‘Levels of Electronic Integration within Textiles’ Chart

A visual categorization system to allow collaboration between Engineers, Computer Scientists, and Textile Designers to produce industrially-feasible Electronic Textiles

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ABSTRACT

The state of the art in electronic textile (e-textile) research are not currently commercially viable/industrially feasible due to technical challenges around the architecture (reliability of exposed electronics, lack of flexibility), data security and production equipment. Hence, it is important for engineers, computer scientists, and textile designers in this field to have a universal understanding whilst collaborating to develop e-textile products. To simplify this, this paper introduces an ongoing design of a novel categorization chart that measures the extent of electronic integration within textiles. This chart can indicate how textiles’ level of electronic integration impacts the its degree of computational intelligence, necessary security, commercial viability and industrial compatibility.

CCS CONCEPTS

• **Applied Computing → Physical Sciences and Engineering**; • **Hardware → Emerging Technologies**; • **Social and Professional topics → Computing/technology policy**

KEYWORDS

Electronic Textiles, Categorization System, Wearable Technology, Electronic Integration, Flexible Electronics, Textiles.

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1 INTRODUCTION

There have been attempts to create standardised definitions for a clearer distinction between different types of e-textiles based on their functionality and practicality [1]. This has been completed via EU-funded projects such as Dephotex [2] and pioneers of the e-textile field like Xiaoming Tao [3]. However, due to advances in flexible electronics for textile applications [4], miniaturization of mobile and tablets electronics, and increasing computational power, these definitions have become outdated. Therefore, an updated standardization that includes the textiles featuring the smallest electronic and computation components available in the market is needed. This will unify understanding of different types of e-textiles, hence easing collaboration [5] between different research fields that are familiar with different terminologies and definitions.

2 THEORY: HOW TO USE THE CHART

This chart was inspired by The Smith Chart [6] used in Radio Frequency (RF) circuit analysis to solve reflection coefficient values. The ‘Levels of Electronic Integration within Textiles’ chart uses a hierarchical, graphical mapping method to intuitively categorise and define types of technological textiles and subsequently their level of electronic integration by going left to right.

Left: Conductive textiles (only having metallic fibres) cannot be classified as electronic textiles due to their lack of electronics – hence the red dividing line. Electronic textiles have incremental displays of intelligence – represented as the colour gradient. Though, ‘Smart Electronic Textiles’ are only passive and active whilst ‘Intelligent Electronic Textiles’ are only active or function through artificial intelligence (AI) means.

Middle: The table shows that greatest extent of electronic integration in textiles is dictated by the size of electronics to be used - applies for electronic textiles only. The greatest level of electronic integration would be at yarn-level whereby hardware and computation would occur at the core of a yarn. Weaving these electronic yarns make a flexible e-textile.

Right: Bronze to Platinum hierarchy represent a grading system to evaluate how functional the textile is. The far-right circle categories how industrially feasible the electronic textile would be to manufacture.

For example, this chart can correctly describe Google and Levi Jean’s gesture-control jacket [7] as a *conductive textile* as only metallic fibres are in the fabric. Conductive textiles are not intelligent or smart so describing the jacket as ‘smart textile product’ is incorrect. If its electronics were in the fabric and not a rigid, detachable electronic cuff, it would be an Electronic Textile, with some degree of intelligence due to its wireless communication abilities, which include cybersecurity algorithms to protect its sensitive data.

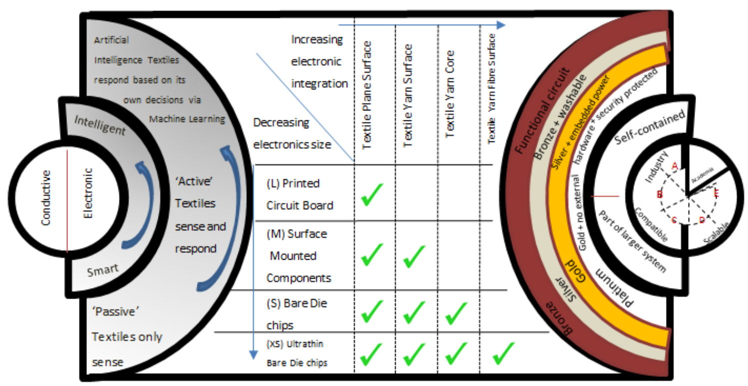

Figure 1: ‘Levels of Electronic Integration within Textiles’ chart

3 CONCLUSIONS

With further development, uniting terminologies from electronics, computer science, and textile fields, the ‘levels of electronic integration within textiles’ chart will offer an intuitive understanding of the different types of technological textiles, their likely behaviours and technical features, and how industrially feasible they could be to manufacture. This will allow ease in collaboration in this multidisciplinary e-textile research field. This chart is the first that also proposes that the greatest industrially-feasible computational electronic textile product would be where the hardware is at yarn-level.

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