Design Process for Wearable Technologies and Urban Ecology, AirQ Jacket

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Abstract

This paper reports the creation and research process of the AirQ jacket, a wearable device that conveys temperature and air quality data through embedded electronic devices emitting light and sound. The project is oriented to enhance environmental awareness to the local passerby, since the proximity of Manizales (Colombia) to an active volcano brings the topic of air contamination to the everyday life city concerns. While the research process is introduced, some topics will be discussed such as the policies and actions taken by governmental institutions in monitoring air pollution or some wearable technology projects and approaches facing similar challenges. The paper will also describe in detail the prototyping process, on the one hand, by discussing high-level topics such as the perceptualization of scientific data. On the other, by addressing low-level topics related to the assemblage and electronic components embedding, such as portability or washability. Our systematic method of design research will be presented, outlining the dilemmas we faced and solutions we followed in the four stages of the research process.

Keywords

Wearable Technology, Urban Ecology, Soft Computing, Sonic Interaction Design, Environmental Awareness

Introduction

A challenging topic for creators and designers in Manizales, the place we live and work, is air contamination, since the city is exposed to continuous toxic gas emissions due to its proximity to a volcanic region. Beyond the discussion triggered by the pollutants, the factors, the policies and the actions we can take, we would like start thinking about air as a mixture of gases that forms the atmosphere. Beyond the discussion it triggers around pollutants, factors, policies and actions, we would like start thinking about air as a mixture of gases that forms the atmosphere. The surrounding air retains the gravity force of our body allowing us to breathe and move with stability. That is why air is so important in the permanence of human beings. Accordingly, an ecological perception principle suggests that the "loco-motion" of the body is molded by the environment. (Gibson, 1986, p. 130). In our design process, we incorporate this insight in the local context, taking as a premise that the environmental conditions affect the passerby mobility in the urban space.

On the other hand, the pedestrian perspective of the city is another inspiring topic in our creative process. According with Michel de Certeau there is an opposition between a city view from "up there" that is totalizing and allows, "seeing the whole", and another view from "down below" where live "the ordinary practitioners of the city" (Certeau, 1984, p. 93). Likewise, we could think that the urban environment can be twofold. It has both, a physical and an electronic layer. Meanwhile, Lemus suggests that urban spaces have "informational territories", "zones of control of emission and reception of digital information for individuals who are circulating in the public space..." (Lemos, 2007, p.129).

In this paper, we will discuss about how wearable technology can enhance environmental awareness by allowing its user to confront the experience in the physical space with electronically retrieved data about the surrounding contamination. The design process took into account global perspectives in the fields of environmentalism and wearable technology, trying to adopt them as variables in our proposal. The design purpose seeks to empower the city passerby with portable devices and garments allowing him/her to face the local environmental conditions.

The first section will address air quality, by determining not only, the factors and consequences of air pollution, but also by discussing public policies and actions taken by governmental institutions. We will state here that wearable technology can provide new perspectives in the interpretation of scientific environmental data, bringing to the sphere of the everyday life concerns about air contamination. The second section will go into

the wearable technology practice, confronting recent projects and examining their designer's assumptions and purposes. While some of these creators propose different solutions to similar problems and similar solutions to different problems, they raise relevant topics on our design research, such as the developing of new materials, the relation with the urban space and the particular circumstances faced by wearable technology designers from peripheral places. The third section will deepen on the research process that gave rise to the AirQ jacket device. The design problem was addressed from different perspectives that leaded us to take into account topics such as perceptualization, portability or washability. Informed by theoretical resources in the field of design methodology, we opted to follow a systematic as well as creative- based approach to design research. Accordingly, analysis, synthesis, prototyping and assemblage stages will be reported. Last section will discuss some conclusions and final remarks.

Public Policies and Actions on Air Quality

Air Care and the widespread concern about climate change require from both, designers and engineers, plausible solutions around the world. In order to improve the urban life conditions, governmental institutions have been taking actions. They have created local policies, air pollution monitoring programmes and advertising strategies to make the community aware about climate phenomena according to the exploitation of economic and environmental resources. One remarkable example of that is the Canadian Ministry of Environment and Sustainable Development (MDDLECC, 2016). It takes actions through a platform that warns the population about contamination levels and the polluting factors according to each zone. The institution provides real-time scientific data about the environment to Internet users according to their location. Air Quality is determined by an Index (AQI) established in the Clean Air Act considering a number of pollutant gases such as O3 (ozone), PP (polystyrene particles), CO (carbon monoxide), SO2 (sulfuric dioxide) and NO2 (nitrogen dioxide) (AQI, 2017).

Both, air quality and climate change, suggest ecological challenges while they depend, on the one hand, on large natural cycles and, on the other, on human production and consumption activity. In a city such as Manizales, there are some governmental agencies working to mitigate the impact of natural phenomena

in the urban environment, warning the population about contamination levels and smog. Manizales is located near an active volcanic zone, due to this fact; there are constant emissions of toxic gases that are invisible to the passerby. In addition, the vehicular fleet and industrial park growth have recently become important factors in the local air quality.

Corpocaldas, as the highest environmental authority in our region, is responsible for monitoring air quality in Manizales. They have placed air quality monitoring stations at different points in the city, focusing on SO2 and NO2 levels (CORPOCALDAS, 2016). Moreover, they warn about acidic precipitation, which contains high level of SO2 and silicon particles, producing an effect in the sky how Ballantyne called "scattering" (2007): the landscape becomes visually contaminated and the sunbeam produces light effects caused by volcanic gas emissions. The Colombian Geological Service (CGS) manages a risk plan by monitoring in real time the regular activity of the Nevado del Ruiz volcano. The 2015 "volcanic tremor" (VRM, 2015) produced an ash layer in the atmosphere that was more intense than the ones seen in past years. It increased the acidic rain as well as the levels of silicon particles and SO2 in the air. CGS risk plan faces unexpected meteorological events that can affect the community, while it is known that human exposure to air contamination weakens the cardiorespiratory system and produces eyes and skin irritation among others consequences.

Despite the actions taken by these Colombian institutions, there is little clarity about the impact of warning environmental and climate change information in the local community's everyday life. According to the World Health Organization (2016) societies with meteorological and atmospheric imbalances have great impact in the displacements, the migrations, the malnutrition, the intensification of conflicts of gender, changes in habits and the alternate use of the soil in agricultural production.

While the WHO recommendations head towards environmental awareness, the wide spread of scientific information about air quality still remains as a challenging task. In this regard, wearable technologies can be helpful since they can introduce technological processes, such as, monitoring air quality, to the sphere of the community everyday life. By regularly interpreting pollutant levels the pedestrians will have informed criteria to take better decisions and personal

actions related to the environmental conditions. This should improve habitability and convivial in the urban space. Furthermore, by providing a portable air quality monitoring system to "ordinary practitioners of the city" (Certeau, 1984, p. 93), wearable technology solutions can contribute to the above mentioned institutional endeavours, offering alternative ways to retrieve environmental information.

The Practice of Wearable Technology

Fashion and costume design has been strengthened by a new generation of clothing technology based on informatics. Computer`s mobility and portability have fostered a new conception of the human body and have encouraged major fashion corporations to develop new materials. Wearable computing design practices have been growing in the past decades and today there is a significant number of studies and specialized laboratories. The research on wearable technology has diversified in directions that we have been identifying, such as art, performance and activism, urban practices, dance, athletic performance, surveillance and security systems, medical care or environmental awareness among others. Electronic- empowered experimental garments go from very simple DIY electronic devices (Mellis, 2014) to sophisticated cyborg-like garments.

It is worth mentioning that, since the first microprocessor launched in the 1950's, the industry has been developing novel materials with chemical and physical properties that have been placed in the enduser personal computer models. Today, some of these technological innovations are near to appear in the fashion mass market with wearable technology initiatives supported by agencies such as Google or Levis. It is the case of the "Jacquard" project (Project Jacquard, 2016), a denim jacket made with an interactive textile allowing its wearer to control smartphone applications from the garment.

Wearable technologies have been eliciting new conceptions about the urban space and contemporary citizenship. They can provide ubiquitous access to electronic and online services to pedestrians and people in transit through the city. While smartphone interaction is usually restricted to a deeply focused user, electronic garments and accessories promote alternative ways of dealing with computer technology in public places. With the help of sensors and actuators, wearable interaction systems expand the human body by enhancing its physical and mental capabilities.

Many of these experiments could not be carried out without the Internet, while most information on wearable technology is available as online tutorials (Instructables, 2016) or downloadable code (Github, 2016). From this perspective, wearable technology practices are very open and accessible to designers and artists, even for those that are not familiar with electronic prototyping and programming. However, one of the challenges we faced in our design process was finding materials. Some components, microcontrollers, sensors and, most important, specific wearable technology parts are not easy to find in a peripheral online marketplace such as the Manizales one. In our design process we have tried to deal with this restriction following the premise: "more construction, less parts" (Hannah, 2011). We have opted to work with locally available materials and components, leading us to insights and prototypes that have risen by exploration and serendipity.

Inspiring Cases

In this section we will gather a group of creators coming from design, art and technology, equating their different approaches in the practice of wearable technology. Although, for many reasons, their projects differ from ours in the purposes and goals, discussing them will reveal different solutions and proposals facing common problems and shared challenges. In some way, they express the "future of clothes" (Tilbury, 2014), by unveiling a shift of thinking about the body in fashion design practices. While the human body expands its both, physical and mental capabilities, these projects take advantage of the portability of electronic items (Gershenfeld, 2013) to propose new ways of embodiment without losing attention to environmental and ecological awareness. By adapting shared design knowledge about electronic prototyping (Banzi, 2011), they enclose global problems in a single piece of cloth.

From a fashion design global perspective, Paulina Van Donger's Wearable Solar integrates different procedures in a single "scientific creation" (2015). The project consists of a jacket with an embedded solar panel acting as a power bank to recharge smartphone and other equipment. The garment is intended to the Wadden Sea workers, since this Netherland's natural reserve is away from electrical energy sources. As a "worn on" (Van Donger, 2015) project, it allows the workers to keep the circuit running (e.g. charging the jacket) while

doing their regular activities. When one considers the distinction between "internal and external stimuli" placed by wearable technology designer and theorist Barbara Layne (2007), Van Donger's creative proposal suggests a rewarding example of the latter. According to Layne: "the most interesting advances in smart textiles are being made by a new generation of artists, engineers, designers and programmers: people who have a strong expertise in an area and also learn skills in fields that complement each other..." (Layne, 2007).

On the other hand, chinese-born designer Ying Gao explores embedding motors and other physical actuators in *haute coutur*e fashion design. Her "code couture" (Gao, 2016) work settles closer to Hussein Chalayan's approach (2000), however Gao includes wearable robotics in fashion shows, performances and artistic installations suggesting an original contribution to the field. In Gao's work, wearable technology is the result of a convergence between engineering and dressmaking labs. As a result, new fabrics, textiles, materials and garments are produced. However, there are some other designers adopting a sort of ready-made processes, taking advantage of obsolete artifacts and second-hand clothing in their experiments and testing stages. C02 Corset by Kristine O'Friel could be an example of this. She embeds a set of servomotors in an existing female corset. The motors tighten or release the adjusting strap mechanism according to the C02 levels in the environment reported in real time by an embedded sensor. The dress hacking process suggests alternative ways to capture and make perceptible information that the human senses are not aware of. (O' Friel, 2008).

On one side, there are industrial processes and the production of new fabrics and material for wearable technology, such as Van Donger's or even the Gao's one. On the other, there are homemade processes supported by DIY and online tutorials, such as the C02 Corset. Whether, the former or the latter, the new generation of "reactive fashion" (Berzowska, 2005) and "soft computation" (High-Low Tech, 2016) is immersed in a multidisciplinary collaboration context where engineering, design and art rediscover each other. They share the challenge of finding out new ways of creating wearable and interactive artifacts (Dunne, 2005).

The AirQ Jacket Device

The AirQ Jacket is a wearable device that conveys temperature and air quality data through embedded electronic devices emitting light and sound. Jacket reacts to environmental conditions and notifies them to its user in a symbolic way. The AirQ Jacket (2016) is the MA degree project of fashion designer Maria Paulina Gutierrez, in the Universidad de Caldas, Design and Creation Program in Manizales. It was carried out under a funded research project entitled, Sound Design for Urban Space, coordinated by program member and PhD Julián Jaramillo Arango (Sonology, 2016).

While the Manizales contamination is originated by im-ponderable factors, such as the natural volcanic activity, the industrial production or vehicle C02 emissions, the jacket electronically retrieve environmental data providing a meaningful context to interpret scientific information about the urban space. Although air quality is not always detectable by the human's senses, it does affect the population health producing a number of associated diseases. In this regard, environmental awareness is an urgent task in our region. The jacket intend to bring to the sphere of the Manizalian population daily life, the question and concern about air quality.

AirQ Jacket invites the passerby to interact with the environment in a reciprocal loop. This criterion comes from Sonic Interaction Design (SID) theorists (Rocchesso et al, 2008, p. 3969). They propose that in the phenomenon of Sonic interaction, humans get immersed in a "feedback loop" where actions govern sound and, reciprocally, sound become the main criterion in deciding what will be the next action.

Perceptualization

The AirQ jacket creation process also looked into the field of perceptualization (Barras&Vickers, 2011, p. 153), in this case, the mapping of scientific data to visual and auditory stimuli. On the one hand, temperature and air quality data are visualized by two arrays of colored leds attached to the upper and lower sides of the jacket. The circuit maps the information in a traditional symbolic way: blue-to-red to show temperature in the upper side, and green-to-red to show pollution in the lower side. This changing color symbolism is also associated to the scattering effect. On the other, the sonification system runs in a custom-made artifact attached to the jacket that was built with a piezo-electric device located inside a plastic cabinet that totally kills the sound, unless you approach the ear, such as telephonic equipment. Our sonification strategy demands an exploratory analysis process from the user and adopts a "reference" or

contextual sound (Walker&Ness, 2011, p. 26). The user hears a couple of regular metronomic ticks. The first one displays the temperature data changing the pitch. It also lets hear the pollution data changing the velocity. The second tick acts as a grid of reference, it represents "normal" state. When the pedestrian compares the two ticks he/she can appreciate the environmental conditions.

Figure 1. AirQ Jacket prototype. ©Maria Paulina Gutierrez & Julián Jaramillo Arango

Portability and Washability

A challenging task in the AirQ Jacket design process was embedding the electronic circuit (power source, sensors, microcontroller, leds, speaker, chords). The distribution of such components in the jacket leads us to a rewarding interchange between electronic prototyping and dressmaking. While portability became a goal in the AirQ jacket design, the patternmaking and the choice of materials adopted the criterion of lightness.

It is worth mentioning that, in the field of fashion design, lightness is a sign of modernization. In fact, when Barthes discusses the "real dress" (as opposed to the photographed one) he addresses the fashion system changes according to social processes such as the democratization and homogenization of design and the rise of a set of new citizens' needs:

> *"The displacement from heavy to light is evidenced by the evolution of the real dress; the sales of the coats has decreased in profit of the most light garments (water-proof, raincoats), perhaps because of the urbanization of the population and the development of the automobile".* (Barthes. R. 1978, p.115)

Not only the growth, but also the modernization of the urban space has made fashion design to evolve.

Wearable technology requests a layer of electronic devices implanted in the "real dress" and intended to inhabitants of the digital city. In terms of patternmaking, Rudofsky argue that a piece of traditional clothing "...is equipped with about seventy or more buttons and about two dozen of pockets, most of them useless.", and "... thanks to mechanized cleaning methods, they come loose" (Rudofsky. B. 1971, p. 170). Washing machines have influenced modern pattern making. In our days, sustainable design suggests additional demands since they argue that "the sense of community pay attention to the important thing of life" (Manzini, 2008). Accordingly, "post-growth, local wisdom" and "craft of use" notions research aims to create "garments that link you with the natural world", "garments that catch your attention each time you wear it" and "garments that are made up of separate pieces that can be interchanged" (Fletcher, K. 2010, p. 1412). With these concepts in mind, the AirQ jacket was created with two layers: on the one hand, an uncomplicated washable layer with strategically located pockets in order to attach electronics. On the other, an electronic layer that distributes the circuit in a way that it can be detached when the piece is going to be washed.

Design methodology

The AirQ Jacket has been the result of a research process. It enclosure different stages in our insights about wearable technology and environmental awareness. Since we didn't find a shared methodology for such an undertaking, we adopted design methodological resources that allow us to create a prototype as the main research result. We took into account theories such as project-based-research (Findeli, 2008), active practice through design (Archer, 1976), social design (Manzini, 2008) and the systematized method of design research proposed by Jones (1984). As a result the research was segmented in four main stages or phases, each one with its own purposes and challenges: (1) analysis, (2) synthesis, (3), prototyping and (4) assemblage. While theoretically the research findings were expected to emerge during the construction of the device, in reality the research focused the last two phases. There is not enough space here to describe the whole research process, but we will mention some aspects in each of their stages.

1. Analisis The analysis resulted from a gathering of wearable technology proposals developed in the past ten years. We pay special attention to both, the available

technologies allowing to undertake this practice and to proposals focused on environmental awareness. Raising art and design projects that have faced similar problems and challenges allows us to match different solutions and to find appropriate materials and procedures for our local context. Although, we started the research with the analysis stage and it was supposed to finish after some weeks, it extended along the whole prototyping process. In other words, we found projects that give us valuable feedback in the different stages of the research.

Although wearable technology practices have been growing meaningfully in the last few decades, in Latin America and particularly Colombia, it is just possible to find a handful of initiatives. We expect this situation will be coming to change soon, since relevant information to the subject is available thanks to knowledge democratization allowed by the Internet.

Another topic we raised in the analysis phase focused on the public health and environmental policies followed by global and local institutions. They propose a set of recommendations and actions in order to monitorize Air quality and guarantee the wellbeing of urban inhabitants facing environmental contamination.

2. Synthesis The synthesis process consisted in reducing the found phenomena to solvable problems. We found that environmental awareness is an important demand for artist and designers involved with technology, since there are available resources to work in this direction. In this regard, we imposed ourselves the task to create a wearable device capable of monitoring air quality. In this stage, we tested with different materials, sensors, actuators and systems that allow us to measure the concentration of different toxic gases. At the same time we tried with different strategies to make perceptible the retrieved data. The final components and materials involved in the AirQ jacket were found in the synthesis phase.

3.Prototyping Materials and Instruments In the prototyping process we gather the materials from both, electronics and dressmaking. It triggers laboratory activities that progressed by serendipity, in which the crafting of both disciplines were combined and hybridized. Accordingly, the materials and instruments we use in the AirQ jacket prototype were from electronic components, sensors, microprocessors, the computers and solder, until, fabrics, conductive threads, sewing machine and iron.**Sketching** With the appropriate materials, the first step consisted in creating a intuitive scheme where considerations of electronics and dressmaking were posed. The Figure 2 shows in red, the electronic sketch dealing with the operational facet of the device, and in black, the patterns of the jacket in which the electronic components are distributed. This initial sketch arouses during an exercise where the goal was appreciating the soundscape and the environment by tracing an intuitive course through Manizales (Arango, 2015)

Figure 2. AirQ Jacket intuitive drawing. ©Maria Paulina Gutierrez & Julián Jaramillo Arango

The Electronic Circuit The electronic circuit attached to the AirQ jacket is very simple. It uses the MQ-135 and MQ-9 sensors to retrieve Air quality, and the DHT-11 to gather temperature data. There are also four led panels and a sound device (a speaker inside a plastic cabinet that was previously described). We linked sensors and actuators with an Arduino device. Because of the size and efficiency, we chose the Arduino Pro model. It is feed by a portable power bank providing 5V, usually used to charge mobile phones. While the Arduino Pro is fed with 3.3V we adapted a FTDI converter between the power bank and the Arduino.

4.Assemblage Coding In addition to the electronic circuit building and the components embedding, the AirQ jacket required a custom made code in Arduino. The code is responsible for linking sensor and actuators, mapping the input environmental information to a perceptible (by light and sound) output. The code

allowed us to test different configurations and links between input and output, and leaded us about musical composition and visual design concepts. They were useful in the finally adopted solutions that were discussed in the perceptualization section.

Dispersing Light Panels The light dispersion is one of the acid rain collateral effects. The solid particles present in the atmosphere turn in various colors making visible the contamination through the sunbeam when one views the horizon. This effect, called as "scattering", was translated to the jacket through dispersing light panels we made with four textile material layers (see Figure 4): the first one is the is the plastic bag material developed to cover the jacket, the second one is a dark surface with holes dispersing the led light, in the third one the leds are sewed and the last one is the inner lining.
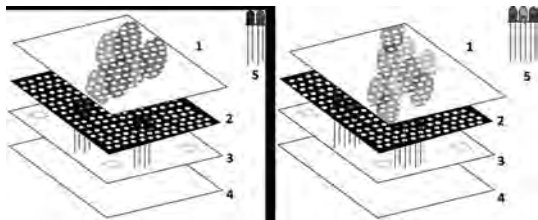
Figure 4. AirQ Jacket layered led panel. ©Maria Paulina Gutierrez & Julián Jaramillo Arango.

Plastic Bag Material In addition to the dispersing panel, we searched other strategies to smooth the effect of the led`s light. Our approach was creating a sort of reactive material that could cover the outer layer of the whole garment. We inspected in some materials dealing with biological waste and toxic agents, such as DuPont's Tyvek, which inspired us to propose a recyclable solution. The outer layer of the jacket was made with shopping plastic bags, that were printed in the jacket's outer layer with a double-sided thermal-adhesive film (see Figure 5). This solution helps to protect the components from the rain and provided translucency, giving the appearance that the jacket changes its color.

Figure 5. AirQ Jacket plastic bag material. ©Maria Paulina Gutierrez & Julián Jaramillo Arango.

DIY Pattern Making We adapted standard jacket patterns from models found online in DIY tutorials with different sizes and cuts. We made some changes in one of them, in order to distribute the electronic components and embed them in the patterns. In a L size model, we included some pockets for the sensors, the arduino and the actuators, as well as some covering films for the wires and jumpers (see Figure 6). The final patterns were cute according to cover-ability with the plastic bag material, size, weight and the number of components to be attached in the jacket.
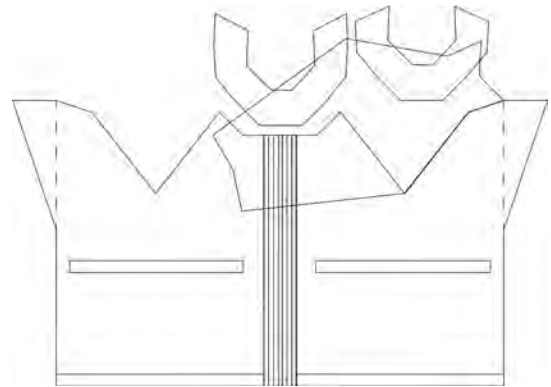

Figure 6. AirQ Jacket pattern making model. ©Maria Paulina Gutierrez & Julián Jaramillo Arango.

Zippers, Clasps and Pockets Electronic components, at least those that we could find in Colombia, are not washable. In this regard, the AirQ jacket design took into account a mechanism able to mount and remove the whole circuit from the jacket. We designed some lockable with zippers and clasps covering pockets that easily allow unmounting the components, such as the

one covering the AirQ sensor that shows the Figure 7. It allows the jacket`s wearer to wash the garment separately from the circuit, since electronic materials require a very different maintenance from the textile ones.
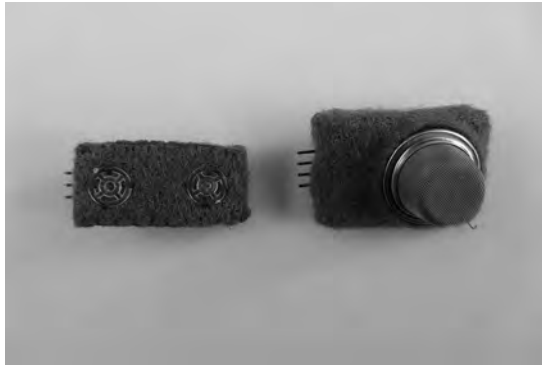

Figure 7. AirQ Jacket gadget solution. ©Maria Paulina Gutierrez & Julián Jaramillo Arango

Anti-pollution Mask The anti-pollution mask is a supple-mental resource attached to the jacket allowing the wearer to protect himself when there are low levels of air quality, such as "Moderate", "Unhealthy for Sensitive Groups", "Unhealthy" or worse (AQI, 2017) . The mask filters pollutant particles and was sewed to the jacket's hood. The mask filter can be easily changeable, allowing the user to choose his/her own degree of protection.

Figure 8. AirQ Jacket gadget solution 1. ©Maria Paulina Gutierrez & Julián Jaramillo Arango

Remarks and Future Work

Wearable technology is relevant to the particular context of design, art and technology that is concerned with sustainability and environmental awareness, since the research on physical computing has raised new possibilities and challenges to envision applications, systems and prototypes.

The AirQ jacket does not compete with the current institutional actions and programs dealing with pollution monitoring, instead the device is complementary to them. Although the AirQ jacket retrieved data are not so reliable than those provided by, Corpocaldas, for example, our garment does provides dynamic data in the current pedestrian place.

One challenge to wearable technology is embedding (relatively) heavy and rigid electronic components to light and flexible textile fabrics. In this regard, some DIY and DWO tutorials focused on particular projects propose original solutions in dealing with the balance and the articulation of electronic and dressmaking materials.

While the AirQ jacket provides dynamic and emplaced data to its wearer, it is envisioned that the garment could also share this information with others. In this regard, including Internet access to the circuit is a future goal for us as designers, since IoT (Internet of Things) applications and services matches with wearable technology aims and technical possibilities.

Acknowledgments

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Authors' Biographies

Maria Paulina Gutierrez Arango is a clothing and interactive designer. She has been working in arts and design since 2011. She is professional in fashion design and thesis student of MA interactive design. She has participated in young designer experience like Arts of Fashion Symposium in San Francisco 2010 and Colombiamoda 2008. She has worked in collaborative, individual and industrial projects in Colombia like Camilo Álvarez fashion designer, Taller Abierto, Casa Tres Patios, La Caja Producciones, Color Siete and Locus Espacio Creativo and Exploratorio. She is currently working with arts, music and technology laboratory designing daily life and sustainable experiences with Julián Jaramillo.

Julián Jaramillo Arango is composer and researcher working in the field of new media design and focusing on experimental sound practices, multimodal communication and in the development of interactive applications and services. Jaramillo Arango`s works bridge the gap among science, arts, technology, creativity, society, community and sustainability through works that explore different modes of sonic interaction. He holds a PhD in Sonology adviced by Dr Fernando Iazzetta, São Paulo University. Currently Julián conducts a postdoctoral research in the Caldas University Design and Creation program where he develops novel interfaces for the local urban space. Julián lives and works in Manizales, Colombia.