INNOVATIVE APPROACH IN DEVELOPING ELECTRONIC CIRCUIT

OWUTUAMOR FREDERICK TOUN & HARMON EBI OKILO
Department of Electrical Engineering,
Federal Polytechnic, Ekowe,
Bayelsa State,
Nigeria.

ABSTRACT
The study dwells on innovative approach in developing electronic circuit. The work was able to highlight modern innovational ways of developing electronic circuits. The study was able to highlight literature review of electronic engineering design; research seems to indicate most work is progressing on automatic synthesis of electronic circuits by computer programme. Also, product development engineers of today need expanded training which requires knowledge of manufacturing processes. Further, trends in the replacement of the manual assembly of discrete components used until that time, thus cutting down tremendously on production time and cost, as well as product sizes.

Keywords: Innovative, Developing& Electronic Circuit

INTRODUCTION

The world is advancing in science and technology in all ramification of life. New technologies are been introduced to make work easier and faster in achieving our goals. Advancement in technology has migrated from its preliminary stage to a higher level of knowledge analysis. Amongst different area of significant advancement in science and technology is the electronics engineering design.

Electronic engineering design is complex, it involves both humans and their computer support tools and is the subject of much academic research (of: Pugh and Morley, 1988); Coyne et al., 1987; Culverhouse et al., 1992; and scholarly works in, for example, IEEE Design Automation Conference, the International Conference on Engineering Design and other engineering conferences)**.**

Unlike other major areas of design, electronics engineering is an advance designation, but rather a fast developing area where technological change is rapid. Since the advent of the century, designers of electrical circuits have had to understand and use several different physical properties of materials, from electro- magnetic, through hot emission vacuum valves to semiconductor bipolar transistors and field effect switching technology. Electronics circuit designers have had to develop electronic circuits during these periods of change and a number of design practices have developed over the years to support these activities. On a contrary view, the motor car has benefited from a dominant design (the internal combustion engine) and new products have tended to be in terms of motor car styling or in providing new features through developments in electronics products, for example electronic ignition or anti-lock braking systems. Thus, although electronics designers only have one dominant physical effect to work with (the conduction of charge carriers through a medium), they are hampered by evolutionary and stepwise changes in the underlying technology.

The efficient use of time and knowledge during the electronics design process is therefore a particularly important factor in design cycle time and design technique, and design support in electronics engineering should be understood to allow computer support tools aiding this process to be developed.

A lot of research and literatures have been done on the application and use of electronic design. A literature review of electronic engineering design research seems to indicate most work is progressing on automatic synthesis of electronic circuits by computer programme, rather than understanding the design process itself. Thus over the last decades, research has focused on detailed circuit layout and simulation, resulting in a number of commercial tools providing specific circuit simulation and layout capabilities, for example: the systems offered by Mentor Graphics, Racal Redac, Valid Logic, Intergraph and Cadence. Recent advances in the capabilities of these tool sets now allow an engineer to enter a circuit schematic diagram into a computer, simulate the activities of the devices in the network so created, and place and route the circuits in order to fabricate a circuit board, a hybrid circuit device or an integrated circuit. Data on thermal emissions from each component in the design allows thermal modeling of both the circuit board and the local environment it is designed to operate in. Reliability calculations may also be performed automatically on these results. More recently, circuit synthesis tools promise to save digital engineers from having to develop detailed circuit connectivity, engineers are only required to specify the initial Boolean expression of the desired logic circuit; logic creation and layout for the integrated circuit being completed automatically. Although computer aided design (CAD) is still some way off being able to automatically synthesize digital circuits from customer requirements, hardware definition languages like ELLA and VHDL can now be used to understand the issues and problems of conceptual design support by computer for digital electronic circuits. Computer support for analogue engineering has not progressed at such a blistering pace, due perhaps to the additional complexities imposed on a design by the inherent low noise immunities of analog circuits.

This inclusion of sensitivity of analogue circuits means that a physical layout of a circuit has a significant effect on the function of that circuit. So, a plethora of computer support tools (CSTs) now exist to aid specific parts of the engineering design process. Unfortunately, a suite of computer support tools does not guarantee an efficient and speedy design process, nor does it ensure new products can be made in a timely manner. A case study review of twenty-eight companies around the world engaged in electronics product design (Hughes et al., 1990; Culverhouse et al., 1991) indicates that although CSTs are being sold as solutions to engineering design problems, CSTs are not solving the major problems in engineering design; the more intractable problems are due to management and communication problems within companies. This indicates that in order for CSTs to improve the design cycle time they must support engineering management and communication functions in addition to the existing and specific technological processes in order to achieve this. It would, therefore, seem sensible to study the mechanisms of the generic design process, in addition to the detail of technology support tools to further the support necessary for engineering designers.

Prototypes of Engineering Design

A lot of prototype design has been done to demonstrate innovative ways of developing circuits. Several workers have concentrated on understanding the design process itself and a short review below of some published materials show there is general agreement that there are several different types of design, which involve varying degrees of creativity and the re-application of existing engineering knowledge to new design tasks.

Gero (1990) refers to Routine Design, Innovative Design and Creative Design in a recent discussion of artificial intelligence techniques supporting the design activity. Routine design is, in this definition, the selection and refinement of a design prototype. Design prototypes are retrieved and selected, producing instances. Instance refinement is carried out in two ways, by pruning the set of variables to the application set and by changing the values of the applicable set of variables using available knowledge. Innovative design is, then, design prototype- instance refinement, but using an adaptation of some of the knowledge concerning the applicable ranges of variable types. Creative design uses new variables, producing new types and extends the state space of possible designs.

Henderson and Clark (1990) discuss innovation with respect to the impact on components and the linkages between them. The resulting four element matrix provides four innovation categories; incremental, architectural, modular and radical innovation. Incremental innovation refines and extends an existing design, improvement occurs in individual components, but the core concepts and linkages remain the same. Radical innovation establishes new core concepts, which are linked together in a new way. Modular innovation changes the core concepts, without altering the overall structure; for example, replacing analog electronics with digital electronics. Architectural innovation modifies the linkages, but leaves the core concepts and components essentially unchanged.

Interpreting Electric Circuit

The electric circuit, especially in the direct current (DC) circuit is an important material in physics learning. Many studies have said that students have difficulty in understanding the behavior and misconceptions in an electric circuit. One of them is the opinion of Bilal & Erol (2009) which says that the students have some common misconceptions in the electrical material, that is; the electric field, the field lines, the field intensity, the electrostatic force, and electric circuits. It is strengthened by the results of research by McDermott & Shaffer (1992), and Shipstone & Cheng (2001) which suggest that many students have difficulty in understanding the electric circuit behavior. The students' difficulties are: (1) the inability to apply the formal concept in electric circuit in the form of difficulty towards the common nature of electricity, the lack of understanding of a real circuit, fail to understand and apply the concept of a complete electric circuit, difficulty with concepts related to electric current, the difficulty with the concepts related to the electric potential difference, and difficulties with concepts related to resistors; (2) inability to relate formal representation and numerical measurements in electric circuit; (3) the inability to provide a reason qualitatively about the habits of the electric circuit.

The research results of Li & Singh (2016) also revealed that there are misconceptions that students have toward electric circuit, especially in determining the brightness of the bulbs in the circuit, namely (1) the students assume that greater power is always brighter whether it is arranged in series or parallel; (2) fail to understand the correlation between the resistors on the bulbs and power dissipation; (3) consider that greater power for a constant voltage source will have a major resistor; (4) fail in understanding the basic of a parallel and series circuit; (5) in the series lights, students assume that in the first bulb that is close to the bigger voltage source than the second bulb, because the electric current flowing to the first bulb will cause a voltage drop so that the voltage in the next bulbs is reduced; (6) fail to understand that it is the power dissipation which determines the brightness of the bulb; and (7) the confusion in the concept of resistors, electric current, and voltage. It is also stated by Timmermann and Kautz (2014) that the students in Kirchoff law materials have difficulties in linking the concept between voltage and potential so that in the research concluded that the concept of voltage and potential is very different for the students in their learning process.

Jill Marshall (2008) describes that a key element in understanding the electric circuit is to create and interpret the electrical circuit. Jill Marshall also said in his research, the two main things seen in interpreting the electric circuit are the ability to describe the electric circuit by describing the electric current flow in the circuit and the ability to orient the electric circuit based on the potential difference in each branch point. The research results indicate that students can be at loss when conventional electric circuit is only served as a measurement or a major benchmark without the explicit discussion on the issue of how to represent it. The research results conclude that in understanding the behavior or the nature of the electric circuit, students are required to be able to create or interpret an electric circuit in the sense of being capable of interpreting or simplifying the form of a circuit.

Implications for Future Innovation throughout the Electronics Industry

Author and researcher Dr. Rao Tummula highlighted the increased importance of electronic packaging in our modern world (Tummula, 1999). The ever-increasing demand for consumer electronics has resulted in significant growth in this industry. Tummula suggests that product development engineers no longer have the time to learn on the job. They must commit to formal cross-disciplinary training throughout their careers to remain effective as innovators in this complex discipline (Tummula, 1999), well beyond the conventional training characteristics of heritage scientific and engineering disciplines. The results of a survey of the electronics industry, taken by Georgia Institute of Technology Packaging Research Center (Tummula, 1999), suggest a wide range of educational needs for our next generation of electronics product development engineers. Classical training at most universities in “fundamentals of engineering”, “cross-disciplinary training” and “fundamental science” will no longer be adequate (Tummula, 1999). Indeed, the recent records of many widely respected and historically innovative U.S. companies lack examples of new product lines and business generation, often due to absence of updated institutional learning (Lynn, Morone & Paulson, 1996). The coming two decades will see an even more rapid convergence of biotechnology, materials science (including nanotechnology), artificial intelligence, robotics, computing, entertainment, and telecommunications (Lacohee, Wakeford & Pearson, 2003). Product development engineers of today need expanded training to include: “knowledge of manufacturing processes”, “communication skills”, “management skills”, “business economics”, “foreign language and culture” and “global markets” (Tummula, 1999).

Trends in Electronics

Electronic products are controlled by their Integrated Circuits (ICs), formed by a collection of transistors. Looking at the history of electronic products, we see that the transistor density increased at an incredible pace. In the 1950s the first semiconductor IC integrated a large number of tiny transistors into a chip. This replaced the manual assembly of discrete components used until that time, thus cutting down tremendously on production time and cost, as well as product sizes. In 1965, Moore believed the number of transistors in a chip (a measure for the computational performance) would double every year. By now, Moore's law has been corrected to double the number of transistors every 2 years. The solid line indicates that this trend for CPU processors produced by Intel.

According to Moore's law, the number of transistors integrated into one IC is expected to pass one billion around 2008-2009. To sustain this rate and continuously achieve the increased computational performance demanded, feature sizes decrease and the IC runs at higher frequencies. As a consequence the IC's required power input increases as well. This revealed that by the dashed line, approximately doubles every 3 years.

According to the Uptime Institute, the latter trend will cause "the economic meltdown of Moore's law", as "by 2009, the 3-year cost of electricity per server will exceed the purchase cost of the server". In operation, all transistors crammed together generate heat which must be extracted from the IC. As the power leakage of ICs is an appreciable percentage of the overall power input, the amount of dissipated power also increases according to the aforementioned power trend. Until two decades ago, this was not seen as a problem as Moore stated in his publication: "Since integrated electronic structures are two-dimensional, they have a surface available for cooling close to each center of heat generation". The transistor or junction temperature of ICs remained low enough to guarantee a reliable product, throughout its life expectancy.

Conclusion

In all, the work was able to highlight modern innovational ways of developing electronic circuits. The study was able to highlight literature review of electronic engineering design; research seems to indicate most work is progressing on automatic synthesis of electronic circuits by computer programme. Also, product development engineers of today need expanded training which requires knowledge of manufacturing processes. Further, trends in the replacement of the manual assembly of discrete components used until that time, thus cutting down tremendously on production time and cost, as well as product sizes.

Recommendation

It would be recommended that the advancement in the development of electronic circuit should be taken into consideration by young engineers to enable them get informed on the latest happenings in the globe.

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