WACANA SENI
Journal of Arts Discourse

Innovative-Wear Nusantara (I-WEAR NUSA): The Implementation of Experimental Fashion Design Method through Interactive Wearable Fashion Creation

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Published online: 31 December 2025

To cite this article: Olivia Gondoputranto. 2025. "Innovative-Wear Nusantara (I-WEAR NUSA): The Implementation of Experimental Fashion Design Method through Interactive Wearable Fashion Creation." *Wacana Seni Journal of Arts Discourse* 24(Supp. 1): 163–190. https://doi.org/10.21315/ws2025.24.s1.9

To link to this article: https://doi.org/10.21315/ws2025.24.s1.9

ABSTRACT

This research was based on the digital phenomenon of the Fourth Industrial Revolution with a specific focus on the fashion sector, classified as one of the largest contributors to Gross Domestic Product (GDP) but lacking in product innovation through technology application. The aim was to develop innovative clothing that integrated cultural traditions with modern advancements through the use of electro-fashion and embedded augmented reality features. The design showed the culture of Sasak Sade community as part of the indigenous tribes that had received government attention for preservation and promotion due to its local wisdom and heritage. Moreover, Innovative-Wear Nusantara (I-WEAR NUSA) was explored as an experimental fashion design method to produce clothes. The implementation of this method enabled practical experimentation in the production of innovative fashion that seamlessly combined cultural traditions with contemporary advancements through the incorporation of elements such as electro-fashion and integrated augmented reality features. The results were expected to enhance the understanding and application of technology in the fashion sector while promoting the cultural heritage of Indonesia both nationally and globally.

Keywords: *augmented reality, cultural heritage, fashion design, fashion technology, wearable technology*

INTRODUCTION

The global transition into the Fourth Industrial Revolution (4IR) is known to have significantly impacted the development of modern people, economy, and politics (Dogaru 2020). In this context, technology has a very fundamental role in transforming human activities compared to the complexity and scope of previous experiences (Ghufron 2018). The trend is observed in the fact that the use of Artificial Intelligence (AI), Machine Learning, Big Data, Computer Aided Design (CAD), 3D Printing, and Extended Reality (XR) is not perceived only as a concept from a science fiction book, but rather a necessity in different sectors and industries. Certain changes are also reflected in the habits and mindset of people around the world, as evident in the attitude of those who appreciate the value of digital technology.

In Indonesia, the change in mindset of people led to the acceptance of the digital economy, which was progressively recognised in line with the increasingly global use of information and communication technology. According to Zimmerman, as cited in Kominfo (2019), this concept refers to the global impact of the rapid development and application of information and communication technology on social and economic conditions. The digital economy is expected to produce approximately 3.7 million additional jobs in 2025 (Kominfo 2019). The plan to adopt the concept was also in line with the strategy of the government to implement 4IR in the country. This was proven by the launch of the Making Indonesia 4.0 roadmap issued by the Ministry of Industry of Indonesia. The roadmap expected the phenomenon of 4IR to develop several opportunities in supporting the vision of the country to be among the 10 largest economies in the world (Kemenperin 2018). It also served as a strategy in competing globally and is projected to ensure Industry 4.0 connectivity through synergised, efficient, and quality information and communication technology.

The fundamental concern of the Indonesian government in the roadmap is the Creative Economy sector due to its potential contributions to the achievement of the 2030 sustainable objectives. Technology is also an important pillar in the actualisation of the Indonesian Creative Economy Vision and Mission 2025. The trend is associated with the tangible and intangible nature, which focuses on applying mental or physical processes in achieving a certain value. It is also recognised as a fundamental pillar due to the usage in production, collaboration, distribution and socialisation processes (Purnomo 2016). The book entitled *Digital Economy Development in Indonesia*, published by the Ministry of Communication and Digital Affairs, showed that the era of culture-based Creative Economy was expected to dominate the future (Kominfo 2019). This was because modernisation led to cultural backflow by examining the related values and local wisdom, which was perceived to be an important aspect of the Creative Economy recognised as an industry for producing innovative and globally competitive products. The context characterises competitive products based on local content, and the concept is often termed glocalisation. Preliminary research described the concept as a process of global adoption and adaptation with local content (Suksmawati et al. 2021). Glocalisation also corresponded with the increasing pace of globalisation by providing a world where social interactions between different identities led to the evolution of new cultures. The concept further intensified the support of technology as well as the displacement of indigenous values such as traditional culture and local wisdom. This shows that glocalisation is often used in strengthening strategies to preserve and protect cultural heritage (Septiyana and Margiansyah 2018). The trend was identified in the fashion and textile subsector, which contributed approximately 17 trillion to the Gross Domestic Product (GDP) of the 17 Indonesian Creative Economy subsectors (Kemenpar Creative Economy 2021). This prompted the government to support the exploration, innovation, and development processes in the subsector in line with the 4.0 roadmap plan for the Indonesian Digital Economy.

The implementation of 4IR has been widely accepted in the fashion sector. This was observed from the report of Business of Fashion analysts and a global socio-economic consulting firm known as McKinsey & Company, which found that the world's fashion brands invested approximately 1.6 to 1.8% of their total revenue in technology in 2021. The percentage was also projected to increase from 3 to 3.5% by 2030. Moreover, digital technology was predicted to be influential in the sector, from internal processes to customer experiences (Business of Fashion and McKinsey & Company 2022). The advancement in the field of Fashion Technology is expected to progress rapidly in the ecosystem. This is needed to drive the growth of digital fashion trends, technology-based companies, and related products. The conditions differed in Indonesia, even though the government had adopted several strategies in addressing the challenges associated with 4IR. A major challenge is the uneven adoption of digital technology, with specific attention to the limited understanding of its application among Human Resources (HR). Furthermore, only a few fashion products had been produced through glocalisation, as

evident in the consideration of the sector to be the largest GDP contributor. A similar statement was made by Deputy Minister of Tourism and Creative Economy, Angela Tanoesoedibjo, that the core of the Creative and Indonesian Fashion Industries was required to adopt digital technology, including online sales and data processing. The sector also needs to be supported by efficient HR with the capability to maximise the implementation of digital technology (Ananda 2021). This was in line with McKinsey & Company Executive Report on Indonesia Digital Archipelago, which stated that only a few HR experts were in the digital field. The experts are considered to be significant towards the development of the digital economy (Das et al. 2018). There is also a need to incorporate local content into innovative fashion products for the global market. The essence is to ensure the products show the national identity and local wisdom based on the perspective of globalisation. Therefore, global commitment and cooperation, which lead to the exchange of knowledge, can advance sustainable development. This is achievable by considering the different conditions of each country, including the adoption of specific solutions to enable sustainable development. The efforts applied need to be based on cultural conditions and local wisdom of the country. In Indonesia, the trend is characterised by the plurality of ethnic groups and cultures practised by different regions (Raharja 2018). Local wisdom also provides the strength and selling power of Indonesian products to compete in the global market in line with the objectives of the Indonesian Digital Economy. This motivated the government to provide strong support to creative products with a touch of local wisdom reflecting the culture of the people. In the context of globalisation and the digital economy, extreme competitiveness is very significant in the success and survival processes (Sopanah et al. 2020). Culture and the economy are more normatively conservative and progressive through digital technology, but a synergy of the two can lead to a promising opportunity. The production of innovative products exhibiting cultural components and local wisdom serves as an alternative in the global market.

Wearable technology is a typical example of innovative products that has only been scarcely explored in the past, with most research focusing on the computing materials from the perspective of fashion design practice, and this leads to the possibilities for extensive investigation (Genç et al. 2018). The technology includes electronics, computer devices, and wireless communication networks assembled in the form of fashion products (Seymour 2008). The process is associated with the introduction of technology and clothing reacting and responding to stimuli. According to O'Mahony and Gwilt (2016), wearable technology is also known as interactive clothing. It serves as an expressive medium to communicate certain messages towards providing an interactive and immersive multisensory experience, which is increasingly being demanded. The experiences lead to impressions that are discernible through visual, tactile, auditory, and kinesthetic senses. Therefore, the interest is to provide a valuable user experience through the attractiveness of the product with the aim of exposing users to new cognitive and perceptual experiences (Nguyen and Bednarz 2020). The rapid influence of digital technology on daily activities has led to an upward trend in wearable technology products globally. The trend is also related to the market opportunities and developments of similar products using imaging technology. This was supported by results of the in-depth research and analysis conducted by a consulting and analyst company known as Market.US (2024), which projected that the wearable technology market would experience increased growth estimated at USD 231 billion by 2032 from the USD 70 billion reported in 2023. The growth was also estimated to increase by 14.60% during the forecast period from 2023 to 2032.

Developing countries such as Indonesia experience large market opportunities and sales potential for wearable technology. This is due to the strong desire to use and easily adapt to the development of technology-based products (Aripradono 2021). However, there are currently few fashion products with technology imaging in the Indonesian market. The existence of these products, regarded as innovative fashion, is a manifestation of the digital ecosystem unification in reality. The trend was confirmed by Piliang's (2022) report that people had started living in

the reality of a trans-cultural society with digital networks connecting one another. This was also in line with the Society 5.0 concept, which outlined two types of symbiotic relationships, including the connection between technology and people. Preliminary research also showed that technology mediated the relationship between people (Deguchi et al. 2020). Moreover, technology is considered a part of people in 4IR by increasingly blurring reality to provide a unified transition between cyberspace and the real world. The process is observed to be changing lifestyles and the economy. The condition shows the existence of harmony during the integration of digital technology into social life to provide a form of unity. Innovative fashion products also require the incorporation of local wisdom through the concept of glocalisation. Another important observation is that the adoption of digital technology in the fashion sector is uneven due to a lack of competent HR capable of producing innovative products reflecting cultural values. HR is unfamiliar with the production of culture-based wearable technology. This has led to the implementation of an experimental process to produce an innovative fashion product to protect culture.

The focus of this research was to analyse the adoption of an adequate method to produce wearable fashions based on cultural protection and improve future HR quality. Another aim was to design products considered to have valuable uniqueness in the global market. Previous research has investigated the production of wearable fashions using different methods, such as the combination of science and creative processes (Tenuta and Testa 2018; Cappellieri et al. 2020), user-centred procedure (Ferraro and Ugur 2011; Zeagler 2017), as well as narrative and cultural semantic exploration based on anthropological design (Chang and Lin 2020). However, none of the production methods was related to cultural protection. This research was conducted to formulate a creative production method in accordance with the purpose of protecting culture and local wisdom. The implementation process was realised through an experimental fashion, which was perceived as innovative products based on cultural protection.

The influence of technology and user experience on the production of wearable and interactive fashion was further explored with the aim of safeguarding culture. The results were expected to serve as a contribution to the development of the industry by formulating a method of producing wearable fashion based on cultural protection. This was aimed at improving the quality of future HR in the fashion sector as well as protecting several valuable cultures and local wisdom.

LITERATURE REVIEW

Wearable Fashion Technology

Wearables in the fashion world include clothing, accessories, and jewellery that integrate aesthetics or beauty and appearance or style with technological advancement (Seymour 2008). Initially, these were referred to as wearable computers and were first introduced by Ed Thorpe and Claude Shannon in 1966 through a mini analogue computer which was the size of a cigarette box. The computer had four buttons to show the speed of the roulette wheel, and the results were predicted through radio transmissions connected to ear accessories. However, Steve Mann designed a backpack with a computer installed to function as a control for photographic equipment in 1998. Mann (1998) also showed that a wearable computer was conditioned with respect to the personal space of the user. This could be controlled by the user and characterised by operational and interactional robustness as well as easy accessibility. Therefore, the term wearable technology refers to electronic engineering, physical computers, and wireless communication networks recognised by fashionable functions when worn. Diamond (2016) reported that the ideation of an ontology was the fundamental drive connecting human memory and information technology in computer science. This was realised by incorporating the

affective aspects of a fabric piece into a component for the purpose of integrating intelligence. Diamond (2016) further showed that the piece of fabric contained a memory charge formed through visual and tactile senses. The ability to store memory allowed the traditional piece of fabric to explore scientific and technological paradigms.

Wearable technology integrates clothing to be an interface that connects with the user and acts as a transmitter or receiver of emotions and meaningful experiences. According to McLuhan (1994), clothing is an external interface mediated through digital technology. The definition led to the description of wearable technology as an external exhibition of interfaces mediated through digital technology. This clothing type has the expressive potential to present multiple thoughts or meanings using the technology worn. Fashion in the form of wearable technology is currently considered an appropriate mediator and an embodiment of fantasy for presenting information (Seymour 2010). The trend shows that fashion acts as a communication medium with unlimited potential in the present contemporary era. Moreover, wearable technology is more fashionable due to the incorporation of related elements transformed into an attractive interface.

Wearable Fashion Experimental Methods

The design of wearable technology requires a creative process that combines several disciplines to produce interactive products. Tenuta and Testa (2018) reported that the boundaries between scientific and creative methods were increasingly blurred in the contemporary domain, with innovation regarded as the meeting point. The process explored the hybrid methods of combining certain elements related to fashion design and engineering. The methods blend two different processes by defining the problem through background research on user needs and desires, fashion market analysis, innovative trends, and assessing existing technology for industrial production. Furthermore, the needs definition, which is regarded as the brainstorming phase, is often followed by defining future scenarios. The product is considered an important element that connects the user and the environment with other objects in the process of defining the concept and implementation. The adoption of both qualitative and quantitative tests, considered as scientific methods, ensures the assessment of user interaction based on experience and emotional measurement of the relationship developed with the product. This method proves that (1) the integration of science and creativity in terms of both knowledge and process is important, (2) the appropriate wearable fashion is to design physical devices with due consideration for the overall user experience, and (3) the potential to generate knowledge and concepts related to fashion design and science is very important (Cappellieri et al. 2020).

User needs are required to be considered during the process of producing wearable fashions (Ferraro and Ugur 2011). The process aids the design of appropriate wearable technology to influence the interaction between the user and the surrounding environment or body. Wearables not designed in accordance with the needs of the user are not an ideal solution. The trend shows the importance of user needs in the design with a focus on ergonomics, expression, and desires. Furthermore, wearable technology is an exceptional method of proving that the idea of producing fashion originates from the user. This was in line with the opinion of Zeagler (2017) that several factors should be considered when designing wearables, including proxemics, described as a human perception related to size and weight distribution. The trend shows the need to install wearables on body parts that are occasionally moved to avoid limiting or interfering with user mobility, as well as the consideration of social acceptance. An important observation is that the placement on the body affects the social acceptance of the community and other perceptions. Chang and Lin (2020) also confirmed that interactive design mediated the narrative and semiotic concepts in fashion design and technology. The interactive aspect of wearable technology is associated with the narrative and semantic characteristics presented

through detailed creative performance. Some examples of wearable fashion technology developed in this research can serve as references.

Wearable Fashions through Innovative-Wear Nusantara (I-WEAR NUSA)

This research was conducted through a process of empirical experience, reading, and the observation of Zeitgeist and common trends. Moreover, user behaviour and knowledge of fashion and technology were processed in accordance with structured development to provide an innovative product. The process led to the discovery of a method to produce wearable fashion designs and safeguard the culture known as I-WEAR NUSA. This is different from other methods previously explained by producing wearable fashion technology to safeguard culture. The method assisted in understanding the process of producing wearables in accordance with the local culture. It was also proposed to produce more wearable fashion products promoting local values, both in the national and global markets. The trend is in line with the recent development of digital technology for the purpose of preserving or promoting different cultures and local values.

Digital technology has recently developed to preserve cultural traditions that are threatened with extinction. This is achieved by adopting technology for the preservation of traditions through digital media to ensure subsequent transfer to future generations (Pebriyani et al. 2021). The method deviates from those adopted to produce wearable fashions in previous research, such as Tenuta and Testa (2018), Cappellieri et al. (2020), Ferraro and Ugur (2011), Zeagler (2017), and Lin and Kreifeldt (2001). The difference is observed from the combination of the experiences of the producer as a wearable fashion designer with the consideration of relevant needs and opportunities based on local wisdom.

The report published by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in Alivizatou-Barakou et al. (2017) and UNESCO (2018) showed the need to safeguard culture and local wisdom through the identification, documentation, research, protection, preservation, and promotion. Ratna Cora (2021) further defined safeguarding as an effort to maintain culture through inventorying, protection, care, and promotion. This trend shows the possibility of using technology for the purpose of culture preservation and promotion based on relevant actions. Therefore, I-WEAR NUSA was introduced as an experimental method for the design of wearable fashions produced based on cultural safeguarding purposes through the stages presented in Figure 1.

I-WEAR NUSA is an intersection between technology and the traditional richness of the archipelago culture. In an academic context, this interdisciplinary concept combines wearable technology with cultural heritage to produce an experimental method to explore the harmony between modernity, culture, and local wisdom. The stages used in producing culture-based wearable fashions using I-WEAR NUSA are explained as follows.

The first stage was to investigate a phenomenon symptom, followed by the identification of a more specific problem. This led to the observation of empirical or measurable evidence of problems or phenomena. The three basic elements identified were: (1) characterisation through observation, definition, and measurement of the research object; (2) hypothesis generated from observation and measurement processes; and (3) theoretical prediction based on inferences from data collected and theory.

The second stage focused on the structured and in-depth division of the two research processes into cultural and technology-related methods. The objects were assessed based on the theoretical predictions generated, which led to an in-depth evaluation of cultural objects

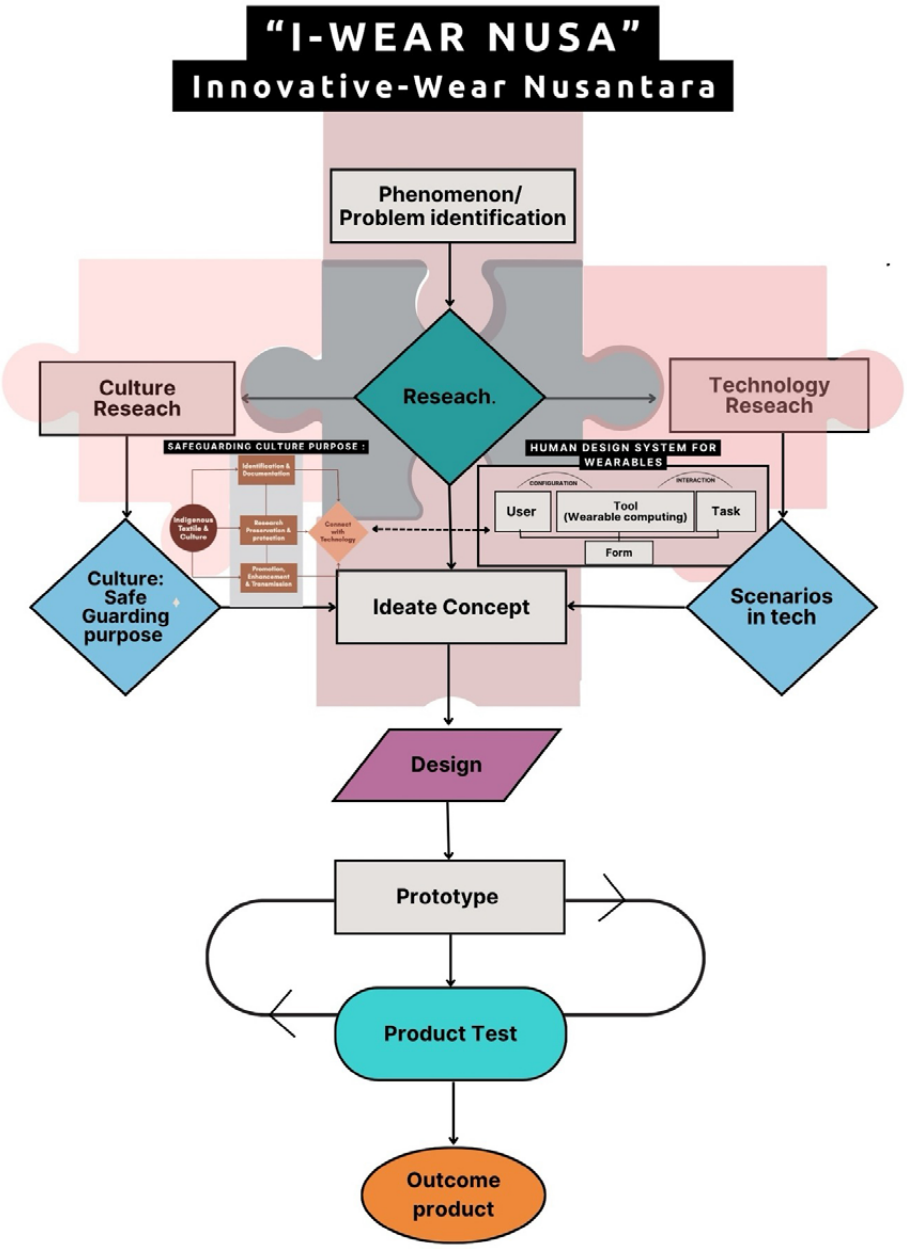

Figure 1 I-WEAR NUSA wearable fashion experimental method based on culture safeguarding purpose

Source: Illustrated by the author

and technology research. Moreover, the procedures implemented include: (1) the collection of information and data sources from different main actors, experts, and related stakeholders; (2) processing; and (3) interpretation of data and information collected to form an ideation solution. A culture-based method was also applied to analyse the related conditions with the aim of safeguarding local values. Meanwhile, a technology-related method was used to support the purpose of safeguarding culture by comparing the functioning of the human brain and computers or digital technology.

Figure 2 shows that the cultural safeguarding process can be conducted using digital technology. This was achieved by comparing the functions of computers and human brains in terms of storage for the identification, documentation, and promotion of the purpose of safeguarding

culture. The trend showed that the safeguarding process enabled the identification of objectives and was subsequently used to determine the most suitable technological scenario for achieving the research purposes.

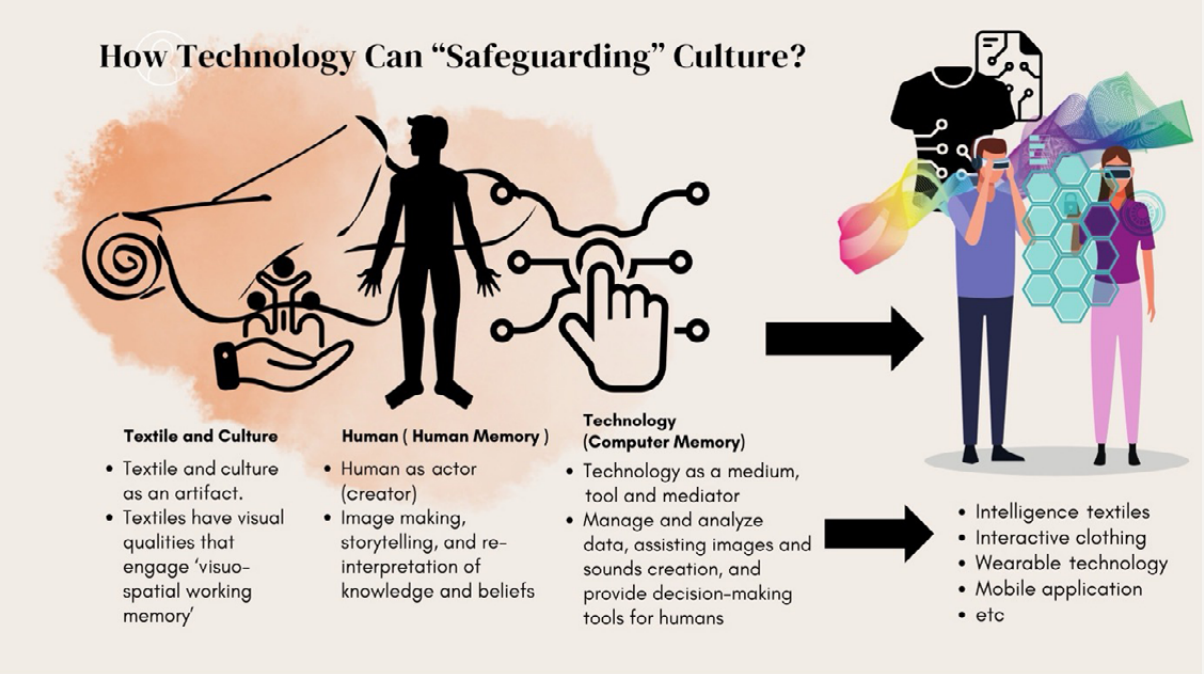

Figure 2 The work process of technology in safeguarding culture through the association between the functionality of the human brain and computers

Source: Illustrated by the author

The safeguarding process enabled the identification of objectives, which were used to determine the most suitable technological scenario for achieving the research purposes (Figure 3).

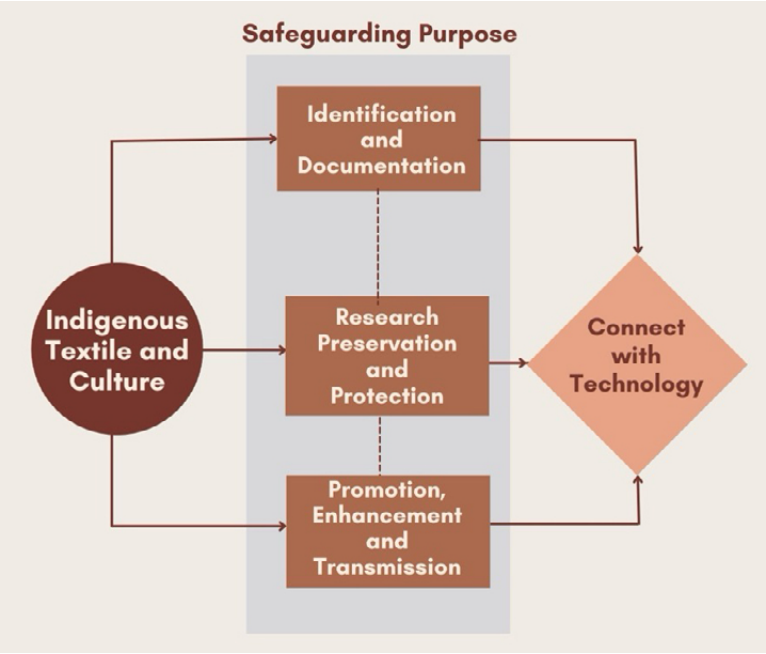

Figure 3 Safeguarding purposes and connection to technology

Source: Illustrated by the author

The production method combined two different ideas, which were traditional culture and modern technology. The integration and diffusion of both through research led to an interesting combination of past and future elements into innovative wearable fashions (Figure 4). The cultural method served as the basis for the adoption of certain decisions for safeguarding purposes, such as: (1) identification and documentation; (2) preservation and protection; and (3) promotion, transmission, and enhancement of culture. Meanwhile, the technological method focused on designing wearables for the human system based on the detailed considerations presented in Figure 5.

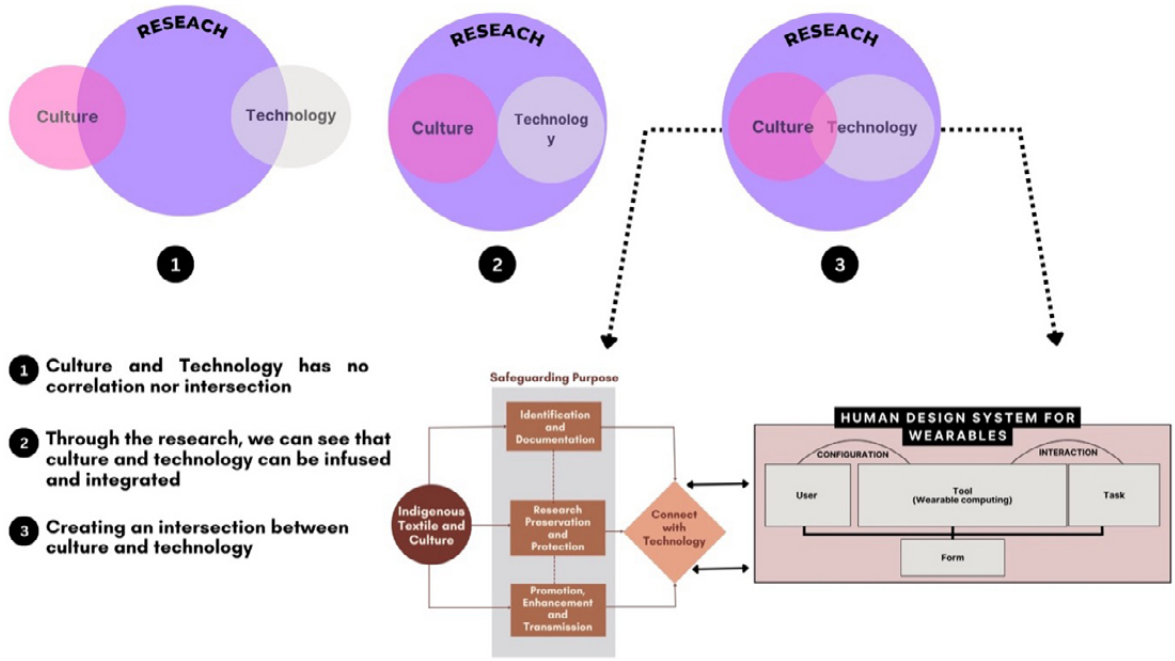

Figure 4 Research phase on wearable fashions from "I-WEAR NUSA"

Source: Illustrated by the author

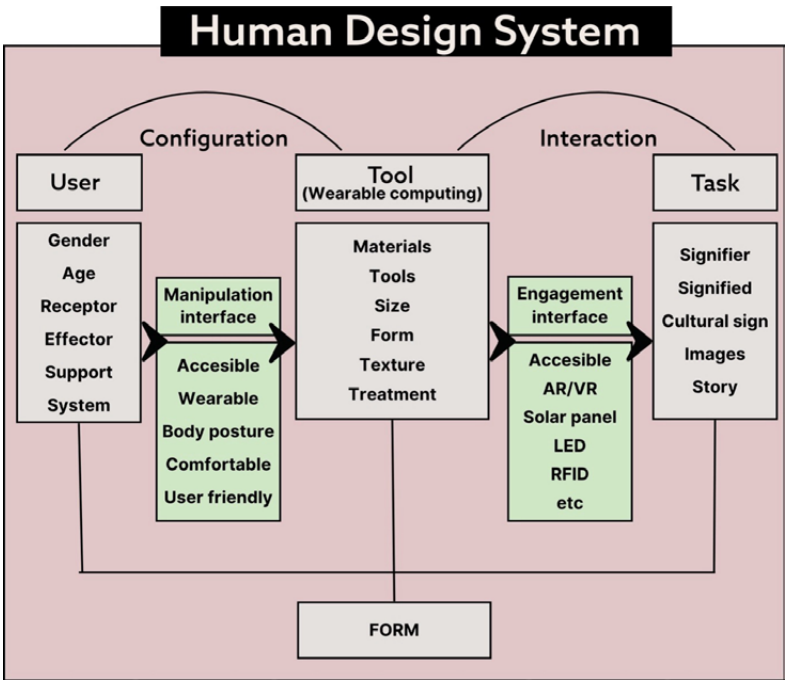

Figure 5 Human design system considerations in technology at the research stage

Source: Illustrated by the author

The design of clothing with respect to the human system is mainly focused on the body of the person. Therefore, there is a need to ensure the design does not cause any discomfort or interfere with movement during certain activities. The human system and the interaction factor initiated by the surrounding environment or other people also need to be considered. Designers are required to significantly focus on interactivity by using technology as a medium and considering the human system when producing aesthetic and semantic wearables. The focus is expected to be on the gender, age, and other characteristics of the user or audience, an easily applicable, safe, and accessible manipulated interface, as well as the adoption of appropriate wearable computing tools in terms of material, size, and shape. The engagement interface, which initiates interaction with the user or audience, was considered the most suitable and could be in the form of light-emitting diode (LED), augmented reality (AR) or virtual reality (VR), radio-frequency identification (RFID), and others. The task performance was also used to communicate the social and cultural functions of the design through three types of reasoning or logic integration, including (1) input to the device, (2) output from the device, and (3) shape or display as a visual expression of wearables. Furthermore, the most appropriate technological scenario was required to be in line with the purpose and function of the design. The results were in the form of the intersection between cultural and technological research to produce an ideation for design solutions (Figure 6).

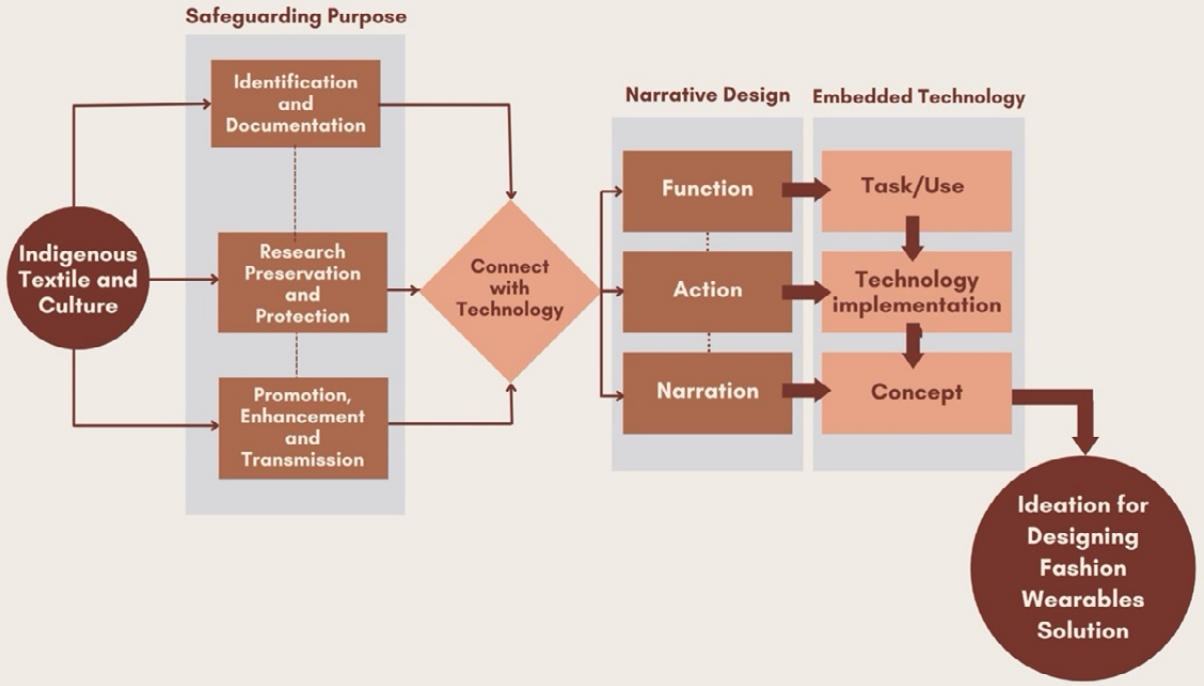

Figure 6 The results of the intersection between cultural and technological research to generate ideas for solutions to produce wearable fashions

Source: Illustrated by the author

The third stage centred on the results of cultural and technological research, which proffered ideation on the solution to produce wearable fashions. This was based on the objectives of related analyses and understanding of the technological scenario used to achieve exceptional designs. Moreover, the fourth stage was the design process, where the ideation and solution were translated into drawings by the producer. Recent design trends were also explored to ascertain the tendency of the main target market.

The fifth stage focused on the production of a prototype to determine conformity with the purpose and implementation of further improvement and development when needed. Moreover, virtual prototyping was preferred over the physical type to offer realistic visualisations of models through hyper-realistic depictions of 3D virtual clothing. These were successfully used to replace the prototype of a particular design. The virtual prototype offered several advantages, such as rapid and easy introduction of changes when developing models compared to conventional methods. The process had a profound effect on several modules in the apparel industry, with associated branches perceived as a method of elevation. Furthermore, computer-based prototyping has great potential due to its ability to ensure the rapid development of 3D virtual models. The patterns, colours, fabric types, and other parameters affecting the appearance of products can be changed (Jevšnik et al. 2017). These allow the designers to be expressive and achieve the desired details by projecting the products using 3D avatar models. The process ensures the end product is visualised without having to use physical prototypes (Gondoputranto 2022). DressX, as cited in Periyasamy and Periyasami (2023), reported that digital fashion production led to a 97% reduction in carbon emissions compared to physical processes. The inference was made based on a real case study of DressX as a Digital Fashion Company working on a project with a British Fashion retailer known as Fartech. The plan was to launch 20 collections of menswear and womenswear from well-known brands such as Burberry, Off-White, Balenciaga, Palm Angels, Dolce and Gabbana, Khaitek, and Nanushka. DressX and Farfetch launched the designs through digital fashion through a pre-order system, and the process led to a sustainable marketing campaign by avoiding unnecessary production and shipments. The digital campaign was reported to have saved 346,698 litres of water, equivalent to 2,515 kg CO_2, which led to the identification of the collection as the first carbon-neutral fashion campaign in the world (DressX 2021).

The use of digital prototypes certainly does not eliminate the need for physical prototypes. This is associated with the difficulty often experienced by small businesses and solo designers in investing in the technology. Another disadvantage is the dependence on digital simulations to make design decisions, which can limit the understanding of conventional pattern construction. Therefore, both digital and conventional prototyping should be combined based on usage to show the importance in the fashion industry (Habib and Alam 2024).

The sixth stage was the assessment of the prototype by the users or audience to obtain feedback and review. This also included the input from experts in related fields to obtain useful insights. However, the previous stage was revisited when improvement was required in an effort to produce a better product. The seventh stage was the refinement of the final culture-based wearable fashions in accordance with the purpose of production, followed by the launching and promotion.

Technology was very important in the production of wearable fashions. Its integration into conventional fashion design led to a harmonious interface that determined the success of the production. Moreover, the production of wearable fashions based on cultural protection and preservation was associated with technological advancement. User experience was perceived as important due to its ability to present messages related to cultural preservation. The concept led to the production of valuable wearable fashion products and the communication of the purpose of cultural safeguarding according to relevant needs.

The adoption of appropriate technology through an experimental creative method in I-WEAR NUSA led to the production of unique products. The method showed the significance of technology in addressing specific cultural protection needs. This was in line with the observation of Chang and Lin (2020) during the process of analysing the narrative method. However, no scenarios were formulated to establish an accurate technological level in relation to cultural preservation demands. The condition was that I-WEAR NUSA only served as a phase

for developing a fashion technological scenario based on scientific and creative processes (Tenuta and Testa 2018). The method considered a human design system with a reference to the needs and ergonomic factors of the user (Zeagler 2017; Ferraro and Ugur 2011). The process was different from previous methods used in producing wearable fashions by showing certain aspects of cultural protection. This was achieved by the application of appropriate technology to review user requirements, which was not considered in previous methods.

IMPLEMENTATION OF I-WEAR NUSA THROUGH EXPERIMENTAL DESIGN PROCESSES

The focus of this research was on the production of wearable technology, which was regarded as the external display of an interface mediated through a digital tool. The process was characterised by expressive potential in presenting multiple meaningful thoughts through technology. This is possible because fashion design in the form of wearable technology is currently an appropriate mediator and embodiment of fantasy for the transmission of information (Pedersen 2013). The concept bridges the gap between the physical, visual, and perceptual experiences of both the user and viewer, in addition to cultural protection. The process is evident through kinesthetic, proxemic, and haptic experiences (Hrga 2019). The technology was incorporated to achieve the purpose of this research, considering the importance of integrating clothing as an interface that connected with the user.

Wearable technology was reported by Seymour (2008) to offer several functions. The physical or material aspect was perceived in the function that served as a form of protection, cover, or attraction. Moreover, the cultural function was in relation to the social and psychological purposes where the technology acted as a communication medium to express personal views regarding socio-economic, political, and religious beliefs. These were evident in the production method adopted, which was used to communicate relevant messages and objectives. For example, the physical aspect was to gain attention and promote culture through the electro-fashion LED scattered on the clothing and AR integration. It was also observed that each culture was promoted through interactive and narrative experiences. The trend was in line with the report of a previous research that human and machine interaction through interface design could reflect imitation or mimesis of existing reality (Laurel, as cited in Mura 2011).

The method was implemented to generate a process of producing wearable fashions to protect a particular culture. The focus was on the culture of the Sasak Sade community in Lombok, East Nusa Tenggara, Indonesia. The community received special attention due to the traditional hamlet, which showed past experiences and reflected daily cultural practices. It was also characterised by a variety of local wisdom perceived as highly competitive in the global arena, considering the potential in adapting to glocalisation. Therefore, this research integrated two original cultures of the Sasak Sade community into wearable fashion products through the I-WEAR NUSA experimental method, based on several stages explained as follows.

The first stage was the phenomenon or problem identification. The potential wealth of the nation was portrayed through tribes such as the Sasak Sade community, which got special attention from the government to preserve culture and local wisdom. This led to the need for the promotion of the culture, particularly for the future generation.

The second stage was the cultural and technological research conducted with the aim of safeguarding culture. The technological research focused on the human design system to produce fashion-related scenarios suitable for the production process. However, the cultural aspect was used to promote the community with a specific focus on the Gendang Beleq tradition and Sasak Sade Coffee. The human design system was applied with a focus on the existing target

market, which was the future generation. This was used to select the most suitable fashion scenario, which was subsequently used for the design concept ideation.

The third stage was the design concept ideation through the exploration of the urgency to promote and safeguard the Sasak Sade culture while considering the most suitable fashion technology scenario to be applied. The process led to the production of wearable technology using electro-fashion as a visual expression and including AR to promote the Sasak Sade culture. The specification of the digital tool adopted was based on the results of the technological research. The aim was to select the most suitable fashion technological scenario for the production process, which led to the adoption of AR and electro-fashion as typical examples of I-WEAR NUSA. AR was used to show information received from the user environment, at any location, and from any object in virtual form. This combination of both physical and virtual worlds offered valuable dramatic possibilities that are unreliable in other media. AR also increased the possibility of producing valuable and personalised experiences for users. The dramatic and narrative possibilities led to relevant information and awareness in the form of fashion beyond the current possibilities of traditional methods (MacIntyre et al. 2001).

AR was specifically selected for its ability to present virtual content in the real world in order to ensure a composite appearance. This is different from VR, which produces an immersive three-dimensional illusion display, but all the interactions require the use of a headset. The environment provided by VR is not physical and is separated from real life through a screen or display accessed using a headset (Boardman et al. 2020). However, the object of this research is clothing, which is marketed and worn by users. The condition led to the consideration of AR as more suitable compared to VR, which required a headset. The situation requires a real display of clothing that blends with virtual content presented in the physical world. This is in line with an attribute of AR, which is accessibility through filters in interactive settings or mobile applications displaying virtual content in relation to the physical world.

The development of AR requires some considerations, which include performance, perception, interface, and collaboration (Dünser et al 2008). This research showed the need to add the factors of visualisation and interaction due to the consideration of users or audiences as active participants. The process led to the development of AR, as presented in Figure 7, for the consideration of aesthetics in producing artificial reality.

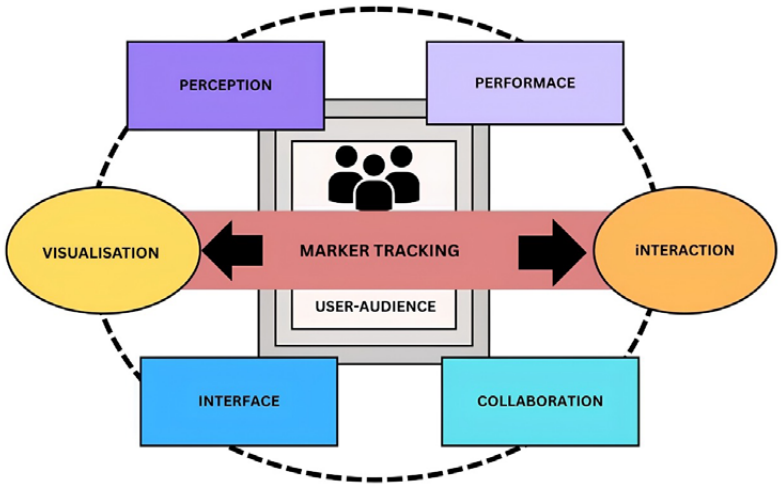

Figure 7 Aesthetic consideration in the development of artificial reality using AR

Source: Illustrated by the author

The first factor is perception, which is explained as the observation and construction of objects by humans in their minds. The process is through sensory stimulation via the visual, auditory, tactile, and olfactory senses, which further produces an integrated response known as perception. This shows that perception is formed through visualisation and interaction with AR activated by the user or audience. The second factor is performance, which is associated with the tasks performed by the user through marker tracking activation to interact with the technology using AR media. The performance can be used by the user to evaluate the aspects of visualisation and interaction. The third is the user interface, which is applied to review the usability of the system and is required to be user-friendly and considered by designers. The fourth is collaboration, which refers to the interaction caused by AR display between several users and is divided into direct (face-to-face) or remote. Face-to-face collaboration occurs when users interact directly in person when activating AR, while the remote aspect is through "share or live broadcast" using electronic or digital media such as social media, live streaming platforms, shared stories, and others. The collaboration allows the dissemination of the visualisation and narrative of AR through digital media.

AR is the new media that combines three features to be different from previous, more conventional media. It blends the virtual and physical worlds through user engagement and interactivity to offer a rich and dramatic experience not available in other media. The concept requires converting 2D images into animation based on a structured six-stage process, and the workflow for cultural promotion through fashion is presented in Figure 8.

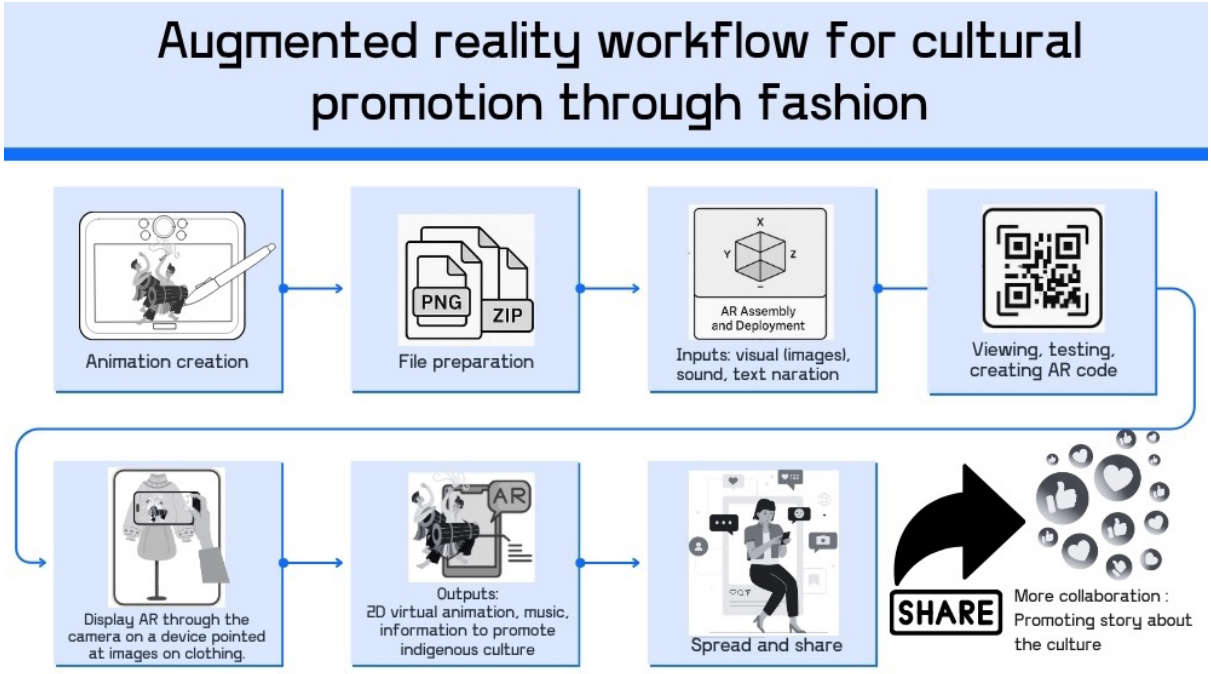

Figure 8 AR workflow for cultural promotion through fashion

Source: Illustrated by the author

The integration of AR into fashion and cultural products requires a structured workflow that is in line with the digital animation of the physical objects through marker-based triggers. Therefore, the workflow in Figure 8 is divided into sequential phases of animation production, file preparation, AR assembly, deployment, and user interaction, each designed to ensure technical fidelity, cultural relevance, and interactivity.

Animation Production

The process was initiated with the design and development of 2D animations using tools such as Spine 2D, Adobe Animate, or Unity with AR Foundation. Transparency is a key design parameter because animations need to feature an alpha channel to allow seamless overlay on clothing or textiles. At this phase, cultural motifs and symbolic elements were encoded into the animation to ensure cultural integrity and narrative depth.

File Preparation

The completed animation was exported as a PNG sequence to preserve both quality and transparency. These sequences are typically compressed into a single ZIP archive to streamline transfer into AR authoring platforms. Alternative formats such as GIF can be used, but PNG sequence is preferred for high-resolution output and greater frame control. Moreover, proper optimisation of file size ensures efficient rendering on different mobile devices to balance the visual fidelity with system performance.

AR Assembly and Deployment

The zipped PNG sequence or equivalent was imported into AR authoring tools such as Adobe Aero, Unity AR Foundation, or 8thWall. The digital assets were spatially arranged in a 3D coordinate environment and configured to interact with image markers or triggers. In fashion applications, the marker is often an illustration, textile motif, or printed symbol on clothing that serves as the point of recognition. The AR engine continuously scans the camera feed of the user and calculates the position and orientation, or pose estimation, after detecting the marker to anchor the animation correctly in real space. Additional inputs, such as sound or text narration, can be incorporated to produce multimodal cultural storytelling.

Viewing, Testing, and Distribution

AR experience was tested for cross-device compatibility to ensure stable performance across smartphones and tablets. A QR code or hyperlink could be generated to allow end users to access the AR experience without requiring specialised applications. At this phase, developers also evaluated tracking accuracy, cultural fidelity, and user interactivity to refine the deployment.

User Interaction and Marker-Based Triggering

AR engine recognised the marker and triggered the 2D virtual animation when an end user pointed the smartphone camera at the cultural motif integrated in the clothing. The result was an immersive cultural visualisation with the clothing functioning as both material objects and digital storytelling media.

Dissemination and Cultural Impact

Finally, the completed AR experience was shared through social media or collaborative platforms to enable community participation and cultural promotion. The integration of the indigenous cultural narratives into digital clothing allowed the workflow to support both cultural preservation and innovative engagement strategies in contemporary fashion practice.

Electro-fashion was deliberately selected for this research in the form of lights due to the consideration that visual expression could be produced through the combination with fabric (Genç 2017). Smart textiles integrate technology into the product in different stages related to the manufacturing of fibre, yarn, or fabric. The process is often through advanced chemical and material engineering technologies. Moreover, smart textiles depend on passive technologies that have generally been formulated over several years in other fields, and this often leads to a longer period of development (Ishan 2023).

An example of other wearables is Haptic Feedback, which uses physical input on the body and new channels for non-verbal communication. It focuses on the experiential dimension of interpreting signals and stimuli perceived through the body. Moreover, feedback is provided through vibration, movement, or touch (van Rees et al. 2018). This research considered electro-fashion as the most appropriate and suitable due to time constraints and emphasis on cost efficiency. Electro-fashion was designed to provide a visual impression that supported cultural illustrations on clothing. This was achieved by integrating the concept into each piece of clothing according to the cultural story to be displayed. The method was considered more efficient and personalised compared to using smart textiles that required a relatively long time to develop. Furthermore, electro-fashion provided in the form of LEDs was able to reflect the visual expression intended in this research. The trend was observed in the expressive stories showcasing culture in the form of contemporary products. This led to the actualisation of added value and a more interesting experience for the users (Shaw et al. 2021).

The fourth stage focused on designing Gendang Beleq Sasak Sade deliberately as menswear. This was based on the fact that the Sade and Gendang Beleq cultures were mainly expressed by the men. The term "Gendang Beleq" was derived from the Sasak language based on the deng or dung sound produced by drums, while *beleq* was interpreted as big. The community had existed since ancient times and often played war music when accompanying the soldiers to the battlefield based on the belief that loud sound increased enthusiasm. In line with the changing times, *beleq* drums were used by the Sasak Sade community for entertainment during Begawe Nyongkolan tradition or wedding ceremony. The drums were also often played any time tourists or guests visited the community, with the shape printed on clothing, pants, and vests. Therefore, the pants for men were designed in this research to resemble the silhouette of the drum through a detailed visual arrangement of ropes and woven fabric similar to the shape. The same design was applied to the front of the vest through a rhythmic principle. The red colour of the Sasak woven fabric, which was termed the Perese Motif or shield, symbolised courage and was mainly worn by the men. The woven fabric was placed on both the right and left sides of the pants. The placement on the left side was lesser to ensure the side was not significantly heavy because the pocket was perceived as an accent, and a balanced design principle was required to be achieved. A figure of Sasak Sade men playing *beleq* drums was inscribed on the back of the vest to form a geometric panel, which also functioned as a marker for the activation of AR technology. Moreover, the top panel of the vest had an electro-fashion in the form of an LED array which form formed an image to show the title of the concept. The panel at the back of the outfit functioned as another point of interest (Figure 9).

The Sasak Sade community is known for a unique coffee, which is a signature commodity. The distinctive coffee powder was traditionally produced using certain indigenous tools. This was based on the belief that traditionally stacked coffee beans produced delicious aromas and flavours. The beans were initially roasted, mixed with a small quantity of rice grains, mashed by the women using traditional tools, and served to the men (Apriani 2021). The coffee beans were used as a design principle of focus or point of interest, with a proportion applied on the outer part of the outfit to form geometric flaps. Moreover, a figure of women pounding red coffee beans using traditional mashing tools around the plants was provided. The shape was improved by embedding electro-fashion in the form of LED light points to produce visuals resembling

the red coffee beans. The outer front, which was similar to a pottery for pounding the coffee, was made of elastic material. Meanwhile, the pants had slits that facilitated movement and also accented the application of line elements. These were combined with Krodat woven fabric to show peace and tranquillity in the family. Sasak Sade women believed that having a peaceful and harmonious family required serving and respecting their husbands. The attire had a belt made of unique woven fabric with motifs symbolising the harmonious life of the community and was related to cultural dynamics (Figure 10).

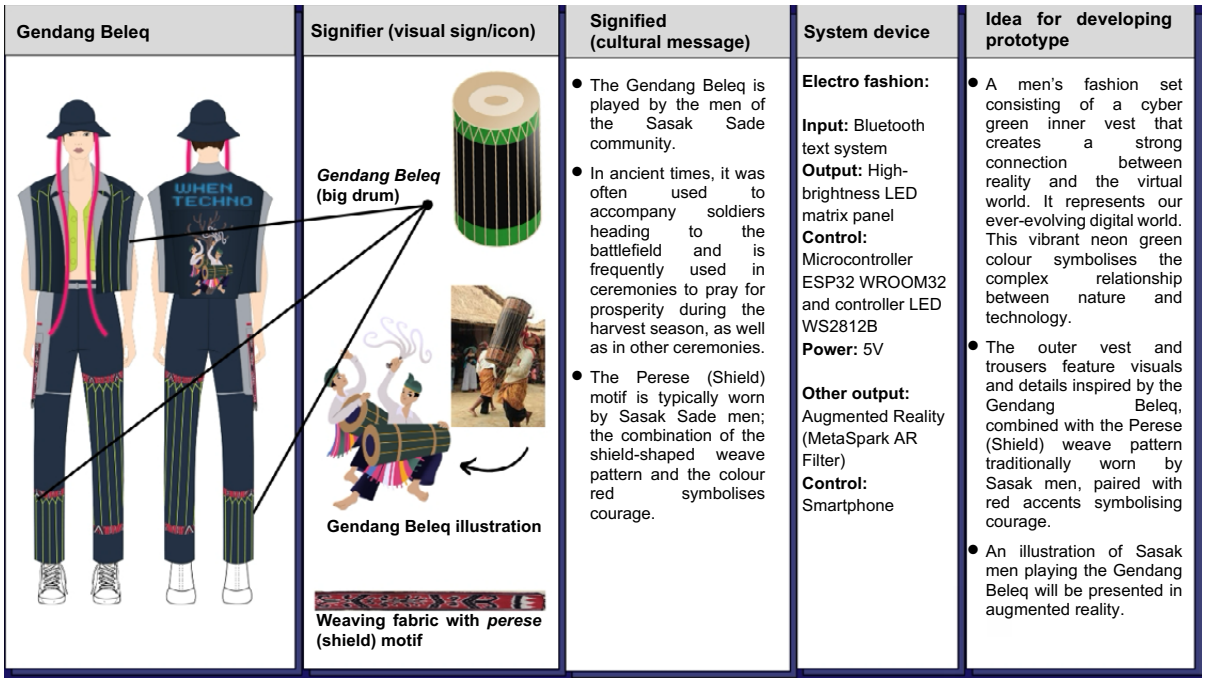

Figure 9 Gendang Beleq narrative and wearable semantic design through the implementation of design elements and principles

Source: Illustrated by the author

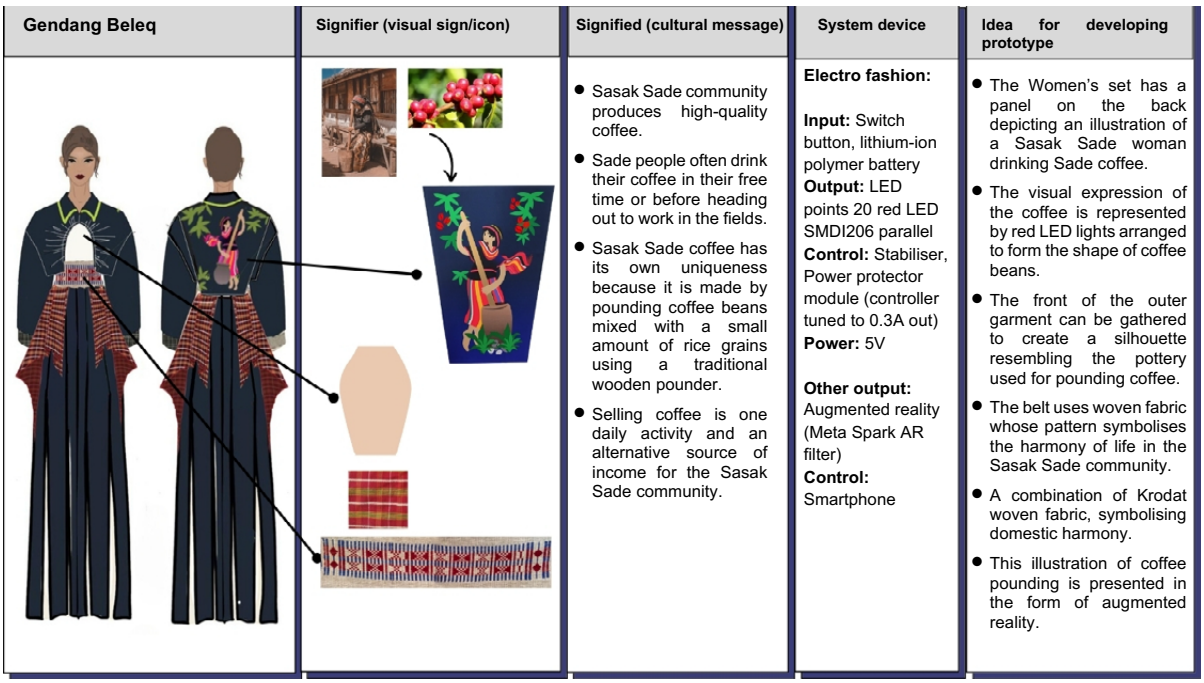

Figure 10 Sasak Sade Coffee narrative and wearable semantic design through the implementation of design elements and principles

Source: Illustrated by the author

The fifth stage was the production of the prototype using a virtual method due to the need for time efficiency and accurate design (Figures 11 and 12). The adoption of CAD software enabled designers to facilitate pattern alterations without having to make physical prototypes. The virtual model also ensured the clothes were properly fitted when worn on the model (Spahiu et al. 2014). This assisted in reducing the production time with high yield and accuracy compared to the traditional method of making fashion prototypes (Papahristou and Bilalis 2017).

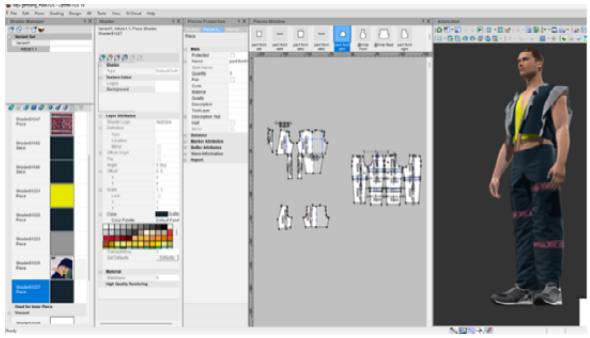

Figure 11 Virtual prototype of Gendang Beleq design

Source: Illustrated by the author

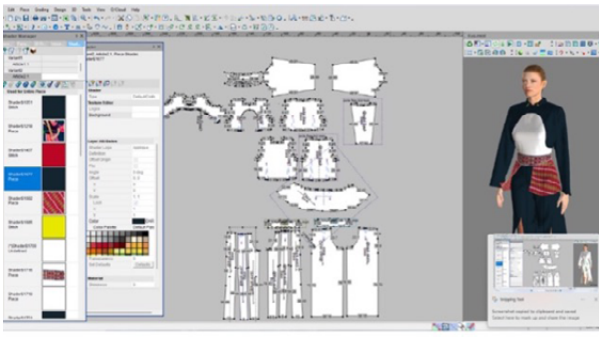

Figure 12 Virtual prototype of Sasak Sade Coffee design

Source: Illustrated by the author

The sixth stage was the physical product trial by the users for the purpose of feedback and review (Figure 13). This was conducted using a total of six people, consisting of both males and females in the age range of 18 to 27 years, who were subjected to face-to-face discussion after trying the product. The people were professionals and university students residing in an urban area and interested in traditional culture. The completed physical prototypes were worn by the six users, who asked detailed questions to explore the experimental method. The focus was on diverse opinions about the products, which included AR implementation level, use of electro-fashion, and creative concept associated with preserving the beautiful Sasak Sade Lombok culture.

The trial results showed that four users were initially unaware of the Sasak Sade community, and this produced new information and knowledge about the culture through the clothing. The acquired information was accessed through AR and electro-fashion, which led to easy memorisation compared to when obtained through news portals or physical books. The two users who already knew the community were also exposed to a new experience by accessing information through the interactive wearable fashions. All the users reported that the narration, music, and immersive visuals led to an increase in interest in visiting and learning about the community and culture. However, three users thought that the background music was slightly loud and the narration could not be clearly heard. Four users preferred the expressive use of electro-fashion, and two showed the need for a manual to

Figure 13 Physical prototype trial for feedback and review

Source: Photographed by the author

facilitate usage. It was also observed that all the users preferred the visual display in the form of animation due to the clearer visualisation of the culture enabled. AR and electro-fashion appropriately communicated the narrative for the preservation and promotion of Sasak Sade culture. Furthermore, the users expected more interactive, innovative products in the market in the form of clothing, which also functioned as a medium for cultural preservation.

The feedback and input from the users were used to improve the products with a focus on ensuring the narration of stories about culture was not affected by the volume of the music. A simple manual was also produced to enable users to activate wearable technology on the clothing easily.

The seventh stage was the final production of the culture-based wearable fashion products. This was after improvements were made based on the reviews and feedback from the users.

The men's clothing was designed to promote Gendang Beleq culture and ensure an attractive visual (Figure 14). This was evident in the pants, which resembled a tube by enabling the passage of a rope to the outer vest. In terms of appearance, electro-fashion was presented through an LED array that showed visual images. This reflected the inscription of a text under the title "Technokultur" followed by the slogan "when culture meets technology". The design allowed for an interesting and interactive promotional strategy through the LED light display. The technical bill of materials and production feasibility of the Gendang Beleq final product are presented in Table 1.

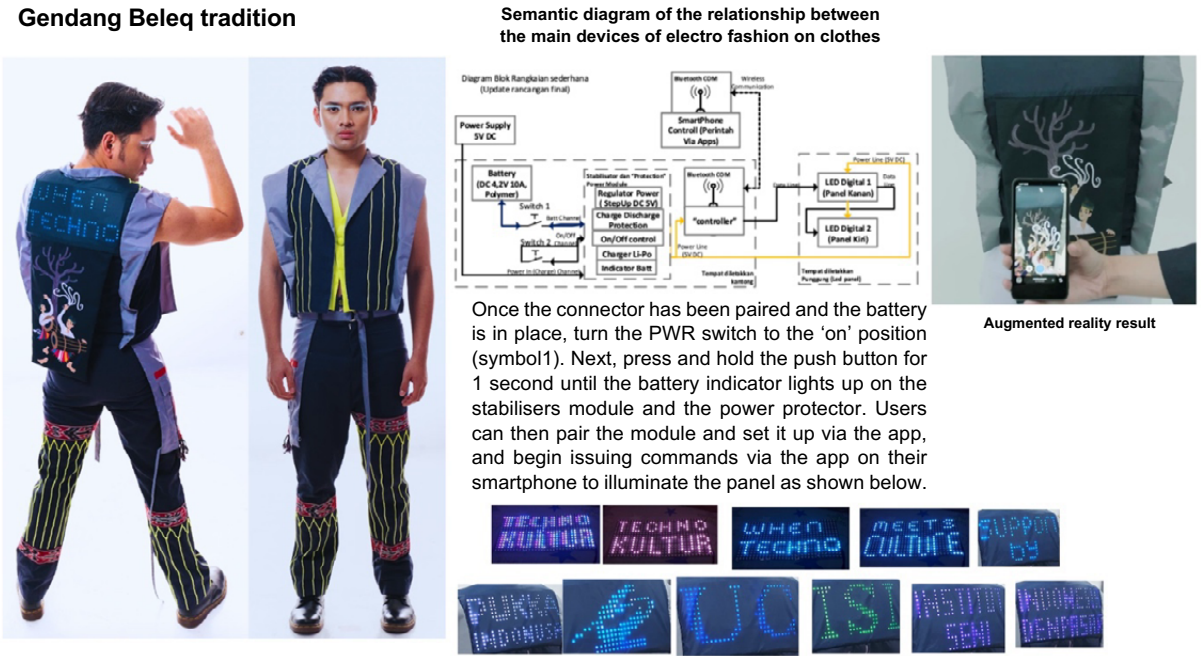

Figure 14 Final design of Gendang Beleq product

Source: Illustrated by the author

Table 1 The technical bill of materials and production feasibility of Gendang Beleq set

No.	Component	Specification	USD	IDR	Description
1	ESP32-C3 mini	Wi-Fi + BLE, 160 MHz	4	62,000	Compact microcontroller unit for LED + app control
2	WS2812B 8 × 8 LED matrix	64 px, 5 V	7	109,000	Smaller LED matrix for light display

(*continued on next page*)

Table 1 *(continued)*

No.	Component	Specification	USD	IDR	Description
3	Buck converter 5 V/3 A	LM2596/XL4015 type	5	78,000	Stable 5V output with protection
4	Li-ion battery	3.7 V 3000 mAh, 1S	12	186,000	Rechargeable, lightweight cell
5	Switch + push button	SPDT + tactile	2	31,000	Power and mode control buttons
6	JST connectors and wires	AWG 20/22 silicone	2	31,000	Flexible cabling system
7	Pocket enclosure	Fabric + foam lining	2	31,000	Protective removable pouch
8	Misc. components	Caps, resistors, shrink	1	16,000	Supporting electronics
9	Textile labour	Integration + sewing channels	10	155,000	Harness + pad integration
10	Assembly and QC	Functional test, safety check	8	124,000	Testing and calibration

A retail pricing framework was developed for the wearable electro-fashion collection to balance cultural accessibility with market feasibility. Therefore, the cost-plus pricing method was used to calculate the prices based on the multipliers of 1.8× the cost of goods sold for wholesale and 2.0× for retail. This led to a wholesale rate of USD155 (approximately IDR2.4 million) and a retail price of USD169 (estimated at IDR2.62 million) (Table 2).

Table 2 Production cost summary

Category	USD	IDR (approximate)	Description
Subtotal: electronics + integration	53	823,000	Includes controller, LED panel, and assembly
Base clothing (inner, vest, outer, and pants)	30	465,000	Fabric and tailoring cost
Packaging and documentation	3	47,000	Box, label, care card
Total cost of goods sold	86	1,335,000	Estimated cost to produce one unit

Sasak Sade Coffee clothing comprised three pieces: a plain white inner, a crop outer jacket, and culottes with double slits on the front and back sides (Figure 15). The front of the crop outer jacket had an elastic string and a stopper to adjust the wrinkled shape. This is a representation of the silhouette-shaped pottery commonly used by the people when pounding coffee beans. The back of the jacket also has a geometric panel piece, considered the point of interest. Moreover, the geometric panel piece has a figure of a Sasak woman pounding Sade speciality coffee with a traditional tool surrounded by leaves and red coffee fruit. The shape was visualised interactively through electro-fashion using red LED points deliberately arranged in series close to each other. The activation of LED points produced a visual impression that resembled clustered red coffee beans. Considering the relevant business and production aspects of the final Sasak Sade Coffee product, the details of the technical bill of materials and production feasibility are set out in Tables 3 and 4.

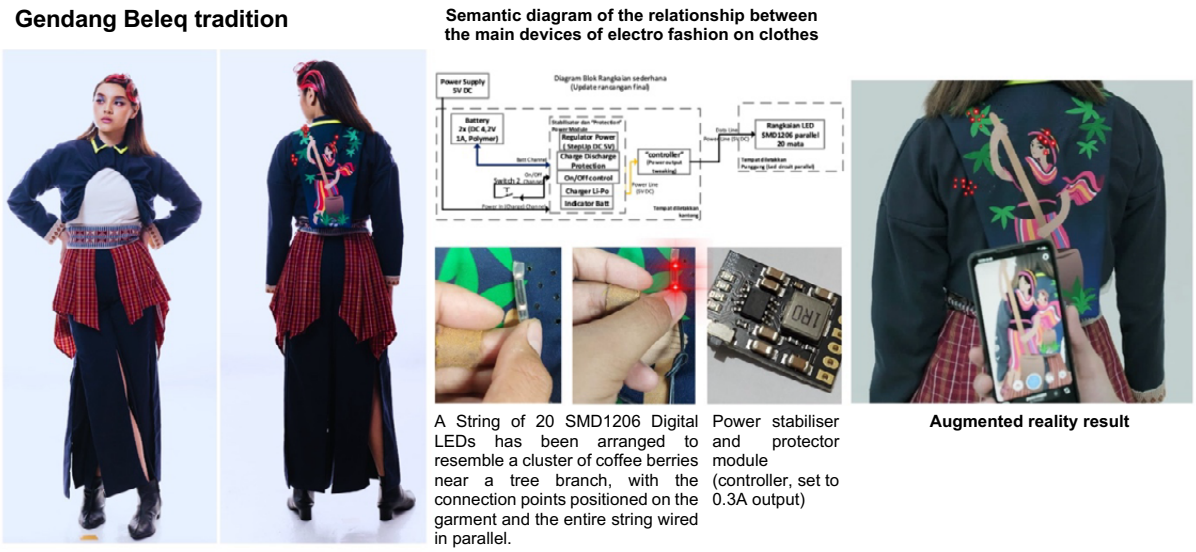

Figure 15: Final result for Sasak Sade Coffee design

Source: Illustrated by the author

Table 3 The Technical bill of materials and manufacturing feasibility for Sasak Sade Coffee set

No.	Component	Specification	USD	IDR	Description
1	Power supply adaptor	5 V, 2 A	6.00	93,000	Provides stable DC power input for the LED and controller circuit
2	Li-ion polymer battery	3.7 V, 1500 mAh	8.50	132,000	A rechargeable power source supplying portable energy for wearable use
3	Power stabiliser and protector module (controller)	Voltage regulator with surge protection	6.00	93,000	Maintains consistent voltage output and protects components from overload
4	Cables (AWG 20 and AWG 22)	PowerLine and DataLine	2.00	31,000	Connects all electrical components; flexible and heat-resistant
5	Switch + push button	SPDT + tactile	0.50	8,000	Enables manual activation and circuit control
6	JST SM 3-pin connectors (pairs)	Male–female connector type	2.00	32,000	Provides detachable, modular wiring connection between circuits
7	SMD1206 LED circuit	20 LEDs, branch-like arrangement	12.00	187,000	Produces uniform illumination, connected in parallel for stability
8	Case (pouch type)	Textile with foam lining	6.00	93,000	Encases and protects electronic modules while remaining detachable

Table 4 Production cost summary for Sasak Sade Coffee set

Category	USD	IDR (approximate)	Description
Subtotal: electronics + integration	17	264,000	Includes controller, LED and assembly
Base garment (inner, vest, outer and pants)	26	403,000	Fabric and tailoring cost
Packaging and documentation	5	78,000	Box, label, care card
Total cost of goods sold	48	745,000	Estimated cost to produce one unit

Based on a total cost of goods sold of approximately USD48 (≈ IDR745,000), a two-tier markup system was applied to address distinct market segments. The wholesale price was established at USD86 (≈ IDR1,333,000), reflecting a 1.8× markup, while the retail price was set at USD96 (≈ IDR1,488,000), representing a 2.0× markup over production cost.

For both products, consistent with the targeted range of USD100 to USD190 determined through production feasibility analysis. The wholesale tier is designed for institutional and collaborative orders, such as museums, cultural organisations, or academic institutions, while the retail tier targets gallery sales and direct-to-consumer markets. This two-level structure provides a sustainable balance between fair profit margins and affordability, ensuring that the garments remain accessible while supporting small-scale producers and artisans. Ultimately, the pricing strategy underscores the project's vision of integrating technological innovation with cultural heritage, positioning electro-fashion not only as a design experiment but also as a market-ready model for promoting wearable culture within the creative economy.

Refined products are not sold at retail but are currently promoted through a rental system. Moreover, simple qualitative interviews were conducted with end users to assess the comfort, comprehension, and cultural acceptability of both products. This led to the inclusion of 10 people, comprising six females and four males, with an age range of 18 to 27. Each user interacted with wearable fashions, and semi-structured interviews were used to collect data with an emphasis on the experience rather than quantitative measurement. This allowed the users to share their subjective perceptions of cultural resonance, technical knowledge, and physical comfort in line with the questions presented in Table 5.

Table 5 Semi-structured interview framework for user evaluation

Section	Focus area	Interview questions
A: Comfort and wearability	Physical comfort and ergonomic usability	1. How would you describe your overall comfort while wearing the clothing?
		2. Did you experience any discomfort due to weight, wiring, or temperature while the LEDs were active?
		3. How suitable do you think this clothing would be for longer use or cultural performance contexts?
B: Comprehension and interaction	Understanding and intuitive interaction with technological features	4. How easy was it to understand the function of the lighting and AR features?
		5. Did the AR visual layer enhance your understanding of the cultural story presented in the design?
		6. How intuitive was the interaction process (scanning, observing, or responding to the clothing's light pattern)?

(continued on next page)

Table 1 *(continued)*

Section	Focus area	Interview questions
C: Cultural acceptability and aesthetic response	Cultural resonance and user perception of technological integration	7. How do you perceive the combination of traditional cultural motifs with electronic and digital elements?
		8. Did the clothing maintain respect toward the Sasak cultural identity and its symbolic meanings?
		9. Would you feel proud to wear or showcase this kind of cultural-tech hybrid in public or artistic settings?
		10. How do you think such wearable innovations can contribute to preserving or promoting local heritage

The interviews produced three key themes that corresponded to the three evaluative dimensions of comfort and wearability, comprehension and interaction, as well as cultural acceptability and meaning. For the comfort and wearability aspect, most users (n = 8) described the clothing as light and flexible, with an emphasis that the electronic components were effectively distributed and did not restrict movement. The users appreciated the detachable power modules that reduced thermal discomfort. Two users suggested minor improvements, such as softer backing for LED zones and lighter battery compartments for longer durations of use. The general perception of the clothing was that it was ergonomically comfortable and aesthetically wearable for fashion shows, special occasions, events, or exhibitions.

For the comprehension and interaction aspect, all the users successfully interacted with the AR feature and reported a clear understanding of the relationship between the lighting behaviour and the cultural narrative. The lighting was described as "symbolic" and "rhythmic," particularly in the Gendang Beleq prototype, where the pulsing LED visually represented the main theme. The Sasak Sade Coffee prototype was perceived as more intimate and narrative-driven because users could recognise the symbolic connection between the light flow and the pounding coffee beans in the Sasak Sade tradition. Moreover, the AR scanning process was observed to be intuitive, and the use of digital storytelling to reinforce the meaning behind the cultural motif figure was appreciated.

The aspect of cultural acceptability and meaning had a similar trend, as observed in the unanimous agreement of the users that the combination of technology with traditional motifs was respectful, meaningful, and contemporary. The design was believed not to be a disruption to tradition but an evolution of cultural storytelling. Most users expressed pride and emotional connection by reporting that "this clothing makes culture feel alive again" and "it shows that heritage can evolve with technology." Some emphasised that the methods could engage younger audiences who were typically distant from traditional fashion. The majority (n = 9) strongly agreed that combining wearable electronics and AR could enhance cultural education and appreciation without diminishing authenticity.

The production of the two wearable fashions showed how the application of the appropriate fashion scenario provided significant results. The latest technology in the form of AR media was used to provide education and information about the Sasak Sade culture to the public in an interactive manner. The electro-fashion in the form of LED lights also provided more expressive and interesting wearable fashions, including a semantic narrative to present the design elements.

The application of the experimental method showed that the objective of cultural safeguarding was achieved by exploring the background of the phenomenon. This led to the need for further research on a specific culture, appropriate technology, indicators, and thematic objectives of cultural preservation, as well as the determination of the most suitable scenario. Subsequently, the production of wearable fashion products served as a medium for cultural preservation.

CONCLUSION, LIMITATION, AND FURTHER RESEARCH

In conclusion, the production of wearable technology required a combination of knowledge, aesthetics, and fashion design. There was also the need to understand that the value of fashion was to portray style and aesthetics as tools used in communicating culture, values, and status of the users. This was because the clothing was an interface that led to a connection with the surrounding environment and acted as a transmitter to provide a meaningful experience. The process led to the consideration of aesthetics as an important factor in the design of wearable technology. This research applied clothing as an intermediary between the body and the virtual space. As an epidermal interface, the clothing allowed users and audiences to feel the blurred boundaries between the real and virtual world. Therefore, future research should focus on interfaces in wearable technology, including the meaningful and valuable experiences communicated.

The aim of this research was to propose an experimental wearable fashion method that focused on safeguarding culture. The process led to the implementation of seven stages of production, which were different from existing methods. This assisted designers in combining the diverse processes while considering the human system, and research was conducted to safeguard culture. The ideation led to the production of interactive wearable fashion products that were capable of promoting local culture. The feedback from users after the trial was used to ensure the final products were perfect, innovative, and responded to the needs of the current digital era. Moreover, the method increased HR in the field of fashion technology in the archipelago with due consideration for its relevance.

The limitation observed was the fact that the technology implemented and exemplified was in the form of electro-fashion and AR. Therefore, future research should apply other technology scenarios and provide recommendations for cultural protection according to more complex needs.

ETHICAL CONSIDERATION

This research acknowledges the cultural ownership and rights of the Sasak Sade community in Lombok, Indonesia. Open discussions and informal interviews were conducted with community elders and cultural practitioners to ensure the interpretation of Gendang Beleq and Sasak Sade Coffee traditions was both accurate and respectful before developing the wearable electro-fashion prototypes. Moreover, verbal and video-recorded consent was obtained, and the community members granted permission for the adaptation of their cultural expressions into wearable fashions and digital forms. The process emphasised mutual trust, respect, and collaboration to ensure the voice of the community remained central in the design and presentation. All cultural elements used in this project continue to be acknowledged as the collective heritage of the Sasak Sade community.

A benefit-sharing principle was applied to ensure the Sasak Sade community directly benefited from the use of their cultural heritage in Gendang Beleq and Sasak Sade Coffee wearable fashion projects. The process was established on mutual understanding and collaboration, where community representatives agreed that the designs would assist in promoting Sasak Sade culture through academic, creative, and public platforms. The aim was to increase visibility for the traditions, inspire cultural pride, and open potential opportunities for local artisans and cultural tourism. The role of the community was fully acknowledged in every exhibition and publication related to this project. Furthermore, the development of any form of commercialisation in the future would lead to discussion on benefit-sharing arrangements with the community leaders to maintain fairness and shared ownership of outcomes.

Ethical approval for this research was granted by the Research Ethics Committee of Universitas Ciputra Surabaya under approval code No. 012/EC-FDB/UC/X/2024. This research followed institutional and international ethical standards by covering procedures for informed consent, cultural collaboration, and data confidentiality. Both the Sasak Sade community, as cultural knowledge holders and users, who engaged in prototype testing and interviews, were included. All participation was voluntary and conducted with respect, transparency, and sensitivity to cultural and personal rights in the research process.

ACKNOWLEDGEMENTS

The authors are grateful to the Institute of Research and Community Development, Universitas Ciputra Surabaya, for the generous support provided through the International Research Internal Funding Scheme (Grant No. 001/UC-SCI/ST/VI/2024). This support allowed the design, technology, and cultural collaboration in the development of this wearable electro-fashion research. The authors are also grateful to PT. Pukka Indonusa for providing access to the CAD system and technical guidance that contributed significantly to the accuracy and innovation of the design process. Most importantly, the authors are grateful to the Sasak Sade community in Lombok for the invaluable openness, cultural wisdom, and collaboration. The insights provided and participation enriched the creative direction of this project and also ensured that the cultural expressions represented were treated with authenticity, respect, and care.

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