ELEC 5032M

Modern Industry Practice

Final Essay

Functional Blocks: A Novel Solution to Reducing Electronic Waste

Abstract

The Electronics industry is one of many fields that struggle with implementing sustainable behaviour. There is an exponentially increasing amount of waste from consumer electronics produced at manufacturing and end of life stages, some of which possessing high toxicity levels. There are many options that could be taken towards reducing e-waste, but many of them focus on what to do with the waste produced. Functional Blocks aim to address this issue at a design level which allows the re-use of electronic components, removing complex recycling techniques that yield very little raw materials that can be repurposed from the equation.

1 - Introduction

The United Nations (UN) has 17 Sustainable Development Goals (SDGs) aiming for peace and prosperity across all nations, and the 12th goal deals with the sustainability of consumption and production patterns [1]. One particular field which lacks in sustainable behaviour is the electrical and electronic products industry [2]. Electronic appliances have become essential to the modern lifestyle, but many products such as mobile phones are often treated as fashion items and are replaced before their intended design lifetime [3]. Sometimes this problem is accelerated by the manufacturers themselves with planned obsolescence by either cutting off software support or marketing new line of product in a way that makes previous lines undesirable. Ruling out planned obsolescence might not be the fairest solution to the problem as if the manufacturer themselves does not make their own product obsolete, another brand will, which would cause unfair competition. There is always the option of investing in research and development of more sophisticated electronic component recycling techniques and a push on biodegradability of hazardous materials and processes generated during and at the end of the lifecycle of electronic products, but there are also other options to explore at the design level of electronic appliances.

2.1 - Recycling Electronic Components

Consumers have an unending appetite for owning newer or better versions of what they already own before they reach the end of their lifecycle [4]. This encourages manufacturers to periodically update their designs to drive sales which is the source of planned obsolescence strategies. Consumers on average renew their mobile phones every 18 months and given that lifespan of mobile phones are 3.5 years, mobile phones have the highest replacement rate compared to any other device in electronics industry which makes it a prime example to analyse in terms of electronic waste produced [5]. The ever-growing dependency on electronic products and their associated high replacement rates mean the effect on the environment will increase exponentially. Prematurely ending the lifecycle of products rapidly increases the waste produced at the end and considering that only 17% of all electronic products are recycled, mobile phones making up about 5% of it, a solution has to be devised since the remaining electronic waste that are not recycled produce hazardous materials with varying degrees of toxicity [5]. For a PCB to be recycled, it has to be burnt or washed in acid to salvage what little raw materials such as gold, copper and aluminium they have. Integrated circuits (ICs) themselves are hard to remove once mounted which makes the effort invested into removing ICs without damaging them unworthy [6][7]. This means that in term of recycling electronics, re-using components rather than salvaging for raw materials could be a better way to minimise effect the electronics industry has on the environment. One way of removing the need to recycle whole PCBs is by dividing PCB designs into Functional Blocks so that a main function is carried out by a single piece [8]. This would get rid of the issue with removing ICs from boards and since a block recovered from a recycled device can be repurposed for the same function in another device. With this method, there is no need for complex PCB recycling techniques, it would work similarly to how a ram stick can be inserted and re-used elsewhere between different computers [9].

2.2 - Reducing E-Waste with Functional Blocks

Making Functional Blocks a viable solution is a tough one as they have to be standardised to allow cross-compatibility across many devices in a way that can satisfy the needs of the manufacturers. A recent example to how standardisation of a component could be beneficial to the environment would be to look at the EU directive for smartphones to use USB Type-C as a standard which would force Apple to change their design in favour of their own proprietary charging cable in an attempt to reduce e-waste [10][11]. The standardisation of Functional Blocks would act similarly to how coding libraries function. Writing code for a specific application might provide better performance but inability to use it in a different context might come at the cost of coding time. In order to save from wasting time, general use libraries are used to adapt to the application and in a similar fashion, Functional Blocks would save from depleting raw materials while also reducing waste [12]. With the advancements in technology, the popularity of Internet of Things (IoT) devices will increase exponentially so re-usability of electronic components might play an important role in making the electronics industry more sustainable since more and more appliances will require common computing components todays mobile phones uses that makes them considered to be “smart” or “intelligent”. As software develop, their hardware needs do so with them, but older hardware components might not meet the criteria to deliver them. Not all devices have the same functional needs and computational power. With re-usable Functional Blocks, new components would be manufactured for devices carrying out performance intensive tasks whereas older models are used to replace products doing less intensive tasks to form a component recycling hierarchy. For example, a mobile phone released 5 years ago might not meet the needs of a user today but would be quite adequate for a kitchen appliance, or a smart home system. A key component for making interchangeable Functional Blocks to work is by utilising Field-Programmable Gate Arrays (FPGAs) which can provide reconfigurable hardware so that entire new circuits could be created from the by-products of old electronic products through hardware updates [5][8]. Functional Blocks would also make repairing easier and cheaper as well since components of a device could be replaced only at the faulty blocks, which in the end produces less wasted components by discarding entire PCBs.

2.3 - Possible Impact on the Industry

A concept like Phoneblocks, a mobile phone concept for a modular design that was aimed at reducing e-waste by replacing modules to upgrade instead of entire products, would end up creating more waste by giving the interchangeability option to the user [13]. Unlike Phoneblocks, Functional Blocks allow the manufacturer to take the responsibility at a design level so that parts are designed to be re-used or products are manufactured from re-used parts. This makes sure that the motivation for recycling is driven by manufacturer's desire for profit by using refurbished parts for cutting down cost of investing into manufacturing while benefitting the environment. Re-using components does not have to negatively affect the global electronics industry. Instead of investing heavily in development and manufacturing new components, the process would be much slower so that some of the investment could be shifted into maintaining of components, the jobs lost at manufacturing are replaced at maintaining and updating of hardware components switching from a more production-oriented jobs to service based ones. An example to this could be given from software companies that have switched to subscription-based sales where they get a continuous steam of income to maintain a software rather than working on new programs to sell from ground up, rendering old versions obsolete [14][15]. Re-using components would require extensive automated hardware testing which possibly create business opportunities in collection for re-purposing of parts and re-define electronic design industry.

3 - Conclusion

There are many ways of addressing this issue, and even though Functional Blocks have the possibility of having a bigger impact in reducing the quantity of waste going into landfill, it is near impossible to implement. The reason PCBs are made as small as possible, with the core components like the CPU and the RAM being closely packed together is because increasing the distance between components decreases the transfer speeds. It would also be quite hard to enforce a change to how an entire industry functions and getting all manufacturers to co-operate with each other for a standardised system. The current rational solution is by the acting regulatory body in the European Union, the European Commission (EC) which has introduced a suite of Producer Responsibility legislation [2]. The legislation is aimed at reducing and eliminating the use of hazardous materials and providing a more sustainable approach to the production of electronics to reduce the quantity of waste going into landfill which leaves the manufacturer responsible for adjusting their design process to reduce waste. Small and steady steps might not immediately show results but as Hans Rosling has put it "Slow change is not no change" [16]. With technological advancements, the viability of Functional Blocks might increase in the future but for the time being it is far away from reality.

4 - References

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