NEED OF ACCESSIBILITY AND AESTHETICS - IOT BASED SMART WEARABLE DEVICES AND HEALTH WEARABLE DEVICES

Abstract

The field of wearable health devices and digital jewellery has rapidly increased. It becomes essential to understand the expectations of style, social notions, personal choices and identity. The need for social acceptance and personal expression has to be acknowledged for the success of the wearable device and digital jewellery. Emphasis has to be laid on the process through aesthetics along with functionality. Function integrating the people centric stylistic approach embodying the essence to expression would lead to more adherence to the device.

Drawing from the interdisciplinary methodologies like accessory, jewellery, technology, sociology and expression of self this article analyses the use of each through compiled case studies. Directing towards how the aesthetics of the wearable device should be moulded to meet the identity of the wearer. The article reflects on designing devices that are accessible with a combination of fashion.

The article also talks about the importance of material, soft materials and internet of things, importance of first-hand insights (ethnographic research) and lastly empathetic approach.

Authors

Ms. Awani Sankritya
Research scholar
Department of Design
Delhi Technological University
Delhi, India.

Ms. Taruna Singh
Assistant Professor
Department of Design
Delhi Technological University
Delhi, India.

Dr. Devendra Tiwari
SSPGI
Noida,Uttar Pradesh, India.

Shraddha Chadha
Research scholar
Department of Design
Delhi Technological University
Delhi, India.

I. INTRODUCTION

Considering health is one of the most important aspects that affects human beings, it is critical that all the possible resources are used to make it easily available. IoT (internet of things) is one of the most trending aspects that is used to provide solution in every area of life including health care and assistive tech. IoT has found its way into health care and is being implemented in health care in many ways like: precautionary measures in diseases, treatment solution of certain diseases and healing along with monitoring the health and healing process. IoT technology in hand with wearable devices has become one of the leading and wide range used product in health care observation. It is also useful in accurate data collection providing correct information for better health management. In the recent years the improvement in the field of semi-conductors and sensors has made a promising growth in wearable device as well. The wearable devices are growing in their market and also in terms of advanced IoT technology. The wearable devices have found their use from being a part of a simple day to day accessory to more complexed and specialized versions performing practical applications. These smart wearable devices are interacting with an array of other smart devices like smart phones to provide essential data for computing as well as better communication.

The rapid increase in the usage and availability of the smart wearable devices with medical sensors and IoT (internet of things) it is inevitable that it would add an intelligent functioning aspect to fashionable jewellery developing a synthesized multifunctioning intelligent device that would also serve as a jewellery by the use of sensors. There by increasing communication and linkage through the use of IoT.

Expanding on the methods and methodologies of fashion and jewellery design inclusive of smart clothing technology as well as fashion studies this article discusses the interdisciplinary prospects of accessory design to pave out ways for principles and methodologies that can be applied to create accessible health wearable devices. This article will also try to propose concepts in amalgamation with accessory design practices and accessibility of the wearer to provide a more personalized health accessory. The intelligent jewellery is based on an ontology model to rapidly manage the data produced by the sensors present in these devices for smooth running of health management systems. The personalized service of the device in terms of health issue is most of the times provided to the user through an application

II. REVIEW OF LITERATURE

In most of the cases the health wearable devices no matter how good functionally gets rejected because they are not aligning with the identity of the user. The question arises that can these devices if designed with the principles of accessory design express the identity of the user? Reflecting on the aspects of fashion accessory as well as health wearable devices this article will talk about how the devices can hold both: the standards of fashion and the standards of proper health management device. It is imperative that the people using the device feel as an undivided part of society, hence implementation of creative processes and practices that can benefit the process of creation of health wearable devices should be important.

Discussing the rapid growth and utilization of the health wearable devices in the aspects of disease monitoring and in some cases also curating solution. Identifying that this is the future it is also essential to acknowledge the use of material, refining the designs and empathy towards the wearer.

The wearable smart devices with IoT technology are used in different forms and ways from: external accessories, smart clothes (embedded textiles) to being implanted in the body or tattooed on the body. They are excellent in order of collecting, sending and receiving data in form of information by connecting to easing the process of smart decision making. These devices have gained massive popularity as they can collect data on the move whether they are on humans or animals. Wearable devices are effortlessly working to bring together the factors of optimization of information in application, improved quality in life and health care management and better productivity. The advancements made in the field with smaller sensor, electronic devices and smart wearables is enabling development of wearable device technology at a faster pace. This advancement has led the people to witness various adaptations of smart wearable devices in the past years. Products including smart watches, ear buds, fitness bands, foot straps, body straps and even some smart jewelleries have been developed for various uses and applications.

Advancements In Iot Based Wearable Devices: Aside from the fact that the wearable device can be used centrally for prevention of diseases and becoming one of the focal points of health care it has now also started moving towards prevention of diseases. Along with that with the better research in the field now the use of wearable devices is also moving towards relevant and customized personal medical issue management: early diagnosis of a medical condition, maintenance of health blended with prevention is increasingly becoming popular.

Now that everyone prefers to have all within the reach of the hand including health care the popularity of IoT based health care devices and jewellery /accessory is extremely high even in Big Data. The concept of intelligent jewellery is derived from health management wearable devises that are aesthetically pleasing. Coping with the heterogeneity of the IoT devices adapting the semantic approach. The additional function that this platform provides is to keep up with the evolving set of medical rules and conditions.

Emerging technical advances have had a huge impact in human beings changing their perceptions on (sensory capabilities, physical capabilities and cognitive capabilities) along with changes in lifestyle that might include leisure and social interaction. Presently the inclination towards wellbeing is higher than ever and hence it is also making a change in the technology of wearable devices. The wearable technology is rapidly increasing and so is the research in the area representing it involving studies all across disciplines such as physics, physiology, micro and nano technology, biology and material sciences. The devices developed can perform simple to very complex functions that would include: navigation, sensory actions and communication. It is important to understand the role of technology in and along with human body in accordance with perception and ergonomic factors for better design of wearable devices and innovation.

III. SENSE OF ADORNMENT AND IDENTITY

"Human beings have been adorning their bodies with decorative objects for as long as there have been human beings" (Polhemus, 2005). Anthropologists like him along with sociologists like Roach and Eicher have always addressed that humans have a natural and undying inclination to adorn themselves. This has also been accepted and written about by various writers in the field of fashion as well. The importance of jewellery in relation to contemporary world has also been very well explained by Cunningham in his works. This deep need of adornment which is a part of human psychology also plays a part and influences how we dress ourselves; kind of jewellery we wear and how all of it is related to our identity. Hence when we discuss a health wearable device working as an accessory helping people express their identity is the need of the present time. Misunderstood most of the time and presumed to be just decorative body ornamentation and adornment is more than that. The purpose of jewellery, accessories and clothing or display of any kind on the body is sometimes essential to get positive reinforcement and attention. Viewing the health wearable devices just from the point of functionality makes it narrow, it is important to take in consideration the exigencies of delivering accessories that make himself and herself being accepted and also contented.

"...that emerge between the object and the wearer over time, and which often have profound symbolic layers" (Nygaard ,2018).

The wearable devices have been well entangled with our daily lives; referring to the aspect of being used all the time and also carried around interminably by the user. This factor does essentially adhere to the fact of medical/health management areas. Now, one thing that has to be defined properly is wearable devices are the ones that are worn by the user on their body instead of being just held. The wearable device hence qualifies as an accessory that needs to have both: functionality and aesthetics (need of looking good or even pleasing), similar to the aspects of any clothing item. The commercialization of wearable devices has made them omnipresent with a wide range of user base; sufficing the real needs of consumers. When the device is specifically designed to monitor a health condition it makes the user uncomfortable even giving them a feel of alienation in some cases.

"Wearable sensors and systems are defined, as wearable sensors/actuators and sensor-based communicative systems that can monitor and/or stimulate, and/or treat, and/or replace biophysical human functions" (FERRARO & INGARAMO, 2014). The functionality of these devices has to be top play but the user doesn't always comprehend just plain and simple the advantages of wearing these devices. Things like these happen as the wearables in many cases are not adaptable or attractive enough. The appropriateness of the wearable device to adopt the personality of the user or fit the personality and identity of the user is essential; same as any other clothing item that has to be worn on the body.

"A wearable needs to both work and look good and be worn in the same way the user wear clothing in order to achieve the paradigm anytime, anyplace, by anyone" (Marculescu, 2003)

IV. WHY DESIGN AESTHETICS ARE NEEDED IN WEARABLE DEVICE

Humans have built a very close relationship with wearable devices: the interaction between technology of wearable devices, users' body and electronic devices gives potential to the development of technology. To be worn on the human body comfortably the devices can also be embedded on a garment or as a beautiful accessory. The accessory design approach should be more towards comfortable and easily acceptable use of the devices as the functionality they provide is already a part of the solution. Due to the immense proliferation of wearable devices in the society, the wearable devices require them to be treated as an interface not only as an artefact that has been intimately attached to any part of body. Aspect of the gap between design (accessory and aesthetics), technology and other social concerns of the users that need to be mediated; the perception of others towards the device and the user. The wearable device must feel like an extension of the wearers personality while managing the physical condition and space to the comfort of the user.

In terms of design the dominant issue faced is wearability of the wearable device: translating to concerns wearing the device because of its physical appearance or shape. Accessory design essence has to be brought in ; to make the product more acceptable by the user and mould the technology of health care management and design together.

Wearable devices from bands, bangles to attached exoskeletons has expanded exponentially. Taking in consideration the notions of personal wellbeing, addition to style, personal identity and wearability the designs need to be understood. "*Designers and design teams, therefore, need to be able to generate and communicate such suprafunctional elements at all times during a design process and within the product itself. Mood boards offer an opportunity to communicate at emotional levels."* (McDonagh, 2006)

The design of the wearable health device is conventionally based on a biomedical representation. The designs do not adhere to the social and psychological needs and impact on the user. The current designs of health wearables are often perceived as unstylish and unwearable thereby resulting in low adherence to the device.

"Practitioners such as occupational therapists and physiotherapists may prescribe either custom-made or 'off-the-shelf' prefabricated splints" (Paterson, Bibb, & Campbell, 2012). In his work Paterson has described the incongruous use of split for a patient that leads to low adherence to the routine due to discomfort in use, lack of visual appeal and impracticality of daily use. Furthermore, the reasons suggested by the users promptly include: feeling stigmatized, taboo, being viewed differently and also poor use of materials.

Considering the perspective of design, a more circumferential view of wearable devices could be defined by elements of jewellery: engaging desirability and forming a personal relationship between the user and the device.

V. CASE STUDIES AND PROJECTS

"...observation describes the garment as being an interface to the exterior mediated through digital technology. Fashionable wearables have great expressive potential that is amplified through the use of technology" (Seymour, 2008). Seymour defines that the

wearable devices (body -worn devices) are an experiment, the success of which depends on the capacity of the device to monitor human movement conjointly meeting the social needs and aesthetic appeal. The term used by Seymour "fashion wearable" becomes a key in order to describe the products through: accessibility, function, having an accessory that the user relates to (personality wise, socially as well as psychologically). The field of fashion technology provides us with multiple examples and case studies that would facilitate understanding on the topic of wearable devices.

1. **Fall Detection Wearable:** A study was conducted by *Trine Møller* in collaboration with an engineering firm to design personalised and engaging wearable fall detection device customised for care home residents. The accessory approach was taken to accommodate the needs and varied cultural fits of the users. As understood accessory design, fashion design and jewellery design do not align completely; having different design-based involvements. The accessory design approach is also preferred as it obliges both the need for functionality and wearers need for expression of self (psychological as well as social). This approach and research had proved that – better insights can be gathered of users preferred choices that would lead to deep understanding and hence incomparable iterations to customise the product. Taking the human computer interaction route enabled the wearables in amalgamation with accessory design to become a better cultural and social fit.

   "…wearers are care home residents that have to wear a fall detection alarm at all times…. the design experiment was set up to explore how a design approach could be introduced and implemented in the company to design engaging wearables." (Møller, 2018)

   Different research scholars and designers from various fields have already been exploring and investigating the field of digital jewellery, Internet of things combined with accessory design. It was essential to move forward in this direction for customised and quality wearable devices that become priority of the wearer without making them feel self-conscious also attending to their personal style. In the research we see that the designers were later made a part of the team and made personal observations regarding the wearer's choice, wardrobe and personality traits. The research also mentions Newell et al. Implying that empathy has to be developed towards the individuals (users) So that aesthetic considerations can be made to make the target group adhere to the wearable products and assistive technology products.

   An example of a dark grey fall detection device can be seen in the research which accentuates the importance of accessory design – next to the fall detection device one can see a gold bracelet that suggests a different narrative and a personality of the wearer. Figure 1 given below Helps to perceive the relatability of elements of accessory design and functionality of health care devices need to run hand in hand. As research proceeds, a pearl fall detection wearable device was designed keeping in mind the aesthetic choices of the wearer and also having competitive fall detection technology including GPS along with two way communication. The device in figure 2 can be seen in the form of a brooch sixteen different variations were done of the fall detection device adding the knowledge of accessory design the devices were made to constitute the cultural variations and worlds helping the wearers to express an integral part of their identity.

Figure 1: a home care resident wearing a fall detection device
(PHOTO Reff. "Trine Møller,2018")

Figure 2: newly designed pearl fall detection device in accordance to the choices and personalities of the wearers
(PHOTO Reff. "Trine Møller,2018")

2. **Digital Jewellery:** IBM research concepts of 2000 throws light on exploring the niche of digital jewellery. Denise Chan a mechanical engineer created a concept of a set of jewellery objects that, when put together can function as a mobile phone. The indication of an incoming call would be a light flashing on a ring, the phone number of the caller would be displayed on a bracelet and the user could answer the call by pressing a button located on the bracelet whereas the microphone would be on a necklace and lastly the speakers would be in the earrings. *"if you have something with you all the time, you might as well be able to wear it"* (Miner, 2003). Cameron Minor founder and the lead researcher on the IBM's design lab supported and also provided explanation in research of digital jewellery.

IBM delineates the primary catalyst to be changing the face of multifunctional devices through the challenge of Researching digital jewellery "by *taking the interface apart, putting it in the appropriate places, and allowing them to communicate wirelessly, IBM thinks it has a practical way to solve the problem." (*Schwartz, 2003*).* IBM Research aspired to convert the present digital devices into wearable devices that were ubiquitous

in the market. On aesthetic terms Figure 3 below shows that generic notions of Jewellery Design were followed making the wearable device slightly altered to look like how a stereotypical bracelet or necklace would look.

Figure 3: IBM'S digital jewellery design from 2000s
(PHOTO Reff. http://electronics.howstuffworks.com/digital-jewelry2.htm)

3. **Soft Material And Iot:** A combined study was done by Sarah Kettley and Trine Møller Taking in consideration the expression that comes through the wearable device or the object. The study was done with various participants who provided a wide range of context and experiences ranging from their careers to their choices of fabrics colours and other sensitivities. E textiles were used to cater the needs of the participants - it was found the participants choose and rejected fabrics on the basis of aesthetics. The participant showed associations and authorship over the designs and created some of their own pieces relating to their favourite choice of foods and even public figures, as shown in figure 4.

"…one participant wanted something she could shake at places she had emotional associations with, while others wanted to squeeze their handheld objects to feel comforted in the moment, or to let someone else know they "were OK." The phenomenological experience with these accessories was thus developed in tandem with emotional expression, whether hidden or overtly expressed." (Møller & Kettley, 2017)

"Finally, in trying to evidence participant experiences within the workshops, we also used materials, tools, and the made objects to help individuals recall how they had felt in the moment" (Jones & Fielding, 2015).

Researchers designed small accessories like hats, ear warmers and gloves to assimilate personal expression of the wearers. The figure 5 below shows two of the participants wearing the basic accessory designed by the team. After some time, the team also design accessories that could be concealed inside the sleeves or carried in pockets as per the requirement of the User.

Figure 4: small wearable devices made by the participant's of the study
(PHOTO Reff. Sarah Kettley and Trine Møller, 2017)

Figure 5: participants can be seen enjoying the wearable devices in external social placements like Christmas fairs without any fear of being viewed differently
(PHOTO Reff. Sarah Kettley and Trine Møller, 2017)

4. **Scent Whisperer:** Scent Whisper is a jewellery project done by G. Jenkins, A. Manz and J. Tillotson. The project talks about working on wireless sensor networks for offering social and therapeutic value. The project holds two devices that are key one is the spider (which holds the sensor) and the beetle (the emitting device). The devices were designed by Don Baxendale Central Saint Martin's college jewellery dept. in form of brooches to work efficiently on Wireless Personal Area Network. The objective of the research project was to favour the wellbeing of human beings by the stimulus of the olfactory nervous system. Fragrances such as lavender for healing or lowering anxiety or insect repellents could be used for protection.

   The fragrances can also be used for communicative purposes, the spider that has the sensor for whispers could send a signal to the person wearing the beetle which releases a fragrance to send certain messages. *" The spider's sensor, implanted in its abdomen records the humidity of the breath and releases scent from the beetle onto a localized area, creating a personal "scent bubble". The devices involve microfluidics and wireless technology that link a remote sensor with a fragrance-dispensing unit to create two items of jewellery that constitute the "wireless web"."* (Jenkins, Manz, & Tillotson, 2006)

Figure 6: the brooch prototype for the scent whisper devices
(PHOTO Reff. (Jenkins, Manz, & Tillotson, 2006)

The work done in the research promises high future prospects in the area of galvanic skin responses through the use of sophisticated sensors that can detect when the user suffers from anxiety or has any other emotional response that requires immediate attention.

VI. CONCLUSION

In assumption to the literature read before both in theory, and in practicality the ideation of health care wearable designs can be drawn from the traditional elements of accessory design. Reflecting on the existing choices of wearable care health designs or lack thereof is hence of relevance to exploration of amalgamated ideas. The concept of accessory at its core gives various powers to the to the object including- materials, personal choice and

aesthetics, cultural fit, gender and economic. Since accessories is an autonomous object providing comfort to its wearers by giving them a choice of personal preference. Both of the features of expression and function need to be embedded in the wearable healthcare devices. Combining all the literature in single light whether it is jewellery research, style, wearability, human centred approach, empathy and identity show us the relevance of designing healthcare devices through an aesthetic approach (accessory).

Analysing the four Case studies and Projects mentioned Designer's role and relevance in taking the accessory approach towards designing wearable devices is essential as- empathetic connection with the wearer is crucial in hand with basic material knowledge and refined crafting skills. Primarily A wearable healthcare device design should start by understanding three major factors

1. First hand insight on users psychological and social needs along with their physiological body
2. As , every human being has inherited need of adornment users need of the same should be understood
3. Making an empathetic connection with the user helps understand the cultural factors required for a better wearable design.

Development of Healthcare wearable devices and smart accessory/jewellery requires the designers to Synchronise the narratives of various accessories and how they have a relationship with the body of the wearer to give a full emotional and sensory experience of wearing the designed items. The designer must also have knowledge regarding electronic components and digital technology so as to a certain both the fashionable and the cultural aspect of healthcare wearable device as per the preferences of the wearer. "*In that sense the designer needs to know how to gain insight into the wearer's personal preferences at the biopsychosocial level" (Møller and Bush, 2018)*

Accessibility or access corresponds to "an approach" An approach to designing and enabling accessible wearable healthcare device through accessory framework which has also been discussed in this article. The article also talks about how accessory design approach can offer a different course to current wearable healthcare designs. Forming a relation to the wearer gives the approach more meaning rather than traditional design of healthcare wearables which relate to pure functionality.

When talking about healthcare wearable devices they should commonly fall in the standard of assistive design whereas accessibility covers an overall definition to be inclusive for all. This is due to the stereotype that is attached to accessible healthcare devices - linked to designed for people with disability versus an ideal body type. *"The stereotypical characteristics associated with people with disability are often exaggerated, unjust, and concern a person's entire identity and life, not just disability" (Jacobsen, 2014)*. The idea of accessory design elements in the milieu of wearable healthcare device design is intriguing and gives life to creating power objects in healthcare Device systems that are typically designed on a biomedical model. The idea is to facilitate the acceptance of health care wearable devices in the wearers as well as the viewers. The implication of a wearable device

should never just be disability it should be more personal experience supporting the health as well as aesthetics and social needs.

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