'She is not alone!' Afrofuturist Wearable Devices for Speculative PTSD Treatment in Kenya

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ABSTRACT

This research explores speculative wearable technology to reimagine Post-Traumatic Stress Disorder (PTSD) treatment for female-identifying domestic abuse survivors in Kenya. The speculative wearable devices are envisioned to aid in continuous monitoring of PTSD associated with domestic abuse as well as aid in self-directed PTSD treatment. The development of the wearable devices employs mixed methodologies that combines Health Design Thinking, Design for Wearability, Speculative Design, and Modular Design to imagine the form, functions, wearability, and design of the wearable prototypes. Drawing design inspiration from Kenyan culture situated within Afrofuturism and Africanfuturism frameworks, aims to convey symbolism of empowerment for female-identifying domestic abuse survivors and in a much larger context highlight the importance of raising awareness of domestic abuse in Kenya.

Keywords: Wearable Technology, Domestic Abuse, Post-traumatic stress disorder (PTSD), Gender-Based Violence (GBV), Afrofuturism, Kenyan Culture, Speculative Design

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GLOSSARY

BLAST (Bi-lateral alternating stimulation-tactile technique) – is a type of trauma treatment that involves a unique procedure in which a therapist exposes the patient to bilateral stimulation of both the right and left hemispheres of the brain.

BLE (Bluetooth Low Energy) – is a wireless personal area network technology ("Bluetooth Low Energy (BLE)")

BPM – (Beats Per Minute) – pulse is measured by counting the number of times your heart beats in one minute. ("New questions in Science - Brainly")

CAD (Computer Aided Design) – is the two-dimensional or three-dimensional modelling of physical structures and material properties, using specialized software on a computer. ("CAD - Computer Hope")

CBT (Cognitive Behavioural Therapy) – is a practical, short-term form of psychotherapy.

ECG (Electrocardiogram) – records the electrical signals in the heart.

EMDR (Eye Movement Desensitization and Reprocessing) – is a trauma psychotherapy that encourages the patient to briefly focus on the trauma memory while simultaneously experiencing bilateral stimulation (typically eye movements), which is associated with a reduction in the vividness and emotion associated with the trauma memories.

FGM (Female Genital Mutilation) – is a procedure where the female genitals are deliberately cut, injured, or changed, but there's no medical reason for this to be done.

GBV (Gender Based Violence) – is violence directed against a person because of that person's gender or violence that affects persons of a particular gender disproportionately.

HRV (Heart Rate Variability) – is simply a measure of the variation in time between each heartbeat. ("Six Mindfulness Tips for Working From Home - Total Brain")

IBI (Interbeat Interval) – is the time interval between individual heart beats.

PRV (Pulse Rate Variability) – refers to the changes in pulse rate over time, when measured from pulse waveforms. ("Measurement of heart rate variability: A clinical tool or ...")

PTSD (Post Traumatic Stress Disorder) – is an anxiety disorder caused by very stressful, frightening, or distressing events.

1. INTRODUCTION

1.1 ABOUT THE RESEARCH

As an African who grew up in Kenya mental health was not something that was openly or freely discussed, and it is common to hear people say that mental health is not an "African Problem" (Gberie 2016) which is not the case. This, perception led me to start questioning and further explore why this bias exists in the first place. Upon embarking on the research, I set out to figure out how to change the mental health narrative in Kenya. However, that led me down a rabbit hole as it is an enormous undertaking to tackle alone. Despite this realisation, I was still curious to find out more, and the COVID-19 pandemic acted as a jumping-off point.

Over the course of the COVID-19 pandemic, people have started to be vocal about mental health including world famous athletes Naomi Osaka and Simone Biles, who both took time off major sporting events to focus on their mental wellbeing (Blackistone 2021). On account of this our mental health is just as important as our physical health (Mental Health Foundation 2015). Therefore, the same amount of effort we put into trying to live a healthy lifestyle should also be emulated when it comes to our mental wellbeing. Oftentimes the conversation around mental health tends to be a sensitive topic to discuss, because speaking about our feelings can be daunting. What is more difficult is finding outlets to express ourselves without fear or vulnerability. However, technology can in one way help break the barriers of the fear and vulnerability by offering us the opportunity to join supportive online forums for emotional and mental health issues (Prescott, Hanley, and Ujhelyi 2017). Although these forums exist, they have both benefits and risks and should not be used to avoid seeking professional help.

Over the past two decades, our mobile phones have become an essential part of our daily life. They break the barriers of distance so we can stay connected worldwide. One commonality we share as human beings is our lived experience. We all go out into the world and learn, make mistakes, try new things just to mention a few and in times of difficulty and hardship, most of us find it hard to express our pain and suffering. Hence, upon embarking on this thesis

project I asked myself this question: Is it possible for someone to use wearable technology to embody healing from past trauma?

When the COVID-19 pandemic hit the world, we all had the same narrative across continents to stay safe and stop the spread. Something we learned the hard way from the pandemic is that human connection is an important part of maintaining our mental well-being, (Selina 2020) and none of us was prepared for the social isolation brought about by lockdown and the stay-at-home order imposed worldwide. Through this isolation, the term "*shadow pandemic*" was coined by Phumzile Mlambo-Ngcuka, the Executive Director of United Nations Women (2021a) which is described as violence against female identifying individuals during the COVID 19 crisis (UN Women 2021b). In other words, since the beginning of the COVID-19 pandemic, there has been a rise in cases of domestic violence across the globe and Kenya was no exception, with 1 in 5 women reporting feeling unsafe in their household (2021a).

According to the United Nations "domestic abuse, also called 'domestic violence' or 'intimate partner violence', can be defined as a pattern of behaviour in any relationship that is used to gain or maintain power and control over an intimate partner" (n.d.). Domestic abuse can take on different forms including but not limited to the following: "coercive control (a pattern of intimidation, degradation, isolation and control with the use or threat of physical or sexual violence) psychological and/or emotional abuse, physical or sexual abuse, financial or economic abuse, harassment, and stalking online or digital abuse" (Women Aid n.d.). Domestic abuse can take a toll on people who experience or witness the abuse. Survivors tend to face ongoing and challenging effects after enduring physical, mental, or emotional abuse. The effects can be short term, long term and in severe cases death depending on the type of abuse. "It can take time for a survivor to acclimatise back into society and adjust to living in a safe environment, especially if a perpetrator committed the actions over an extended period" (Joyful Heart Foundation n.d.).

Domestic violence across Sub-Saharan Africa is considered one of the highest worldwide (Otolo 2020). In Kenya, more than 47% of female-identifying individuals have experienced either physical or sexual violence which has resulted in lasting physical, emotional, and mental

trauma for the victims and their children who also witness the violence (Mutahi 2013). This high rate of domestic violence highlights the gaps in violence prevention, response, and access to health care services after the fact. Over the years cultural ideologies have provided the opportunity to justify the violence in certain circumstances (wa Teresia 2021), the abuse also extends to "harmful cultural practices such as forced or early marriages, denial of certain foods for cultural reasons, and female genital mutilation (FGM)" (Kaluyu 2007).

Due to the perception, stigma, and fear surrounding domestic abuse in Kenya cases are not widely reported which also leads to difficulty in efforts to try and mitigate the problem (Otolo 2020). With the increase in cases of the shadow pandemic, conversations around domestic abuse are now beginning to gain recognition in the country, and the government has seen the need for evidence-based interventions that work towards ending domestic abuse. As such the Government of Kenya in mid-2021 made a valiant decision to end Gender-Based Violence (GBV) including sexual violence by 2026 (Equality Now 2021). In October 2021 a tragic incident happened that involved the death of the two-time world championships bronze medallist and Olympian Agnes Tirop, and it was believed that her husband was responsible. The case drew attention to violence against female-identifying individuals in the country, and Kenyan runners brought an international spotlight to the issue with tributes to the promising runner during the 2021 New York City Marathon (Boren 2021).

As the conversations around domestic abuse are now beginning to gain recognition in the country there is a need for interventions that work towards realising the government's five-year action plan of ending GBV. One of the commitments made by the Kenyan Government in this regard is "integrating GBV services such as medical, legal, and psychological support services into the essential minimum package of the Universal Health Coverage (UHC) by 2022" (Equality Now 2021). Aforementioned GBV can take a toll on a survivor's mental well-being and the most prevalent psychological effects experienced by survivors "include depression, alcohol or substance abuse, anxiety, personality disorders, post-traumatic stress disorder (PTSD), sleeping and eating disorders, social dysfunction, and suicide" (Alejo 2014). Therefore, aside from preventing domestic abuse, there is also a need for long term aftercare to help survivors cope with the psychological effects. Hence, the government's action plan also

includes an annual GBV research, and innovation fund to boost evidence-based programming by 2026 (Equality Now 2021).

1.2 MOTIVATION

Over the course of the COVID-19 pandemic watching the news had been especially difficult. With the daily tally of COVID cases and deaths projected on the screen, and all the unknowns about this new disease it had been a tough time not just for me but everyone around the world. Aside from global news about the pandemic there had also been several stories about domestic abuse in the Kenyan news. The stories highlighted were not just about GBV but also included child and elder abuse. At the time of watching these news stories back home in Kenya, I did not realise the impact it had on me or that it would lead me to my thesis project. Domestic abuse in Kenya had been happening long before COVID-19 but the pandemic exacerbated the cases. According to a survey by Kenya's Department of Gender "more than 5,000 cases were reported between 2020 and 2021, nearly five times the number of reported cases in 2019" (Amunga 2021). Now more than ever there is a growing concern about the magnitude of GBV in Kenya.

With the growth of awareness on GBV in Kenya, I had this innate urge to be part of the conversation and gain further understanding on domestic abuse and its effects. My specific interest was geared towards the psychological effects associated with domestic abuse and investigating what interventions exist. My research led me to PTSD which is prevalent in domestic abuse survivors (American Psychiatric Association 2013). PTSD is a "psychiatric disorder that may occur in people who have experienced or witnessed a traumatic event." (American Psychiatric Association n.d.) According to the American Psychiatric Association, PTSD "is more prevalent among females than males with increased risk attributable to a greater likelihood of exposure to traumatic events, such as rape, and other forms of interpersonal violence" (2013). PTSD symptoms include intrusive thoughts and re-experiencing of the traumatic event, negative alterations in cognition and mood, persistent arousal and reactivity associated with the traumatic event, and avoidance of stimuli associated with the traumatic event (2013).

PTSD is a relatively recent diagnostic construct and is considered to be different from other psychiatric disorders in that, diagnosis requires that symptoms are caused by an external traumatic event (Jenkins et al. 2015). While effective interventions to treat PTSD like psychotherapy and medication are available, these interventions typically require expert mental health professionals providing treatments that are usually lengthy and costly to the health service (Sijbrandij et al. 2016). Hence my research investigates wearable technology as a complementary or additional Speculative PTSD Treatment. With my background in Industrial Design and my interest in Afrofuturism, I was drawn to the idea of designing an Afrofuturist wearable device to aid in speculative self-directed PTSD treatment. With the understanding that domestic abuse is both a sensitive and important topic it was crucial for me to highlight both facts within my research. Hence the objectives of this thesis are:

- To explore wearable technology as a complementary or additional PTSD intervention for female-identifying domestic abuse survivors in Kenya
- To leverage Afrofuturism as a design lens to empower domestic abuse survivors in Kenya
- To design a wearable device rooted in Kenyan culture to raise awareness of domestic abuse in Kenya

1.3 SCOPE AND LIMITATIONS

With the several facets weaved into domestic abuse, it was important to prioritise the research within the scope of a one-year graduate thesis. Therefore, this project is concerned with the exploration of speculative wearable technology as a complementary or additional speculative treatment for PTSD associated with GBV in Kenya. The aim is not to design a new medical device but explore wearable technology as a possible tool for speculative self-directed PTSD treatment. The wearables are specifically for Kenyan female-identifying domestic abuse survivors hence the design aesthetic is based on Kenyan cultural adornments that borrows inspiration from Africanfuturism and Afrofuturism.

While I will not be engaging with the intended users for the wearable devices who are female-identifying domestic abuse survivors, the project recognises privacy and data collection pose certain concerns when it comes to wearable technology. However, due to time limitations

this concern will not be addressed within this research as it is beyond the scope of my expertise. The Speculative Afrofuturist Wearable Devices are intended to be networked prototypes that communicate with each other. Networking will not be explored in the prototyping process at this stage of the project however, it will be highlighted as proof of concept. The nature of this research requires expert advice from mental health care practitioners in the field to offer insights on functionality and feasibility of the speculative wearable devices. However, I will not be user testing the wearable devices due to the COVID-19 pandemic that has been a limitation of access to health care professionals. Therefore, at this stage of the project I will be testing the devices on myself and offering my own insights and reflections.

1.4 OVERVIEW OF THE PROJECT

The first chapter of this document introduces what is encompassed in the research, the objectives of the project and the scope and limitations. The second chapter features the literature and contextual review which starts off by detailing the areas of wearable technology situated within this research. It then introduces the histories and aesthetics of Afrofuturism and Africanfuturism. The chapter ends by tying together wearable technology, Africanfuturism and Afrofuturism situated within a Kenyan context. Chapter three provides insights into the research methodologies that shape the thesis project. Chapter four presents the Afrofuturist wearable prototypes made for the project which are divided into two categories one being functionality of the wearable devices and the other being the envisioned design of the speculative device. Chapter five, I reflect on the making process, the discoveries made, and the outcomes of the thesis project, what the research accomplished and future work.

2. LITERATURE AND CONTEXTUAL REVIEW

"The wheel is an extension of the foot, the book is an extension of the eyes, clothing an extension of skin, electric circuitry an extension of the central nervous system."

(McLuhan 1967, 40)

2.1 WEARABLE TECHNOLOGY EXPLORATION

Over the years technology has become like our second skin. We have this strong attachment to our devices to such an extent, that we sometimes feel empty when we do not have our phones with us. According to Eysenbach (2019) when it comes to wearable technology it is considered as a category of objects, which, "due to its intrinsic properties such as closeness to the body, frequent interaction, and access to personal information it is likely to be embodied." He argues that "when we experience external objects like wearable technology in such a way that it is perceived as an integral part of someone's body it is called embodiment"(2019). This section provides insight into the relationship between wearable technology and the human body to try and understand the possibility of embodied healing from trauma.

2.1.1 WEARABLES ECOSYSTEM IN BIOMEDICINE

Wearable devices or wearables such as smartwatches have been widely embraced (Mining Technology 2021) and offer us the opportunity to track and monitor our own health and changes in our bodies. As wearable technology continually revolutionises the field of biomedicine through mobile and digital health it enables continuous, longitudinal health monitoring outside of the clinic (Dunn, Runge, and Snyder 2018). The kind of data we can access from wearable sensors empowers us to take control and be stewards of managing our own health. Since the beginning of the COVID-19 pandemic it has been increasingly difficult to access healthcare services, which has led to the need for remote monitoring for both physical and psychological health (Channa et al. 2021). Wearable technology can act to facilitate remote monitoring as it uses algorithm development for automated health event prediction, prevention, and intervention (Dunn, Runge, and Snyder 2018).

Mental health falls under a broad spectrum and affects everyone differently (Enhancing Student Wellbeing 2016). PTSD is a trauma and stressor-related disorder (Zoellner, Rothbaum, and Feeny 2011), and it is most linked to people who have experienced a traumatic event (National Institute of Mental Health 2019). However, it is important to note that not everyone who experiences trauma develops PTSD, and not everyone who develops PTSD requires psychiatric treatment (National Institute of Mental Health 2019). In Kenya there is evidence of the prevalence of PTSD associated with domestic abuse (Hossain et al. 2021), and since several cases of GBV go unreported psychiatric disorders like PTSD go undiagnosed. Although for some people PTSD symptoms can subside overtime, many others need professional treatment to recover from psychological distress that can be intense and disabling (WebMD 2022). Talk therapy also known as psychotherapy and medication provide effective evidence-based treatments for PTSD. Some of the effective types of PTSD psychotherapy include Cognitive Processing Therapy (CPT), Eye Movement Desensitisation and Reprocessing (EMDR), Prolonged Exposure Therapy, Stress Inoculation Therapy and Group Therapy (WebMD 2022).

Regarding wearable technology there is still a lot to learn especially in the field of healthcare as it gradually becomes accessible to everyone. Shifting to our mobile devices, they have become a part of who we are and evolved into an integral part of smart healthcare solutions becoming an interface that actively gathers self-reported data from individuals (Dey et al. 2020). As humans we are always working towards improving our way of life, dedicating hours into research for the next frontier and leveraging technology to extend our reach. What wearable technology then offers us is a glimpse into the inner workings and further understanding of how the human body functions. We have become accustomed to consumer wearable devices that focus on fitness and daily health monitoring (Tong 2018). However, the development of healthcare and mental health specific wearables (Tong 2018) is just as important as we have seen such technologies start to surface in the market.

Pertaining to mental health because it is something that happens from within the body and cannot be seen, it can be difficult to ascertain an objective measurement for diagnosis or

treatment (Psychology Today 2020). It is often detected by behavioural aspects that a person demonstrates (Psychology Today 2020) and perhaps developing more wearable devices geared towards understanding mental health can help us learn about its complexities. However, our smartphones offer us an objective and ecological source of measurement. It is known as *digital phenotyping* and refers to "the moment-by-moment quantification of the individual-level human phenotype, in situ, using data collected from personal digital devices" (Boston 2014). "Digital phenotyping is based on sensors (activity and location), voice and speech (sentiment and prosody), and perhaps most important, human-computer interaction" (Insel 2018).

PTSD is correlated with several physiological measures including heart rate variability (HRV), blood pressure, respiratory rate, skin conductance, and heart rate (Sadeghi et al. 2022). As one of the wearable devices is intended to measure HRV as a biomarker for continuous PTSD monitoring there is a need for exploration into non-invasive biosensors. Mejía-Mejía et al. (2020) describe HRV as a "non-invasive technique for monitoring changes in the cardiac cycle." Typically, HRV information is usually measured from the electrocardiographic signal (ECG). However, ECG is not easily available in personal health applications. "In the past few years, several studies have reported the use of physiological signals other than the ECG to extract HRV information"(Mejía-Mejía et al. 2020). According to Yuda et al. "with the popularisation of pulse wave signals by the spread of smartwatches incorporating photoplethysmography (PPG) sensors"(2020), "the term Pulse Rate Variability (PRV) has been used to refer to HRV information obtained from pulse wave signals, such as PPG"(Mejía-Mejía et al. 2020).

Although PPG sensors are more easily accessible, they also have some disadvantages. There have been debates as to whether consumer wearables, which mostly incorporate PPG biosensors to measure heart rate, give accurate readings for skin of colour. In 2015 the 'tattoogate' controversy emerged in which Apple Watch users at the time-shared posts about the PPG sensors not working accurately, for people who had wrist tattoos (Kim 2017). In a study that was done in 2020 at Duke University in the USA, some of the popular consumer smartwatches were investigated for inaccuracy of optical heart rate sensors on different skin

tones. The heart rate accuracy varied from each of the devices with no change in accuracy on different skin tones, but the average accuracy dropped significantly when a participant was active (Bent et al. 2020). Although there is still no concrete evidence to the issue of PPG sensors not working accurately on skin of colour, studies and conversations surrounding the topic are still underway and well worth it in designing devices that are more inclusive.

PTSD psychotherapy sessions happen in 12 - 16 weekly sessions over 3 - 4 months depending on the type of treatment and severity of symptoms (American Psychiatric Association n.d.) It tends to be difficult to objectively measure for mental health as physicians rely on patients' self-assessment to track progress. Thus, exploring the use of wearable technology in PTSD treatment could potentially offer a more objective measure. Even though the prevalence of GBV in Sub-Saharan Africa is high, few health care facilities offer mental health services and little data exists on scalable treatment models for survivors affected by GBV in the region (Meffert et al. n.d.). For something like PTSD, it is helpful for both the patient and physician to keep track of symptoms and progress over an extended period. By way of digital phenotyping, we are presented with the possibility of continuously self-tracking our mental well-being rather than a single assessment of one point in time.

2.1.2 PTSD WEARABLE AND MOBILE TECHNOLOGIES

As the Kenyan government works towards ending GBV, one of the significant measure's worth mentioning is '*Komesha Dhuluma*' (Komesha Dhuluma n.d.) which is Swahili for Stop the Violence. Komesha Dhuluma is a public awareness campaign to end GBV, that consists of partners from civil society, the private sector, development agencies and philanthropists across the board. The campaign brought about the Komesha Dhuluma mobile application that strengthens the referral pathway to GBV service providers (Kobia 2021). The app offers users an alternative option to report GBV as well as give referrals for healthcare facilities related to GBV effects. Kenya is leveraging technology as a means for wider accessibility to GBV hence wearable technology is a possible driver towards evidence-based solutions for GBV effects.

Currently in the market there are few wearable devices that exist specifically for PTSD treatment. However, consumer wearable devices and mobile apps are being leveraged to aid

in PTSD treatment. One example is BreatheWell, an app designed for wearable technology aimed at assisting military service members with PTSD to manage stress. The BreatheWell app was developed for Google Glass and Android Wear smartwatches to help users practice breathing and provide support for pacing, inhalation, and exhalation (Wallace et al. 2017). Having such an app can prove to be beneficial in improving PTSD symptoms, as it incorporates conventional PTSD treatment techniques to foster daily practice in an innovative way. Coupled with the fact that almost everyone has access to a mobile device it offers accessibility to a wider reach.

Adversity breeds innovation and over the course of the COVID-19 pandemic we have witnessed the emergence of innovative technologies to improve our way of life. In 2020 the Food and Drug Administration (FDA) permitted marketing of a new device intended for the temporary reduction of sleep disturbance related to nightmares in adults 22 years or older, who suffer from nightmare disorder or have nightmares from PTSD (U.S. Food and Drug Administration 2020). The wearable is called NightWare and is a prescription digital therapeutic system for the reduction of sleep disturbance related to nightmares from PTSD (NightWare n.d.). Sleep disturbance due to nightmares is a symptom associated with PTSD. Therefore, NightWare tailors its therapy based on the users sleeping pattern and adjusts treatment interventions to the user's unique sleep patterns (NightWare n.d.). The device is designed to work in tandem with existing PTSD therapies as well as other treatments for nightmares hence it offers an additional form of self-directed PTSD treatment.

Eye Movement Desensitisation and Reprocessing (EMDR) is a form of PTSD psychotherapy involving a "3-pronged approach that focuses on memories, present disturbances, and future actions to reprocess the memories and experiences that cause distress to resolve symptoms" (TheTouchPoint Solution™ n.d.). EMDR led to the development of Bi-lateral alternating stimulation-tactile technique (BLAST) also known as the BLAST Technique (The Blast Technique® Association n.d.). The Blast Technique helps someone revisit their traumatic experience whilst stimulating normal communication between the hemispheres of the brain (Day 2020). TouchPoints is a wearable device developed using the BLAST Technique and works by altering the body's stress response. "The device uses gentle, alternating vibrations

on each side of the body to shift someone's brain from their default 'fight or flight' response to a calm and in-control response"(TheTouchPoint Solution™ n.d.). While EMDR is a traditional form of psychotherapy and requires guided sessions with a healthcare professional, the BLAST Technique can be used as a form of self-directed treatment.

With the PTSD treatments that exist, continuous monitoring is important however, the methods of monitoring are limited to in-person therapy sessions (McDonald et al. 2019). Wearable technology has the potential to extend monitoring capabilities between therapy sessions with the use of longitudinal monitoring and wearable sensors. "The Apollo Neuro is a wearable device developed by neuroscientists and physicians, as a safe, non-invasive stress relief tool for adults and children. It works by combining low frequency inaudible sound waves (vibration that you can feel but cannot hear) to safely and reliably change how someone feels through their sense of touch and can measure those physiological changes in near real time"(Apollo Neuro n.d.). According to the science behind the Apollo technology it works to improve HRV through different waves of vibration. Lehrer and Gevirtz argue that "HRV measures the rate of change of the heartbeat over time and improving HRV means that the body can quickly adapt and recover from stress"(2014).

Ideally mobile and wearable technology has the potential to complement or add to existing PTSD treatments while offering more accessibility to a wider reach. Current conventional PTSD interventions can be explored for integration into wearable technology as seen with the NightWare and TouchPoints wearable devices. Longitudinal monitoring also has the potential to provide further understanding of PTSD that may not otherwise be offered by in person therapy sessions. Aside from the utilitarian aspect of wearable technology, aesthetic consideration is just as important because the wearables should also leverage design to focus on empowering domestic abuse survivors in Kenya.

2.1.3 WEARABLE FASHION AND DESIGN

Our clothes and accessories are the ways in which we express our personality to the world, and fashion is ever changing and evolving with time. Smartwatches have all sorts of designs and colours with the endless possibility to customise them to our personal preference.

Personally, I wear the Xiaomi Mi Band 4 (Xiaomi n.d.) smartwatch which I change the strap according to the colour of my outfit as a simple form of self-expression. With the speculative PTSD wearable devices, it is important to offer the users who are female-identifying domestic abuse survivors the option of customising their own devices. This in turn has the potential to empower the wearer to boldly wear the device without feeling uncomfortable because it is a representation of the wearer's personality.

Kristina Höök coined the term "soma design" which she describes as "a process that reincorporates the body and movement into a design regime that has long privileged language and logic"(2018). She argues that "an aesthetically oriented, soma-grounded design approach will render better design processes, far better suited to the development of interaction design right now"(2018). Design in relation to the body is like canvas and paint, the body is a canvas, and our clothes, accessories, and technologies are the paint that are either for utilitarianism or aesthetic purposes. Hence in designing wearable technology some of the considerations include placement on the body, comfort, material, and form just to mention a few. With a device that also incorporates healthcare, pulling away from the technicality of how the device works in terms of design and focusing on empathy in the design process is crucial. Trying to answer the question 'how will I feel when I wear this device?' becomes a guide towards designing more empathetically.

Höök offers this idea that "when we hone and care for aesthetic qualities of the technologies, we use to construct our interactions, and when we attend to our own experiences, the designs we bring forth can orchestrate experiences that spur improved aesthetic engagement for our end users"(2018). When empathy and contemplative reflection is part of the design process, it works to alleviate the rigidity of contemporary design practices that focus on fast pace and arriving at a solution as quickly as possible. Höök argues that "soma design provides an alternative to this aggressive, goal-oriented design process; it offers a slower, more thoughtful approach" (2018). The specificity of the users within this project drew me towards focusing the design of the wearables rooted in Kenyan culture with Afrofuturist influence. This works to blend both designing a device that will be relatable to Kenyans as well as

incorporate aspects of speculative and futurist design that has the potential to be relevant outside of Kenya.

2.2 AFROFUTURISM

Afrofuturism in my research acts as a design lens to empower female-identifying domestic abuse survivors by, leveraging wearable technology to reimagine PTSD treatment and drawing design inspiration from Kenyan culture to relate to a Kenyan audience. While digging deeper into the complexities of GBV, the delicacy required in its discussion is of utmost importance. Therefore, in designing a wearable device that is intended for improving mental wellbeing empathy comes at the forefront of the design process, as it should be viewed as a device for empowerment.

The term Afrofuturism was coined in the early nineties by Mark Dery (1994), can be defined as "a literary and cultural aesthetic that uses the tools and tropes of science fiction, as well as references to African and non-Western mythology, as a means to confront and analyse the present-day issues faced by people of colour"(Winchester 2018). Originally it has been situated as an aesthetic discourse for creative practices, but Afrofuturism offers a deeper layer of Black culture, innovation and imagination which creates an awareness of the importance of empathy, empowerment, inclusivity, and impact in design.

Osborne Macharia who is a self-taught Kenyan photographer and visual artist defines Afrofuturism as:

> An artistic re-purpose of the post-colonial African narrative by integrating historical elements, present culture, and future aspirations of people of African descent. Using Narrative, Fantasy, and Fiction to re-imagine a New Africa. Governed by two key elements being, Cultural Identity and Fiction it creates a powerful platform to convey important messages on topics such as Equality, Inclusion, Representation, Gender Abuse, Ivory Poaching, FGM, Albinism, Dwarfism, Conservation and Care for the Elderly (n.d.).

These two definitions are not separate from one another as each describes its own meaning in relation to the context of the creator's own personal experience. Considering this realisation, what is interesting about Afrofuturism is that its meaning is continually evolving

to reflect present day culture and context. It is a multifaceted framework that can act to create inclusion in design, by bringing forth more meaningful and impactful solutions to African cultures and histories. Although Afrofuturism is often linked to the African diaspora experience, it still relates to Black audiences from Africa because there is a degree of connection in the stories and experiences.

The histories of African culture continue to be associated with negative narratives (Becker 2019) and we find that "the danger of the single story is still being realised" (Kahiu 2017). Kahiu argues that Afrofuturism "seeks to create fissures in the present moment by using references to the past to envision futures that counter a negative historical imaginary" (2017). To further explore this idea, Wanuri Kahiu a Kenyan storyteller offers some insights from her 2017 TEDx talk. She recalls her first encounter with science fiction from the stories her mother used to tell her growing up, then she went ahead to recount the feedback she got about her own writing

> So, when I started to write my own science fiction and fantasy, I was surprised that it was considered un-African. So naturally, I asked, what is African? And this is what I know so far: Africa is important. Africa is the future. It is, though. And Africa is a serious place where only serious things happen. And it doesn't. My work is about Nairobi pop bands that want to go to space or about seven-foot-tall robots that fall in love. It's nothing incredibly important. It's just fun, fierce, and frivolous, as frivolous as bubble gum – 'AfroBubbleGum.'(2017)

While this idea shifts focus from agenda-based creation that is vital and important, it also presents a different narrative that African art can also be vibrant and exciting (2017). Hence, Afrofuturism tends to be described as a re-imagining of past histories in a futurist context. According to Lisa Yasek, Afrofuturism is "not just to remember the bad past, but to use stories about the past and the present to reclaim the history of the future"(2013).

The critically acclaimed Black Panther (Black Panther 2018) film "has been hailed as ground-breaking in its empowering depiction of black characters, its creation of heroic figures and its reference to African cultural forms"(Becker 2019). From this perspective Afrofuturism is used as a framework that reclaims the African narrative and works to empower Black futures. Kodwo Eshun (2003) describes "Afrofuturism's intentional and necessary dislocation of time

as an attempt to create both counter-memories and counter-futures to contest the colonial archive"(Becker 2019). To further understand this idea Eshun explains that "The powerful employ futurists and draw power from the futures they endorse, thereby condemning the disempowered to live in the past. The present moment is stretching, slipping for some into yesterday, reaching for others into tomorrow"(2003). This meaning separates the ideology of both a negative prediction of black futures and the negative narratives associated with the histories of African culture. Within my research I envision the reimagining of current PTSD interventions using both Afrofuturism and wearable technology, as tools that potentially shift the perception of PTSD treatments in Kenya.

Afrofuturism can "function as a framework for activism as well as a lens for imagining new and more inclusive technologies, Marvel's Black Panther film clearly elucidates this premise"(Winchester 2019). The Afrofuturistic imagining of advanced technology within an African nation free from Western influence offers a glimpse into innovative technological advancements that represents Black Culture. "Featured technologies such as the Kimoyo Beads, an advanced ubiquitous wearable communication technology powered by Vibranium provides a provocative and compelling depiction of this notion"(Winchester 2019). According to Marvel, "each individual is given a Prime Bead at birth, and it provides a lifetime's worth of medical knowledge plus health data about the individual Wakandan"(Central Intelligence Agency 2020). Each bead also has its own other functions such as comms, there is one for healing, eavesdropping on the enemy, remote piloting, and presentations (Central Intelligence Agency 2020). Afrofuturism in this context is used as a design lens for empowerment to highlight the use of innovative technology to address social, cultural, and environmental needs.

The Black Panther film has been viewed as feminist by some, while others have highlighted its aspects of African culture focusing on its traditional elements and Afrofuturistic aspects (Thames 2021). Thames wrote in an article that she found the roles of the leading women characters in the Black Panther film represented Africana Womanism (2021). Africana Womanism was introduced by Clenora Hudson-Weems who describes it as "an authentic theoretical concept designed for all women of African descent. It is family centred, rather

than female centred, and advocates race empowerment, rather than female empowerment"
(2019). As an African woman envisioning a wearable device for female-identifying domestic
abuse survivors, design is not just about aesthetics but also investigates the symbolism and
impact it can have towards the society. The ideologies within Africana Womanism links to this
idea within my own research as it provides the potential to empower female-identifying
domestic abuse survivors and highlight the importance of raising awareness of GBV in Kenya.

Winchester writes about the importance of inclusive technology where he states the growing
need for "technologies that take into consideration the sociocultural diversity of users and
context of use"(2019). As such Afrofuturism offers the potential of inclusivity in design. As an
African designer most of my work is rooted within Kenyan culture because that is what I relate
to. Drawing back to Macharia's meaning of Afrofuturism, he says Afrofuturism uses
"Narrative, Fantasy, and Fiction to re-imagine a New Africa"(n.d.). When the two ideas of both
Winchester and Macharia merge the result is powerful. On the one hand there is diversity and
inclusion and on the other hand there is a re-imagining of what Africa could be. This
intersection is where I draw my inspiration.

2.3 AFRICANFUTURISM

Author Nnendi Okorafor coined the term Africanfuturism, defined as:

> similar to "Afrofuturism" in the way that blacks on the continent and in the Black
> Diaspora are all connected by blood, spirit, history, and future. The difference is that
> Africanfuturism is specifically and more directly rooted in African culture, history,
> mythology, and point-of-view as it then branches into the Black Diaspora, and it does
> not privilege or centre the West. Africanfuturism is concerned with visions of the
> future, is interested in technology, leaves the earth, skews optimistic, is centred on
> and predominantly written by people of African descent (black people) and it is rooted
> first and foremost in Africa (2019).

The Black experience of Africans in the diaspora and those from Africa are quite different but
have some similarities as some of the cultural ideologies cut across the lack of collective
shared experiences. On the one hand, I have my own personal experience of growing up in
Kenya and on the other hand, living the African diaspora experience in Malaysia and more

recently in Canada. Therefore, I have gotten a glimpse into both worlds which gives me the two perspectives of what it means to live both experiences. Africanfuturism within my study then acts to bridge Afrofuturism and Kenyan Culture, by tying together the ideologies rooted in African culture from both diasporic and African experiences.

In an interview with CNN, Osbourn Macharia reflects about his work when he started out as a photographer, and at the time did not consider his work part of the Afrofuturism movement (CNN 2018). However, Macharia's work which is Afro-Futuristic Digital Art and Photography intertwines with Africanfuturism as some of his creations are influenced by Kenyan culture and themes. One notable example of his work titled Magadi, is a fictional story set in Kenya's lake Magadi. "It is about an imagined group of former female circumcisers living in the vast salty plains of the lake, who abandoned their former practice and took up Ethnic Fashion as an alternative livelihood. They now shelter young girls escaping early marriage, teaching them about fashion skills such as styling, fashion design, print work and modelling for both local and international runways"(Behance 2017). The work which was inspired by Osbourne's mother who is an activist highlights FGM which is a type of domestic abuse experienced in Kenya. Africanfuturism in this context highlights the use of Afrofuturism to relate to a Kenyan audience.

Thus, in trying to bridge Afrofuturism and Kenyan Culture, Africanfuturism offers a way for both ideas to meet in the middle, to create a narrative that is understood by a Kenyan audience. To echo Okorafor's description of Africanfuturism, "it is self-referential, having access to African culture and traditions that continue to inform the way Africans live and see the world"(Hodapp 2021). The wearable devices should be able to speak to a Kenyan audience, but because domestic abuse is a global issue leveraging speculative design from an Afrofuturistic perspective opens a broader understanding to a wider audience. In essence it is a blend of both worlds where Kenyan ideologies meet Afrofuturist ideals but work in tandem to highlight the importance of raising awareness of domestic abuse through wearable technology.

2.4 DESIGN INFLUENCES FROM KENYAN CULTURE

Exploring the use of wearable technology as a complementary or additional intervention, for female identifying domestic abuse survivors in Kenya to aid in PTSD treatment is an immense undertaking. Nevertheless, now is the time to explore such an idea with the Kenyan government working towards ending GBV by 2026 (Equality Now 2021). However, there is still a long road ahead with the fact that domestic abuse is "normally ignored, disguised, minimised, covered up or denied for the sake of protecting cultural traditions and family privacy"(wa Teresia 2021). It therefore becomes increasingly difficult for data regarding the prevalence of domestic abuse to be collected in Kenya, largely because the vice is still accepted as a cultural practice or considered a private affair that should not be reported to the authorities (Otolo 2020). The Komesha Dhuluma app (Komesha Dhuluma n.d.) is a step towards wider accessibility to GBV services although the app is limited only to android users it also paves the way for more innovative solutions.

Wearable technology is continually revolutionising the field of biomedicine through mobile and digital health. In Kenya, studies about the feasibility of wearable technology as a healthcare intervention is becoming increasingly popular. One study worth mentioning is the continuous neonatal monitoring technologies for use in public tertiary hospitals in Nairobi, Kenya. The study objective was to assess the feasibility and acceptability of two non-invasive neonatal wearable devices for use within a resource-constrained healthcare setting in Kenya (Kinshella et al. 2022). "The study concluded that participants were positive about the usefulness of the investigational technologies to strengthen clinical care quality and identification of at-risk neonates for better access to timely interventions. However, health system strengthening is also critical to support sustainable uptake of technologies into routine care"(Kinshella et al. 2022).

With such studies and expanded research into alternative evidence-based healthcare solutions in Kenya like wearable technology, it opens up the possibility for innovative healthcare interventions. Roy Allela a Kenyan engineer and innovator founded Sign-IO an assistive wearable device that translates sign language to speech ('Sign-Io-Inc' n.d.). "The wearable comprises a pair of gloves, which capture sign language gestures, and a companion

mobile application that is paired to the gloves via Bluetooth. The mobile app vocalises the signed gestures in real-time therefore enabling seamless communication between sign language users and non-sign language users"('Sign-Io-Inc' n.d.). In an interview with the Guardian Allela said he was inspired by his young niece who is deaf, to communicate with her (Kapfunde 2019). This is one example of innovation in wearable technology based on real life experience.

As much as the wearables are intended for PTSD treatment associated with domestic abuse, there should be careful consideration about how the wearables are presented. Therefore, aside from the functionality, aesthetics is also important. The role of design situated in an Afrofuturist context is intended to empower domestic abuse survivors. One way that Kenyans represent themselves as the people of their nation is by wearing the Kenyan band (See Figure 1) that has the colours and design of our National Flag. Being part of the Kenyan diaspora and having the opportunity to travel to different countries across the world, other Kenyans have recognised me because of the band. The band offered a starting point to explore my design idea. Kenya has a vibrant informal sector where artisans innovate all kinds of crafts using raw, reused, and recycled materials and the '*Maasai Market*' is one of the most popular open markets to purchase these crafts. The informal sector known popularly in Kenya as the '*Jua Kali*' sector directly translates to 'Hot Sun' in Swahili, (Soroba 2018) empowers creatives and artisans to make, share and sell their crafts.

Figure 1: Me wearing the Kenyan Band and the Xiaomi Mi Band 4

Traditional cultural adornments in Kenya continually evolve with time to match current trends but what remains a constant is that the work is handmade. Meaning each piece of work is uniquely its own design. Jewellery making practices have existed in Kenya for a long time, ostrich shell beads believed to be 40,000 years old were discovered in the *'Enkapune Ya Muto'* (Twilight Cave) in Kenya (Kimani 2017). While jewellery making was originally done by female-identifying individuals it has since evolved and these days it is being done by anyone. Jewellery was used to convey different messages within the community such as wealth, status, and cultural practices across different tribes (Kimani 2017). Today the Kenyan band is immensely popular and is adorned by many Kenyans. Hence by incorporating aspects of Kenyan culture in the design of the wearable it acts as a tool to relate back to a Kenyan audience.

Ideally by masking the wearable as an adornment that incorporates both Kenyan culture and Afrofuturism it shifts the focus away from functionality towards aesthetics. The role of design situated in an Afrofuturist context with Kenyan influence is intended to raise awareness of GBV in Kenya and empower female-identifying domestic abuse survivors. Hence, design in part function as a visual representation that draws attention towards the fight against GBV as well as offer the users a tool that allows them to take control of their own narrative.

2.5 WHY WEARABLE TECHNOLOGY

The focus of my research which is an exploration of wearable technology as a speculative device for self-directed PTSD treatment associated with domestic abuse, the question that arises is "Why wearables?"

Before I started my thesis project, I took an OCAD graduate studio class called 'Body Centric Technologies' which was taught by my Primary Advisor Kate Hartman. The class offered me the opportunity to gain first-hand experience designing with the body and explore the hardware tools, software programs and sensors used in the realm of wearable technology. With my overlapping curiosity for both mental health and wearable technology I became invested in blending both topics in my research. Although the initial idea was to design a wearable device to improve overall mental well-being, upon further exploration the focus became about speculative PTSD treatment associated with domestic abuse.

I have been wearing the Xiaomi Mi Band 3 (Xiaomi n.d.) since 2017 and later transitioned to the Mi Band 4 (Xiaomi n.d.) (See Figure 1) in 2019 to date for self-tracking my daily activities. This was the beginning of my interaction with wearable technology, and I was intrigued to learn more. When I first purchased the band, I mostly used it as a smartwatch and fitness tracker however, overtime it has helped me learn more about myself. The device has 2 wearable biosensors: a photoplethysmography (PPG) sensor for heart rate and sleep monitoring and 3-axis accelerometer and gyroscope for activity monitoring (Xiaomi n.d.). "Wearable biosensors (WBSs) are portable electronic devices that integrate sensors into/or with the human body"(Sharma et al. 2021). "Wearable Biosensors have many types of clinical applications."(Tamsin 2015) "Some of their current capabilities include physiological, biochemical, and motion sensing for both diagnostic and monitoring applications"(Patel et al. 2012).

Exploration of wearable technology offers the possibility for expanding research within the healthcare field. Therefore, novel innovations in the development of wearable devices are being employed for analysing biomarkers to improve healthcare management (Sharma et al. 2021). "Early diagnoses and improved patient monitoring for… mental health are becoming possible with continuous monitoring afforded by wearable sensing" (Dunn, Runge, and Snyder 2018). Wearable devices also have the potential to "differentiate between mental health conditions that have shared symptoms which may cause delays in diagnosis or treatment, imprecise treatment or misdiagnosis"(Dunn, Runge, and Snyder 2018).

While several applications exist for wearable technology in healthcare there is still a long way to go. "…cohort validation studies and performance evaluation of wearable biosensors are needed to underpin their clinical acceptance"(Sharma et al. 2021). My exploration of wearable technology using speculative design offers the opportunity to reimagine the future of healthcare in Kenya. With the "considerable progress and development in wearable biosensors/devices, the current state of the art of wearable biosensing swim around demonstrating the proof-of-concept of wearable devices for the determination of various

biomarkers"(Sharma et al. 2021). Therefore, exploration of wearable technology needs to be further developed within healthcare fields to improve the industry and patient life.

3. RESEARCH METHODOLOGIES

This thesis situates itself within a present and future context both working in tandem to re-imagine speculative PTSD treatment associated with domestic abuse. It in part borrows ideologies from present day wearable technology, and speculative design through an Afrofuturist lens. The study employs the use of Health Design Thinking to articulate empathy within the design process by placing the user's needs at the forefront. Drawing from my creative practice in Industrial Design the prototype creation process will entail iterative prototyping and design thinking. Insights into the methodologies used within the thesis development process are reviewed in this section.

3.1 HEALTH DESIGN THINKING

Bon Ku and Ellen Lupton describe health design thinking as an approach to generating creative ideas and solutions that enhance human well-being in the context of medicine. They argue that "it is an open mindset rather than a rigid methodology"(2020). Health Design Thinking offers the opportunity for creators and designers neither in engineering nor medical fields to design medical devices. Health care systems around the world employ design teams to improve patient care. Therefore, health design thinking works because design teams focus on human problems, and not technology. Users are included in the design process, and this educational immersion helps clinicians cultivate empathy and creativity (Ku and Lupton 2020).

> Two core principles illuminate the rich and varied practice of health design thinking. First, by embracing a human-centred perspective, each person becomes a more caring listener and a keen observer. This work requires patience and attention. Next, by actively applying a creative mindset to design and health care, we become inventors, makers, and storytellers, equipped to help build a culture of wellness. People do not think of health care as a creative field (Ku and Lupton 2020).

According to Jones et al. "as wearables become increasingly prevalent, there is a concurrent and growing expectation that we use these devices to track and monitor our bodily states to be responsible biocitizens"(2017). Therefore, design plays a critical role in ensuring that people without medical backgrounds can safely use wearable health devices (Ku and Lupton 2020).

In employing empathy within the design process and placing the user's needs at the forefront, it moves away from designing a wearable device for design's sake. With rigid design practices there is no human touch to the outcome but what health design thinking offers is more fluidity in the design because it works to have the human touch and feel to it. According to Ku and Lupton "The principle of human-centred design is inclusive and collaborative and works by approaching members of a community as experts in their own life challenges. Users become active participants and creators of knowledge, as opposed to passive subjects to be measured and manipulated"(2020).

Although there is no personal engagement with the actual users of this project this methodology places less emphasis on designing a wearable just for the functional purposes. It offers the designer the opportunity to design the device in a caring and empathetic way.

3.2 SPECULATIVE DESIGN

Anthony Dunne and Fiona Raby propose "speculative design as a kind of design that is used as a tool to create not only things but ideas." According to them, "design is a means of speculating about how things could be, to imagine possible futures"(2013). Speculative design as a methodology is a "conceptual design practice concerning itself with speculation, imagination, world-building, fantasies, utopias, dystopias, stories, fictional objects, and political ideologies" (Dunne and Raby 2013).

While Dunne and Raby have contributed to Speculative Design discussions, it continually evolves in its meaning. According to James Auger "speculative design serves two distinct purposes: first, to enable us to think about the future; second, to critique current practice"(2013). Within my research I draw inspiration from the past and situated my design within a futurist context to solve a present-day problem. Auger argues that "a design speculation requires a bridge to exist between the audience's perception of their world and the fictional element of the concept"(2013).

Understanding patient needs is a key factor in the design of healthcare services, however ethnographic research methods can be intrusive in sensitive care settings (Hoang et al. 2018) such as when researching mental health. Hoang et al. offer the idea of "Fiction Probe as a contribution in the form of a field study tool that uses storytelling to allow patients to tell their story from their perspective"(2018). The authors "use speculative design and a multi-choice narrative, represented as a pick-a-path storybook, to re-imagine the form and content of field study research tools"(2018). Speculative design in this way acts to "de-alienate health conditions, as well as provide insights into patients' experiences of the healthcare system and create meaningful representations of a patient's experience of their condition"(Hoang et al. 2018). Within my research I design the wearable devices with me as the subject considering form, feel and changes based on my own experiences as I interact with the devices. Thus, fiction probe is present within the development of the prototypes as it provides the opportunity for me to tell my own story based on the interactions with the devices.

Overall speculative design aims to help explore the overlap of the past, present and future. By relating past experiences to reimagine future outcomes in the present moment. This methodology also works to reimagine ethnographic research methods in designing a wearable device that places the user's needs first.

3.3 DESIGN FOR WEARABILITY

As an industrial designer I have employed human centred design within my design practices. While my work has mostly involved ergonomics and designing tangible products, I am still new to designing with the body. Hence design for wearability plays a vital role in designing wearable technology in relation to placement on the body. Gemperle et al. define wearability as the interaction between the human body and the wearable object (1998). He argues "dynamic wearability extends that definition to include the human body in motion. A product that is wearable should have wearability" (1998). Exploration of where the wearable should be placed on the body was a crucial part of the design process.

Clint Zeagler (2017) argues that a designer might choose to locate a wearable device on one body part rather than another for many reasons. He further explains "most choices in on-

body location come down to a balance between the desired use of the wearable device and the affordances different parts of the body offer"(2017). Several factors go into deciding the placement of a wearable on the body some of which include "proxemics (human perception of size), weight distribution (where to carry weight and amount), body mechanics and movement, movement sensing consideration, biometric sensing, and tangible/ tactile / haptic feedback (passive touch)"(Zeagler 2017). My research is situated in biosensing and biofeedback, hence in exploring design for wearability as a methodology it acted as a guide for mapping the ideal placement of the wearable devices.

3.4   MODULAR DESIGN

Modular design was introduced in 1965 by Martin Starr (1965) in which he described it as the production of a product in separate parts to develop different variations of a product. Tseng et al. argue that with modular design "it possible to modify specific modules for a new requirement without interfering with the main infrastructure, so that the complex problems can be decomposed into several small ones"(2018).

In simple terms modular design splits up complex systems into simple modules to organize complex designs and processes more efficiently (Tseng, Wang, and Jiao 2018). While this concept was developed over 50 years ago, today it is widely employed in many fields of design and manufacturing (Tseng, Wang, and Jiao 2018). Modular design can be beneficial in the development of products as it offers the flexibility to easily modify, upgrade or augment at any point of the production process. The prototyping process within my research is divided into two parts which include the technical functionality and design thus, modular design plays a crucial role in the development of the wearable devices.

Breaking up the design process into several parts offers a wider overview in realising how all the prototypes are intended to work together. The work entails iterative prototyping through ideation, sketching, 3D modelling, rapid prototyping and testing. With the distinct functions and connections of the devices modular design offered the possibility to groups similar components to allow ease of modification in realising the final prototypes.

4. AFROFUTURIST WEARABLE DEVICES

This chapter introduces the project inspiration and presents the development of the wearable prototypes. The process takes a Modular Design approach which is divided into two categories: functionality and design. The functional outcome consists of three working wearable prototypes that use electronic components for health and wellness monitoring. In addition, design concepts are presented via illustrations, Computer Aided Design (CAD) modelling and 3D printing - blending Afrofuturism and influence from Kenyan culture to envision form and design of the wearable devices.

The wearable prototypes have Swahili names which is the National language of Kenya to relate to a Kenyan audience. The first prototype is called *'The Moyo Monitor'* - which translates to 'The Heart Monitor,' and the second one is called *'The Tulia Band'* - which translates to 'The Calm Band.'

4.1 PROJECT INSPIRATION

My thesis project was inspired by a graduate studio class I took in the Fall semester of 2020 at OCAD University called 'Possible Futures' taught by my Secondary Advisor Dr Cindy Poremba. At the time, I was attending the class online from Kenya and became interested in mental health hence for the final project of the class I worked on a reflective journal to research what a future Africa could possibly look like if mental health is managed, and the potential of Africa being a futurist continent. The objectives were:

➢ To reimagine an Afrofuturist African continent with a focus on how mental health can be managed using speculative wearable devices.

➢ To explore Transhumanism to heal memories and cleanse the mind to help one heal from past traumas.

While this was an extensive topic to tackle it paved the way for my research which specifically focuses on Kenya. The exploration within the reflective journal linked to the idea I present in this paper. The journal highlights the evolution of African cultural adornments and links the past and present to reimagine the future which is further discussed below:

- The Past - from long ago Africans have adorned their bodies in several different ways. They have used their bodies as a canvas by painting, tattooing, piercing and even scarification. These were all forms of beautification and status and in my study, I shall be exploring some of these traditional adornments in a futurist context.

- The Present - Africa has evolved the traditional adornments to suit modern-day fashion. They still maintain the tradition of using beads, tattooing and body painting to retain their culture that has otherwise been overshadowed by modern-day cultural assimilation. Much like any culture Africans adorn themselves to retain their sense of self and heritage.

- The Future - What I hope to achieve in the outcome of this study is to tell a story of what I believe Africa could potentially look like in the future. The idea is to bring to life lost traditions as seen from my perspective in a whole new light. The design work will be a diegetic narrative with a twist on the Afrofuturist movement. Let's journey together into a future Africa!

4.2 THE MOYO MONITOR

Description

The Moyo Monitor prototype is a speculative wearable device with two biosensors for heart rate and motion sensing. The device is intended to collect longitudinal HRV data which is then sent to *The Tulia Band.* This prototype compares two heart rate sensing methods (See Figure 2) - one being a photoplethysmography (PPG) signal and the other an electrocardiogram (ECG) signal. A PPG sensor "uses a light-based technology to sense the rate of blood flow as controlled by the heart's pumping action"(NeuroSky 2015). While an ECG sensor "measures the bio-potential generated by electrical signals that control the expansion and contraction of heart chambers"(NeuroSky 2015). *The Moyo Monitor* that uses the PPG sensor also uses a 3-axis accelerometer for motion sensing.

Electrical ECG Signal	Optical PPG Signal
Uses electrical signal produced by heart activity	Uses electrical signal derived from light reflected due to changes in blood flow during heart activity
Measures heart rate accurately	Can measure heart rate but only suitable for average measurements
Uses electrical signal produced by heart activity	Uses electrical signal derived from light reflected due to changes in blood flow during heart activity
Heart Rate Variability (HRV) can be accurately derived	Pulse Rate Variability correlates with HRV for longer periods of measurement
Meaningful readings can be obtained within a short time	Requires a longer settling time due to the need to measure ambient light

Figure 2: Comparison of Electrical (ECG) and Optical based (PPG) Biosensors in Wearable Devices

4.2.1 THE MOYO MONITOR (PPG)

Concept

The Moyo Monitor PPG is designed as a wearable biosensing device that explores heart rate sensing methods using a PPG sensor as well as motion sensing using a 3-axis accelerometer. The output for both sensing methods is displayed using LEDs for visual output. This prototype is intended for the exploration of heart rate sensing methods as a biomarker for PTSD symptoms for further development in later iterations.

Process

This prototype is constructed using a PulseSensor and the Adafruit Circuit Playground Express microcontroller (See Figure 3). The PulseSensor works by emitting green light from an LED mounted on the sensor and shines the light onto the fingertip, or any other capillary tissue, and the photosensor reads the amount of light that bounces back (See Illustration 1). The prototype also utilises the microcontroller's on-board accelerometer for motion sensing.
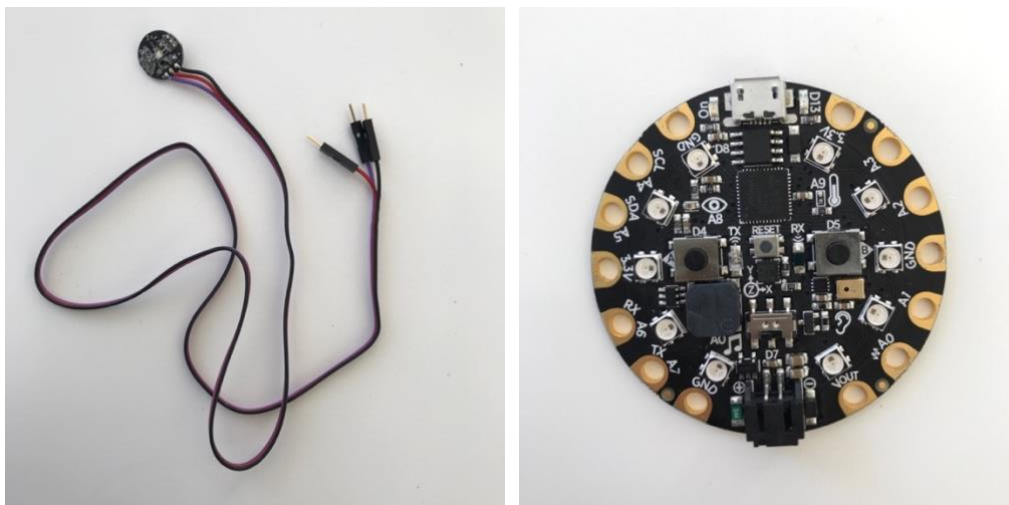
Components used:

Figure 3: Images of electronic components used in The Moyo Monitor (PPG) – PulseSensor (Left); Adafruit Circuit Playground Express (Right)
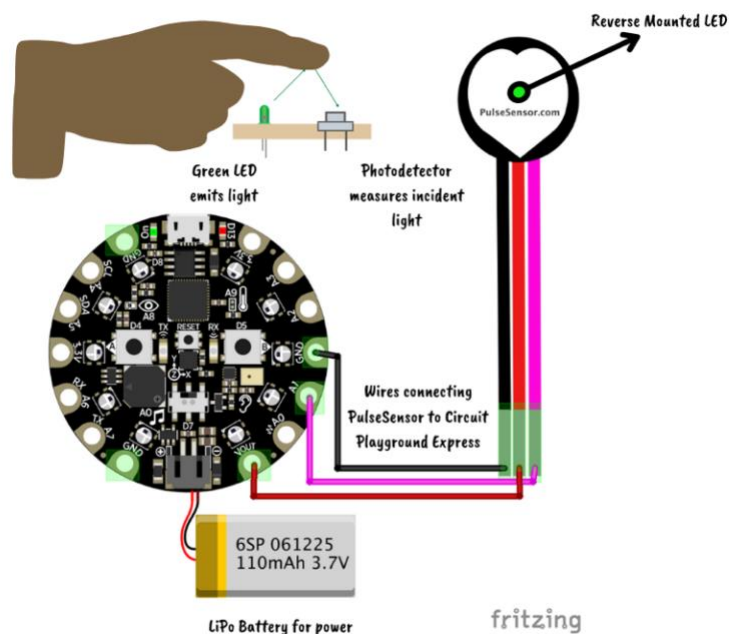

Illustration 1: Circuit Diagram of PulseSensor connected to Circuit Playground Express

Prototype

With my knowledge of physical computing, I first programmed the PulseSensor and Circuit Playground Express using Arduino IDE software to test out the code and functionality of the prototype. (Figure 4)
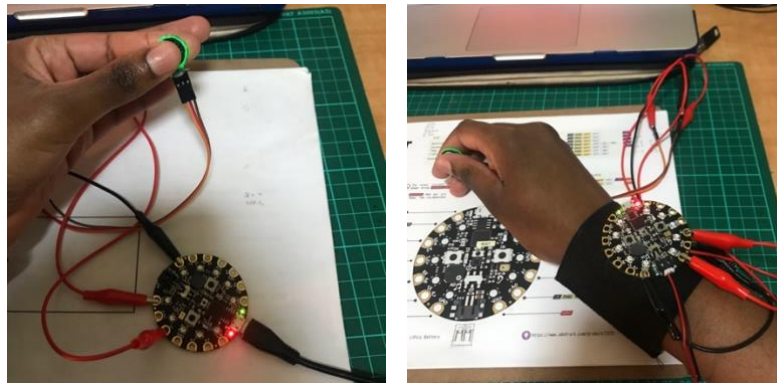

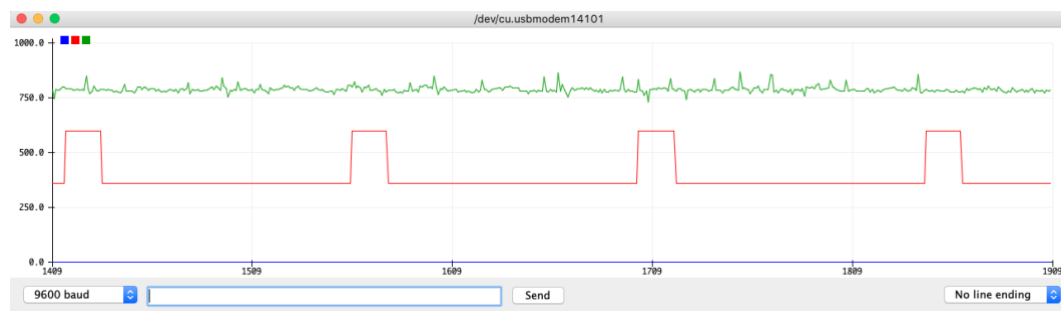*Figure 4: Initial testing of the PulseSensor attached to the Circuit Playground Express*

Figure 5: Screenshot of my BPM (Green) and IBI (Red) reading recorded on Arduino IDE Software

The construction of the prototype was designed as a non-invasive wearable biosensor in the form of a wearable cuff. The materials used were felt, thread, conductive thread, jumper wires and Velcro. (Figure 6)

Figure 6: Materials used in the construction of the wearable cuff - Front view (Left); Back view (Right)

The wearable cuff is used to measure Beats Per Minute (BPM) and Interbeat Interval (IBI) which is the time interval between individual heart beats. The cuff also has motion sensing to detect when a person is active to differentiate changes in BPM while the body is in motion and at rest. The Circuit Playground on board LEDs lights up when a heartbeat or movement is detected. (Figure 7)

Figure 7: Me wearing the cuff - LEDs light up when a heartbeat is detected (Left); LEDs light up when motion is detected (Right)

Reflection

While testing the PulseSensor on various parts of the body it was unable to detect a heartbeat except on the palm and fingers. The heart rate readings with the PulseSensor were unstable therefore the next iteration explores an ECG sensor to compare accuracy of readings. This first prototype is proof of concept for the envisioned outcome however, this prototype uses a PPG sensor and cannot measure HRV which gives more precise data of changes in heart activity. The motion sensor data was stable and able to be used to detect a few movements. This iteration of *The Moyo Monitor PPG* is currently quite bulky and not intended to be worn on the wrist as the outcome is envisioned as a wearable patch.

4.2.2 THE MOYO MONITOR (ECG)

Concept

The Moyo Monitor ECG explores heartrate sensing using an ECG signal to measure electrical activity of the heart. This prototype iteration was tested for exploration purposes only to test heart rate sensing using an ECG sensor compared to the PPG sensor.

Process

This prototype is constructed using the SparkFun Single Lead Heart Rate Monitor which is connected to an Arduino Nano 33 IoT microcontroller placed on a breadboard. (Illustration 2) The Heart Monitor is used to measure electrical activity of the heart that can be charted as an ECG reading.
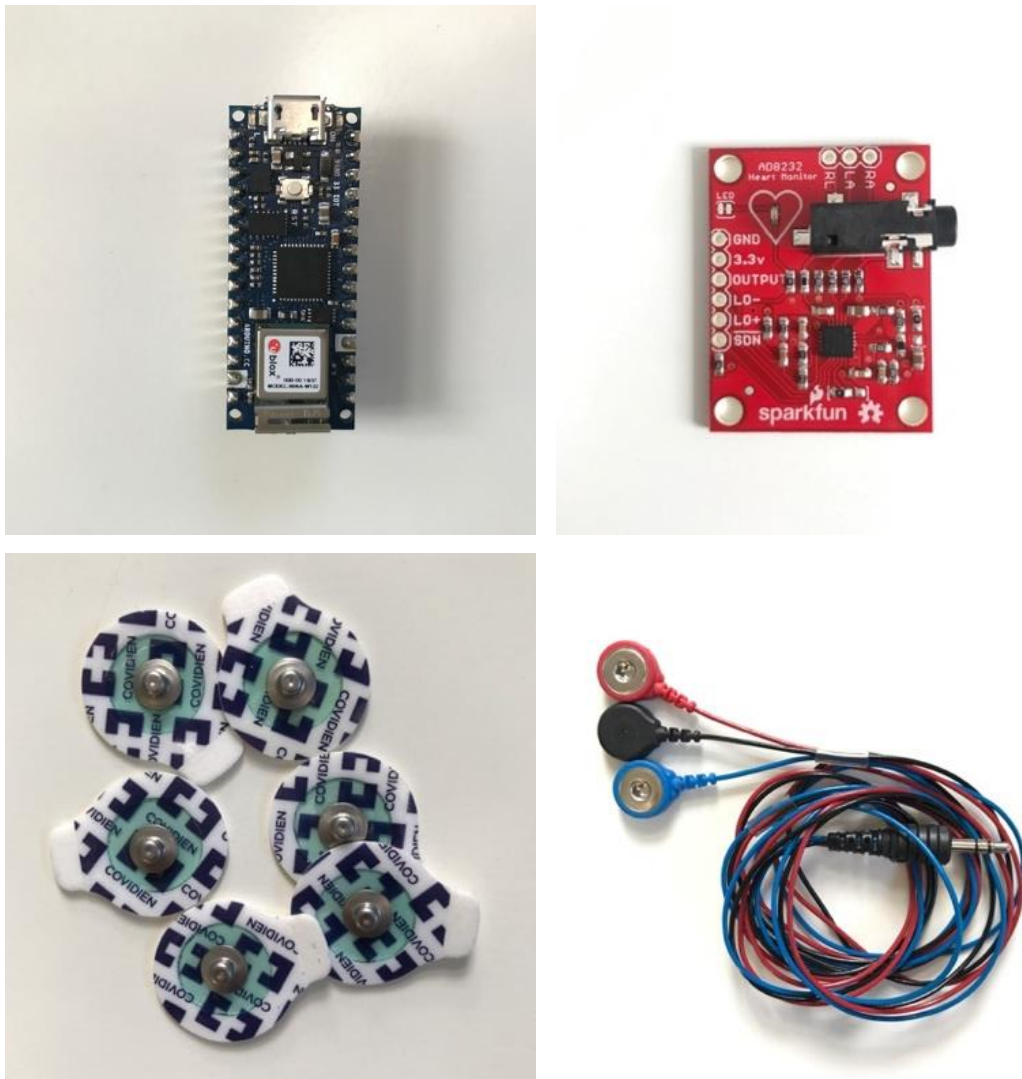
Components used:

Figure 8: Images of electronic components used in The Moyo Monitor (ECG) - Arduino Nano 33 IoT (Top Left); SparkFun Single Lead Heart Rate Monitor (Top Right); Disposable Surface ECG Electrode (Bottom Left); Sensor Cable Electrode Pads (Bottom Right)
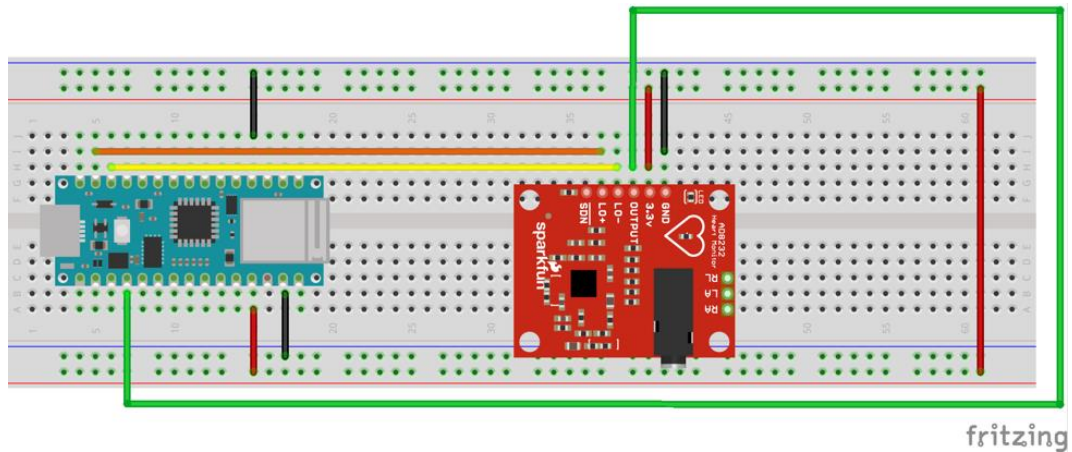
Illustration 2: Circuit Diagram of the SparkFun Single Lead Heart Rate Monitor connected to microcontroller

Prototype

The first stage of the prototyping entailed connecting the Arduino microcontroller to the Single Lead Heart Rate Monitor which connects to electrodes (See Figure 9). The next step was coding on Arduino IDE software to test the Heart Rate Monitor's functionality. (Figure 10)
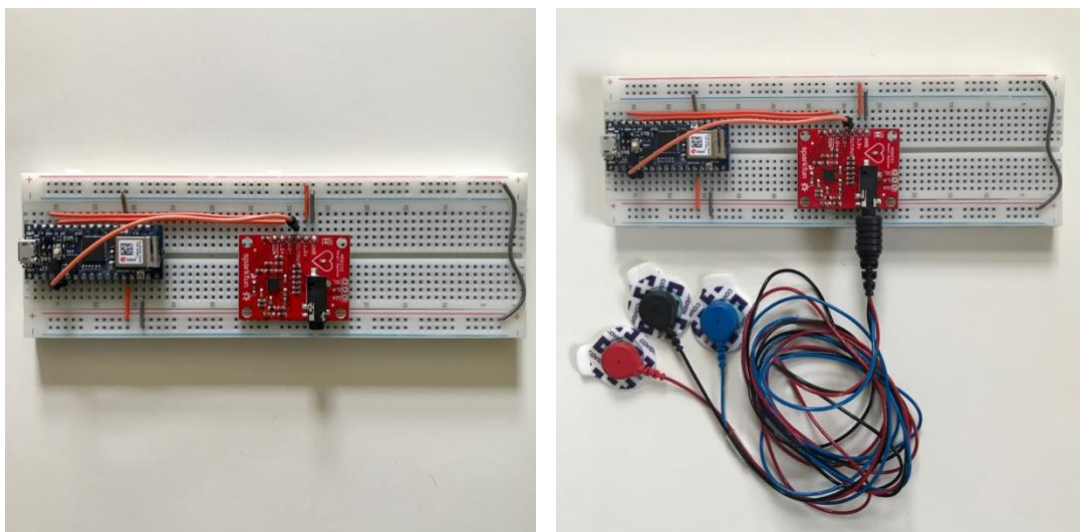

Figure 9: Microcontroller connected to Heart Monitor (Left); Heart Monitor connected to sensor cable electrode pads (Right)
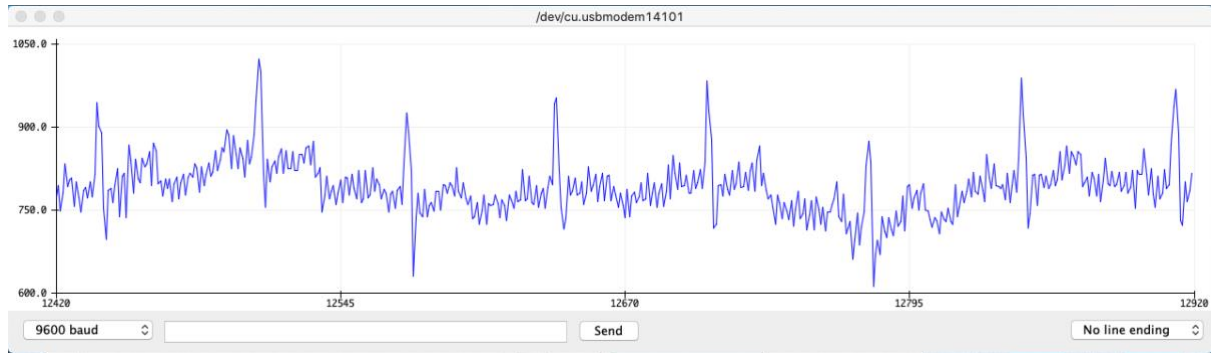
Figure 10: A screenshot of my BPM reading recorded on Arduino IDE Software

The cables attached to the sensor pads are colour coded for ease of understanding where to place them on the body (Illustration 3). After construction I tested out the Heart Monitor on myself to record my BPM. The output was displayed on the Arduino IDE software (See Figure 10) as well as the on-board LED of the SparkFun Single Lead Heart Rate Monitor. (Figure 11)
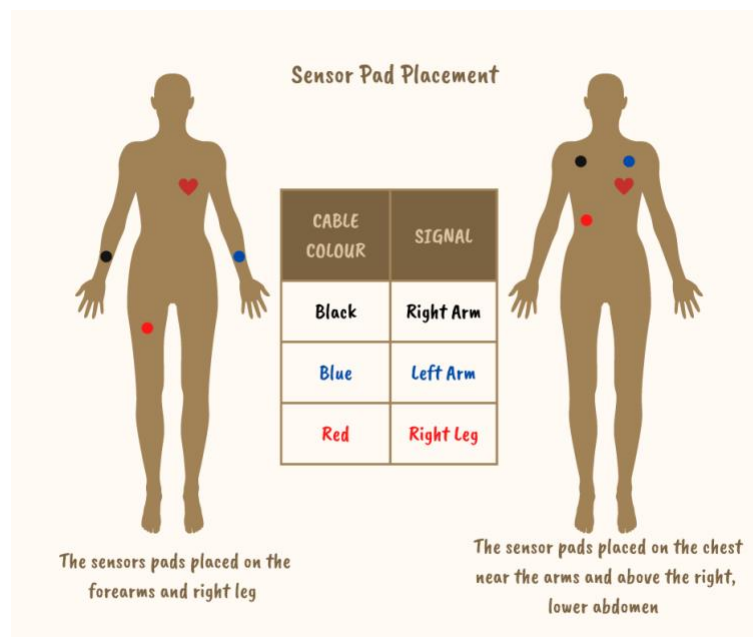

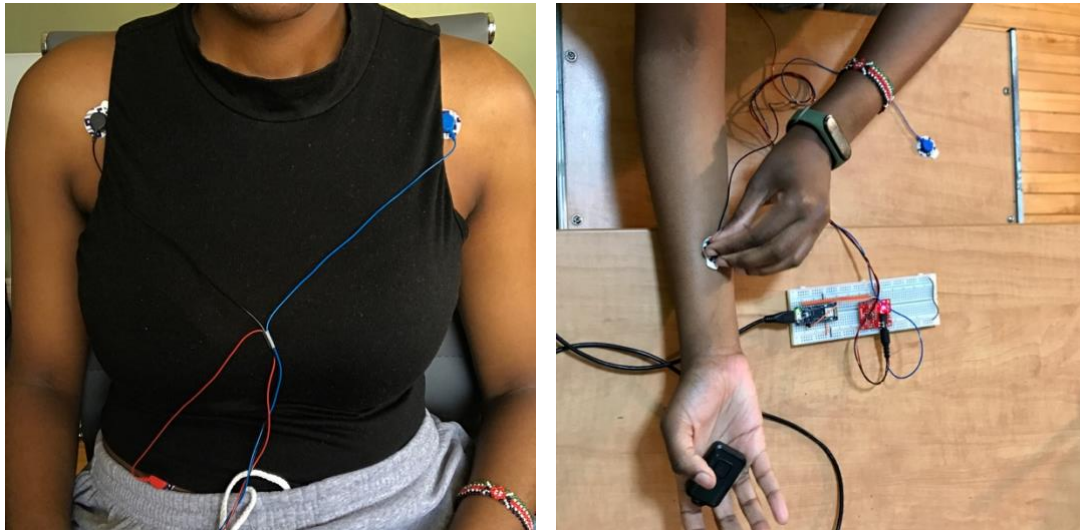*Illustration 3: Placement of sensor electrode pads on the body*

Figure 11: Me wearing the sensor electrode pads

Reflection

The Single Lead Heart Rate Monitor yielded more stable BPM results compared to the PulseSensor. However, the sensor pads were uncomfortable to wear over an extended period as the cables were obtrusive. Heartrate detection was also much faster compared to the PulseSensor. The raw heartrate data produced from *The Moyo Monitor ECG* on the Arduino IDE software was difficult to interpret especially when movement was detected the readings were not stable. Overall, both the PulseSensor and Single Lead Heart Rate Monitor had their advantages and disadvantages. Further exploration of both heartrate sensing methods would be beneficial for exploration of longitudinal monitoring of HRV.

4.3 THE TULIA BAND

Description

The Tulia Band prototype is a speculative wearable PTSD treatment. The band is intended to be a networked device connected to *The Moyo Monitor* that sends an alert when unusual HRV activity is detected. *The Tulia Band* is envisioned as a speculative self-directed PTSD treatment based on existing PTSD interventions (Illustration 4). The prototype has three different modes based on existing PTSD treatments which include:

➢ EMDR treatment which is a type of psychotherapy that encourages patients to briefly focus on the trauma memory while simultaneously experiencing bilateral stimulation such as rapid eye movements to reduce vividness of the memory (Maxfield et al. n.d.).

➢ Breathing Retraining is taught by a therapist to help patients manage distress and anxiety and works by taking a breath and exhaling very slowly to calm the patient (Wilson, Friedman, and Lindy 2012).

The band is also designed as a proximity sensor so when two users are close to each other the band sends an alert using haptic vibration and an ambient light turns on.

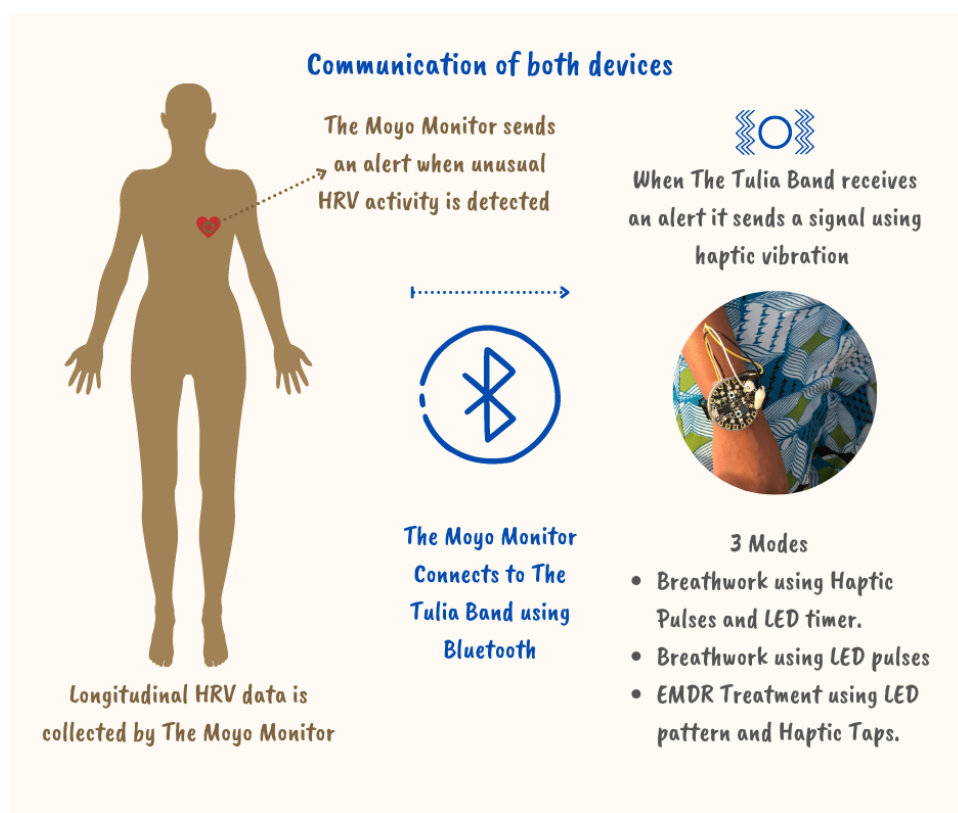*Illustration 4: Communication between The Moyo Monitor and The Tulia Band*

Concept

The Tulia Band is designed as a speculative wearable device for self-directed PTSD treatment associated with domestic abuse. The three modes for speculative self-directed PTSD treatment are:

1. EMDR based treatment that uses haptic taps and LEDs that move in a circular motion – This mode is designed to work as a calming technique.

2. Haptic Breathwork treatment which uses haptic pulse vibration as a breathing guide for inhalation and exhalation. This mode also uses LEDs that has a 10 second count down timer after each exhalation haptic pulse.

3. Visual Breathwork treatment that uses LEDs that pulse to indicate inhalation and exhalation while breathing. (Illustration 5)
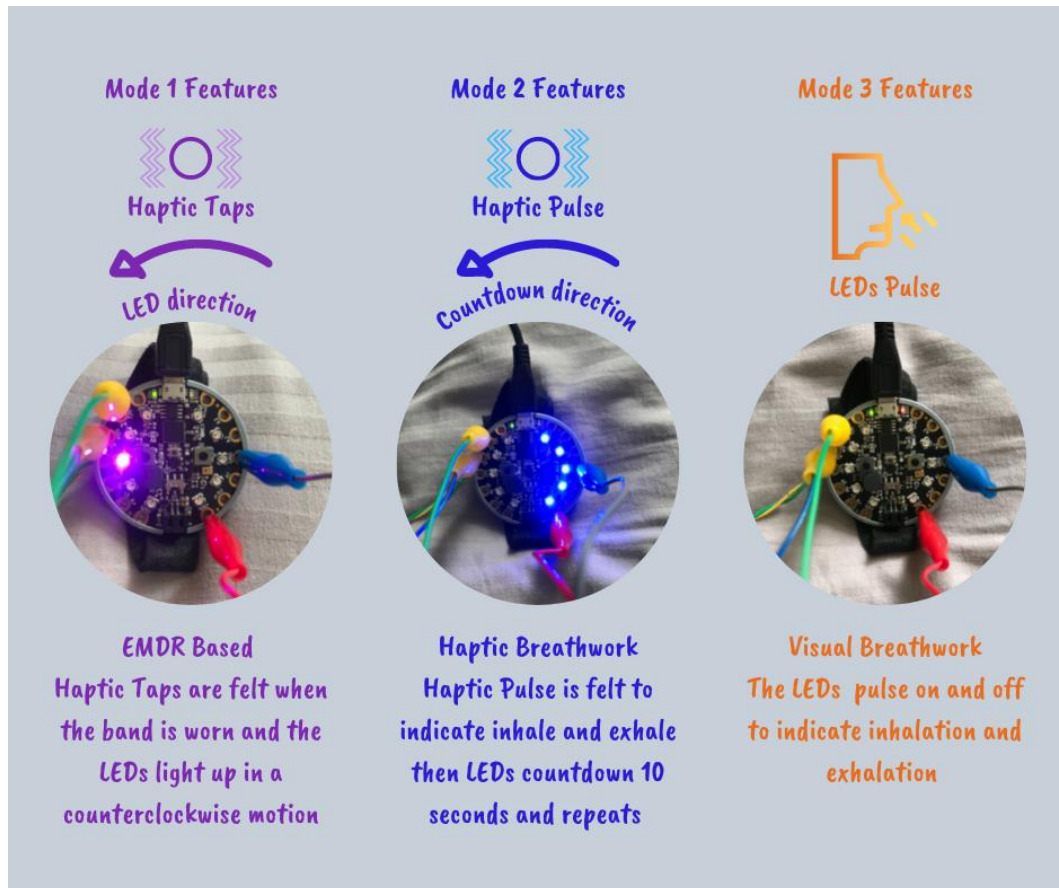
Illustration 5: The Tulia Band Modes for Speculative PTSD Treatment

Process

The prototype is constructed using an Adafruit Circuit Playground Express microcontroller, and a vibrating motor attached to a haptic driver for exploration of various haptic vibrations (See Illustration 6). The microcontroller is mounted on a 3D printed casing and has a strap attached to the casing so that it can be worn on the wrist. The prototype utilises the microcontrollers on-board LEDs for the various mode settings. To change from one mode to another the two buttons and one switch located on the Circuit Playground Express are used for each of the three modes.

Components used:

Figure 12: Images of electronic components used in The Tulia Band - Adafruit Circuit Playground Express (Left), Vibrating Motor (Centre), Haptic Driver (Right)

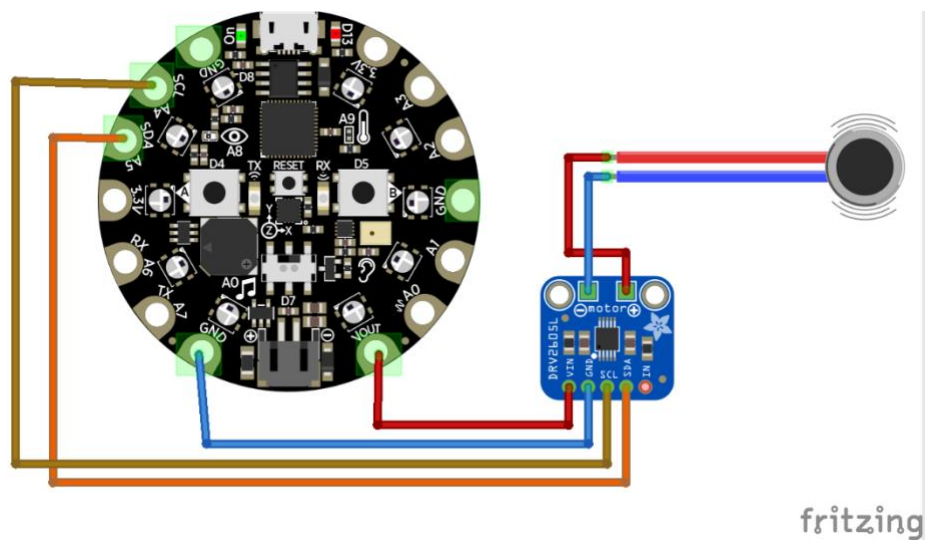*Illustration 6: Circuit Diagram of Microcontroller connected to Haptic Driver and Vibrating Motor*

Prototype

The first stage of the prototyping was connecting the circuitry and coding the three modes on Arduino IDE software. (Figure 13)
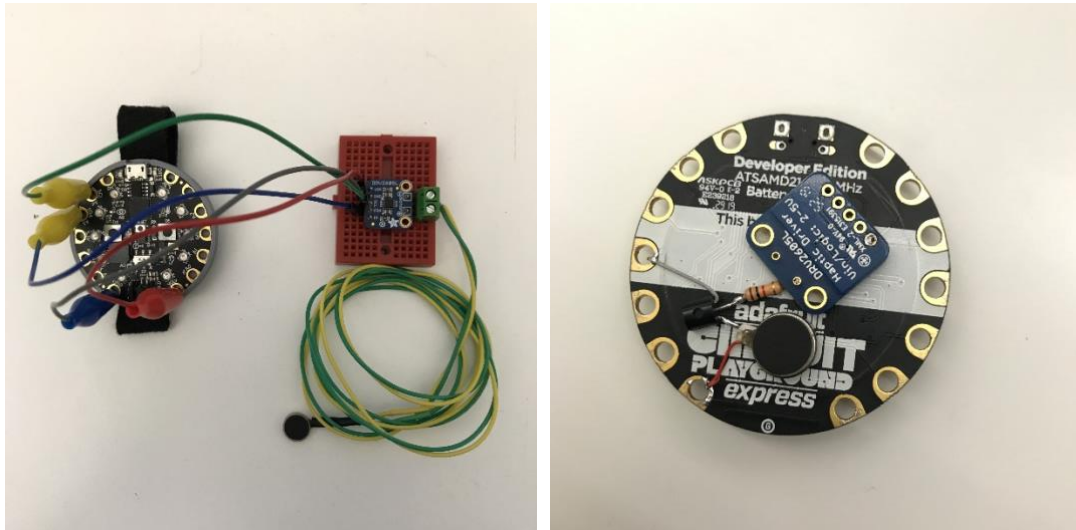
Figure 13: Microcontroller connected to Haptic Driver and Vibrating Motor

The next step was testing out the functionality. The Circuit Playground Express has two push buttons and one slide switch which I used to trigger the three mode functions. The left and right push buttons are labelled A and B respectively on the microcontroller. Button A is for the Visual Breathwork mode and button B is for the EMDR Based mode while the slide switch is for the Haptic Breathwork mode. (Illustration 7)
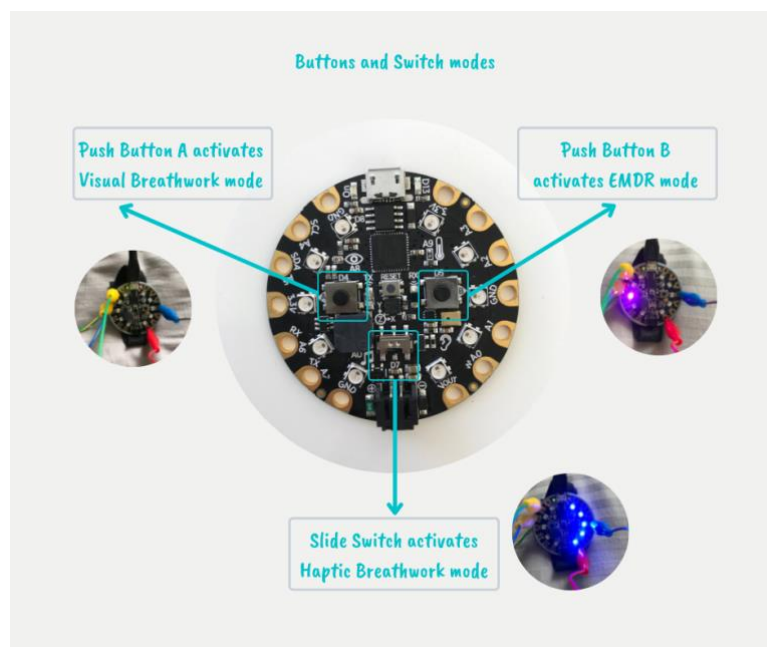
Illustration 7: How each of the 3 modes are activated on the Tulia Band

The first iteration of the prototype was constructed using a felt strap, Velcro, and a 3D printed case using grey PLA filament to hold the Circuit Playground Express. (Figure 14)

Figure 14: Initial construction of The Tulia Band

The final stage of the prototyping process was designing a case to fit all the electronic components. For the casing I explored two different flexible plastic 3D printing materials one was red NinjaFlex filament, and the other was blue Polyurethane TPU Filament (Figure 15).

Figure 15: The Tulia Band prototype with 3D printed casing

Figure 16: Me wearing The Tulia Band

Reflection

The wearability of the device was comfortable however the battery pack was obtrusive as it was attached as a separate piece. There was a lag in switching from one mode to another, but the functionality offered proof of concept of the envisioned features. The networking and proximity sensing features were not explored for *The Tulia Band* but will be incorporated in the next iterations. *The Tulia Band* is intended to be a networked device that connects to *The Moyo Monitor* using Bluetooth Low Ener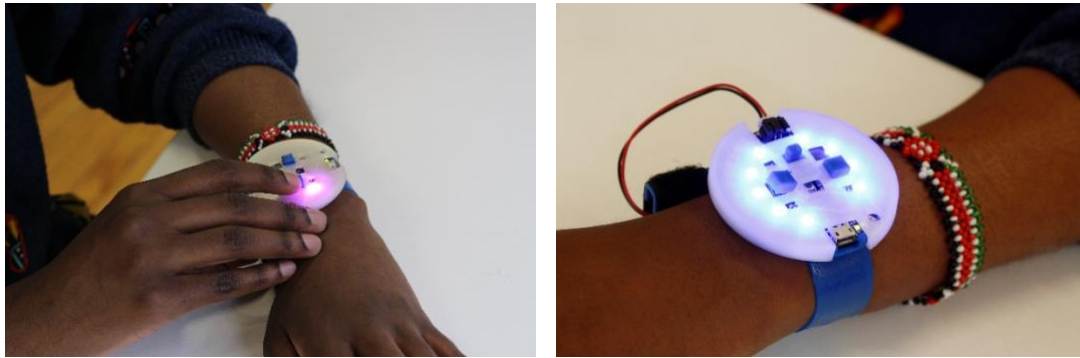gy (BLE) however, this wireless communication between the two devices will be explored in the next iterations. *The Tulia Band* is also imagined with a proximity sensor to alert a user when someone else wearing the band is nearby the idea is to create an unspoken bond so that the user does not feel alone through their healing journey.

4.4 THE DESIGN

Stepping away from the technicality and functionality of the prototyping process this section encapsulates the envisioned design outcome of the Speculative Afrofuturist Wearable devices. Through Africanfuturism, Afrofuturism and design influence from Kenyan culture I envision the social implications of the wearable devices for the intended users who are Kenyan female-identifying domestic abuse survivors. I also conceptualise the visual design of the wearable devices through speculative design and its importance towards raising awareness of GBV in Kenya.

As an Industrial Designer I tell stories through my creations and the design process is fluid and ever-changing resulting in different outcomes each time. In moments where I must design for user-specific scenarios, I must step outside my comfort zone and imagine myself as the person I am designing for to allow me to better understand the importance of the design. With topics like GBV and mental health which are both important and sensitive, empathy within the design process becomes an important guide. Hence, employing speculative design as a method of exploration offers the opportunity to probe and generate design solutions.

Through my exploration of wearable technology, it made me think of self and its relation to the objects that we put or place on our bodies. The power of the sense of touch is linked to how we feel and when we wear objects long enough, they become a part of who we are to the point we feel some emptiness or absence when we take them off. This is where my exploration of *The Moyo Monitor* and *The Tulia Band* began. From my personal experience of wearing the Mi Band and Kenya Band (See Figure 1) every day I have observed that they have personal connotations in my life, but they also send an outward message that can be interpreted however someone else views them. As the wearable devices are designed with the intention to both aid in mental health care management and be an outward symbol for raising awareness of GBV in Kenya the question I asked myself is:
How I could separate the role of health management for the wearables which the wearer has complete autonomy over, from the design which is intended to empower the wearer as well as be a symbol of GBV awareness.

In designing the wearable devices for myself as the subject I document my experiences and thought process while leveraging ideologies from Speculative Design, Afrofuturism, Africanfuturism and Kenyan culture to explore my journey.

The Moyo Monitor

The Moyo Monitor is envisioned as a Speculative Afrofuturist Wearable Patch that is used to collect longitudinal data of biomarkers specific to PTSD. This would include symptom biomarkers such as HRV or PRV and motion mapping as well as therapy progress markers that would allow the user to keep track of their own progress. By offering the user the opportunity

to learn about their own progress it creates a sense of ownership in managing one's own healing process.

The placement of the wearable patch is intended to blend in with the body as not to be obtrusive or invasive and allows the wearer to have a more personal experience with their own healing. The monitor is designed as a non-invasive wearable patch that can be placed on specific parts of the body to simultaneously sense heart rate and map motion (See Illustration 8) depending on the user's personal preference and allows for unobtrusive monitoring over an extended period.
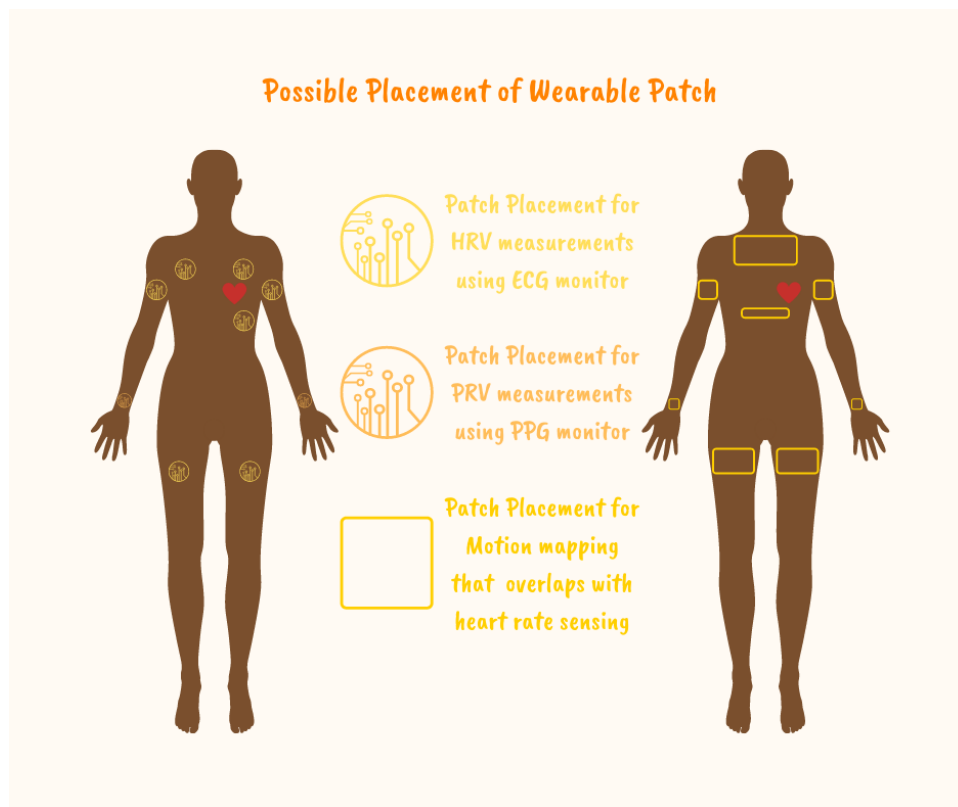
Illustration 8: Placement of The Moyo Monitor Patch

The envisioned design of the wearable patch is inspired by the layout design of a microcontroller and design patterns of Kenyan adornments. (Illustration 9) The patch is intended to have assorted colour variations with the option to customise the design i.e., if the wearer prefers it to look like a wearable tattoo. (Illustration 10)

Illustration 9: Concept Idea for Wearable Patch

Illustration 10: Sample ideas of customisation of colour and design for the Wearable Patch
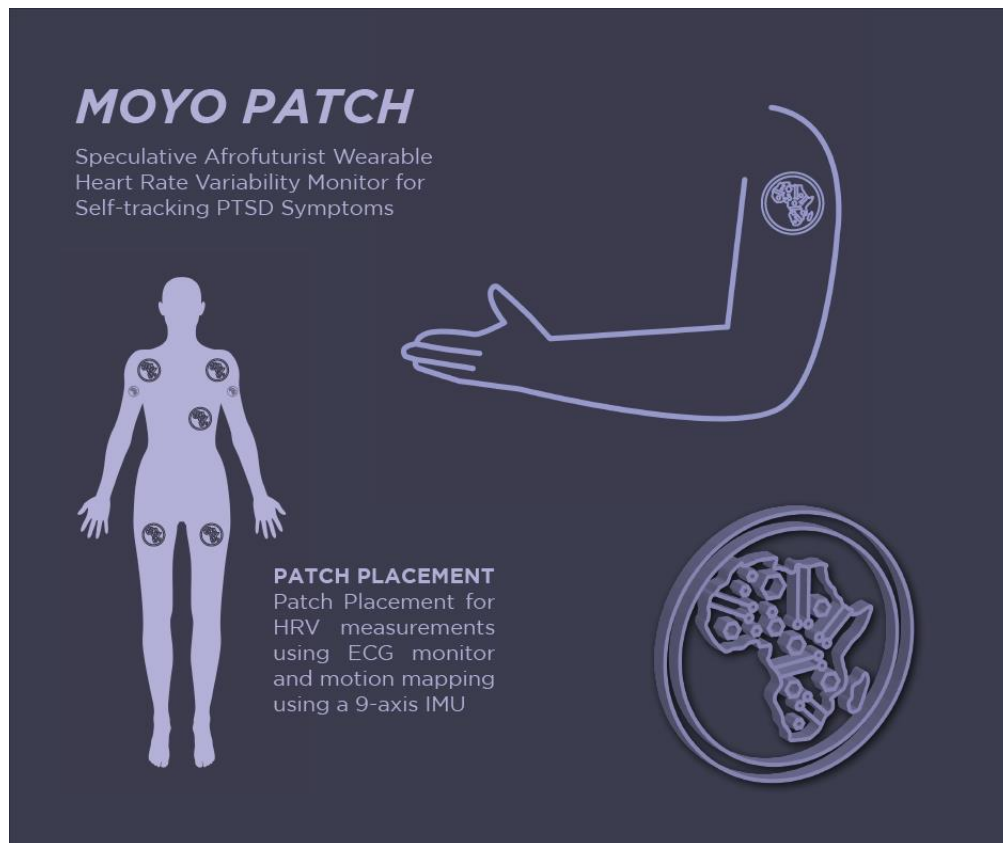
Illustration 11: The Moyo Patch envisioned

Reflection

The opportunity to customise the wearable patch offers the wearer a more individualized touch to the device, as opposed to designing a more consumer-based wearable that is intended to have one uniform design and limited customisation. This ownership of providing the wearer autonomy to decide what the wearable should mean to them highlights the importance of exploring *The Moyo Monitor* as a separate device to *The Tulia Band. The Moyo Monitor is* designed to help the wearer learn about their own healing process but also relates back to the idea of *self-empowermen*t, whereby the device allows the wearer to manage their own self-care while also deciding how they want to display the device out to the world.

The Tulia Band

The Tulia Band design draws inspiration from my Possible Futures project as this was the foundation of my thesis idea. To recap through Speculative Design, I reimagined an Afrofuturist African continent with advanced wearable technologies (Figure 17) that can heal memories from past traumas. *The Tulia Band* is imagined as a Speculative Afrofuturist

Wearable Device, that is intended to aid is self-directed PTSD treatment associated with domestic abuse for Kenyan female-identifying domestic abuse survivors. It is envisioned as an additional or complementary PTSD treatment with functionalities that borrow concepts from existing PTSD interventions.

Figure 17: Afrofuturist Wearable Devices from the Possible Futures Reflective Journal – CAD model of Afrofuturist Glasses (Left), CAD Model of Afrofuturist Cuff (Right)

The envisioned design of *The Tulia Band* draws inspiration from Kenyan design influence and symbols that represent GBV, and mental health imagined through an Afrofuturism and Africanfuturism design lens. *The Tulia Band* borrows design elements from the Kenya Band as it is symbolic and easily recognizable to Kenyans. The band is usually made with small glass beads that have the Kenyan flag colours which are a tricolour of black, red, and green with two white edges imposed. (Figure 1) While the Kenya band is not an official National symbol of unity it unites Kenyans as One Nation. As purple is the colour that represent GBV awareness it is incorporated into the design of *The Tulia Band* to raise awareness of GBV in Kenya. Lastly the colour green is symbolic as it represents mental health awareness and is also use in the design of *The Tulia Band. (*Illustration 12*)*

The role of Afrofuturism and Africanfuturism is to bring all the design elements together to reimagine a futurist wearable device that aims to:

➢ Be a symbol to raise awareness of GBV in Kenya

➢ Empower the wearer to take charge of their own mental well-being

➢ Create a sense of connection and belonging among domestic abuse survivors
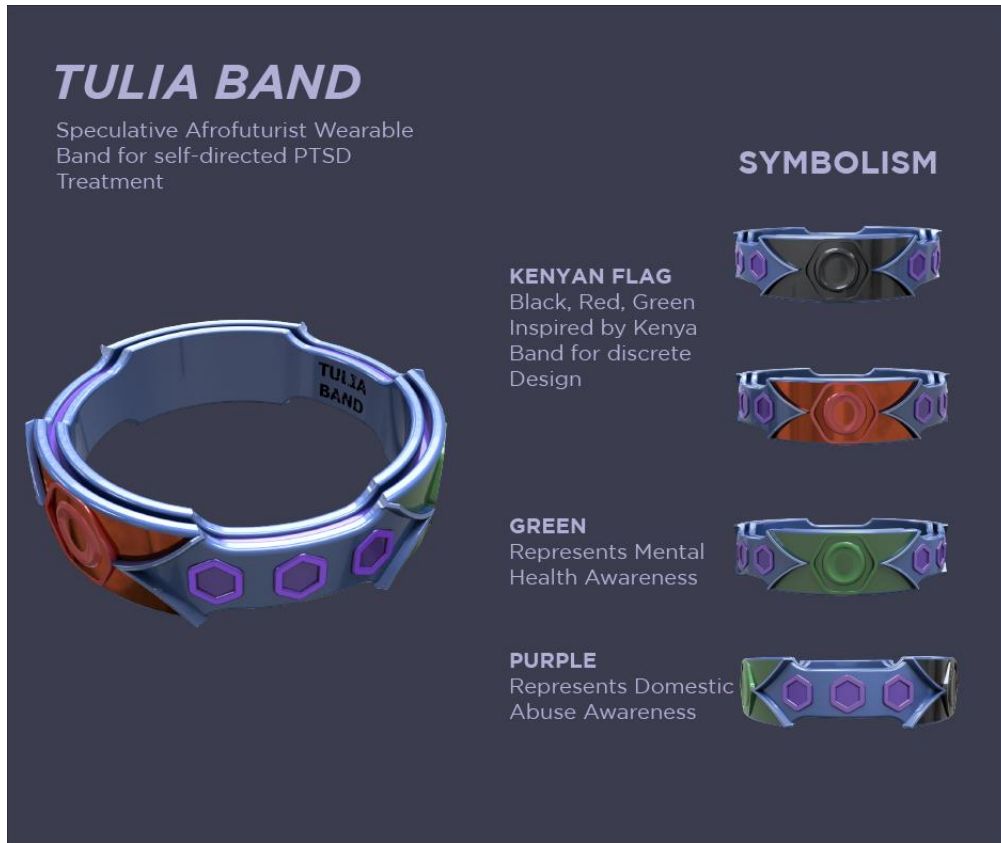
Illustration 12: Design Influence of The Tulia Band

Presently *The Tulia Band* has three modes of function that include Haptic Breathwork, Visual Breathwork and EMDR based therapy (Illustration 13). However, it has the potential to be modified based on the user's needs. Some of the envisioned features of the band include:

- Talk therapy – that works by allowing the user to speak to a health care professional or counsellor from the band.

- Ambient Awareness – that works by offering the user a sense of companionship by discretely sending an alert when two or more users are nearby and wearing the device.

- Fits like a glove - this feature allows the band to automatically adjust to the user's wrist size to offer comfort whenever it is being worn.
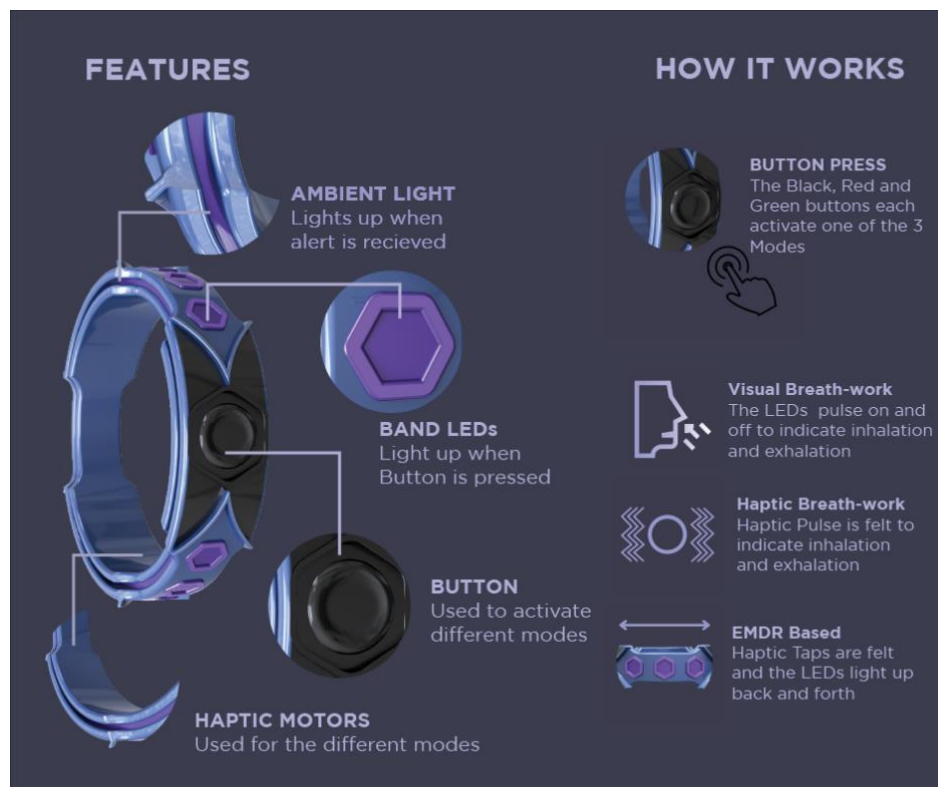
Illustration 13:Tulia Band Features and How it Works

Figure 18: A friend and I wearing the envisioned Tulia Band 3D printed prototype

Reflection

The Tulia Band is envisioned as a speculative wearable device for self-directed PTSD treatment, as well as a symbol for raising awareness of GBV in Kenya. Merging the two concepts aims to convey meaning to both the intended users who are Kenyan female identifying domestic abuse survivors and the Kenyan community at large. Therefore, the design is intended to empower the wearer to be a steward of their own health and healing and aims to raise awareness of GBV in Kenya to the Kenyan community at large. *The Tulia*

Band in comparison to *The Moyo Monitor* communicates a more outward message from the wearer but maintains subtly of the functionality and use of the device. Through the design process one unintended outcome of *The Tulia Band* was the creation of the *Tulia Tu Band* (See Illustration 14) that is envisioned as a speculative symbol for domestic abuse awareness designed to be worn by the wider Kenyan Population. The band is also envisioned to convey the same powerful meaning of the Kenya Band that is viewed as a symbol for national unity.

Illustration 14: Tulia Tu Band design

Figure 19: A friend and I wearing the envisioned Tulia Band and Tulia Tu Band 3D printed prototypes

5. CONCLUSION, REFLECTIONS AND FUTURE WORK

5.1 CONCLUSION

This thesis was inspired by my interest in mental health and trying to understand the perception and stigma surrounding it in Kenya. While this falls under a much larger topic of discussion, it paved the way for exploration into Gender Based Violence (GBV) in Kenya and the associated mental health effects which led me to PTSD. I set out to explore wearable technology to reimagine speculative PTSD treatment for female-identifying domestic abuse survivors in Kenya. Through this research I explore current PTSD interventions and worked to prototype speculative wearable devices that could complement or add to existing PTSD treatments.

The project was informed by my background in Industrial Design and my interest in wearable technology. The prototyping process explores design for health situated within speculative design envisioned through an Afrofuturist design lens. As the wearable devices are intended for Kenyan female-identifying domestic abuse survivors it was important to draw design inspiration from Kenyan culture to relate to a Kenyan audience. Hence the design of the wearable devices blends Afrofuturism and Africanfuturism with design influence from Kenyan culture. Aside from design, functionality of the wearable prototypes was also explored. Therefore, the wearable prototypes borrow concepts from existing PTSD interventions envisioned to aid in speculative self-directed PTSD treatment.

The research documents the development of *The Moyo Monitor* (The Heart Monitor) and *The Tulia Band* (The Calm Band) which are the two wearable prototypes made in this project. The two wearable devices have separate uses: *The Moyo Monitor* is intended for data collection of biomarkers used to monitor PTSD symptoms, while *The Tulia Band* is designed for speculative PTSD treatment. The importance of separating the uses of both devices aims to allow the wearer autonomy to understand the changes in their mental health and empowers the wearer to manage their mental wellbeing and healing. The designs of the wearable prototypes are inspired by Kenyan cultural adornments, Afrofuturism, Africanfuturism and symbolisms that raise awareness of GBV and mental health. By blending these ideologies and

frameworks the role of design is intended to empower female-identifying domestic abuse survivors as well as raise awareness of GBV in Kenya. Therefore, *The Moyo Monitor* which is designed as a speculative wearable patch offers the wearer the option to customise the design according to wearers personal preference. While *The Tulia Band* is designed as a speculative wearable band intended to be an outward symbol to highlight the importance of GBV awareness in Kenya.

5.2 REFLECTION ON THE PROJECT

The working wearable prototypes consist of *The Moyo Monitor* which is designed as a wearable biosensor to aid in continuous monitoring of heart rate data and motion mapping. While *The Tulia Band* is designed to aid in self-directed PTSD treatment based on existing PTSD interventions that has three modes of function. The envisioned Afrofuturist wearable devices include *The Moyo Patch* that draws its design influence from body art and Kenyan adornment designed as the circuit layout of a microcontroller with the option for colour and design customization. While *The Tulia Band* draws its design influence from the Kenya band that has the tricolours of black, red, and green of the Kenyan flag. It also uses green within the symbolism of the colours to represent Mental Health Awareness and purple to represent Domestic Abuse Awareness.

The prototyping process had both positive outcomes and challenges. Reflecting on the project the wearable devices are designed as separate pieces which allowed me to explore biosensing methods with *The Moyo Monitor* and the envisioned speculative PTSD treatment with *The Tulia Band*. Designing the wearables as separate devices offered me the opportunity to learn more about the wearable technology however, it was also difficult to keep track of all the separate pieces. Through my personal experience and the interactions with the wearable devices from the Digital Futures Exhibition it would be worth exploring the possibility of combining the two devices as one in the next iteration. One unintended outcome from of *The Tulia Band* was the *Tulia Tu Band* that is envisioned as a speculative symbol for domestic abuse awareness designed to be worn by the wider Kenyan Population.

3D printing was the main method of prototyping used to design the wearable devices as it was easily available however, I did not get the opportunity to use the intended colours for the final design. Further exploration of different materials could offer the opportunity to have a more finished look of the envisioned design. One of the features I hoped to explore during the making process was networking of the devices. This feature would allow two users wearing the band close to each other have their bands communicate. The idea is to foster a sense of togetherness and community and would work by sending out an ambient alert using haptic vibration. While this feature is yet to be explored the idea received positive feedback from the interactions with the wearables during the Digital Futures Exhibition.

5.3 REFLECTION ON METHODOLOGIES AND CONTEXTUAL FRAMEWORK

The research process involved exploration into domestic abuse, its effects including PTSD and its treatments. Through Health Design Thinking, I was able to conceptualise my idea of designing a wearable device. Initially, I envisioned designing a new mental health wearable product however, this proved to be a challenge as extensive research is required in the creation of new medical products. By scoping down the research to focus on PTSD associated with domestic abuse I employed Modular Design in the prototyping process to explore design and functionality of the speculative PTSD wearable devices. This proved to be beneficial as it allowed for deeper exploration into design for wearability and designing more empathetically.

Afrofuturism within this research was a gateway into reimagining new modalities of the discussions surrounding mental health and domestic abuse. It offered a framework beyond design and brought forward ideologies of empowerment and inclusivity for a topic like GBV that is otherwise viewed with stigma in Kenya. In terms of design, both Afrofuturism and Africanfuturism worked to help me situate the work to relate to a Kenyan audience by blending the ideologies from both frameworks within a Kenyan context. Through the exploration of other Kenyan Afrofuturist creators, artists, and designers I was able to link ideas that are rooted within Kenyan culture to help me realise the outcome of the project.

The wearable devices designed in this thesis project presently function as proof of concept and have the potential to be fully functioning wearable devices for use if introduced as a PTSD wearable treatment in Kenya. Speculative Design within the research and prototyping process created interesting outcomes of the envisioned wearable devices. One of the unintentional outcomes of the development of the wearable devices was the creation of the *Tulia Tu Band* that had design influence from *The Tulia Band*. Speculative Design was also used as a framework to reimagine the possibility of PTSD treatment using wearable technology. This was done by looking at past cultural adornments from Kenyan culture and incorporating these elements into the envisioned design of the wearable devices. The idea was to intersect past designs with futurist design elements of the wearable devices to solve a present-day problem of offering domestic abuse survivors an additional PTSD treatment.

5.4 FUTURE WORK

The next stage of this thesis project will be to bring together the design and functionality of both *The Tulia Band* and *The Moyo Monitor* to have fully functioning prototypes of the envisioned design. This will entail exploration of smaller microcontrollers and sensors to fit into the envisioned design of the wearable devices. As networking using BLE is one of the intended features of the wearables, development of this feature will be explored and incorporated in the next iteration. As one of the challenges I faced throughout the making process was designing *The Moyo Monitor and The Tulia Band* as separate devices possibly merging both devices as one wearable could be considered in the development of the next iteration. Lastly exploration of different materials of the wearable would be beneficial in the design process to allow for more customization possibilities.

User testing is an important part for further development of the wearable devices this is intended to be done with healthcare practitioners to gain insights on functionality. User testing will allow me to gain insights into the current physiological sensing methods used in *The Moyo Monitor* which include HRV sensing and motion mapping. The user testing will also allow for deeper exploration of other physiological sensing methods that would be beneficial to incorporate into *The Moyo Monitor*. Gaining insights from the perspective of health care

professionals could potentially offer more practical functionality of *The Tulia Band* based on expert advice and make discoveries for ways to improve the current functions.

With the action plan set in place by the Kenyan government to end GBV by 2026, user testing with government healthcare institutions could potentially lead to further exploration and development of the wearable. Seeking expert advice from health care professionals to further develop the wearable devices could potentially open pathways for collaboration with stakeholders of the Komesha Dhuluma campaign (Kobia 2021). The wearables could also be designed to work with the Komesha Dhuluma app (Komesha Dhuluma n.d.) and the *Tulia Tu Band* could function as a symbol for the campaign. As the wearable devices are intended for PTSD treatment working with healthcare professionals could open up the possibility of exploring other mental health and wellness treatments.

As craft making in Kenya is sometimes used as a method of upskilling domestic abuse survivors in Kenyan safe houses and shelters, potentially collaborating with women shelters and safe houses in Kenya to run workshops and co-design sessions could be beneficial as a way of involving the potential users as part of the design process. Workshops could be developed to teach domestic abuse survivors how to construct the wearable devices as the tools used to make the wearable devices are relatively accessible. The co-design sessions will be an open forum for collaboration in design of the wearable devices through brainstorming, mood boarding and prototyping.

One of the potential outcomes of the co-design sessions could allow for further exploration of materials used to construct the wearable devices. Incorporating more traditional craft making practices into the design process of the wearables using materials such as beads, shells, and clay could offer more customization options. Blending ideas of digital design with analogue outputs could provide interesting interactions with the wearable devices, adding a fidget feature using beads as one example for exploration. Through the workshop sessions development of the functionality for the devices can be informed by the user to allow for customization based on user specific needs as the effectiveness of the functionalities can vary from person to person.

Addressing affordability and privacy are beyond the scope of this thesis but are both crucial in proposing wearable technology as a speculative treatment for PTSD. Therefore, exploration of parts and materials of the wearables will be part of the next stage of this project as well as learning about data collection and privacy of wearable technology.

5.5 ENIVISONED USER JOURNEY MAP

The wearable devices are designed for use by Kenyan female-identifying domestic abuse survivors and are intended to complement or add to existing PTSD interventions offered by healthcare institutions. In partnership with women shelters and safe houses in Kenya that cater to domestic abuse survivors the wearable devices are intended to be distributed from these locations. The parts and materials used to construct the wearable devices will be locally sourced and made in Kenya to reduce the construction costs. If the wearable devices are accepted by users and are feasible to make and distribute eventually the idea will be to partner with interested stakeholders to fund the project to provide the wearables for free.
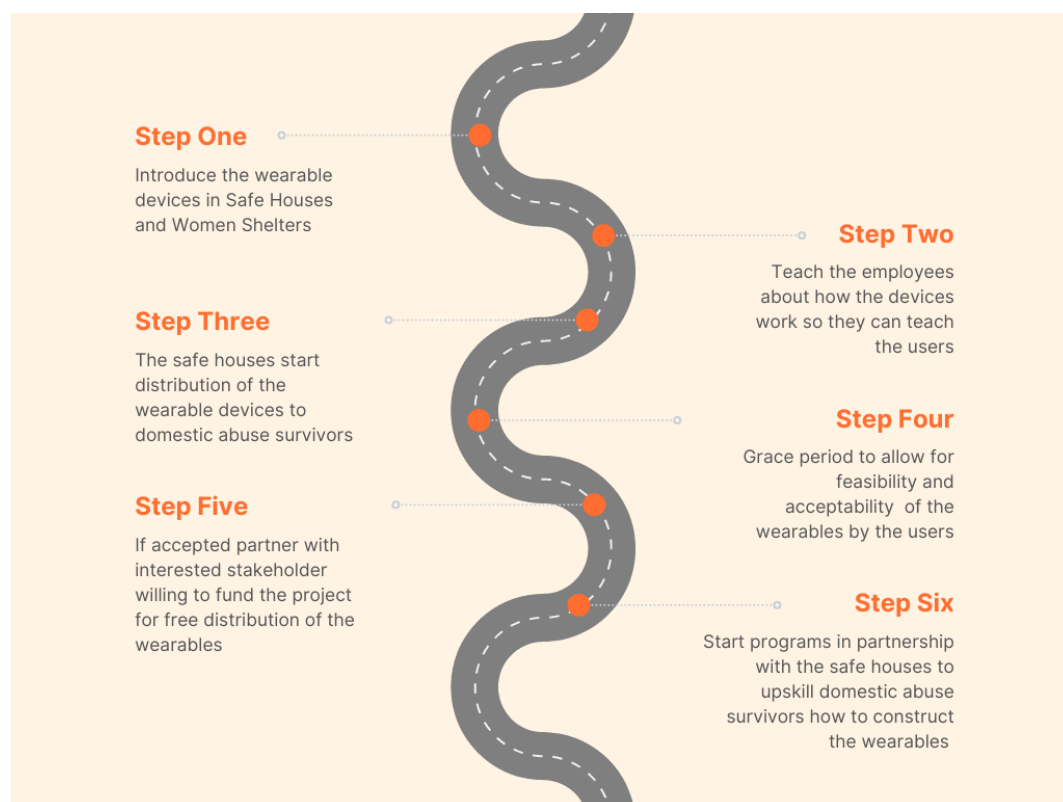

Step One
Introduce the wearable devices in Safe Houses and Women Shelters

Step Two
Teach the employees about how the devices work so they can teach the users

Step Three
The safe houses start distribution of the wearable devices to domestic abuse survivors

Step Four
Grace period to allow for feasibility and acceptability of the wearables by the users

Step Five
If accepted partner with interested stakeholder willing to fund the project for free distribution of the wearables

Step Six
Start programs in partnership with the safe houses to upskill domestic abuse survivors how to construct the wearables

Illustration 15: User Experience Journey Map

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APPENDIX A: EXIBITION POSTERS

Illustration 16: Poster explaining the overall project

Illustration 17: Poster explaining The Moyo Patch

Illustration 18: Poster explaining The Tulia Band

HOW IT WORKS

- The Tulia Band is designed with 3 modes for self-directed PTSD Treatment.
- It connects to the Moyo Monitor using Bluetooth to receive alerts.
- It has a proximity sensor to detect when someone nearby is wearing the band.

BUTTON PRESS
The Black, Red and Green buttons each activate one of the 3 Modes

SYMBOLISM

Visual Breath-work
The LEDs pulse on and off to indicate inhalation and exhalation

KENYAN FLAG
Black, Red, Green inspired by Kenya Band for discrete design

Haptic Breath-work
Haptic Pulse is felt to indicate inhalation and exhalation

PURPLE
Represents Domestic Abuse Awareness

EMDR Based
Haptic Taps are felt and the LEDs light up back and forth

TULIA TU
Support band to Raise awareness of Mental Health and Domestic Abuse

Illustration 19: Poster explaining how The Tulia Band works

APPENDIX B: EXHIBITION IMAGES

Figure 20: Graduate Thesis Exhibition Display at 0CAD University