"Touching Our Heritage": Exploration of Crossmodal Senses in Experiencing Heritage Indonesian "Batik" Textiles

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Abstract: Culture binds groups of humans together, and as a byproduct, culture produces tangible artifacts that people can experience. Cultural heritage is preserved via these artifacts, creating a historic, distinct identity in which people can group under. The actors within a culture that contribute directly to its preservation, such as craftsmen, historians, and so forth, are the minority within the general population. Since culture is an identity adopted by a general population, extending the experience of directly interacting and forming connections with our culture beyond those who directly contribute to its preservation is imperative. This paper utilizes Indonesian *batik* textile as an example of such cultural artifacts, as it is a hand-made form of art that only skilled craftsmen can create. Utilizing audiovisual synesthetic sciences and software, it is possible to create novel immersive experiences that allow viewers to form a new, direct connection with culture. This paper is an exploration of culture utilizing TouchDesigner, experimenting with the connection between audiovisual sensory perception and haptics in the context of Indonesian *batik* textiles.

1. Introduction

1.1 INDONESIA: BATIK

Indonesia, the largest archipelagic nation in the world, harboring over 17,000 islands, is rich in cultural heritage. Though the country has historically been a melting pot of identities due to its nature as a seaport and trading hub, it still possesses a unique cultural identity independent, or minimally influenced by outside groups. One such tradition, the Batik textiles, continue to persist, and will do so as long as the Indonesian people continue to preserve it as a cultural symbol.

Batik, derived from "*mbat*", an archaic Indonesian word meaning "dotting", is a type of Indonesian cultural artifact that is created by hand-stenciling traditional motifs with wax on a plain sheet of fabric that is then dyed to produce a patterned cloth [2]. These cloths have a variety of uses, most of which includes clothing or ornamentation, particularly in Indonesian traditional uniforms - such as with the Balinese *Paya Agung* or paired with the widely-used *Kebaya*, among others [3]. *Batik* is not restricted to traditional use, as it is also commonly used as a material in creating clothing such as western-style suits and shirts.

Though *batik* is commonly associated with a lengthy process of hand-drawn patterns, technological advances have allowed *batik* craftsmen to increase efficiency using automation - which has caused controversy amongst communities and their definition of *batik* [4][5][6]. The general controversy surrounding automated *batik*-making processes is multi-faceted, with those pro-automation citing its use as a way to efficiently spread Indonesian culture to a wider audience and those anti-automation claiming that true *batik* is limited to a specific hand-drawn technique. Despite their polarizing stances, both sides of the argument are in favor of preserving *batik* as Indonesian cultural heritage. Thus, it is imperative to view cultural preservation based neither on what is *currently* defined or how it *was* defined, but to think on what is possible in the future.

1.2. TRANSCENDING AS AN OBSERVER

The field of interactive art is blooming, and with it, comes totally novel ways in which to experience artistic intent. This paper is an exploration into the conveyance of the batik creation process through adapting batik as a form of interactive art in which viewers can narrow the observer-artist gap through a mode of cross modal sensory experiences, which include vision, hearing, and haptics in order to facilitate an intimate connection with the cultural artifact beyond viewing a final product.

2. Synesthetic Science

2.1. CROSS-MODAL SENSES

The way our senses interact with each other in order to form perception show that each sense does not run parallel with each other, instead they act as supplements that cross over in order to create a much larger whole. For instance, human olfactory systems work with gustatory (taste) systems and act as chemoreceptors that paint a perception of food or drink. Ocular receptors also allow the visual cues of said food item to be understood, and haptic perception allows us to feel the texture of the food item. Each sensory system works in tandem with each other to provide a full sensory experience [7].

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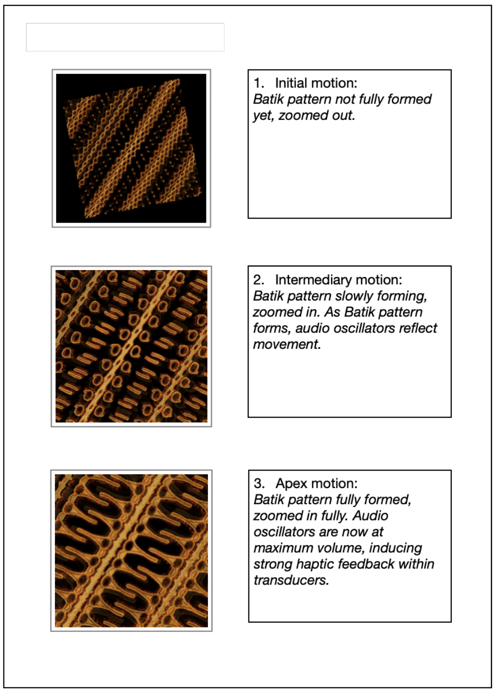

Fig. 1: Summary of final visualizer

Synesthesia is an exaggerated example of this sensory crossover. It is described as the overlap between senses, or rather the overlapped activation of the senses [8]. A synesthete could ascribe colors to numbers, or "see" sounds as if they were part of the color spectrum. Grapheme-colour synesthesia, a type of synesthesia that allows synesthete to associate graphemes, or the smallest meaningful building block of a writing system (i.e letters, numbers, etc) with specific colors, is caused by a mutation that allows for stronger cross-activation between the V4 (the visual cortex) and the number area in the brain [9]. Ramachandran & Hubbard's 2001 paper entitled "*Synaesthesia - A Window Into Perception, Thought, and Language",* reviews synesthesia and other cross-modal sensory perception (such as the well-known and well-reported "Bouba-Kiki effect" [10]), explaining that human synesthetic capabilities may have had an impact in the creation of language, particularly metaphor and other non-literal methods of communication. Regardless of its evolutionary origin, it is clear that fundamentally the brain relies on cross-talk between its various regions in order to perceive the world around us.

Interactive art allows us to tap into this cross-modal sensory perception system on a more direct manner, immersing ourselves as observers able to shape the piece in front of us. Haptic technologies allows us to feel what we see, and in turn can be a valuable asset in creating novel interactive experiences.

2.2. SEEING IS FEELING: HAPTICS AND VIDEO GAMES

Video games are a unique form of media, like interactive art, in which the observer can manipulate information provided to them (quite literally, with a controller). One of the first breakthroughs in video game haptics was the 1997 "Rumble Pak" developed to be used alongside the Nintendo N64 console, a haptic accessory that was to be attached to the regular N64 controller allowing for haptic force feedback when playing certain games like *Super Mario 64* and *Star Fox 64* [12].

In Sony's *Spider-Man 2* for the PlayStation 5, sequences in which the titular hero is required to lift heavy objects are common. As *Spider-Man* is seen lifting heavy boulders and debris within the game, players are prompted to push the left and right trigger buttons, of which DualSense haptic technology is fitted into. Players are then required to delicately balance the left and right trigger buttons as if they were *Spider-Man*'s own arms [13]. Similarly, in Infinity Ward's 2022 video game, *Call of Duty: Black Ops: Cold War* [14], this haptic resistance technology is used to imitate the feeling of using various different firearm triggers, of which there are many in the game. This application of haptic technologies allows for immersive qualities that older video games were unable to reach.

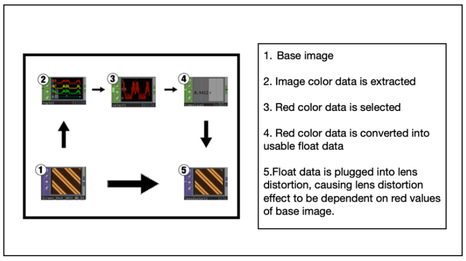

Fig. 2: Rudimentary TouchDesigner node functions

With the advent of new applications and technologies allowing for downscaling and a wider range of applications, haptic technologies can be used effectively in creating novel multimodal experiences.

2.3. FEELING CULTURE

Batik is a hand-drawn textile - how can we convey this to an average observer? This is where the potential for haptic technologies lies. In creating an audiovisual experience that also utilizes haptic technology for the purpose of sensory immersion, representing the hand-drawn nature of each Batik stroke is possible to a degree, of which the objective of this paper is so:

Exploring the applications of synesthetic science and haptic technologies to create an immersive Batik *exhibition highlighting* *its hand-drawn nature.*

This is to be achieved via software capable of acting as a medium between audiovisual output and haptic output, whereby generated *Batik* visuals can induce haptic response.

3. Cultural Visualization

3.1. VISUALIZING BATIK VIA TOUCHDESIGNER

TouchDesigner, described by its developer, Toronto-based Derivative, as “visual development platform” is a node-based programming language created for the development of realtime multimedia works. At its most basic, it allows for most inputs, be it MIDI data, camera data, microphone data, and so forth, to be manipulated, creating any output intended by the artist. It functions parametrically, meaning that variables in every node can be tied to realtime data. As an example, via TouchDesigner, it would be possible to take camera input, convert said input into color data, and use that color data as variables of, for instance, a lens distortion effect node. The lens distortion effect node would then alter its output based on the color data converted from the camera input, meaning that whenever the camera detects a change in color, it results in a parametric alteration of the lens distortion node’s values.

TouchDesigner is also capable of generating its own inputs that can be manipulated into output visuals. This includes audio input (via TouchDesigner’s provided oscillators) or visual input (via 3D primitives and more). Thus, to create an immersive *Batik* exhibition utilizing haptic technologies, it would be necessary to use *Batik* imagery as an input that is then manipulated, of which the manipulation triggers haptic transducers to induce vibrations.

In this case, as we are exploring the replication of *Batik* strokes, we will be utilizing TouchDesigner in creating moving *Batik* patterns via its in-built 3D functionality. By replicating these *Batik* patterns within TouchDesigner, we can then manipulate the stroke length. Utilizing the stroke length data, we can then link these values parametrically to an oscillator, which will generate sound that is then converted into haptic feedback via a haptic transducer. What results is a visualizer that depicts moving strokes of *Batik* that generate audio and haptic feedback based on its movements, creating an immersive multimodal experience. The *Batik* strokes expand and contract, generating audio output listened through headphones, while that same audio output is converted into haptic vibrations felt through the viewer’s hands via small haptic transducers.

3.2 FINAL VISUALIZER: EXPLAINED

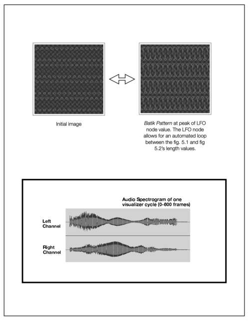

Fig. 4. Visual and Audio description of visualizer

The final visualizer is an infinitely looping moving image of a *Batik* pattern that perpetually zooms in and out, while individual *Batik* strokes undulate in and out. As it does so, audio oscillators equally undulate, associating the movement of the pattern with audio output. *(Please refer to the appendix for a video link to the visualizer itself)*

3.2.1 Step 1: Imagery

In order to replicate *Batik* patterns in TouchDesigner, it is necessary to break down the pattern into its simplest shapes, as TouchDesigner is capable of creating curves that can be parametrically adjusted. By generating each curve, movement can then be introduced, leading us into the second step, processing.

As there are an innumerable amount of *Batik* patterns local to various Indonesian regions, the *Parang* pattern was chosen for its simplicity and commonality in Indonesia’s most populous region, Java. Following instructional videos regarding the drawing of the pattern, it was possible to break down the pattern into at least three simple curves. They were then manually adjusted to fit into the *Batik Parang* pattern.

3.2.2. Step 2: Processing

In this step, the *Batik* pattern will have movement induced via TouchDesigner’s inbuilt low-frequency oscillator (LFO) nodes, allowing a pulsating range of values to be parametrically inputted into the length of each curve. This creates a rhythmically pulsating movement. This movement value will then be associated with the frequency parameters of TouchDesigner’s audio oscillator nodes. This results in audio frequencies to be generated as each *Batik* curve moves.

3.2.3. Step 3: Output

Using the length value of the *Batik* curves, audio is generated via the audio oscillator node, as explained step 2. This audio oscillation is then run through a Foster AP15d, amplifying the signal at a maximum of +15 W. This signal is then fed through the amplifier into two Acouve VP2 haptic transducers which further amplify low-frequency signals that are best felt by mechanoreceptors in human skin. The original audio signal is simultaneously played through a set of headphones. By wearing the headphones and holding the haptic transducers in the palms, while also viewing the visualizer simultaneously, an audiovisual experience becomes an audio-visual-haptic holistic experience.

3.3 EXHIBITION

The full audio-visual-haptic experience was exhibited at the Keio Shonan-Fujisawa Open Research Forum (Keio SFC ORF) on the 23rd and 24th of November, 2023. Please refer to Appendix 2 for images pertaining to the ORF, intended to showcase the exhibition. Please refer to Appendix 3 for hardware specifications.

Via informal interviews with visitors that experienced the exhibition, it was clear that the haptic qualities of the exhibition were novel and thus, most memorable in terms of the exhibition as a whole. Visitors were able to associate the haptic feedback of the transducers with the visualizations presented to them, and noted that the audio was “soothing” and immersive. With the addition of the soft, curved patterning of the *batik,* a wave-like motion was achieved, which could have had an impact on the perception of the movement of the pattern.

4. Discussion and Conclusion

4.1. FURTHER CULTURAL EXPLORATION

Limiting the scope of the project to Indonesian *Batik* patterns, and more specifically, *Batik Parang*, patterns, breaking down the pattern into simple, parametrically editable shapes was a direct and precise task. This can extend to other cultural patterns and designs, specifically other patterns that possess the simple-to-reproduce shapes similar to *Batik Parang*. As long as clear, patterned shapes are distinctly identifiable, it is possible to adapt the same exhibition utilizing the same audio-haptic-visual framework for use with other traditional patterns.

Many traditional Japanese patterns fit the description of geometrically simple, repeating shapes. Specifically, the tradition of *wagara* and its many sub-patterns evoke a similar repeating, patterned structure like Indonesian *Batik*. Unlike *Batik*, however, common *wagara* patterns like *asanoha, yagasuri*, and *kikko,* are much more angular in shape, featuring sharp corners and distinct edges [15]. Thus, the perception of movement that the patterns can invoke within exhibition visitors can be drastically different, contrasting the “warm” and “soothing” undulations of *batik*. Curved *wagara* patterns also exist, like the *seigaiha* and *shippo* [16], and an exploration into how the angularity of a pattern affects the entire synesthetic experience could be a direction that future projects can take. Mimicking the well-known Bouba-kiki effect, patterns that move, sound, and are colored in the same ways but possess different angularities may be perceived differently. Similarly, if any of these factors were to be changed, an exploration into how the displayed traditional patterns are perceived would also be possible.

4.2 Expanding Cross-Modal Sensory Experiences

It is important to consider the current project’s scale and scope, and areas in which it lacked immersive qualities. Sonically, noise-canceling headphones were utilized, creating a pocket of sound distinct away from environmental noise. This creates an immersive soundscape, and ensures that no outside interference, sonically, was experienced. Visually, there is still an observable distance between a viewer and the artwork, and this distance allows for objects in the periphery of one’s vision to interfere with the perception of the visualizer being displayed. A solution that could be considered is virtual reality technology, particularly VR headsets. VR headsets are praised for their immersive qualities, as much like noise-canceling headphones, they allow the user to completely shut off any outside stimuli that may interfere with their immersion of the content they are consuming. Haptically, the feedback experienced by exhibit viewers was localized to the palm of their hands. Human skin possesses haptic mechanoreceptors on virtually every portion of its surface, with varying sensitivities based on the area. For instance, the feet are generally more sensitive to haptic feedback, and portions of the human body where skin-to-bone contact is more direct may resonate differently when encountering haptic feedback [17][18]. A solution to this would be to utilize full-body haptic suits, or, or considering an economical scale, wearable haptic technology that can be fitted onto any portion of the body. It would then be possible to manipulate with portions of the body receive haptic feedback, and how this relates to the perception of traditional patterns can be explored.

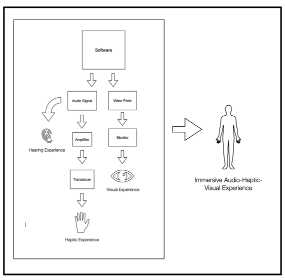

Fig. 5: Software, hardware, and sensory flow of exhibition

4.3 Conclusion

Culture is a form of human expression that is transferable across generations, encompassing a long timescale. The way individuals perceive culture is dependent on this developed, generational perception, creating unique identities for human beings to rally under. As this process takes decades, if not centuries, there are clear disconnects between different cultural groups, and the perception of cultural artifacts. Utilizing technology, forming novel connections between individuals and culture is not only possible, but is actively being undertaken to ensure cultural preservation.

Utilizing haptic technology specifically allows for a direct skin-to-culture contact that cannot be achieved through other sensory means. As experienced through the final exhibition, individuals were able to "feel" a culture they had never experienced, via novel means. Through this, there is a precedent not only for haptic and cultural research, but research regarding human perception and memorability. Similarly, beyond an artistic exploration, there is a potential for cognitive/psychological/neurological sciences to be involved within the research itself.

In conclusion, by exploring culture through novel sensory and technological means, we hold the potential to connect individuals of different cultures, allowing us to communicate our cultural values to each other in a global manner.

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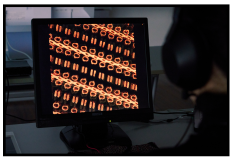
Appendix:

Appendix 1: Visualizer video link

https://www.youtube.com/shorts/5G3oGeqvPrM

Appendix 2: Exhibition images

Appendix 3: Hardware Specifications

Table 1: Full Experience Hardware Specifications

Hardware	Dimensions	Output Type	Function
Foster AP15d Amplifier	110mm (W) x 30mm (H) x 75mm (D)	Digital signal out	Amplifies audio signals, feeds signal into transducers
Acouve VP2 Haptic Transducers	43mm diameter x 15mm(t)	Haptic feedback out	Amplifies lower frequencies, allowing haptic feedback to be experienced
Sony WH-1000xm5 Headphones	-	Audio signal out	Noise-canceling headphones allow for full audio immersion
Monitor	1280*1280p	Visual feedback out	Viewing the visualizer