International Journal of Advanced Research in Statistics, Management and Finance
ISSN Hard Print: 2315-8409, ISSN Online: 2354-1644 Vol. 3. No. 1 September, 2015

IMPACT OF MATHEMATICS IN ELECTRONICS USEFUL IN PROVISION OF SECURITY NEEDED IN DEMOCRATIC SOCIETY

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Abstract
One of the dreams in human society is provision of security. The Nigerian masses, in democratic governance, expect the government to ensure security in the society. However, science and technology can be applied in provision of security needed in a democratic society. An essential aspect of science and technology in this modern era is electronics. Part of resources employed in advancement of electronics is mathematics. The paper discussed the role of mathematics in electronics which in turn is useful in provision of security. Issues the paper focused on are importance of electronics in provision of security, mathematics as a language of science and technology, and application of mathematics in electronics. Recommendations made in the paper geared towards effective study and utilization of mathematics and electronics.

Keywords: *Electronics, Mathematics, Security, Democratic, Science and Technology.*

http://internationalpolicybrief.org/journals/international-scientific-research-consortium-journals/stats-mgt-and-fin-vol3-no1

Background to the Study

In Nigeria, cases of insecurity abound. There are religious war, boko haram operations, kidnapping, riots of different natures, rape, and assassination. One of the needs of human society is provision of security. People expect that their life and properties will be secured. Part of the duty of the government is provision of security to the masses. Infact, the Nigerian masses will be very glad and proud of democratic governance that ensures security in the society. Nwosu, Amechi, Chukwulobe and Chijioke (2014) asserted that provision of security makes it possible to have national development which is the major desire and struggle in human society.

However, science and technology can be applied in provision of security needed in a democratic society. A prominent and essential aspect of science and technology that can serve as veritable resource for provision of security in this era of democratic governance is electronics. Over the years there has been advancements in electronics brought about by mathematical operations. It can be said that mathematics is an essential part of science and technology which is useful in electronics needed for provision of security.

Statement of the Problem

The existence of insecurity gives great concern to the masses and government. So, in this democratic era, one of the dreams and anxieties is how to ensure safety of the populace and their belongings. It is difficult to achieve good democracy and sustainable development in a society that does not have high level of security. Poor level of security can lead to distortion to the social, economic and political order; thereby negatively affecting the expected wellbeing in a democratic society.

However, detection and prevention of insecurity to enthrone security using electronics is a great move towards having development in a democratic society. But activities and operations in electronics demands mathematics; and so, mathematics is involved in the use of electronics in provision of security.

Objectives of the Study

The paper discusses how mathematics has played some role in electronics, which can be used in provision of security. Issues the paper looks at are:

1. Importance of electronics in provision of security.
2. Mathematics as a language of science and technology.
3. Application of mathematics in electronics.

Literature Review

Importance of Electronics in Provision of Security

Electronics is concerned with passage of electricity (electrical charges) through semi-conductor materials or valves (vacuum and gas-filled devices); however, modern electronics is principally concerned with application of electricity mostly in semiconductor materials and devices for technological use. Chiwetalu (2004) also pointed out that electronics involves the study, design, construction and application of devices whose operations are based on the conduction of electricity in vacuum (vacua), or gases or semiconductors. Nwosu and Chijioke (2004) asserted that electronic technology has led to production of solid state devices such as diode, transistors and integrated circuits and the devices has helped in the development of electronic systems such as computer system, communication system and security system. Whenever electronics or electronic technology is mentioned, some of the systems or devices that easily come to mind are radio, television, computer, telephone, internet, satellite, calculator, and video machine.

In this modern era, a lot of human activities are positively affected by electronics towards achievement of good and pleasant life. Inyiama (2004) acknowledged that electronic technology has brought about changes in communication and the important development in electronic communication has impact on the way business, administration, education and government is conducted in the emerging world of the third millennium. Electronics makes modern computerization and communication possible. Ibenta (2004) noted that the once very rigid and unbreakable boundaries of national and regional market have been turned into global electronic village on the eve of twenty-first century as a result of existence of computers and telecommunication. In fact, electronics, as applied in engineering and technology, has influenced human life and activities towards development.

Embracing a value system that promotes effective study and application of electronic engineering and technology will foster socio-economic development, even in area of security. Electronics can be applied in provision of security through the production of electronic-based systems. Security can also be achieved through acquisition of job/employment involving or relating to electronics, dissemination of anti-crime information using electronic products, and embracing of ethics in the acquisition of education in electronic-based programme.

Security measure demands detection and prevention of unauthorized access to facilities, equipment and resources, and ensuring of safety to people and their properties. Traditionally, provision of security can be performed using human resources such as police force, security detectives, and security guards. With advancement in electronic engineering and technology, empowered with

mathematics, certain electronic devices/systems can be used in crime detection and prevention by way of surveillance. Some of surveillance equipment are closed circuit television (CCTV), vehicle tracking system, night vision devices, global positioning system (GPS), electronic video surveillance. Nnake (2014) acknowledged that surveillance can be done using camera, video, biometrics, computer, and aerial. Surveillance cameras are video cameras connected to a recording device or IP network, and may be watched from a distance by a security guard or law enforcement officer for observing an area to detect criminals. Video surveillance makes it possible to have a continuous 24-hour monitoring of surveillance to alert security officers to a criminal act while it is still time to prevent the crime. Biometric surveillance makes it possible to measure and analyze human physical characteristics (eg fingerprints, DNA, and facial patterns) and/or behavioural characteristics (eg gait and voice) for authentication, identification or screening purposes and so can be employed in detection of criminals that cause insecurity. Computer surveillance involves the use of surveillance programs to provide security against crimes done using computer. Aerial surveillance, as in the use of RADAR, usually employs imagery or video from an airborne vehicle to monitor criminal and hostile activities.

A way to ensure security is by providing jobs to make people become government-employed workers or self-employed workers. It is an axiom that employment in jobs helps people generate income for their wellbeing and avoidance of idleness and emotional disturbances that lead to social vices like crime which generates insecurity. Nwosu (2005) acknowledge that employment helps to generate income for a happy and healthy living as well as prevention of idleness that is associated with social vices which inhibit socio-economic development. Adequate exposure in electronics, which may entail basic knowledge of mathematics, can help people engage in electronic-based jobs necessary for promotion of security.

The job opportunities involving electronics can be lecturing/teaching, design and construction, maintenance and repair, marketing (sales), and management. There is need to emphasis on entrepreneurship, which is a means of job-creation, because an issue that threatens national security in this era of democracy is unemployment. It is unfortunate that a lot of people in Nigeria, especially the youths, are unemployed and so are liable to immoral activities that obstruct security such as stealing, killing, duping, kidnapping. Thus, entrepreneurship on electronic-based jobs should be of great value in promotion of security. Nwosu (2003) averred that good moral life promotes national development; no nation can progress effectively under immoral acts.

Use of electronic products as in application of computer and telecommunication helps in generation of anti-crime information by providing of messages and knowledge that can encourage and foster security. Computer can serve as a medium for provision of anti-crime information through its ability to store ethical/scriptural messages installed in it which people can read or listen to desist from criminal or immoral activities. Computer acts as an electronic device for promoting security through entertainment/recreation in that music, drama, and game with ethical messages can be installed in the computer. Focusing on such ethical messages during the entertainment/recreation can impart information to the user to desist from acts that lead to insecurity. Moreover, entertainment and recreation are means of occupying the human mind such that acts that lead to insecurity can be avoided.

Telecommunication system like telephone, television, radio, satellite, can aid in dissemination of anti-crime information. Nwosu and Chukwuebuka-Nwosu (2007) noted that the advantage in the use of telecommunication is that it covers a large audience because it breaks the problems of time and distance. With the use of telecommunication system like telephone, the law enforcement and security agencies can be notified of operations/activities that threatens security. Also, the masses can be informed and educated using telecommunication system like radio, television to desist from acts that bring about insecurity. Integration of computer technology and telecommunication technology brought about the existence of information technology (IT), which includes the internet. Communication of anti-crime information for maintenance of security around the globe is possible using the internet.

Application of electronics in acquisition of ethical–based education helps in provision of security in that education aims at "reshaping" man to be a useful member of society. For instance, in the process of acquiring formal education in electronic engineering and technology, students (mostly youths) are trained to possess good morals and display decent conduct that can aid and foster security in a democratic society for national development. Also, ethical programs, such as drama, discussion, announcement or advertisement, can be broadcasted in the radio and television to educate the masses on the dangers of neglecting security needed in the welfare of human society. Furthemore, telephone and Internet can be used to impart education that fosters ethics greatly needed in curbing immorality that threatens security.

Mathematics as a Language of Science and Technology

Science is derived from the latin word "Scientia" meaning "to know". Science focuses on the study and understanding of nature. Maduabum (2004) asserted that science, in its broad sense, refers to all human activities involving organized knowledge of natural phenomena. It can be said that science is an organized learning or knowledge obtained by objective and empirical study of natural phenomena and it helps in discovery of concepts and techniques that promotes wellbeing of human society. Actually, science is an organized learning or knowledge that involves making observation, investigation, verifying the validity of propositions made for the benefit of mankind; and so, application of mathematics is essential in its study.

Existence of scientific-based society will lead to production of people who are equipped in technology. Technology is the use of science in practical tasks for creation of materials and devices for the purpose of reducing human suffering or for improved productivity so that man's environment becomes more conducive and enjoyable (Nwosu and Nnabuenyi, 2006; Obianwu and Azubike, 1994; Umoru, 2004). For instance, it is the practical application of scientific knowledge of electronics that brought about in the emergence of various electronic technological products useful in fighting insecurity for the wellbeing of man in his environment.

Science and technology has greatly influenced human activities and life in this modern era. Obviously, without a cling to science and technology, it is very hard for a nation to grow and develop. So, strong orientation in science education helps in national development. Thus, effective teaching and learning of science and technology is essential for development of Nigeria economy. To understand and appreciate science and technology, mathematics is needed. Mathematics is a field of study that involves arithmetic, algebra and geometry. Arithmetic deals with numbers and their use for calculations needed to solve problems. Algebra is concerned with the use of letters and signs to represent quantities that can be used for synthesis and analysis of a concept or phenomenon. Geometry pertains to lines, angles and shapes and their relationship.

In fact, mathematics serves as the language of science and technology. If mathematics is a language of science and technology, then mathematics is a basis for equipping people for meaningful living and entering into numerous career choices to function adequately in the modern world. Iji, Ogbole and Uka (2014) pointed out that everybody uses mathematics in one way or the other in solving life problems. Nations that desire to be well rooted and respected in science and technology must provide their citizens with good knowledge of mathematics. It is based on this that more often than not, stakeholders (educators, government,

mathematics lovers) in mathematics education will always be mindful of the mass failure of students in mathematics at the external examination and depressed state of mathematics education in Nigeria (Agwagah, 2001; Iji, Ogbole and Uka, 2014).

Mathematics has wide applications in science and technology. Some of the uses of mathematics in science and technology are determination of unknown parameter, plotting and interpreting of a graph, derivation of formula, simulation and modeling, analysis and interpretation of raw data, and drawing of shapes.

Application of Mathematics in Electronics

An aspect of science and technology which acts as a great driving force in this modern era for a nation to achieve growth and development is electronics. So, for effective understanding and utilization of electronics, mathematics is employed. Mathematics is needed in variety of ways and circumstances in the field of electronics. Some of the applications of mathematics in electronics are doping of semiconductor for formation of electronic (solid-state) devices, calculating the value of electronic components to be used in an electronic design, determination of behaviour of an electronic circuit, and performing logic operations in digital systems.

Mathematics is applied in the process of doping needed in the formation of solid-state devices like semiconductor diodes and transistors. Semiconductors (of which germanium and silicon are the most commonly used) in their pure form are insulators or bad conductors of electricity. Sharma (2003) pointed out that when small quantities of certain impurities are added to these crystals, their electrical properties are modified and they become partial conductors or semiconductors. This process of adding controlled quantities of certain impurities to the pure crystals of germanium and silicon is known as doping. Determination of the controlled and small quantity of impurity for the doping is achieved using mathematical calculation.

Electronic designs involve determination of the appropriate value of circuit components (ie circuit elements) to be used. Usually, the various circuit elements have their specific function(s) in the circuit or system. With the help of appropriate mathematical formula, the value of the required circuit elements can be determined. For instance, a timing circuit employing resistor and capacitor may require the determination of resistance value, R of resistor or capacitance value, C of the capacitor. This can be achieved using a known time (predetermined time), T expressed as T = RC. Mathematics is employed in finding out the behaviour of an electronic circuit by knowing the value of the components that make up the electric circuit. For instance, the frequency, f_o at which resonance will occur in capacitor-

inductor network can be determined by knowing the values of inductance, L of the inductor and capacitance, C of the capacitor using the formula $f_o = 1/2\sqrt{LC}$

In the same vein, mathematical analysis has helped in analyzing of a modulated wave as in telecommunication system. Usually, telecommunication system like radio system involves the process of modulation and demodulation. Modulation is the process of combining an audio-frequency (AF) signal with a radio frequency (RF) carrier wave and the resultant wave produced is called modulated wave, while demodulation or detection is the process of recovering AF signal from the modulated carrier wave (Theraja and Theraja, 1999). The essence of modulation is to enable a low-frequency signal to travel very large distance through space with the help of a high-frequency carrier wave. However, mathematical analysis done in modulation reveals that modulated wave consists of the original carrier wave, upper side frequency, and lower side frequency. In fact, with the help of narrow band filter (designed with application of mathematics), the side frequencies can be separated from the carrier wave.

An aspect of electronics which has made a tremendous impact in this modern era, especially in area of computerization, is digital electronics. Digital electronics deals with study, design and application of digital systems. Gupta (2008) asserted that a digital system is a combination of devices designed for manipulating physical quantities or information that takes only discrete values. The basis of digital systems is a switching action of "ON" or "OFF" which occurs in the system. The "ON" and "OFF" state can be represented mathematically as '1' and '0' respectively. Thus, the use of '1' and '0' gives rise to logic operations in digital systems. All digital systems are founded on logic design (Balch, 2003; Tocci, Widmer and Moss, 2007). The use of '1' and '0' in a digital circuit shows that a digital circuit is associated with binary system. The base for binary system is two (2) because it uses only two digits: 0 and 1.

Balch (2003) pointed out that binary numbering system is appropriate for logical expression and, therefore, digital systems, since binary is a base-2 system in which only the digits 1 and 0 exist. Digital systems are built using logic gates. A logic gate is an electronic circuit which makes logic decisions; and it has one output and one or more inputs (Theraja and Theraja, 1999). Mathematical and logical expressions useful in digital operations are Boolean algebra and De Morgan's Theorem. Sharma (2003) and Theraja and Theraja (1999) pointed out that Boolean algebra, which was invented by George Boolean, is greatly applied as a logic operation in computer circuit analysis and design. As compared to other mathematical tools of analysis and design, Boolean algebra has the advantage of simplicity, speed and accuracy. Laws of Boolean algebra pertaining to various logic gates have been generalized by

Augustus De Morgan in the form of two identities known as De Morgan's theorems (Sharma, 2003). Theraja and Theraja, (1999) acknowledged that the two theorems (or rules) of De Morgan are of great help in simplifying complicated logical expressions.

Conclusion

In this era of democratic rule in Nigeria, provision of security, which is very essential, can be achieved using science and technology. Electronics, as an aspect of science and technology, can be utilized for security purpose. However, mathematics is greatly applied in operations and activities involving electronics. So, it can be said that mathematics makes certain impact in provision of security using electronics.

Recommendations

Since mathematics can be applied in electronics useful for provision of security it is recommended that:

1. Government should intensify effort to encourage the use of electronics in safeguarding of life and properties.
2. Students and stakeholders involved in education on electronics should be diligent.
3. Mathematics education should be promoted in schools by government, school administrators, teachers, and the general public.
4. Serious researches should be embarked upon by scientists, engineers and technologists on the ways to advance electronics using mathematics.

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