The Effect of Semi-Conductor Analogue Electronic Technology on the Development of Other Science Areas

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Semiconductor, Diode, Transistor, Chip, Technology

Abstract

In this study, a brief analysis of the semiconductor era, the development of science and technology, made of semiconductor germanium, silicon and other materials was made. It is seen that analog electronics, which is used as a basic technology, contributes greatly to the development of other fields of science. In other technologies developed depending on this basic area, the pyramid structure is given according to the signal processing techniques and the order of development. Design techniques have been added to this pyramid depending on the signs used by the systems. The designs of the systems are generally determined according to the signal processing techniques, and the processes for modeling, simulation and standard production are determined. In this, system design techniques signal processing techniques, testing, durability, and stages until the production stage are defined together.

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1. INTRODUCTION

There have been many important developments and inventions in science over the last century. However, no invention of the semiconductor has been as influential as the diode and transistor. The diode and transistor did not radically change electronics and other related sciences and technologies. The transistor, the active part of electronic circuits, was invented in 1947 by John Bardeen and Walter Brattain of the William Shockley team at the Bell Telephone Research Laboratories (Jaeger & Blalock, 2016). The team received the Nobel Prize in 1956 for their work. Jack Kilby and Robert Noyce produced the microchip, the next stage of the transistor, from semiconductor for the first time in 1959 (Jaeger & Blalock, 2016). Thus, the packaging of semiconductor transistors entered a new stage. This stage is the placement of a large number of transistors in a small volume and a new breakthrough in the field of circuit systems. The development of this microchip technology has led to a very significant technological change in the field of circuits and systems. This very significant development accelerated the development of electronics and then computers and all other electronic

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systems. This technological change has forced some of the other fields of science to change and has influenced some other fields of science. The first application of the semiconductor transistor was in 1953 when Texas Instruments produced radios (Jaeger & Blalock, 2016). Thus began the semiconductor world or the Ge-Si era. The production of Ge-Si Microchips led to a revolutionary development in the electronics industry. The main ones are the production of computers using semiconductor chips, the production of semiconductor logic gates and the digital electronics era. The production of many different memories such as RAM and ROM designed by these logic gates and then the production of microprocessors as chips can only be counted as the main ones. This new digital technology and computer technology has affected and continues to affect all kinds of business areas. This semiconductor technology and science has entered every field of industry. Chips continue to spread rapidly in our daily lives. Today, they are being further developed and used for different purposes, even in humans or people consisting of biological structures. It is estimated that they will be used much more widely in bio-hybrid systems in the coming years. Perhaps the materials from which the chips are made are nowadays obtained not only from Ge-Si but also from many other elements. But the end goal is the same. In the future, the Ge-Si era will soon be replaced by quantum chips. Because it is given in many open sources that they are working intensively in these areas. The quantum era will close an era in technology and science and start a new era. Therefore, we think that quantum systems or chips are very important.

Technology Level

In this study, it has been tried to determine the current state of use and the trend of the technology as a forecast for the future, which is basically produced from electronic science and technology. For this purpose, the systems were evaluated according to their signaling characteristics in general. While making this evaluation, only very basic features were considered. These include the signal used by the system, the basic structure of the system and the design technique. On the other hand, the marking used in the design, model checking and testing for mass production, and then certification procedures to obtain a production permit were considered.

Analog Technology (AT)

Analog systems or technologies form the basis of today's technologies. The general meaning of this is that all systems that do not use digital signals are called analog systems. The area where it is very commonly used is more commonly used as analog electronics. However, if it is evaluated as the signal it produces or uses, it would not be wrong to use it as the name given to large and small systems that produce or process analog signals. The biggest negative aspect of these analog systems is that the signal used is the use of the same signal continuously from one end to the other. As a result, continuous amplification and filtering noise is very effective (Jaeger & Blalock, 2016).

Digital Technology (DT)

It is used as the name given to systems that process or generate digital signals. In these systems, while the digital signal leaves a system or unit, the signal itself is regenerated. The signal produced in analog systems, or the signal itself entering the system is used without being renewed or reproduced as the original. In this respect, digital systems have advantages over analog systems. However, the negative aspects of these systems are the delay time delays are very high. Working at very high frequencies creates problems or work. With analog systems, they operate at higher frequencies (Jaeger & Blalock, 2016).

Hybrid Systems Technology (HS)

Hybrid systems are dynamic systems consisting of the combination of many different systems. There are many examples such as automobiles, electric-gasoline, gasoline-LPG, gasoline-LPG-electric (Grossman, Nerode, Ravn & Rischel, 1993).

Process Control (PC)

Process control systems are systems built to meet the needs of industry. These systems are based on classical logic and analog electronics (King, 2016).

Operation Control Technology (OT)

Operation control technologies are systems developed for the needs of industry. While the beginning of these systems consisted of analog electronics and classical logic systems, today all kinds of technologies suitable for the purpose are used (Gubbi, Buyya, Marusic & Palaniswami, 2013).

Information Technology (IT)

Information systems are systems that developed after the invention of computing systems. Today, they are widely used in every field (Fox, 2020). It represents the development of software-based systems, especially those that developed after operational technology.

Internet of Things (IoT)

It is known as the Internet of Things or "Industry 4.00". The purpose of these systems is to minimize the human resources working in the sectors, to increase productivity to the highest level, and to reduce costs to the lowest level (Tripathy & Anuradha, 2019).

Cyber Physical Systems (CPS)

Cyber physical systems are a combination of many systems (Lee and Seshia, 2017). Europeans refer to a sub-section of CPS as IoT. However, the US does not set any limits for CPS. Therefore, it can consist of many different systems, large and small. Robots working in a group in a factory and all robots working in the factory are good examples of these. Again, more than 2000 systems used in passenger airplanes and all electronic systems in automobiles are current examples of this field (Alur, 2017).

Systems of Systems (SoS)

SoS are systems that are composed of many independent systems. They can operate both independently and in concert with other systems, or they can operate as a single system. An example is the control of intercontinental missiles with nuclear warheads. Where the missile passes over land, it is controlled by radar systems on land, at sea it is controlled by ship radars, in the air it is sometimes controlled by aircraft radars, and again by applications. Each system is controlled independently and receives feedback. All systems in the system of systems are combined and controlled in a single system structure (Jamshidi, 2009).

Modelling and Simulation (MS)

Modeling is the definition of mathematical system equations of a system or the definition of mathematical ratios for the work to be used appropriately (Birta and Arbez, 2007). Simulation is the operation of these mathematical relations, time base, and frequency plane or ratio equations by computer in the appropriate plane to be used. The more realistic the ratio equations are organized, the

more accurate the results are. In other words, simulation results are obtained depending on the success of the mathematical equations (Kinser, 2022).

Model Checking (MC)

It is the testing of the finished product or model with a large number of variables using model logic techniques. This testing process consists of a structure depending on the variables used in the product. For example, testing a passenger airplane is very different from testing a smartphone. Their variables are also different (Baier and Katoen, 2008).

Reliability Engineering and Testing Certification Process (RE)

RE engineering is the final testing process performed by manufacturing organizations before a finished product is tested for conformity

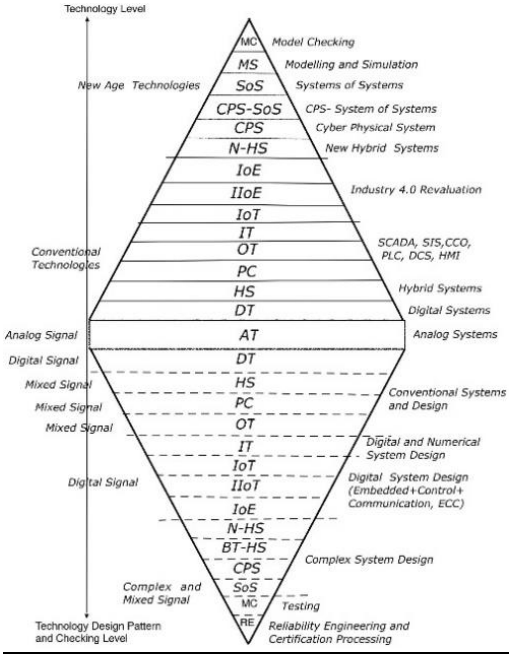

Figure 1. Analog electronics-based systems, signals, and classification

to standards. This is the stage before official corporate production authorization is obtained (Kapur, and Pecht, 2014). In figure 1, all fields of science and engineering have developed and are developing completely dependent on the development of analog electronics.

2. CONCLUSION

In this study, the contribution and development of semiconductor analog electronics to other fields of science is given in historical order. While making this ranking, other fields of science and technology produced from analog electronics, which is the basic technology, are also given. The basis of analog electronics is Semiconductor science. In the development of this science, semiconductor electronic components (diodes, transistors, FETs, etc.) and chips are produced from the combination of physics, materials, chemistry, machinery, and many other fields. In the next 25 years, we expect very serious developments in quantum science and quantum technologies. This will lead to the commercialization of quantum computers, quantum computing systems, quantum communication systems, quantum electronics and quantum chips. This will open up new horizons in science and technology and usher

in a new era. The next industry will be called the "quantum era" or industry 6.00. The next developments will be in the field of quantum biology and artificial synthetic biology in the field of biology. In this period, everything will be produced in organic form. This period will be called the "biology era".

Conflict of Interest

The author declare that there is no conflict of interest.

Contribution of Authors

Abdurrahman HAZER: Wrote the manuscript and contributed at all stages of the article.

Remzi YILDIRIM: Performed the experiments and analyze the results. Wrote this manuscript.

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