Hochschule
Augsburg University of
Applied Sciences

"Study and design of physical interfaces of the body and technology in the context of movement and dance"

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BACHELOR THESIS

Course of Studies: Interactive Media (BA/BSc)

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Tutor:

Prof. Andreas Muxel

Abstract

Title: Study and design of physical interfaces of the body and technology in the context of movement and dance"

In the contemporary landscape of artistic innovation and technological exploration, the project "Martial Noodle" emerges as a pioneering effort at the crossroads of martial arts, technology, and creative expression. Conceived within the framework of the "body / technology / dance" paradigm, this project sought to redefine the boundaries of traditional martial arts by infusing it with elements of interactive sound, cultural resonance, and enhanced bodily awareness.

The core of Martial Noodle lies in its utilization of a pentatonic scale, meticulously integrated into specially shaped noodles, which become extensions of the human body. This choice of scale not only adds a distinct Asian flair but also encapsulates the cultural significance of martial arts, bridging ancient traditions with contemporary technology. The incorporation of Arduino technology and flex-sensors within the noodles empowers participants to actively engage in sound generation through their movements, transforming martial arts practice into a creative endeavour.

Moreover, Martial Noodle triggers a profound transformation in body awareness and control. Participants reported heightened proprioception, offering a deeper understanding of their movements and postures. This sensory enhancement is attributed to the dynamic interaction between movement and sound, an innovation that blurs the lines between art and technology.

As a catalyst for interdisciplinary exploration, Martial Noodle opens avenues for future possibilities in the realm of interactive artwear, participatory experiences, and the convergence of physical and digital worlds. This project represents a testament to the transformative potential when 'body / technology / dance' converges, enriching martial arts practice while inspiring broader inquiries into the interconnectedness of the human body and technology.

Keywords: Martial Arts, Interactive Artwear, Sound Generation, Body Awareness, Technology, Cultural Resonance.

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1. Introduction

1.1. BACKGROUND

The relationship between the human body, technology, and the performing arts has been a source of fascination for centuries. In the contemporary context, this intersection has evolved into a dynamic and innovative field, where the boundaries between the human body and the technical body blur, giving rise to new forms of creative expression and interaction. This thesis explores this rich terrain, focusing on the design and prototyping of interactive performance artwear, where the body becomes a canvas for the fusion of artistic expression and technological augmentation.

1.1.1 Evolution of the Human-Technology Interface

"(…) technology symbiotically attached and implanted into the body creates a new evolutionary synthesis, creates a new human hybrid – the organic and synthetic coming together to create a new sort of evolutionary energy." (Stelarc, s.f.)

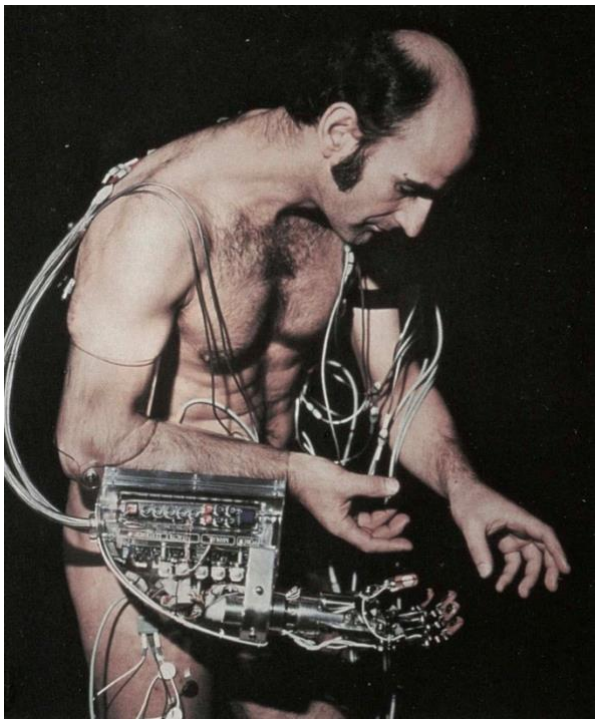

Figure 1.1: Picture of Stelarc (Stelarc, s.f.)

Throughout history, the human body has been a central canvas for artistic expression. From the earliest cave paintings to the grand stages of traditional theatre, the body has been a medium through which stories are told and emotions are conveyed. However, the advent of modern technology has introduced novel possibilities for enhancing the artistic potential of the body.

The digital age has witnessed a profound shift in how we perceive and interact with technology. We are no longer passive consumers but active participants in a world where technology is an integral part of our daily lives. This shift has led to an exploration of how technology can be seamlessly integrated with the human body, transcending traditional boundaries.

1.1.2 Dance and Movement as a Medium of Expression

"(…) dance, the movement of the body in a rhythmic way, usually to music and within a given space, for the purpose of expressing an idea or emotion, releasing energy, or simply taking delight in the movement itself." (Mackrell, 2023)

"Dance is an art form consisting of sequences of body movements with aesthetic and often symbolic value, either improvised or purposefully selected. Dance can be categorized and described by its choreography, by its repertoire of movements (…)" (Wikipedia, 2023)

Dance, as an art form, embodies the essence of physical expression. It transcends language and culture, communicating emotions, stories, and ideas through the graceful and dynamic movements of the human body. Over the years, dance has evolved to incorporate technology as a means of expanding its creative possibilities.

From avant-garde choreography that incorporates robotics to interactive performances where dancers engage with responsive environments, the world of dance has embraced technology as a tool for pushing the boundaries of artistic expression. This fusion of dance and technology has given birth to a new realm of performance art that challenges conventional notions of movement and interaction.

1.1.3 The Role of Code and Hardware in Creative Design

In this thesis, the creative process is underpinned by code and hardware as powerful tools for the realization of artistic visions. Creative coding, characterized by the use of programming languages for artistic purposes, has become an essential medium for designers seeking to merge technology and creativity. Hardware, in the form of sensors and actuators, facilitates the interaction between the body and technology, enabling real-time responsiveness and interactivity.

The exploration of this intersection involves not only technical proficiency but also a deep understanding of aesthetics, user experience, and the potential for evoking emotion through design. It challenges designers to think beyond the conventional boundaries of industrial design and delve into the realms of interactive art and performance.

1.1.4 Prototypical Presentation in an Exhibition/Performance Context

Central to this thesis is the concept of prototypical presentation in an exhibition/performance context. This approach allows for the practical manifestation of ideas, where wearable technology becomes an integral part of the performance, blurring the lines between the performer, the audience, and the technology itself. The prototype serves as a tangible representation of the theoretical concepts explored throughout the research.

In summary, this thesis seeks to contribute to the evolving discourse on the fusion of body, technology, and dance. By investigating creative coding, sensor and actuator technology, low- and high-tech prototyping, and their integration into performance and staging, we aim to shed light on the exciting possibilities and challenges at the intersection of these fields. Through our design process and prototypical presentations, we endeavour to explore new dimensions of artistic expression, ultimately enriching the world of interactive performance artwear.

1.2. RESEARCH QUESTION AND OBJECTIVES

1.2.1. Research question

How can the integration of pool noodles, Arduino technology, and a music synthesizer be leveraged to create a novel form of interactive performance artwear that extends the human body and enhances the expressive possibilities of dance?

1.2.2. Objectives

a. Explore the Creative Potential of Unconventional Materials

Investigate the creative and aesthetic possibilities offered by pool noodles as a foundational material for the design of interactive performance artwear.

Experiment with various forms, sizes, and configurations of pool noodles to determine their suitability for expressive movement and dance.

b. Integrate Arduino Technology for Sensorial Augmentation

Develop and implement Arduino-based sensor systems that can detect and respond to the wearer's movements, thereby enhancing the interactivity and responsiveness of the artwear.

Explore the ways in which Arduino technology can be used to bridge the gap between the human body's movements and the artwear's dynamic response, creating a seamless and expressive connection.

c. Synthesize Soundscapes in Real-Time

Design and integrate a real-time music synthesizer system using Processing Code that is responsive to the wearer's movements, generating auditory accompaniment that enhances the artistic expression of dance performances.

Investigate the synchronization of sound synthesis with the wearer's movements to create a dynamic and immersive audio-visual experience.

d. Evaluate the Artwear's Impact on Artistic Expression

Assess the effectiveness of the created interactive performance artwear in extending the expressive capabilities of dancers.

Explore how the artwear influences the choreography, movement vocabulary, and emotional resonance of dance performances.

e. **Contribute to the Intersection of Art, Design, and Technology**

Contribute to the ongoing discourse surrounding the convergence of art, design, and technology, offering insights into the potential for innovative and unconventional materials in the creation of interactive performance artwear.

Advance the field by presenting a tangible example of how body-extension technology can reshape the boundaries of artistic expression and human-machine interaction.

These objectives serve as the guiding framework for this thesis and delineate the specific aims of the project. Through their pursuit, this research endeavors to create an immersive and transformative experience at the intersection of body, technology, and dance, while also contributing to the broader discourse on the integration of unconventional materials and advanced technologies in the realm of industrial design and interactive artwear.

1.3. METHODOLOGY

1.3.1. Integration within a Structured Course Framework

This design project was carried out within the structured framework of an academic course, where the overarching structure and timeline were provided by the course instructor. The course, titled Physical Interfaces, was designed to foster creativity at the intersection of body, technology, and dance, utilizing code and hardware as creative tools. The course structure provided a clear methodology for the development of this project.

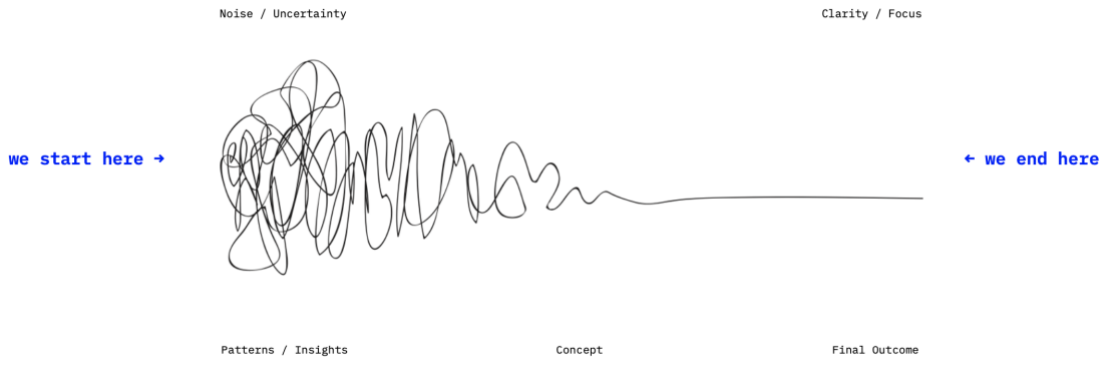

Figure 1.2: Picture provided by the teacher to explain the design process (Muxel, 2023)

1.3.2. Course Structure and Timelines

The project timeline outlines the chronological progression of the 'body / technology / dance' project. It begins with a kick-off phase and is divided into three overarching themes: Body, Technology, and Dance. Each theme consists of several sessions dedicated to exploring specific aspects of the project, from the human body's extension and movement to the technological aspects of sensing and acting. Interim presentations and internal final presentations punctuate the timeline, allowing for feedback and evaluation. The project culminates in a public performance and exhibition, providing an opportunity to showcase the collaborative efforts and creative exploration undertaken throughout the project.

THEME	#	DATE	TOPIC
BODY	1	20.03.23	KICKOFF
	2	27.03.23	HUMANN BODY → EXTENNSION & MOVEMENT
	3	03.04.23	HUMAN BODY → INTERACTION
	4	17.04.23	INTERIM PRESENTATION
TECHNOLOGY	5	24.04.23	TECHNOLOGICAL BODY → SENSING
	6	08.05.23	TECHNOLOGICAL BODY → ACTING
	7	15.05.23	TECHNOLOGICAL BODY → PROTOTYPING
	8	22.05.23	INTERIM PRESENTATION
DANCE	9	05.06.23	PRODUCTION
	12	03.07.23	FINAL PRESENTATION (internal)
	13	28.07.23	PERFORMANCE / EXHIBITION (public)

Table 1.1: Structured of the course given by the teacher (Muxel, Timeline, 2023)

1.3.3. Material

Amount	Item
2	Noodle blue
2	Noodle yellow
3	Noodle black
2	Connector 2 holes
2	Connector 4 holes
2	Connector 6 holes
4	Strap 60cm
2	Strap 120cm

Table 1.2: List of Materials given by the teacher (Muxel, 120359, 2023)

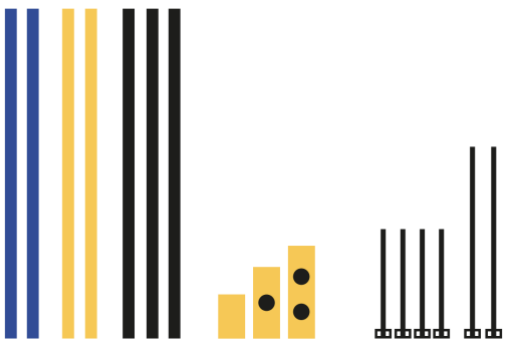

Figure 1.3: Representation of the materials (Muxel, 120359, 2023)

1.3.4. Tools

Throughout the course of our project, we harnessed a diverse set of tools and technologies to bring our creative vision to life. The key tools and technologies at our disposal encompassed:

- Prototyping
- Material Studies
- Lasercutter
- 3D Printer
- Arduino nano
- P5.js
- ml5.js

1.3.5. Software

In the development of our project, we harnessed a range of software tools. It's noteworthy that these software applications were open-source and freely available, aligning with our commitment to accessible and collaborative creativity. These software tools allowed us to explore, innovate, and experiment without financial constraints.

- Arduino IDE 2.0.4, https://www.arduino.cc/en/software
- Processing IDE 4.2, https://processing.org/download
- Helm Synthesizer, https://tytel.org/helm/

2. Research

2.1. MOCOPI & PIXEL

As part of the project within the "Physical Interfaces" course, each student in the class actively participated in the identification, research, and documentation of inspirational examples. This collaborative effort yielded a diverse array of discoveries, reflecting individual perspectives and areas of interest. Students brought their unique insights and analytical skills to the table, enriching the overall breadth and depth of the research.

Furthermore, the collaborative nature of this research effort fostered a dynamic exchange of ideas and encouraged constructive discussions among peers within the "Physical Interfaces" course. Regular group meetings, facilitated by the instructor, provided a platform for sharing findings, debating interpretations, and refining the selection of inspirational examples.

In the context of this thesis, the collective contributions of the students within the "Physical Interfaces" course have been synthesized to present a comprehensive overview of the inspirational examples that informed and influenced the subsequent phases of the research and design process. The collaborative spirit of this endeavour not only enhanced the quality of the research but also underscored the importance of interdisciplinary collaboration in the realm of industrial design, technology, and performance arts.

Within the scope of our research project exploring 'body / technology / dance,' I had the privilege of unearthing two captivating technologies that resonate deeply with our thematic focus. In this contribution, I present these two discoveries, each accompanied by an illustrative YouTube video:

> Hi!
>
> This is what I have found regarding Body/Technology/Dance.
>
> First of all, I would like to talk about Mocopi, a sensor system that allows you to reproduce your movements in real time. What struck me about this technology is the fluidity and naturalness of the avatar's movement. Mocopi may remind you a bit to the pop star Hatsune Miku.
>
> https://as.com/meristation/2022/11/30/betech/1669832980_847860.html

Another technology that has caught my attention is “Pixel”, a hologram that responds in real time to a person's movement. It has been designed by a French dance company.

https://www.wired.com/2014/12/high-tech-dance-performance-melds-human-bodies-code/

March 24th, 2023

3. Design Process

The Design Process, a pivotal phase of our project, was distinguished by its predominantly workshop-driven approach. Throughout the course, workshops emerged as instrumental platforms for the practical application of our research findings and the evolution of our design concepts. These immersive and hands-on sessions, facilitated by our instructor, served as dynamic laboratories where theoretical knowledge seamlessly transitioned into tangible prototypes.

During these workshops, the integration of pool noodles, Arduino technology, and the music synthesizer was meticulously orchestrated. They provided a structured environment where we could experiment with materials, refine sensor systems, and fine-tune the interplay between technology and body movement. Importantly, these workshops fostered an atmosphere of collaboration and innovation, enabling us to leverage collective insights and peer feedback in real-time.

As a result, the collaborative ethos inherent to these workshops became a driving force behind the iterative design process. It enabled us to harness the full creative potential of our interdisciplinary team, reinforcing the belief that the convergence of body, technology, and dance flourishes most profoundly through hands-on exploration and shared experimentation. This chapter unfolds the journey from inspiration to implementation, as catalysed by the workshop-centred design process within the course.

3.1. HUMAN BODY → EXTENSION & MOVEMENT

During the initial workshop the opportunity was given to collaborate in a small group of 2-3 fellow students. The group I was part of was formed by Mamoun Benbrahim, Rokas Judickas, and myself. The shared objective was to transform pool noodles into extensions of our bodies, an effort that required both creativity and experimentation.

In the spirit of innovation, each group was tasked with creating a minimum of three distinct variations, exploring the versatility of pool noodles as a foundational material. This process encouraged us to think beyond conventional applications and push the boundaries of our imagination. Through trial and error, we honed our skills in shaping, adapting, and affixing the noodles to our bodies, seeking to strike a harmonious balance between form and function.

These early collaborative efforts set the stage for our subsequent design explorations. The workshop not only provided hands-on experience but also fostered a sense of teamwork and camaraderie among peers. It was within this dynamic workshop environment that we embarked on our

creative journey, transforming seemingly simple pool noodles into dynamic extensions of the human form.

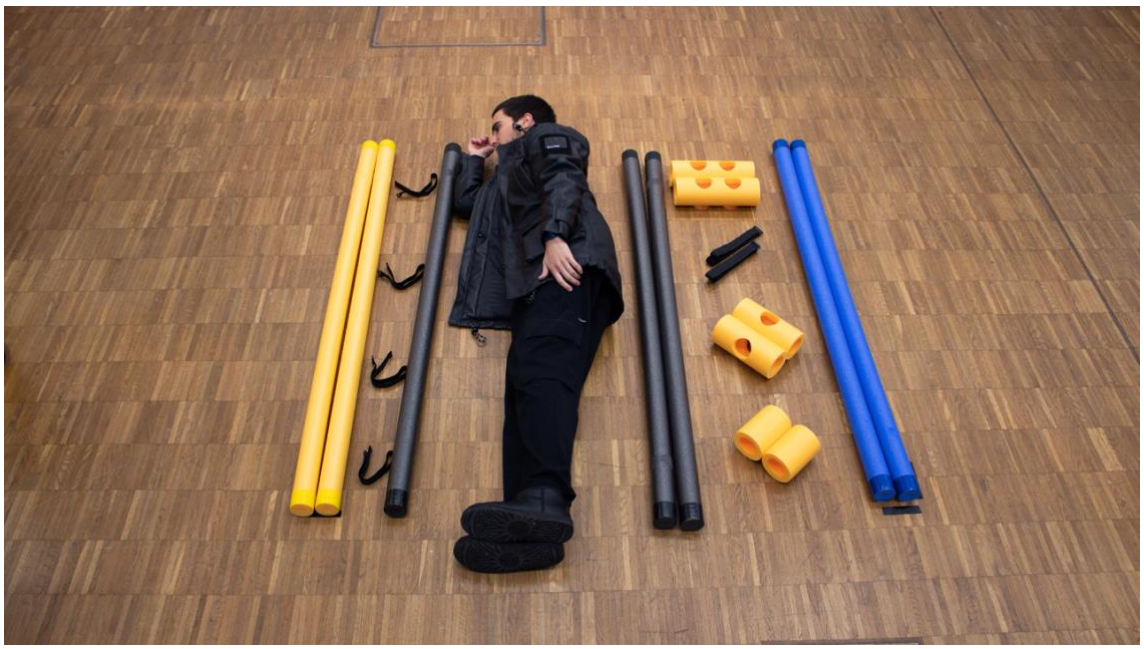

Figure 3.1: Still system with Mamoun Benbrahim

Variation 1:

Figure 3.2: Variation 1, ¾ view

Figure 3.3: Variation 1, front view

Variation 2:

Figure 3.4: Variation 2, ¾ view

Figure 3.5: Variation 2, front view

Variation 3:

Figure 3.6: Variation 3, lateral view

For a more complete visual understanding of the phase, including a wider array of images and videos content, please refer to the Appendices chapter. There you will find an extended collection of visuals that offer a richer context and a more immersive experience of this workshop.

3.2. HUMAN BODY → INTERACTION & PERFORMANCE

In the second workshop, the mission remained aligned with the first: to unleash our creative potential with pool noodles. However, this time, we embarked on a more intricate challenge. The goal was to design extensions using pool noodles that not only transformed our individual bodies but also fostered connections between at least two participants. This collaborative endeavour added a new layer of complexity and artistic exploration to our project.

One notable feature of this workshop was the flexibility in group dynamics. Unlike the first workshop, where we worked in fixed groups of 2-3 students, this time the groups could be more dynamic and varied in size. Anna Zebrowska and Komal Kaur joined the group. This adjustment encouraged us to collaborate with a broader range of peers, enhancing the exchange of ideas and approaches.

As we navigated this workshop, our designs evolved to encompass not only individual expressions but also the dynamics of shared movement and interaction. The workshop provided a dynamic platform for us to explore the potential of pool noodles as connectors, blurring the lines between individual and collective artistic expression. This experience enriched our understanding of the collaborative possibilities inherent in the convergence of body, technology, and design.

Figure 3.7: Variation 1, front view

Figure 3.8: Variation 2, ¾ view

Figure 3.9: Variation 2, front view

Figure 3.10: Variation 3, lateral view

To provide a more comprehensive visual grasp of the second workshop, including a broader spectrum of images and video content, as well as a summary of the two previous workshops in the form of the first interim presentation, please turn to the Appendices chapter. Within that section, you'll discover an expanded compilation of visuals that not only enriches the context but also immerses you more deeply into the experience.

3.3. TECHNICAL BODY → SENSING

During the third workshop, the focus shifted towards exploring the technological dimension of our project, specifically Arduino technology. In this session, we delved into the foundational concepts of Arduino and embarked on an exploration of basic programming principles. From this workshop until the end of the project, the formers of the group and authors of the product presented in this thesis would be Mila Krasteva, Lisa Sophie Schwabe and myself, Cristina Andrés.

This workshop marked a significant step in our project's development as we transitioned from physical experimentation with pool noodles to the realm of electronics and coding. Under the guidance of our instructor, we engaged in hands-on learning about Arduino, gaining a solid understanding of its capabilities and potential applications.

The core of this workshop revolved around learning the basics of programming for Arduino. We familiarized ourselves with coding principles, syntax, and logic, and put this newfound knowledge into practice by creating simple programs that could interact with sensors and actuators. This programming component formed the basis for seamlessly integrating technology with our pool noodle extensions, bridging the gap between the physical and digital aspects of our project.

As we ventured into this technological exploration, our project took on new dimensions. Creativity found expression not only in the physical design of our extensions but also in the intricacies of code and interaction. This workshop was a vital step in equipping us with the technical skills needed to bring our artistic visions to life in the context of 'body / technology / dance.'

In parallel, between the previous workshop and the new one, we continued our experimentation with pool noodles, looking for ways to exploit their potential to the fullest.

- V1: Testing how much the noodles can be bend under pressure. Then adding some extra materials to make it stronger and comparing both outcomes.

Figure 3.11: Noodle not flexed

Figure 3.12: Noodle flexed

- V2: Creating a physical slider with a noodle and a connector.

Figure 3.13: Noodle as a slider

- V3 Simplifying the concept for following and leading. The person who is holding the noodle navigates the one which is inside the circle. The person who is led can feel where the noodle pressure is directing them.

Figure 3.14: Noodle as a holder

- V4 The noodle using as a visualising tool to present the distance between us. When we go too far the connection breaks. When we are very close, we can feel the noodle tension because of the bending.

Figure 3.15: Noodle as a connector of two persons

Results of the experimentation:

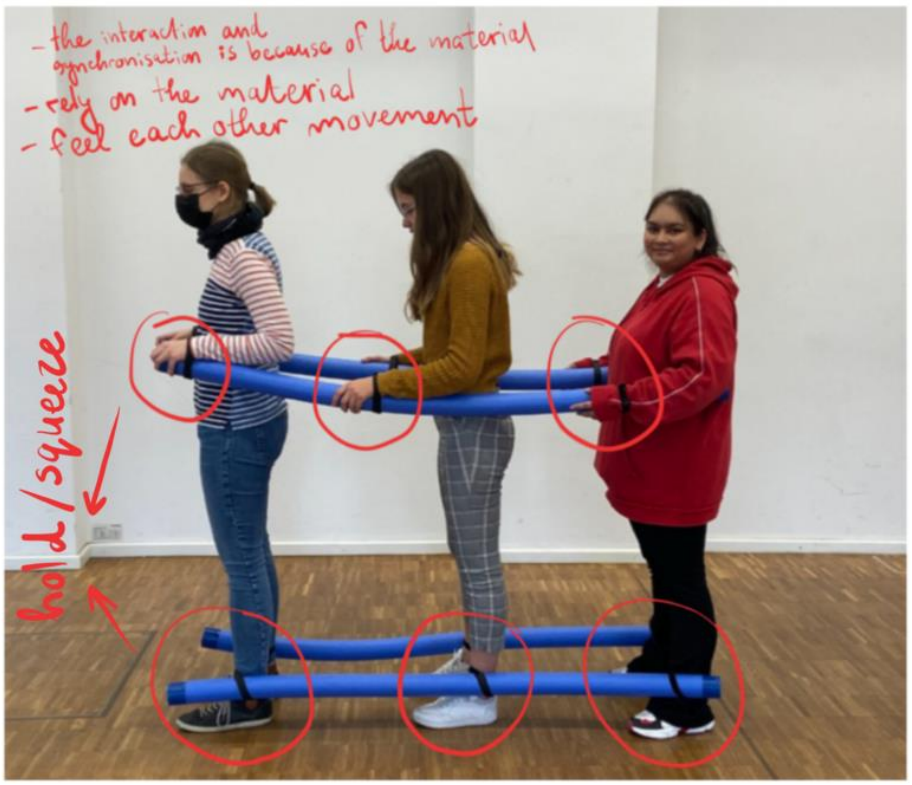

Figure 3.16: Ski Noodles still

Figure 3.17: Ski Noodles in movemennt

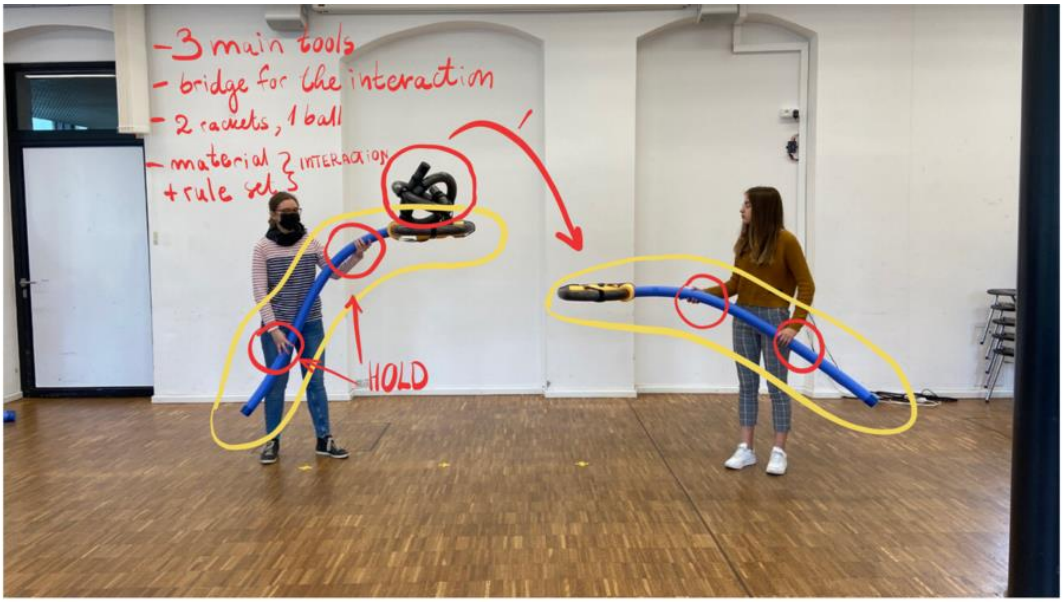

Figure 3.18: Noodles ball game still

Figure 3.19: Noodles ball game in movement

Figure 3.20 Noodles games movement sketch

3.4. TECHNICAL BODY → ACTING

In the subsequent workshop, our focus shifted towards the crucial phase of integrating the technologies carefully explored in the prior session with the pool noodle extensions. This workshop was a significant turning point in the project, where the ideas and technology were brought together into a unified whole.

In a collaborative and hands-on environment, we set out to tackle the complexities of connecting sensors, actuators, and electronic components to our pool noodles. This phase demanded precision and ingenuity as we worked to harmonize the unique attributes of each technology with the tactile and visual aesthetics of our extensions. Additionally, we delved into learning code on Processing to establish a seamless connection between the synthesizer Helm and Arduino, further enriching the interactive aspects of our project.

The workshop provided us with the opportunity to experiment, iterate, and troubleshoot as we navigated the challenges and possibilities of this interdisciplinary fusion. Our journey in this workshop represented the transformation of theoretical knowledge and technical skills into tangible prototypes, bridging the conceptual with the tangible and propelling us closer to the realization of our vision.

Additionally, we took the time to present our initial concept ideas, which had been shaped by the insights gained from the previous two workshops.

Inspiration and Ideas:

a. Musical Instrument + Noodles- sound variation
b. Led Lights, Movement + Noodles- Inspiration:

The Beams London

Varsha Elango Blog

ADD REFERENCES

First Concept Drawings

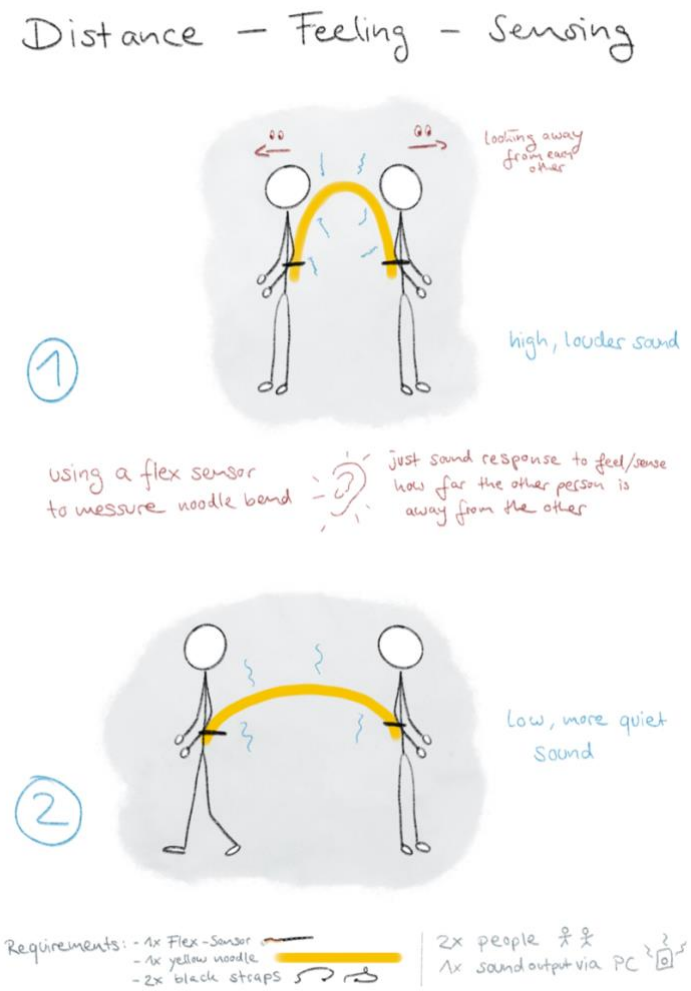

Figure 3.21: Concept 1, First Drawings (by Lisa Sophie Schwabe)

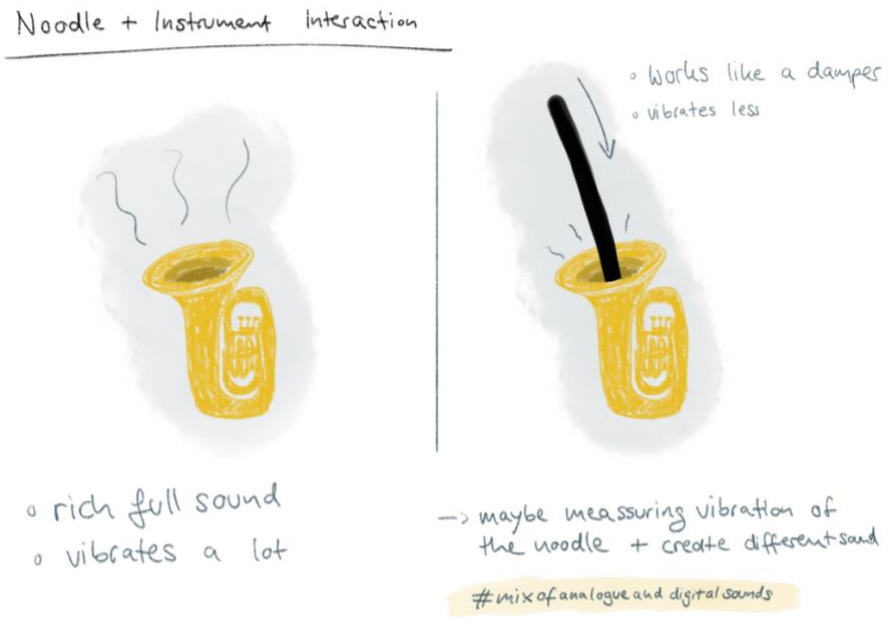

Figure 3.22: Concept 2, First drawings (by Lisa Sophie Schwabe)

3.5. TECHNICAL BODY → PROTOTYPING

In our last workshop, our main task was to define our concept ideas. This workshop served as a bridge, linking the ideation and conceptualization phase with the imminent stage of prototype development.

With all the research and creativity, we've accumulated in earlier workshops, it was time to turn our imaginative ideas into well-structured concepts. We carefully examined each concept, considering what we wanted to achieve artistically and technically.

Building upon our prior work and with guidance from our instructor and input from our discussions, we transformed abstract thoughts into clear and detailed concepts. These concepts became the foundation for our upcoming prototype designs, outlining the artistic, technical, and interactive elements of our artwear.

In this final workshop, we moved from ideas to plans, marking a significant moment in our project's journey. Defining our concepts laid the groundwork for turning our artistic visions into tangible creations. With our concepts in place, we were ready to dive into the next phase: actually, building the interactive performance artwear that would bring our ideas to life.

In addition, we took the time to present the development of the concept ideas, which we continued to build on throughout the week.

Concept 1: Martial Noodle

First Concept Idea

Figure 3.23: Concept 1, Evolution (by Lisa Sophie Schwabe)

Final Concept

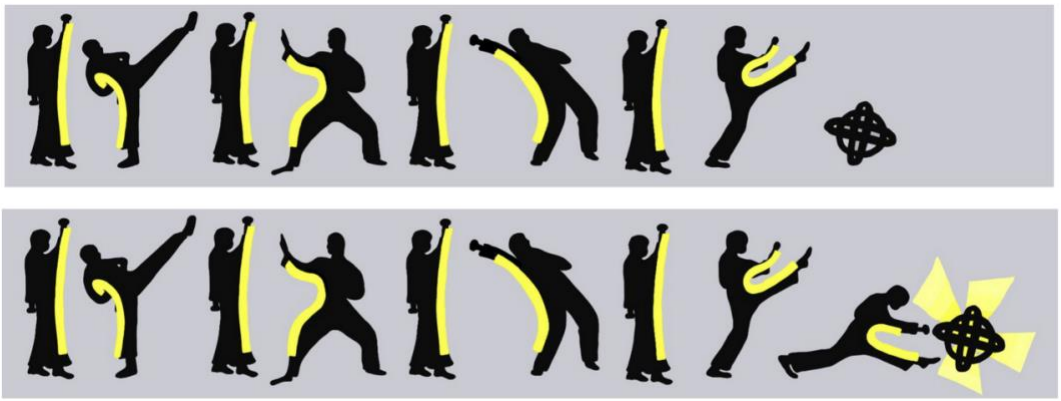

Figure 3.24: Concept 1, Final Drawings (by Mila Krasteva)

Figure 3.25: Concept 1, First prototype (picture by Cristina Andrés of Mila Krasteva)

Here is the link to the videos.

Concept 2: Ball Game Upgrade

First Concept Idea

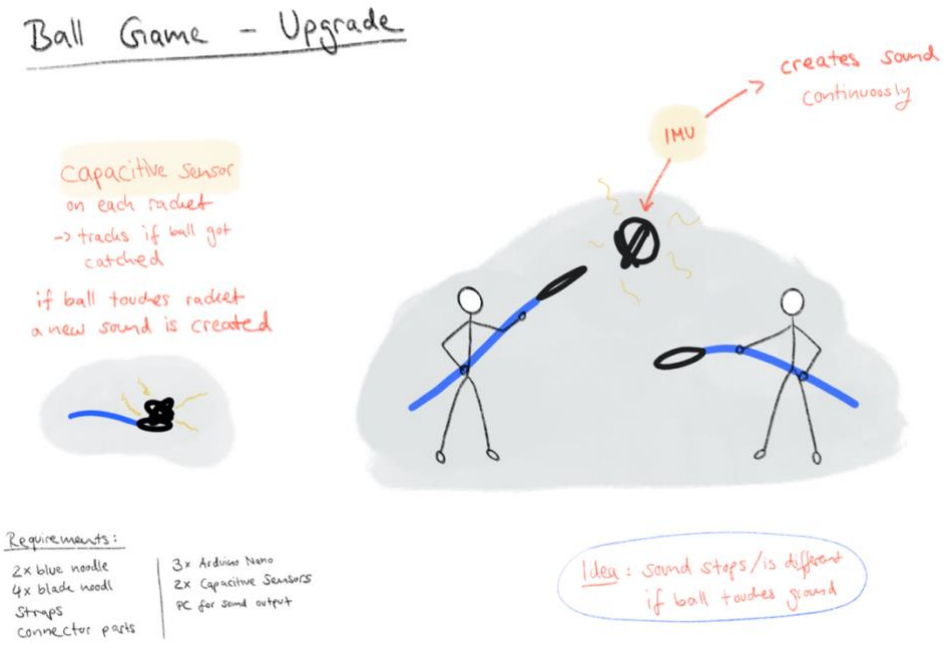

Figure 3.26: Concept 2, Evolution (by Lisa Sophie Schwabe)

Final Concept

Figure 3.27: Concept 2, Final Drawings (by Lisa Sophie Schwabe)

3.6. PRODUCTION

The final phase of our project, production, stood as the lengthiest endeavour, spanning a period of four weeks. At its culmination, our primary objective was to bring our envisioned product to fruition. This product took the form of a specially shaped noodle designed to seamlessly extend the human body. Crucially, it featured an integrated Arduino component, and its connection to the Helm synthesizer was a pivotal aspect of the creative process.

Shaping the noodle to extend from the human body required meticulous craftsmanship to ensure its ergonomic alignment and visual appeal. However, the true complexity lay in seamlessly embedding Arduino technology within the slender confines of the noodle. This effort demanded a meticulous approach as we grappled with the physical limitations of the noodle, ensuring that the technology remained unobtrusive while retaining full functionality.

The goal was to create an interactive artwear piece that could harmoniously interact with the Helm synthesizer, merging the physicality of the body with the dynamics of sound and technology. As we embarked on this ambitious endeavour, the production phase stood as a testament to our collective spirit and unwavering commitment, ultimately resulting in the fulfilment of our artistic vision for 'body / technology / dance' artwear.

4. Product Description: Martial Noodle

Figure 4.1: Demonstrative image

4.1. INTRODUCTION

In the culmination of our 'body / technology / dance' project, we proudly present Martial Noodle, a ground-breaking innovation at the intersection of martial arts, technology, and artistic expression. Martial Noodle is more than a mere accessory; it is a unique sonic experience designed to reshape the boundaries of physical and sensory engagement within the context of martial arts.

4.2. SONIC CREATIVITY: PENTATONIC SCALE AND ASIAN FLAIR

At its core, Martial Noodle is an instrument of sonic creativity. It utilizes a carefully crafted pentatonic scale, encompassing a range of pitches, to evoke an unmistakable Asian flair. This deliberate choice of scale not only enhances the auditory experience but also adds a layer of cultural richness to the art of martial performance.

4.3. INTERACTIVE SOUND GENERATION

Martial Noodle is designed to empower every participant in the martial arts experience. It transcends the traditional confines of passive observation and introduces an interactive dimension. Through their movements and interactions with fellow participants, individuals have the opportunity to create sounds that resonate with their actions. This interactivity transforms martial arts practice from a silent physical discipline into a dynamic symphony of movement and sound.

The Arduino code, skillfully crafted and programmed, communicates with Processing, a dynamic software platform. This connection allows Martial Noodle to give precise commands to Helm, the synthesizer responsible for generating the intricate soundscape.

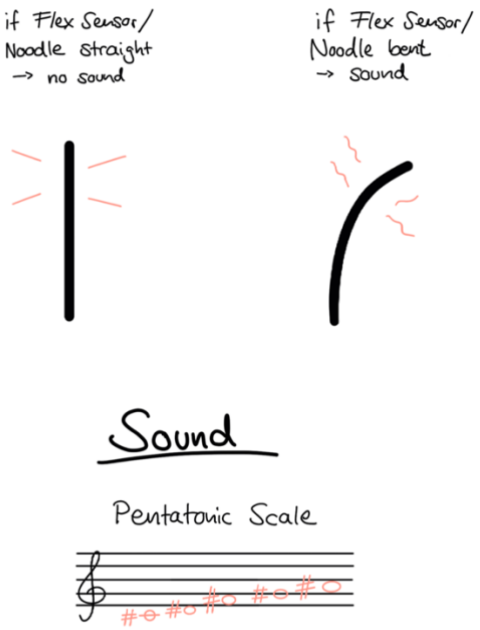

Figure 4.2: Sound Concept (by Lisa Sophie Schwabe)

4.4. HARDWARE COMPONENTS

To bring Martial Noodle to life as a dynamic and interactive artwear piece, several key hardware components were meticulously selected and integrated into its design. These components not only underpin the technological sophistication of the product but also play a pivotal role in realizing the sonic and interactive elements of the experience. The hardware components include:

- **2x Noodles (1x Yellow, 1x Black):** The core physical elements of Martial Noodle, these specially shaped noodles serve as extensions of the body. Each noodle is meticulously designed for ergonomic comfort and artistic expression.
- **1x Two-Hole Connector + 2cm Thick Noodle Cover:** This component serves a dual purpose. It facilitates the attachment of noodles to participants, ensuring stability during martial arts movements. Additionally, the 2cm thick noodle cover conceals and secures essential hardware components within.
- **2x Arduino Nano:** These compact and versatile microcontrollers are at the heart of Martial Noodle's interactivity. They process data from sensors and act as the bridge between physical movements and sonic responses.
- **2x Flex-Sensor:** Integrated into the noodles, these sensors detect and transmit data about the extent of bending and movement, translating martial arts gestures into sound variations.
- **1x Wi-Fi Router (TP-Link):** The Wi-Fi router establishes a seamless connection between the Arduinos within the noodles and the Helm synthesizer, facilitating real-time sound generation and interaction.
- **Yellow + Black Tape:** These tapes serve both aesthetic and functional purposes. They not only provide color coordination with the noodles but also ensure the secure placement of hardware components, maintaining the integrity of the artwear during martial arts performances.

Each of these hardware components plays a critical role in the overall functionality and artistic impact of Martial Noodle. Together, they enable participants to embark on a unique sonic journey within the realm of martial arts, where the body's movements become a canvas for creative expression and sensory exploration.

4.5. ENHANCED BODY AWARENESS AND CONTROL

One of the most striking outcomes of Martial Noodle is its profound impact on body awareness and control. By actively engaging with the noodle's sonic capabilities, participants become acutely attuned to the nuances of their movements and posture. This heightened awareness fundamentally alters their perception of martial arts, offering a more immersive and enriching experience.

4.6. CONCLUSION

Martial Noodle stands as a testament to our project's fusion of body, technology, and artistry. It represents an innovative stride in the realm of martial arts, offering practitioners and enthusiasts a transformative journey into the world of sound and movement. In its essence, Martial Noodle is more than a product; it is a catalyst for reimagining the possibilities of 'body / technology / dance' in the context of martial arts, blurring the lines between tradition and innovation.

5. Discussion

In this pivotal chapter, we engage in a comprehensive discussion that encapsulates the essence of our 'body / technology / dance' project. Through a reflective lens, we examine the key findings, contributions, as well as the challenges and limitations encountered throughout our creative journey.

5.1. FINDINGS AND CONTRIBUTIONS

In this section, we synthesize and present the core findings that have emerged from our project:

Innovative Artistic Synthesis: Our project stands as an innovative synthesis of industrial design, technology, and performance art. We explore the intersection of these disciplines, weaving them together into a cohesive narrative that challenges traditional boundaries and opens new avenues for creative expression.

Enhanced Human-Technology Interaction: Through the integration of Arduino technology, Processing, and Helm, we have successfully enhanced the interaction between the human body and technology. Our work showcases the potential of wearable technology to augment and elevate the human experience, particularly in the context of movement and dance.

Sonic Embodiment: 'Martial Noodle' introduces a novel approach to sound generation through physical movement. This sonic embodiment invites users to engage with their bodies in a profound and sensorial way, fostering a deeper connection between body and sound.

5.2. CHALLENGES AND LIMITATIONS

In this section, we candidly address the challenges and limitations that we encountered during the design and prototyping process:

Technical Complexity: The integration of various technologies, including Arduino, Processing, and Helm, presented technical complexities that required meticulous problem-solving. As students venturing into new coding languages and software, we faced a steep learning curve. The unfamiliarity with coding languages posed a substantial challenge, demanding dedicated time and effort to gain proficiency. Additionally, working with unconventional materials, such as pool noodles, introduced an element of unpredictability and required creative problem-solving.

Resource Constraints: As a student-led project, we faced resource constraints, particularly in terms of budget and access to advanced

equipment. These constraints, however, fuelled our creativity, leading us to explore open-source and freely available software solutions. Despite the limitations, this constraint-driven approach encouraged innovation and resourcefulness in our project development.

Learning Curve: The learning curve associated with mastering new technologies and software was steep at times. Balancing the acquisition of technical skills with the creative aspects of our project demanded dedication and persistence. This limitation underscored the importance of continuous learning and adaptability in a dynamic, interdisciplinary project.

By candidly addressing these challenges and limitations, we provide a comprehensive view of our project's development journey, showcasing not only our achievements but also the valuable lessons learned throughout the process.

6. Conclusion

6.1. SUMMARY OF THE THESIS

In this concluding chapter, we distil the essence of our 'body / technology / dance' project, encapsulating the profound journey of exploration, creativity, and innovation. Our thesis has been a culmination of dedicated efforts and interdisciplinary collaboration that has brought together industrial design, technology, and performance art in a unique fusion.

Summary of Key Points:

- **Research Question and Objectives:** Our central research question delved into the possibilities of augmenting the human body through technology, within the context of movement and dance. We embarked on a creative quest to explore the interplay between the human body, technology, and sonic expression.
- **Findings and Contributions:** Our work has contributed to the convergence of industrial design, technology, and performance art. We successfully harnessed Arduino, Processing, and Helm to create 'Martial Noodle,' an interactive artwear that enriches human-technology interaction through sound and movement.
- **Challenges and Limitations:** We candidly acknowledged the technical complexities, resource constraints, and steep learning curves faced during our journey. These challenges shaped our resilience and resourcefulness, driving us to seek innovative solutions.

6.2. FUTURE DIRECTIONS

As we conclude this phase of our project, we look ahead to potential future research avenues and enhancements for our interactive performance artwear:

Exploring Advanced Technologies: The rapid evolution of technology opens doors to explore more advanced components and platforms. Future research could delve into the integration of cutting-edge technologies to further enrich the sensory experience of 'Martial Noodle.'

Enhancing User Interactivity: We envision the incorporation of machine learning and AI algorithms to enhance user interactivity and responsiveness. This could elevate the artwear's ability to adapt to individual movements and preferences.

Collaborative Performances: The potential for collaborative performances involving multiple 'Martial Noodle' users offers exciting possibilities. Research into group dynamics, choreography, and synchronization could open new horizons for collective artistic expressions.

Accessibility and Education: To promote accessibility and educational outreach, future work may involve creating simplified versions of the technology for educational purposes, allowing students and enthusiasts to engage with the concepts explored in our project.

In concluding our thesis, 'body / technology / dance' is not merely a project but a testament to the endless possibilities of interdisciplinary exploration. We hope that our journey inspires future creators and researchers to push the boundaries of what is possible in the realms of art, technology, and embodied expression.

7. References

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8. List of Tables

9. List of Figures

10. Appendices

Material given by the teacher:

Black Flags (William Forsythe)

Inferno (Louis-Philippe Demers & Bill Vorn)

Body, Movement, Language: AI Sketches (Bill T. Jones)

Doing nothing with AI 2.0 (Emanuel Gollob)

Stäbetanz (Oskar Schlemmer)

noBody (Sasha Waltz)

Workshop 1 videos:

Link to cloudnext for the videos: https://cloud.hs-augsburg.de/s/cdoLoMAdskYBQ3Z

Workshop 2 videos:

Link to cloudnext for the videos: https://cloud.hs-augsburg.de/s/PNHYXN9Q99YeP7Y

Interim Presentation 1:

Presentation link: https://www.canva.com/design/DAFf-VrXQHM/APIJK63ch8BT36MVD2HS-A/view?utm_content=DAFf-VrXQHM&utm_campaign=designshare&utm_medium=link&utm_source=publishsharelink

Interim Presentation 2:

Link to the presentation

Final Presentation:

https://tha.incom.org/action/open-file/130137