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INTEGRATING E-WASTE AND VEGETABLE-TANNED LEATHER TO PRODUCE FASHION ADORNMENTS

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ABSTRACT

Purpose: This study explores the possibility of integrating junk electronic objects and variedly dyed and painted pieces of vegetable-tanned leather to produce fashion accessories.
Design/Methodology/Approach: The qualitative study is grounded in an art-based research (ABR) design. The researchers produced the ornaments using techniques such as soldering, beading, braiding, painting, dyeing, spraying, marbling, thonging, sawing, cutting, and tying.
Findings: The study suggested integrating vegetable-tanned leather and junk electronic objects to produce various fashion accessories. Thirty-nine items were produced, including bags, belts, footwear, earrings, bracelets, and necklaces. Images of these products are duly captured in this paper.
Research Limitation: This research explores the feasibility of integrating vegetable-tanned leather with junk electronic objects to produce fashion adornments. However, the study is limited in evaluating the products' safety and consumer perception. Further studies are needed to shed light on the above.
Practical Implication: Combining e-waste with vegetable-tanned leather to produce fashion accessories is a progressive enterprise that can produce sustainable and environmentally friendly fashion products.
Social Implication: E-waste is dumped in landfills and littered carelessly around the environment. Integrating these waste materials into utilitarian articles can minimise their damaging environmental effects and allow creative people to produce valuable articles for society.
Originality/Value: This study presents innovative accessories that can inspire creative people to transform discarded electronic objects into valuable adornments of various forms, textures and colours.

Keywords: *Accessories. adornments. e-waste. jewellery. leather*

INTRODUCTION

With the ceaseless technological advancement, the mounting heap of obsolete articles and equipment occurs frequently in every society worldwide. Products become obsolete due to defects, excessive wear, overuse, changes in consumer preferences, or the introduction of

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newer, more advanced items, rapidly disposing of older yet functional products. One of the fastest-growing classes of junk in most societies around the globe is electrical and electronic equipment (EEE) waste (E-Waste).

Over the past two decades, many EEEs have been imported into Ghana. In 2009, for example, it is on record that 215,000 tons of EEEs were brought into the country from Europe, the USA, and East Asia. Of these volumes, 70% are used devices, and 15% of the remaining gadgetry is classified as non-functional products (Höltl et al., 2017). Prakash et al., (2010) articulate that many Information and Communication Technology (ICT) related EEEs have been imported into the country to support and drive Ghana's ICT for accelerated development policy. Oteng-Ababio (2012) observed that a substantial volume of these ICT gadgets are used or refurbished products. These new, used, or refurbished devices break down over time, leading to the build-up of e-waste in Ghanaian society. The situation is even getting more alarming, with many companies deliberately planning and designing the obsolescence of their products by changing their software structures or ceasing support for older models (Cho, 2018).

Paradoxically, though e-waste is a menacing challenge and threat to society, it also creates opportunities for income generation (Oteng-Ababio, 2012). Aykanat (2014) avers that junk is generally "one of those new inspirations in contemporary art" and is waiting to be repurposed into novel works. Over the years, many societies have repurposed detritus into valuable items.

Indeed, artists have been inspired by detritus since time immemorial. Junk art is an established art genre seen in many societies across the globe (Chichi et al., 2024). Many ingenious artists have produced assemblages from myriads of electronic discards, demonstrating the possibility of repurposing e-waste into valuable art objects. The continuous build-up of e-waste in our societies presents extensive opportunities for artists and designers to find ways to reuse these junk materials in utilitarian articles to minimise the dangers posed by these waste items.

EEEs contain many micro components with various shapes and colours, which could be combined with other materials to create alluring products. This study aims to integrate various components from waste EEEs with vegetable-tanned leather to produce fashion ornaments. The researchers contend that mass artistic repurposing of e-waste into utilitarian assemblages is an environmentally friendly option for minimising the accumulation of e-waste in our societies. It could equally be one of the most responsible ways of converting these discards into wealth (Kayode, 2006). Indeed, as the world's heap of e-waste grows exponentially, finding creative ways to utilise it has never been more important.

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LITERATURE REVIEW

E-Waste

Electrical and electronic equipment (EEE) are employed in every human activity and contribute significantly to global development. Science and technology are making it possible to integrate electrical and electronic components into virtually every object. EEEs are progressively utilised in household appliances, telecommunication gadgets, Internet of Things (IoT), vehicles, security systems, power generation appliances, garments, furniture, and health diagnostic and treatment equipment (Forti et al., 2020).

EEEs break down over time or may be discarded by their owners without being reused. They become electronic junk, commonly called e-waste, WEEE (waste electrical and electronic equipment), or EEEs (Step Initiative 2014). Forti et al. (2020), StEP Initiative (2014) and Oteng-Ababio (2012) explain that the above designations broadly refer to all old, defective, obsolete EEEs or wastes generated from them. StEP Initiative (2014) further articulates that e-waste, WEEE and EEEs include all obsolete products with power cables or buttery supply systems.

United Nations Environment Program (UNDP) (2007) categorised e-waste into three groupings: large household appliances, information technology telecom gadgets and consumer equipment. The above gadgetries possess distinct components such as metals, compressors, plastics, activated glasses, lead capacitors, cathode-ray tubes, wires, transformers, circuit boards, fluorescent lamps, brominated flamed retardant (BFR) and polychlorinated biphenyls (PCBs) (Iqbal et al., 2017; Carpenter, 2015; Oteng-Ababio, 2012; UNDP, 2007).

E-waste is one of the fastest sources of waste worldwide (Brune et al., 2013; Lundgren, 2012; Widmer, 2005). In 2019 alone, Forti et al. (2020) reported that 53.6 million metric tons of EEE waste had been generated around the globe, with the volume expected to increase to 74.7 million metric tons by 2030. In many instances, e-waste is disposed of in environmentally unfriendly ways, with an astonishing volume of these wastes reaching developing countries such as Ghana (The Royal Australian College of General Practitioners (RACGP), n. d.).

Fashion Accessories

Fashion accessories, generally, are any items that can be used to complement and enhance the overall outlook of an outfit (Cumming et al., 2010). Fashion accessories consist of items that are worn and those that are carried (Cumming et al., 2010). The authors explain that the accessories may include bonnets, caps, hats, shoes, cravats, ties, gloves, and mittens. The others are muffs, jewellery, scarves, shawls, socks and stockings. Those that are carried consist of bags, canes, fans, parasols, umbrellas and swords (Cumming et al., 2010).

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Various clothing and decorative accessories have been used in many civilisations since dawn. There is evidence of the use of fashion accessories by our Neanderthal antecedents (Schwarz, 1979). Equally, Palaeolithic graves have yielded various accessories such as necklaces, bracelets, anklets and girdles crafted from stones, shells, animal teeth and fish vertebrae, suggesting their use during this period (Hill, 2011). Further evidence of the production and use of jewellery around the Neolithic period also exists (Sandlin, 2013). Sandlin further articulates that ancient Egyptians complimented their garments with necklaces, rings, bracelets, anklets, hair ornaments, and various amulets. The Romans during the ancient period are also on record for using costly and ornate garment accessories such as necklaces, armbands, breast chains, brooches and hairnets crafted in gold (Sandlin, 2013).

Fashion adornments in ancient times were not merely used as tools of decoration. They were deliberately employed to convey wealth, status, modesty, and religion and as objects that offer spiritual protection and good luck to the wearer (Lang et al., 2020; Sandlin, 2013; Hill, 2011; Swift, 2004). Fongeallaz (2016) elaborates that fashion accessories are considered beautifiers, strategically employed to direct attention to specific areas of a garment or body parts. They may also be used as tools of allurement or employed to project power, desire, sensuality and romance, especially in public spaces (Fongeallaz, 2016).

Vegetable-Tanned Leather

Leather is a flexible, durable, and non-putrescible material processed from the hides and skins of some selected animals through a process known as tanning (Duraisamy et al., 2016). Leather possesses admirable qualities such as high tensile strength, hydrothermal stability, good breathability, and appreciable chemical resistance (Falcão & Araújo, 2018; Kesarwani et al., 2015), making it suitable for the production of a host of valuable articles.

Vegetable tanning is one of the numerous techniques for converting animal hides and skins into leather. This organic tanning technology dates back to 400 BCE and is believed to have been used by Egyptians and Hebrews during this period (Vijayaraghavan, 2021; Rubel, 2013). The method uses tannin-containing vegetative materials such as tree barks, leaves and fruits, which are employed in a chemical process to bond with the collagens of the hides and skins, converting them into a variety of leather mostly referred to as vegetable-tanned leather, bark-tanned leather or veg tan (Vijayaraghavan, 2021; Mahdi et al., 2006).

Vegetable-tanned leathers have rich and warm natural colours (Cope, 2021) and possess high tearing and tensile strength, flexing endurance, admirable insulation properties, good moisture absorbing abilities, as well as excellent flexibility, breathability and moisture transmitting capabilities (Bi, 2006; Jones, 2000). Additionally, Cope (2021) and Jakoben (2016) concurred that vegetable-tanned leathers are bio-degradable and environmentally friendly. Jakoben adds that it also possesses an “earthy smell”, is hard-wearing, and develops patinas over time, imbuing them with unique aesthetic characteristics.

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Vegetable-tanned leather is mainly used for stamping, machine embossing, hand tooling, moulding and wall hangings (Laier & Laier, 2019; Falcão et al., 2018). They are equally employed in the furniture upholstery, garment, shoe, bookbinding, and saddlery industries (Koloka & Moreki, 2011; Mould et al., 2003).

Vegetable-tanned leather can be ornamented with various decorative techniques, such as cut-out designs, dyeing, painting, embroidery work, scorching, gilding, and sewing, to convert it into valuable material for the production of a myriad of helpful articles (Falcão et al., 2018).

MATERIALS AND METHODS

This study is studio-based research grounded on an art-based (ABR) design.
ABR, which is sometimes referred to as aesthetically based research, arts-informed enquiry, arts in qualitative research, or art-based enquiry (Chilton & Leavy, 2014), is a qualitative design that uses artistic practices and methods to investigate, generate new knowledge and insights, and communicate the research findings in a way that is accessible and engaging to a broad audience (Leavey, 2009; McNiff, 2014). It is often interdisciplinary and can involve a range of creative activities that can be used to explore topics such as human emotions, cultural phenomena, and social issues (Leavey, 2017). As Leavy (2015) noted, ABR can be used at all stages of the research process, such as problem formulation, content generation, analysis, interpretation and presentation. ABR is beneficial for research activities that aspire to explore and capture processes and details (Leavy, 2017).

Materials and Tools/Equipment

Table 1. Materials Used

Materials	Uses
Vegetable tanned leather	Used for producing fashion accessories
Acrylic paints	For painting vegetable-tanned leathers
Basic dyes	Used in dyeing the vegetable tanned leathers
Adhesives (Contact glue, fabric glue, super glue and white glue)	For gluing
Sandpaper	Used for sanding and finishing the articles
Shoe Soles	Was used together with the leather to make slip-ons
Solder	This was used to mend junk e-waste objects together
Waste electronic objects	This was integrated with electronic objects to produce accessories

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Nylon thread	Was used to stitch leather and other components of the articles
Cardboard paper	This was used to cut out templates for the leather articles
Rivets and eyelets	Was used to secure bad handles, to reinforce or decorate some of the leather articles
Earring hooks	Affixed to earrings for use.
Conch	This was used to firm up the bases of some of the bags.
Velcro fasteners	Was used to fasten bag flaps.
Jump rings	For suspending electronic objects and leather pieces.
Detergent	For washing and cleaning junk electronic objects and leather.

Tools and Equipment

Table 2: Tools and Equipment Used

Tools	Uses
Scissors	Was used for cutting leather, paper, and soft conch
Hammer	Was used for hammering
Jeweller's saw	For cutting printed circuit boards
Power drill	For boring holes in printed circuit boards and electronic objects
Hack saw	For cutting printed circuit boards
Pliers	Used for cutting wires and holding objects for unsoldering
Long nose pliers	Used for creating jump rings, for bending, pulling out electronic parts and for opening and closing jump rings.
Files	This was used in filing the edges of cut-out printed circuit boards
Rules	Was used to measure and draw straight lines
French curves	Was used for measuring and drawing curved lines
Spatula	Used for scooping paint and glue
Shears	Used for cutting leather
Tape measure	This was used in taking measurement
Rotary punch	It was used in punching holes in leather for thonging
Sandpaper	Was used for smoothening and finishing the edges of some junk electronic objects.
Pencil	Was used for sketching
Sketch pad	For sketching
Cutters	Was used for cutting various materials
Lighter	Was used in melting nylon thread ends for threading

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Power drill	For drilling holes into some of the electronic components and circuit boards
Soldering iron	For unsoldering and soldering of junk electronic objects
Brushes	Was used in Painting
Awl	Used it for boring holes for thonging and stitching
Stitch markers	Used for marking leather to enable hole-punching
Needles	For stitching
Plastic containers	For washing and dyeing

Materials Sourcing and Preparation

Electronic Wastes

The electronic waste was sourced from friends, refuse damp sites, and electronic object repairers. The collected items comprised spoilt bulbs, discarded solar lamps, radios, mobile phones, television sets, computer accessories, and calculators.

The discarded electronic waste items were first disassembled, and interesting parts were extracted. The researchers were interested in components that can be integrated conveniently with vegetable-tanned leather. The materials were selected for their visual appeal, colour variability and shape. These comprised resistors, capacitors, inductors, diodes, batteries, transistors, integrated circuits, transformers, wires and printed circuit boards. The collected parts were subsequently washed with detergent and properly rinsed (Plate 1).

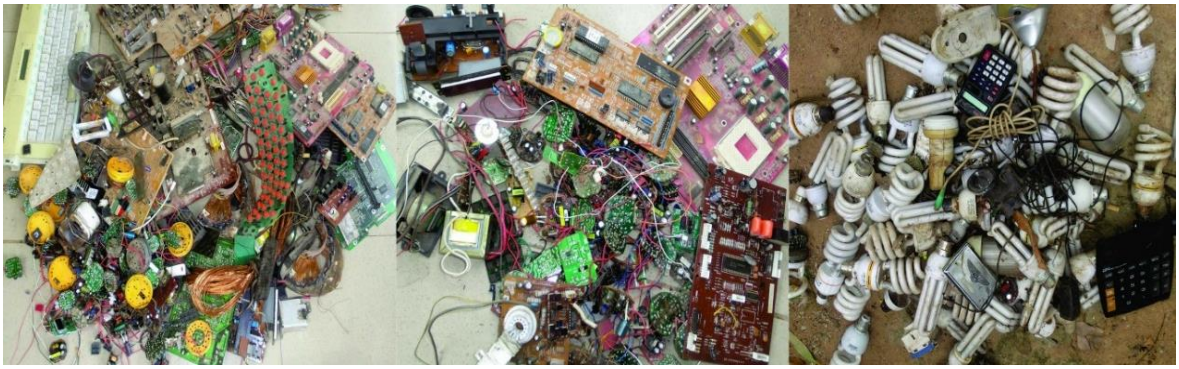

Plate 1: Some selected electronic wastes

Extraction of Electronic Components

Unsoldering was the main technique used to extract the electronic objects from the printed circuit board. The objects were unsoldered from the board with the soldering iron. This was done by gently holding the component with a long nose plier and heating the soldered lead around the pins, anchoring the electronic component to the board on the reverse side and pulling

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it gently out. Some electronic objects were also extracted from the boards by pulling them out with a plier or fingers.

Sawing of Printed Circuit Boards
The sawing technique cut printed circuit boards and metallic components into desired shapes. This was done using a hacksaw and a jeweller's saw, respectively.

Dyeing and Painting of Vegetable Tanned Leathers
Vegetable crust leather (undyed leather) was used for the project. It was bought from markets in Bolgatanga and leather tanners. Vegetable-tanned leather was specifically selected because of its organic and biodegradable characteristics, making it a cleaner alternative than chrome-tanned or faux leather. Scrap leather was also collected from leather craft producers in the region for use.

The crust leathers were washed in soapy water and rinsed properly to remove impurities and unpleasant odours. The treated materials were subsequently dyed with basic dyes using tie-dye, marbling and single-colour dyeing techniques. The dyed leathers were later dried in shady places, oiled and staked. Articles crafted from the dyed leather can be seen in Plates 2,3,4,5, 6,7, and 12. Some of the leathers were also painted with acrylic paints using brushes. The painted leathers produced some of the articles shown below in Plates 8,9,10, and 11, respectively.

Production Techniques Used
The researchers employed various techniques to produce the fashion accessories captured below. These comprised sketching, template making, stitching, thonging, glueing, sanding, braiding, drilling, cutting, hammering, and lining. The techniques employed in crafting the fashion adornments are duly explained below.

Sketch Development
The researchers produced various quick sketches to guide the production of some fashion accessories. These sketches were produced extensively, guided by inspirations from various sources. It is equally important to state that some adornments were crafted spontaneously without pre-sketches.

Template Development
Template development involves preparing templates to cut various shapes and forms. The templates were prepared to guide the leather cutting and the printed circuit boards into the desired shapes to produce the adornments. Outlines of the various sketches were transferred onto cardboard with a pencil and cut out with cutters or a pair of scissors for use.

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Ornamentation

Generally, the extracted electronic objects were used as the main embellishment objects. The objects were variously affixed based on their sizes, colours, or shapes to complement the articles. Using glueing and tying techniques, the electronic objects were glued, tied down with thongs, or affixed.

Stitching

Stitching is one of the basic techniques used in producing some of the fashion accessories. Specifically, it was used to assemble some of the bags and necklace pendants. The stitching was manually carried out using nylon threads, needles, and sometimes copper wires. See Plates 2 (left), 3 (left) and 13 for some of the stitched articles.

Thonging

Thonging is a joining technique that uses narrow strips of leather, known as thongs or laces, to secure the edges of two or more leather pieces into an article. The technique can also be used decoratively to ornament leather articles. A rotary punch bore holes in the items to be thonged to facilitate the process. The thonging method was employed to produce an assortment of adornments, such as those captured in Plates 2 (right), 3 (right), 4, and 5.

Glueing

Glueing was employed extensively in assembling the electronic objects and the leather components into the adornments shown below. The researchers mostly used super glue, fabric glue, and contact glue. The glue was first applied to both surfaces to be glued with brushes when using contact glue. Thereafter, they were allowed to touch-dry for about 15 minutes before aligning the items and hammering them gently to bond. Using super glue and fabric glues, the researchers first applied thin coats of glue to the items to be glued directly from the containers. Subsequently, the items were positioned correctly and then weighted down to adhere.

Filing

The Filing technique was also employed to smoothen the edges of cut-out printed circuit boards. This process precedes the sanding process. The researchers used rough-toothed and smooth-toothed files, starting with the rough files before terminating the process with the smooth one.

Sanding

The sanding process was carried out to smoothen the edges of cut-out printed circuit boards and, in some cases, the edges of articles such as pendants and earrings after glueing. The sanding was done with various grades of sandpapers. The researchers usually commence the sanding process with coarser sandpapers and finish smoother ones.

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Drilling and Piercing

Various holes of various sizes were also bored on various accessories captured below during the production stages. A power drill was used to drill holes in the printed circuit boards and some metallic components, while an awl and a rotary punch bore holes in the leather articles for stitching, thonging and the suspension of jump rings.

Cutting of Leather and other Materials

Scissors and a cutter were employed extensively to cut leather to produce bags, slip-on straps, earrings, pendants, and necklace strips. During production, they also cut leather thongs for thonging, bag linings, and nylon threads. Pliers were also used to cut wires and trim some of the extracted electronic accessories.

Braiding

Four-strand and eight-strand braiding techniques were used to produce some of the articles. The four-strand braiding method was primarily used to produce necklace strings, while the eight-string braiding technique was utilised in crafting the belt, as shown in Plate 4. The researchers first measured and marked the leather into the desired lengths and widths with a metal ruler to commence this process. Thereafter, a cutter, guided by a metal rule, was used to cut the leather into the desired strips for braiding. The strips were later braided using the four-strand and eight-strand braiding methods.

Tying

Tying techniques were also used to firmly secure some electronic objects on the leather articles after glueing. This was done mainly with thongs cut from leather. Plates 4 and 5 show some of these, as captured below. Wires were also decoratively used in some of the articles. Examples are shown in Plates 3(right), 6 (middle), and 10 (left) below.

Hammering

Hammering was primarily used during the glueing stages. To bond firmly, articles glued with contact glue were gently hammered with a hammer or rubber mallet. Some thonged articles, such as pendants, were also hammered at the edges to flatten the thongs and reduce the thickness of the article.

Lining

The lining was used on the flesh sides of the bags and purses presented below. The materials used were mostly leather and polyester fabrics. Depending on the article being produced, these were glued mostly with fabric or contact glue.

Fixing of Finishing Accessories

Various accessories were affixed to some of the articles. These comprised eyelets, rivets, jump rings, earring hooks, head pins, eye pins, press studs, zippers, and velcro fasteners.

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FINDINGS AND DISCUSSION

Design, Prototyping and Production

Thirty-nine assorted fashion adornments were produced using different techniques as described above. Painted and dyed vegetable-tanned leather formed the structural bases and shapes on which the myriads of e-waste components were creatively mounted to produce the accessories. Glueing, tying, stitching and thonging techniques were used to affix the e-waste parts onto the leather surfaces to create textural contrast. The industrial ruggedness of the e-waste components blended harmoniously with the smooth softness of the leather parts, aesthetically complementing each other. The vibrant colours of the dyed and painted leather parts created a visually striking balance with the e-waste.

Art-based methods enabled a comprehensive and creative exploration of e-waste and leather materials to produce wearable accessories. The methodology facilitated intricate detailing and artistic integration of the various materials, resulting in the design and production of novel aesthetic products. This method connects artistic exploration with sustainable design innovation. It demonstrates how creative fields can be utilised to tackle global environmental challenges, establishing artistic innovation as a vital element of sustainable development.

Various prototypes were initially produced, using varied combinations of dyed and painted vegetable-tanned leather and e-waste to make bags, belts, slip-ons, earrings and necklace pendants. Generally, the researchers aimed to create minimalistic products that blend the rugged charm of e-waste with the smooth and supple texture of vegetable-tanned leather to impact the resonance needed in the compositions (Hekkert, 2006). Prototyping aided the researchers in arranging the e-waste components in visually compelling patterns and textures, offering a clear design hierarchy while adhering to established artistic principles (Norman, 2004; McDonough & Braungart, 2002). It was observed that small and coloured components such as capacitors, transistors, inductors, diodes, resistors and wires provided rich colour contrasts, while more prominent elements like circuit boards, rubber and metallic parts served as focal points in the design arrangements. This supports the findings of Chancerel et al. (2009), who observe that e-waste components display distinct colour variations and texture, making them ideal for various creative applications.

Traditional leather crafting and assemblage techniques were experimented with to ensure the integration of the e-waste and leather components. The researchers relied heavily on manual craftsmanship techniques during the production stages. Essentially, each piece of adornment produced is unique due to the random nature of the e-waste material used. The stochastic features of e-waste materials, as noted by Juniper (2003), reflect wabi-sabi design principles, which emphasise the beauty of simplicity, authenticity and imperfection. The methods used for dyeing and painting the vegetable-tanned leather create various colour tones that enhance the texture and colour of the e-waste parts. This shows how innovative surface treatment and

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material integration, as Fletcher (2008) observed, can transform materials into unique artistic products.

Assemblage Integrity and Wearability

All products underwent user trials to assess their comfort, integrity and durability. These trials align with standard procedures in product usability testing, where user-centred evaluations provide insights into new products' functional and ergonomic performance (Norman, 2013). The users were asked to focus on each accessory's weight, comfort and feel. The products were tested for a duration of two to three months. The results revealed that while most of the accessories met basic durability standards, additional reinforcement was needed to strengthen some products, particularly those with more significant e-waste parts. The smaller and lighter products showed excellent wearability. The test results prompted the researchers to address the shortcomings of each product class, emphasising the need for iterative design improvements based on user feedback, as suggested by IDEO (2015).

Production Challenges

The study revealed that traditional leather crafting and jewellery production techniques alone could not secure and incorporate some e-waste materials into the leather parts. The e-waste components require careful handling and innovation during the integrating stages, so the researchers had to adapt innovative methods.

Balancing leather and e-waste also required careful consideration, as certain configurations were too heavy or lacked aesthetic cohesion. Varied experimentations during the design and prototyping stages extensively aided in streamlining the process, echoing Schön's (1983) model of reflective practice in design problem-solving. This iterative process enabled better visualisation of how to balance the organic leather with the more rigid e-waste.

Fashion Adornments

Below is a selection of fashion adornments from the research. These include bags, a belt, a slip-on, earrings, and necklace pendants.

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Bags

Plate 2: Bags (a)

Plate 3: Bags (b)

Belt

Plate 4: Slip-on

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Slip-on

Plate 5: Slip-on

Earrings

Plate 6: Earrings (a)

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Plate 7: Earrings showing the back and front (b)

Plate 8: Earrings (c)

Plate 9: Earrings (d)

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Plate 10: Earrings (e)

Plate 11: Earrings (f)

Necklace Pendants

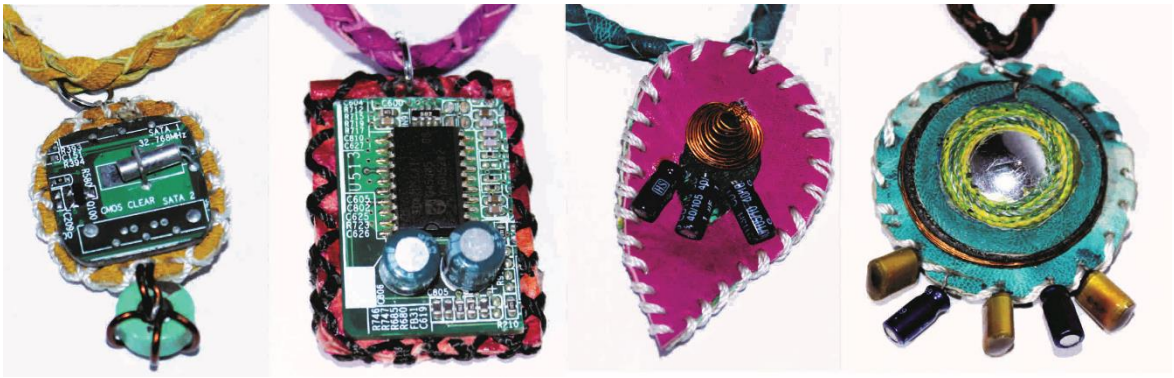

Plate 12: Necklace pendants (a)

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CONCLUSION

The accelerated build-up of E-waste worldwide is a worrying phenomenon. It is forecasted that the volume of EEE wastes worldwide could reach 74.7 million metric tons by 2030, which is alarming. Every effort must be made to reduce the volume of e-waste to minimise its adverse environmental effects.

The outcome of this study revealed that electronic waste can be creatively repurposed in various ways to produce valuable articles that can benefit society. By blending these two contrasting materials, the study explored the fusion of nature and technology in addressing the global issue of electronic waste and raised awareness about the menace. The integrated fashion accessories from the study are just a few creative products that could be crafted from waste electronic objects. Various e-waste components could be innovatively repurposed into mixed-media paintings, collages, light-based art installations, or kinetic sculptures. The advantages of producing helpful articles and artworks from waste electronic objects include the ability to up-cycle materials that may otherwise end up in landfills, choking farmlands and drains, polluting groundwater bodies and posing various health risks. Up-cycling also provides a creative outlet for those with artistic knowledge to evolve unique articles of value for society. Additionally, repurposing waste materials into utilitarian artefacts can help conscientise society about the need to work together to reduce the environmental impact of waste by crafting them into environmentally friendly products.

The researchers believe artistic repurposing e-waste into utilitarian articles is a socially responsible way to reduce the damaging environmental impact of discarded electronic objects. Indeed, this approach can be explored further to repurpose other technical wastes into essential utilitarian accessories.

Longitudinal studies are needed to evaluate the long-term environmental impact of e-waste and vegetable-tanned leather accessories. The authors equally proposed exploring opportunities for community involvement, such as supporting local artisans or engaging in social initiatives that promote sustainable and environmentally friendly production of adornments for the fashion industry. Further studies are also needed to explore additional methods of enhancing durability and expanding the design possibilities of e-waste-integrated adornments.

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