized sound and smell IDs to communication partners, providing a more memorable face-to-face experience [4].

While developing the system, this concept was extended to a variety of fashion accessories with minor modifications to design personalizable electronic sound and perfume accessories to help the wearer to be cognitively or affectively recognized by others.

The aim of this study was to design and study a new range of fashion accessories with integrated electronic

circuits, which provide the wearer with a unique and memorable identity through a personalized sound and fragrance signature.

In this paper, further applications and studies that integrate memorable experience based on electronic sound and perfume accessories in the general fashion world is discussed with more business opportunities in the IT fashion and branding fields.

## **2. AUDITORY & OLFACTORY EFFECTS**

Neuroscience research shows that sounds and smells are related to memory. When you hear or smell something during an emotional experience, the sound or smell is associated with the emotional experience in the same part of the brain. Smelling the same sound or smell can help evoke memories and evoke strong emotional responses.

Yeshurun (2009) found that the first connection between objects and smells produced distinct marks in the brain [1]. Also, Sacco (2010) proved that sound, smell, and memory are interconnected [2].

According to psychology, smells can affect a subject's memory and judgment. Cann (1989) published a study that found that 80% of men and 90% of women were revived by smell, showing a strong association between smell and memory [5].

Fox (2007) showed that the presence of an unpleasant odor caused subjects to underestimate the individual pictured and judge the picture to be less professional. This means that the positive emotional effects of pleasant scents also influence our perceptions of people. In a similar way, unpleasant odors can affect our evaluations [3].

In addition, we can see the application of sounds and smells to clothing and fashion. Since ancient times, auditory and olfactory expressions have been created with jewelry and fashion accessories in different cultures at different points in human civilization. In ancient Egypt, the usage of smell or fragrances was associated with religious purposes and rituals. During the reign of Louis XIV, body odors that resulted from the general lack of hygiene had to be masked. Perfume had to be applied on clothing and jewelry, and scented sachets were used to give handkerchiefs and other accessories a pleasant smell. In addition, they were sometimes put under pillows to improve sleep quality [6].

For sounds, according to Bos (2021), certain clothing items such as face veils with coins, tassels, beads, and other decorations have been worn by women in deserts to produce characteristic sounds. The movement of the wearer's body may increase the distinctiveness of these sounds. For example, during a desert wind, the sound of a woman carrying her personal veil with beaded bells, coins, and tassels of beadwork, which collide with the metal, can be recognized by her relatives. Thus, these garments play an important role of identity in their lives [6].

The indirect interaction through distinctive sounds and smells in fashion can increase the probability of a wearer being cognitively or affectively recognized by others. Moreover, it may help him/her establish a positive impression through personalized branding. In today's fashion world, thanks to the fast development in the fields of fashion design, materials, and technology, we can create strong impressions with different modalities such as audio and olfaction. The range of available options is vast, and users can choose the optimal item depending on their requirements. In this study, a novel approach for embedding sound and perfume into fashion accessories as two major indirect mediums of expression was studied.

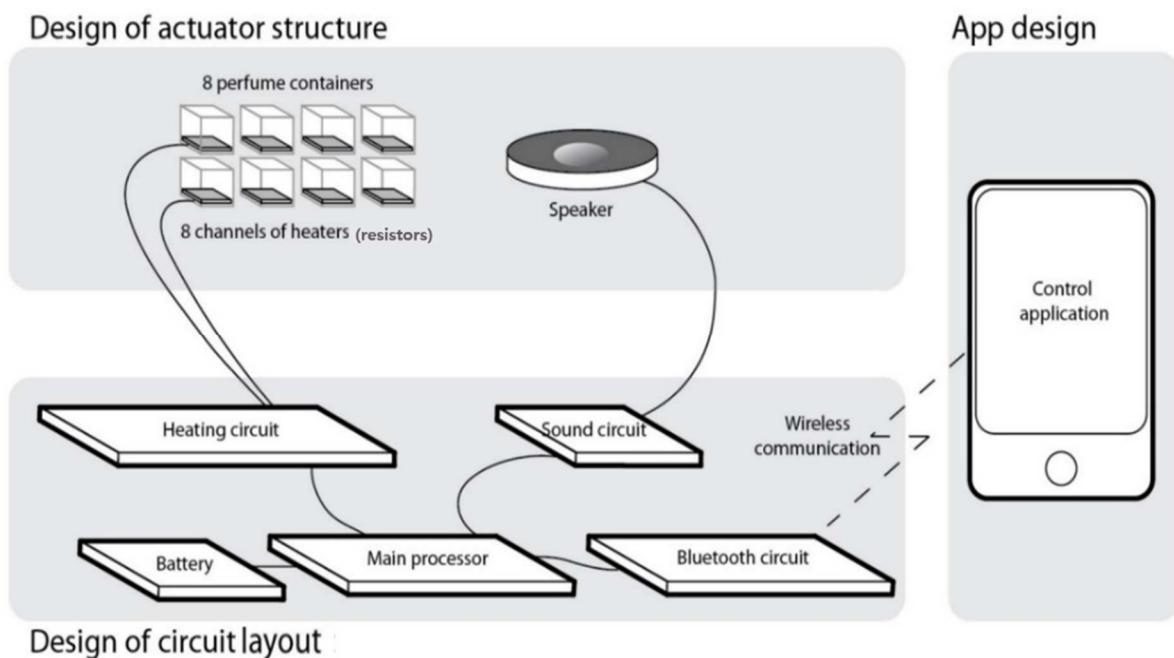
Many sportswear manufacturers, such as The North Face, Burton, and Oakley have successfully studied the possibilities of embedding audio systems into garments and sports accessories. They developed audio jackets that allow you to control your audio player through an easy and wearable interface. Furthermore, MIT's Research Lab of Electronics works on fibers that can pick up sound and act as speakers [7].

The results can lead to the development of smart materials and interfaces that work as sensitive microphones

for speech or bodily functions. Regarding smell, the Smart Second Skin and Scentsory projects are exceptional examples of smell integration in the fashion world. Tillotson (2008) performed extensive studies to bridge smell and fashion; she presented clothing that dynamically emits scent as an integral part of the design. In addition, she investigated their use in health, wellness, and emotional applications [8][9].

### 3. DESIGN OF AUDITORY AND FRAGRANCE ACCESSORIES

To emit the blended perfume successfully, the heating duration of each perfume palette was determined. Based on the structure of the auditory and fragrance actuator, which allows the perfume to spread efficiently in the environment, prototypes that use a unique method for triggering these two modalities simultaneously were developed. The system configuration of the sound and fragrance actuator is shown in Figure 1.



**Figure 1. System configuration of personalizable and controllable sound and fragrance actuator**

Each actuator has sections that contain the solid notes; each has its own heater. The audio speaker is located beneath the compartments. The actuator vaporizes solid perfume notes owing to the heat from the resistor and gently emits the fragrance with pulsating sound from the audio speaker.

The actuator requires several features to be useful. It needs personalizable functions for emitting personalized sounds and perfumes. To fit into different fashion accessories, it must be small and portable. In addition, the power usage was optimized. Because the actuator is embedded into different fashion accessories, it must be wirelessly controlled.

In this study, solid scents, which are more easily portable and controllable in an electronic circuit than liquid ones, were chosen. To gather vaporization data, four different types of solid scents were evaluated: a solid fragrance, a lip balm, an aroma gel, and a solid perfume. The goal was to find a scent with a “low melting point” and “strong odor” to achieve low power consumption and to minimize the size of the device.

The four different solid scents were put onto a Peltier heater to measure their melting temperatures. The lip balm started to melt at approximately 38 °C, the solid perfume at approximately 45 °C, the aroma gel at approximately 68 °C, and the solid fragrance at approximately 85 °C. Because the solid perfume had a stronger

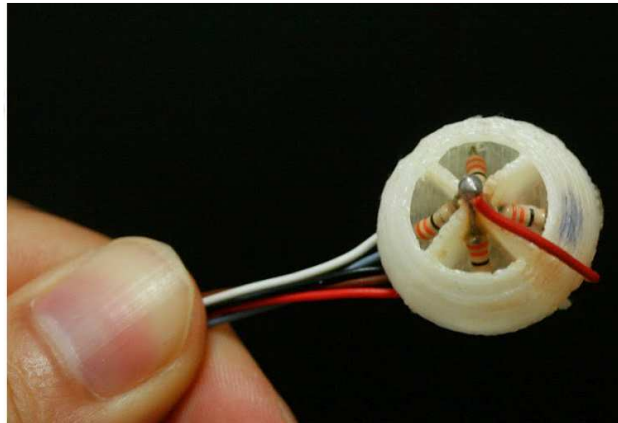
scent than the lip balm, the former was used for the scent samples.

A fragrance actuator module was designed to heat the solid perfume with heat from a resistor. Based on tests in the laboratory and the average current consumption, a 12  $\Omega$  resistor was chosen for the heater. The heater requires 315 mA and reaches the melting point temperature of the essence in approximately 3.5 seconds. The aroma was gently emitted with pulsating sound from the speaker.

Laboratory experiments were conducted to determine which levels of actuation of sound and fragrance from the system can be suitable and to determine the most natural actuation level.

The solid perfumes are heated with a resistor to emit gently the fragrance with pulsating sound from a speaker. The speaker must stimulate the users unobtrusively. To select a suitable speaker for the auditory and fragrance actuator based on feedback for the previous device version, a test sound sample was played for 10, 20, and 30 seconds at three different speaker power levels: 8  $\Omega$ / 0.25 W, 8  $\Omega$ / 0.50 W, and 8  $\Omega$ / 1.00 W.

After three repeated experiments with four participants, the 8  $\Omega$ / 0.25 W speakers with 20 seconds sound duration for subtle stimulation were chosen. The perfume heater was designed in a separate container structure to prevent perfume spillage and generate each fragrance separately, as shown Figure 2.



**Figure 2. Perfume chambers of the prototype. It can generate 4 different fragrances through controlling each resistor**

A fragrance consists of a mixture of several notes; each one has its own unique attributes. Combining several notes can create a unique smell that varies as the perfume interacts with the environment. These changes are based on the volumes of each note and are, therefore, predetermined by the perfume designer. The strength of a perfume is usually split into three stages, each with its own notes. The very first aromas one smells once the perfume has been sprayed are the opening notes, which are followed by the center notes, and then the heart notes (i.e., the base notes).

The earlier version of the auditory and fragrance actuator was designed to heat a selected perfume note. The control application, which is controlled via a mobile phone, allows the user to select his/her sound and perfume notes of choice to create personalized electronic sound and perfumes as shown Figure 3. To allow the user to control the actuator wirelessly, a mobile application was developed for the Android smartphone platform. If the user has a compatible smartphone, the interface allows the user to personalize the operation. More specifically, users can create their own sound and smell triggers by selecting an audio file from the library and controlling the intensity of each perfume note that should be emitted from the actuator. The app communicates wirelessly with the actuator via Bluetooth.



**Figure 3. Settings menu that allows users to browse and choose their preferred sound and perfume blend signature; the user can blend a maximum of four different kinds of perfume notes**

#### **4. DESIGN EXPLORATIONS OF AUDITORY AND FRAGRANCE ACCESSORIES**

In this study, three types of fashion accessories in the form of eyeglasses, a tie, and a gemstone were designed. The rich auditory and olfactory triggers of the fashion accessories are similar to the functions of pheromones, which are chemicals produced by some animals, which enable them to communicate and provoke specific reactions in other members of their own species. In short, this concept can be understood as a “wearable ringtone for the nose and ear” for effective face-to-face communication.

##### **4.1 Form factor eyeglasses: Sound Perfume**

The Sound Perfume was designed to investigate the role of sound and smell on a person’s impression during face-to-face encounters [4]. The system was designed in the form of a pair of glasses; a mobile application allows the user to select his/her characteristic sound and smell and to design his/her ID. When the user engages in a face-to-face conversation with a partner, the latter’s ID will be seamlessly emitted by the former’s glasses.

When a user starts a face-to-face conversation with another person for the first time, the sound ID and perfume ID are shared by both pairs of glasses through an IrDA (Infrared Data Association) module in the bridge of the glasses. The partner’s ID information is used to trigger the auditory and fragrance actuators in the user’s glasses.

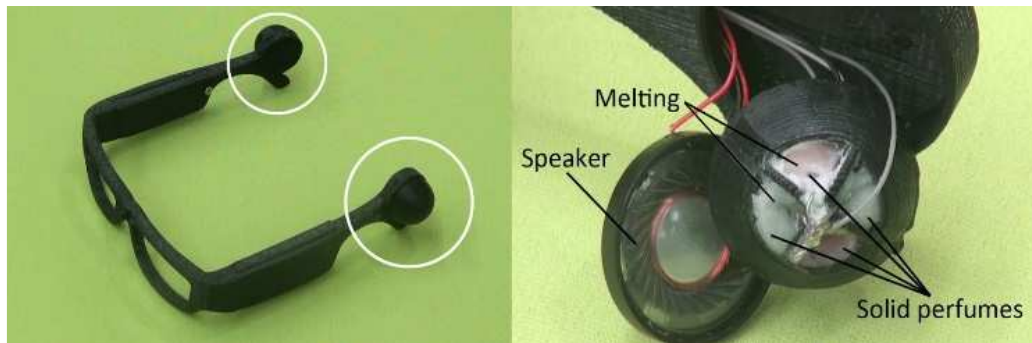
These actuators are attached modules on the glasses behind the wearer’s ears for indirect stimulation as shown in Figure 4. The aroma is created by heating the solid perfume and emitted by the pulsating sound from the speaker, which operates simultaneously. This process is repeated every time the pair meets. This indirect stimulation enables the user to communicate more easily his/her unique ID during face-to-face interactions and awakens memories of the other person when they meet again after some time.

In the design of the Sound Perfume system, to improve face-to-face interactions, the eyeglass structure was chosen because it can easily house the circuit and does not hinder eye-contact interaction in face-to-face communication. The mobile application for the glasses stores the wearers’ contact information and personalized sound and smell identity, which are communicated to the communication partner upon eye

contact during face-to-face interaction.

During the experiments with participants, the users requested a Sound Perfume system with a more aesthetic design. In addition, they brought up issues related to the personalization auditory and olfactory fashion accessories with their favorite sound and perfume samples.

Inspired to explore the design of personalized electronic sound and perfume accessories to handle multi-channel operation on sound and perfume samples in a more esthetic fashion form. Hearing and scent actuators can be embedded in many kinds of wearable everyday accessories such as ties, necklaces, bracelets, headsets, hair bands or chest-pins.

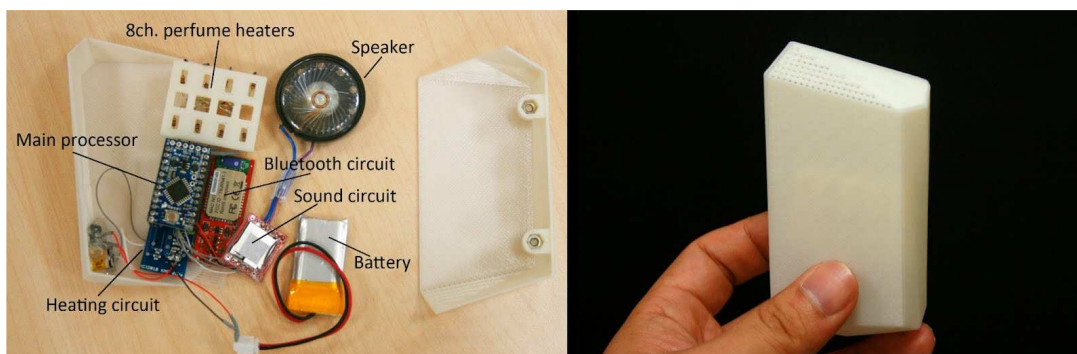


**Figure 4. Sound Perfume eyeglasses with two auditory and fragrance actuator modules. Structure of auditory and fragrance actuator module with four perfume heaters and one speaker that realizes the gentle emission of vaporized perfume fragrances**

#### 4.2 Form factor sachet: GemStone

The following ideas for custom sound and perfume accessories are inspired by gemstones. Artisans turn jewelry into beautiful jewelry and ornaments of various shapes and sizes. Similarly designed, GemStone can be used to express different personalities through sound and perfume signatures.

GemStone is a portable fashion accessory with built-in electronic sound and fragrance actuators. People can easily carry these devices in their pockets or handbags to create personalized sound and fragrance expressions. It works more like a sachet than it can play audio sounds. The hollow body contains heaters for eight different perfume channels, and one speaker (with circuitry) controls the device, as shown in Figure 5. The design itself is slim and easy to carry.



**Figure 5. Hardware configuration of GemStone and working prototype of GemStone sound and perfume accessory**

### 4.3 Form factor neck tie: NeckTie

The development of the NeckTie accessory is an effort to embed the actuator into the fabric. Ties have become an important part of offices and suits. In fashion, a creative choice of tie design makes people stand out from the crowd and is considered an expression of personal fashion. A designed NeckTie accessory should offer the possibility to enhance your personal style without being limited to a specific tie design.

Embedding actuators into ties was challenging because ties come in a variety of styles and patterns. Additionally, each style has a different type of knot, making it more difficult to match the actuator structure. Prototypes typically use pre-tied ties that come with plastic construction. There are knots and zippers to adjust the tightness around the neck as shown in Figure 6. Along with the necessary circuitry, a chamber-like structure containing a speaker and eight perfume compartments was added to the design. The circuits are carefully laid out in a strip-like structure, allowing the tie to move flexibly during everyday encounters.



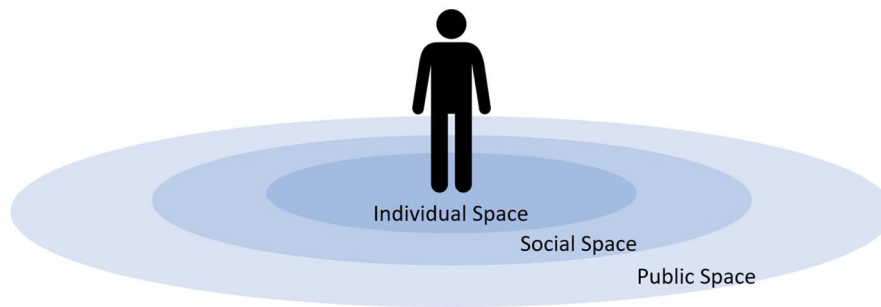
**Figure 6. NeckTie prototype with auditory and fragrance actuators and electronic components in a sleeve**



**Figure 7. Redesigned knot for sound and perfume necktie (left: covered, right: uncovered)**

## 5. USE OF PERSONALIZED DIGITAL AUDITORY AND FRAGRANCE ACCESSORY IN DAILY LIFE

Entwistle (2000) stated that fashion and personal brands are closely related to their influence and influence on personal relationships [10]. In this section, I examine how a variety of personalizable electronic sound and perfume accessories can affect your everyday fashion sense and style. Following Goffman (1971)'s theory of the "magnetic domain" [11] and Emsenhuber (2011)'s study of the olfactory interaction domain [12], the following scenarios were considered: 1) the wearer and the personal space, 2) the social space, and 3) the public space.



**Figure 8. Three major interaction regions based on auditory and olfactory interaction in human communication: 1) wearer and individual space, 2) social space, and 3) public space**

### **5.1 Wearer and individual space: personal health and wellbeing**

Similar to the ideas of the Scentsory Design, by “combining the confidence-enhancing and social acceptability of fashion items with the positive psychological benefits of manipulating moods”, the prototypes can be configured “to identify ways in which the end user can improve quality of life and stay well through clothing and footwear that responds to the psychological state of an individual.” [9]

The developed actuator allows each user to personalize the auditory and olfactory emissions depending on the mood and context of the wearer with the provided mobile app. Numerous combinations can be developed with the prototype for the personal space. During a normal workday, users can schedule a “emotional refreshment” with the NeckTie prototype and choose different playlists depending on their mood. A smarter app can be developed that is connected to the user's calendar and automatically schedules breaks and chooses the personalized sound and perfume blends based on the user's preferences.

Such as scented sachets, the GemStone prototype can be used to overcome sleeplessness with scents that promote sleep such as lavender. There are many mixtures available to induce sleep; users can personalize the blend and place the prototype under their pillows or hang it in the bedroom before they go to sleep at night.

### **5.2 Social space: personal brand and impression management**

A lot of effort and planning is involved in dressing appropriately for an event; we normally consider certain factors such as the occasion, location, time, and intentions when choosing our attire. When you dress in an appropriate manner, people are likely to form positive impressions about your abilities and the professionalism of the organization you represent. If your image is less professional, people will assume the same is true about your abilities and actions [13].

The electronic sound and perfume accessory enables the wearer to create personal signatures for different contexts to form his/her images. A suitable example for this would be the Sound Perfume project that uses glasses, which allow people to express their personalized signatures in front of others during interpersonal encounters. Using this device can help people build stronger impressions through unique auditory and olfactory experiences, similarly to many marketing techniques such as the use of logos, jingles, and sometimes even smell, which make their products more appealing to customers.

### **5.3 Public space: integration contents, objects, and space**

Based on this idea, many interaction scenarios with certain contents, objects, and spaces can be defined with electronic sound and perfume accessories. This idea can be extended to many multimodal applications such as



music, movies, games, social networking services, and forms of digital entertainment in which we can augment the user experience through auditory and olfactory interactions.

When you walk through a shopping mall, you can perhaps smell an attractive cologne coming from the aftershave section inside a department store or the inviting smell of fresh baked bread coming from the bakery in a market. What if these experiences could be expanded and targeted to each user? The marketing possibilities are endless. Individual products can communicate with the user's phone when it is nearby, thereby sending auditory and olfactory information to the accessory.

These devices could also be useful for museums and exhibitions. Tourists or visitors can receive sensory information based on the display or showcase they are currently viewing. Fashion designers could exhibit their work in rich and diverse ways by integrating these types of accessories in their collections. Similarly, artists could develop more memorable experiences based on sensory encounters.

## 6. DISCUSSIONS

Designing a wearable device and fashion accessory with electronic components is a difficult task. The biggest implementation and design problem associated with the current system is the absence of any general structure for the perfume chambers and other electronic components. For each type of accessory, designers and engineers must collaborate to design systems with the required shapes and sizes. I developed three types of wearable fashion accessories that integrate the auditory and fragrance actuator; for each type, the components must be rearranged, and the system must be restructured for each iteration design. Several other problems related to the battery, flexibility, position of the speaker, and heaters must be thoroughly analyzed during the development of similar accessories.

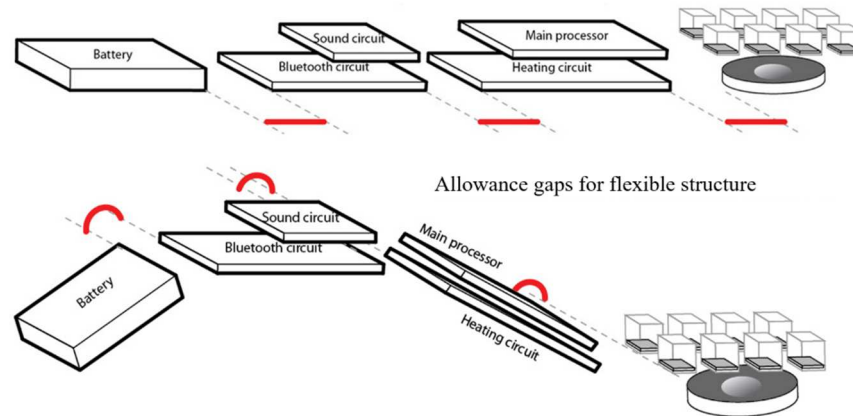
•**Battery:** In the current design, a rechargeable battery is installed underneath the cover of the accessories. Another plausible design alternative could have been based on energy harvesting; in this design, independent battery components were chosen to heat the solid perfume notes and perform simultaneous actuation. The design of all example sound and perfume accessories solves two key design problems: 1) it has a simple interface for battery charging and 2) a simple structure for an easy change of battery.

The plastic housing of the Eyeglass system integrates a simple interface with a mini USB port through which the battery can be charged. However, the design of the NeckTie accessory does not contain the mini USB port; it has a simple structure for replacing the battery without hampering its flexibility.

•**Flexibility and durability:** The accessories were made as flexible as possible through design investigations. Considering the wide range of accessories into which the auditory and fragrance actuators can be integrated, the design of the housing was varied to allow natural flexibility without restricting the user's movement. For example in the NeckTie design, the circuits include allowance gaps for increased flexibility as shown Figure 9. To make the circuits more durable, tubes were installed, which shrink when heated (i.e., when the system is in use), at every connection of the circuits and sealed with silicone glue. The resulting more robust circuit prevents short circuits, broken connections, and heat emission.

“Printed electronics” and “plastic electronics” are general terms used to describe electronics based on semiconducting organic (i.e., carbon-based) polymeric materials; they are good design alternatives that can further improve the flexibility of systems. Organic electronics are not used to replace silicon in conventional chips; nevertheless, there are many applications in which they may offer a competitive or superior mix of characteristics regarding performance and manufacturing economics [14]. The primary advantage of printing technology is the ability to produce lightweight and robust electronics on large-area, flexible substrates at low cost. Printed electronics represent the progress from conventionally manufactured electrical and electronic

components (such as silicon chips) to the production of lightweight, flexible electronic devices on cheap materials such as paper or flexible films.



**Figure 9. Components arranged in a strip-like structure, which ensures flexibility**

•**Waterproofing or separation structure:** When a wearable system is designed, it must be waterproof. Unique wearable technologies have attracted growing interest owing to the amazing achievements in the fields of advanced materials and mobile technology.

The integration of new materials and complex electronic devices such as circuit boards into wearable technology (from everyday use to mobile health diagnostics) provides unique user experiences. However, in most cases, the exposure to heat and moisture must be minimized to prevent the components from corrosion and failure. Constant exposure of wearable textiles to moisture and water (e.g., sweat, during swimming, and when the clothes are being washed) is one of the leading causes of failure.

Many manufacturing companies pack their devices into tightly sealed protection covers [15] or encapsulate them with a liquid silicone solution. However, electronic sound and perfume accessories require additional considerations because they integrate many complex electronic components. More specifically, the SD memory card may have to be updated at times, the battery may require replacement or recharging, and the chambers should be regularly filled. Fabrics require periodic cleaning/washing, which should not be restricted by the integration of auditory and fragrance actuators. Thus, designing a robust system that does not affect the normal usage of the accessory is challenging; the design of the housing should address all these major and/or minor problems.

•**Potential Business Opportunities in IT Fashion:** The development of the Internet, information technology, and media technology has led to a convergence era in which online and offline, media and communication, and content and technology are integrated into one [16].

This has made it easier for people to experience new things and share different experiences and knowledge. People are changing society through the spread of the Internet and digital media, and people's personalities are becoming wider and more diverse, and users' needs are becoming more diverse and more advanced [17].

The present is called the "experience era" after the information age. In other words, today's media technologies and interaction technologies, apart from information-driven services, help people interact naturally and offer a variety of experiences using human senses such as auditory, olfactory, and touch senses.

This change in digital media has influenced consumers to have a much stronger opinion of what they want in the world of instant information and online personalization. It also affects the fashion world, making and customizing products that suit users' personal tastes and characteristics, such as NIKEiD sneakers, through

online sites [18].

One of the characteristics of these personalizable electronic accessories is that they provide personalized sound and perfume blending functions through smartphone applications, which are easy to express and use different personalities.

In addition, these personalized electronic accessories and smartphone applications can be utilized for control and communication to develop custom systems for various functions such as memory enhancement and emotional services. In this scenario, electronic auditory and fragrance actuators could be embedded in a variety of wearable everyday accessories such as bracelets, headsets, hairbands and chest pins, a concept that could disrupt the fashion industry.

•**Potential business opportunities in sensory marketing:** In marketing, companies are beginning to strengthen emotional connections with customers and motivate them to develop their own brands through smells and sounds [19]. Signature sounds and smells are used to generate specific beliefs, feelings, thoughts, and opinions about a brand image in the consumer's mind [20].

Multisensory impressions give your brand a more interesting image and provide a better experience for your customers. The impressions created are varied, subjective, emotional, and context-dependent. It can be used as a technique to engage with customers in ways that traditional forms of advertising cannot. In other words, these personalizable electronic accessories can help companies build stronger emotional bonds with brands people prefer and reach customers in a more personal way. Today, even sound and smell can be trademarks to be remembered as a brand distinct from its competitors. The new trademark system allows anyone to register a symbol that can be identified by sound, texture, or smell as a trademark. The new trademark system allows anyone to register a symbol that can be identified by sound, texture, or smell as a trademark.

These non-traditional labels can provide significant value to businesses, and electronic sound and perfume accessories can effectively contribute to the diversification of sensory brand identities [21]. Overall, these devices offer a very unique business opportunity to create specific combinations of sound and scent branded by an individual, product or organization.

## 7. CONCLUSION

In today's highly interconnected world, the development of the Internet and mobile communication media has made our way of life and social relationships more complex. Fashion and personal brands are closely related to our social relationships. It is a very important way to express our identity and make a unique impression on others.

In this manuscript, I designed personalizable electronic sounds and perfume accessories for fashion and social interaction. Based on the results obtained while developing the Sound Perfume device, I explored electronic fashion accessories using personalized electronic scent and perfume actuators. By using unique sound and smell signatures that are memorable to others, you can help enhance or leverage your personal branding in the future. Based on this, I talked about the possibility of interacting with other people, contents, and things using it in the future, limitations for this, and future issues.

In the interconnected modern world, trends in the media and fashion industries are diverse and rapidly evolving. Although the application of auditory and olfactory representations in this field of research and in the fashion industry is still in its infancy, research has explored many interesting research questions, guidelines for creating similar devices, and plausible designs. I hope to benefit many different applications and industries with this kind of personalized electronic sound and perfume accessory.

## REFERENCES

- [1] Yeshurun, Y., Lapid, H., Dudai, Y., & Sobel, N. (2009). The privileged brain representation of first olfactory associations. *Current Biology*, 19(21), 1869–1874.
- [2] Sacco, T., & Sacchetti, B. (2010). Role of secondary sensory cortices in emotional Memory Storage and Retrieval in Rats. *Science*, 329(5992), 649–656. doi: <https://doi.org/10.1126/science.1183165>
- [3] Fox, K. (2009). The smell report – an overview of facts and findings. Social Issues Research Centre. Retrieved from <http://www.sirc.org/publik/smell.pdf>
- [4] Choi, Y., Cheok, A. D., Roman, X., Ngyuen, T. A., Sugimoto, K., & Halupka, V. (2011). Sound perfume: designing a wearable sound and fragrance media for face-to-face interpersonal interaction. *Proceedings of the 8th international conference on advances in computer entertainment technology*. Lisbon, Portugal.
- [5] Cann, A., & Ross, D.A. (1989). Olfactory stimuli as context cues in human memory. *American Journal of Psychology*, 102(1), 91–102. doi: <https://doi.org/10.2307/1423118>
- [6] Bos, J. (2021, April 3). Egypt’s wearable heritage. Retrieved from <http://ethnicjewelsmagazine.com/egypt-s-wearable-heritage-by-jolanda-bos/>
- [7] Egusa S., Wang Z., Chocat N., Ruff, Z. M., Stolyarov, A. M., Shemuly, D., ... Fink, Y. (2010). Multimaterial piezoelectric fibres. *Nature Materials*, 9, 643–648. doi: <https://doi.org/10.1038/nmat2792>
- [8] Tillotson, J. (2008). Scentsory Design®: scent whisper and fashion fluidics. In: Adams, R., Gibson, S., Arisona, S. M. (eds) *Transdisciplinary Digital Art. Sound, Vision and the New Screen*. Communications in Computer and Information Science, vol 7. Berlin, Heidelberg: Springer. doi: [https://doi.org/10.1007/978-3-540-79486-8\\_32](https://doi.org/10.1007/978-3-540-79486-8_32)
- [9] Tillotson, J. (2009). Scentsory design: a “holistic” approach to fashion as a vehicle to deliver emotional well-being, *Fashion Practice*, 1(1), 33–61, doi: <https://doi.org/10.2752/175693809X418694>
- [10] Entwistle, J. (2000). *The fashioned body: fashion, dress and modern social theory*. Cambridge, UK: Polity Press. eScent Personalised Scent Bubble (2021, April 3). Smart second skin, Retrieved from <https://www.escent.ai/smartsecondskin>
- [11] Goffman, E. (1971). *Relations in public: microstudies of the public order*. New York: Basic Books.
- [12] Emsenhuber, B. (2011). The olfactory medium smell in human-computer interaction. *Science, Technology & Innovation Studies*, 7(1), 47–64.
- [13] Peluchette, J. V., Karl, K., & Rust, K. (2006). Dressing to impress: beliefs and attitudes regarding workplace attire. *Journal of Business and Psychology*, 21(1), 45–63. doi: <https://doi.org/10.1007/s10869-005-9022-1>
- [14] Rogers, J. A., & Bao, Z. (2002). Printed plastic electronics and paper like displays. *Journal of Polymer Science of Polymer Science Part A*, 40(20), 3327–3334.
- [15] Martin, S. E. (2009). Protecting electrical and electronic systems from moisture damage. *Oceans 2009*, 1–3. doi: <https://doi.org/10.23919/OCEANS.2009.5422477>
- [16] Shin, D. H. (2006). Convergence of telecommunications, media and information technology, and implications for regulation, *info*, 8(1), 42–56. doi: <https://doi.org/10.1108/14636690610643276>
- [17] Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! the challenges and opportunities of social media. *Business Horizons*, 53(1), 59–68. doi: <https://doi.org/10.1016/j.bushor.2009.09.003>
- [18] Matt H. (2010 August 4). Nike Hyperdunk 2010 Coming to NikeiD. <https://www.nicekicks.com/nike-hyperdunk-2010-hit-nikeid/> (accessed 2022. April 3)
- [19] Uysal, A., & Ergün, Z. (2017). The impact of sensory branding on consumer behavior, *International Journal of Science and Research*, 6(2), 1094–1098. doi: <https://doi.org/10.21275/ART20164659>
- [20] Hultén, B. (2011). Sensory marketing: the multi-sensory brand-experience concept. *European Business Review*, 23(3), 256–273. doi: <https://doi.org/10.1108/09555341111130245>
- [21] Malbon, J., & Lawson, C. (2008). *Interpreting and implementing the TRIPS agreement- is it fair?* Cheltenham, UK: Edward Elgar publishing.