Middle-East Journal of Scientific Research 21 (7): 1141-1145, 2014
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2014.21.07.21580

Biologically Inspired Computing: Toward Human-Friendly System Development Life Cycle

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Abstract: The paper objective is to examine the effect of Biologically Inspired Computing for the implementation Biological Human Development based on systems development life cycle (SDLC). This paper is focused on the relationship between human development and systems development life cycle through Biologically Inspired Computing. From the conclusion of the study can deduct that there is a positive association between systems development life cycle and human development. Therefore, current study can be important for future researchers and they can improve this study by empirical investigation. Furthermore, requirements comprehending problems inevitably lead to unnecessary re-work, overrun cost and time and poor client-developer relationship.

Key words: Information Technology · System Development Life Cycle · Biologically Inspired Computing · Biological Human Development

INTRODUCTION

Any technology, even the failed ones such as IT that dares to be claimed in history establishes a link among the various streams of science. The recent evolution of ICT (Information and Communication Technology) has resulted in the newer forms of economic activities of which the term 'Digital Economy' is rather relevant. Changes affect those organizations that use ICT systems and the ones who develop them. In the new environment of economics, methods that develop IT systems play a crucial role. At the same time they are needed to achieve the changed requirements [1]. The reason is that when companies are in the growing stage, they can't afford to let themselves to be lagging behind the IT scenarios. On the other hand, when there is a weak economy, most organizations utilize their IT part to cut down their operating expenses. With humans, the biological mechanisms offer a solution for the system movement and development. This is based out of on an engineering and official correctness paradigm into a repair paradigm which is of more flexibility in adapting. Hence an array of biological processes need to be explored and the application of designs in the development of systems [2].

The study here overlooks at the human development theories. The framework of such theories helps us to put together a range of facts so as to understand them. Studies about the human development theories and the frameworks provide us with information and help us to behave in a more rational way in this. They can also aid in the further research of such human behaviors. Over the time theories might change and may even contradict. There are mainly four types of theories in this context- Biological, Behavioral, Cognitive and Psychodynamic. The study here is focused on biological study.

Computer and related technology systems has developed dramatically over the years. Despite all of these advancement, the study here is humbled by the flexibility, adaptability and sophisticated nature of our surroundings. Nature has always inspired the development and advancement of computer from the very first days itself. The main objective of this study is to examine the computing that has been inspired biologically, for the implementation of human development biologically, based on SDLC (Systems Development Life Cycle). In the literature review that follows, we discuss about the information systems,

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development of systems, SDLC, human development and systems that are biologically inspired. The research is finally conducted with the research conclusion.

Literature Review

Information System: IS or information System is the study of the hardware's and software's complimentary networks, that individuals and organizations make use of to the screen, collect, generate, process and share data. Also, any specific IS helps in supporting operations, management as well as in decision making [3]. Further the concept of IS is used to link to the ICT used by an organization and also to the way in which individuals interact with the technologies that supports business activities [4].

In a way similar to the above, some researchers show a clear distinction between the business processes, computer systems and information systems. Information systems normally not necessarily are concerned of ICT but they do have an ICT component and they concentrate on the end utilization of IT. Furthermore, the Information systems and business processes are entirely different. It has also been shown that the performance of business processes is helped by information systems.

System Development: The process of defining, designing, testing and implementing a program or software that is new is termed as Systems Development. This can very well include the customized systems' development (internal), creating a database, or even acquiring software developed by third parties. There are written standards and operating procedures that guide all systems and functions. In every organization, the management must develop and establish standards and adopt proper SDLC methods that govern the development processes, acquisition, implementation and maintenance of computerized systems and associated technologies [2].

The methodology of System Development (SD) is defined as the framework that is put into use to structure, plan and control the steps involved in the development of an information system. Over the years, many such frameworks were established. Each one among them has weaknesses and strengths. Single SD methodology might not suit all projects. Of the available SD methodologies each one best suits certain project types, which is based on consideration such as – technical, team, project and organizational factors [5].

System Development Life Cycle: The perspective of the system is what is defined as SDLC. Software Engineering is defined as the process of creating, modifying and expanding the systems, with incorporation with the models and methods needed for development [6]. [7] divided this process into some steps such as- requirement, design, implementation, analysis, coding, maintaining and testing. These activities are done in many ways depending upon the need of the customer. Each of these methods is called as a SDLC Model. Irrespective of the size of the systems, that is being large or small, all systems should undergo this phase. The results of each of the phases are analyzed and the results are used in the enhancement of new revisions. Change management and control of documents are made use of to track the systems' infrastructure, design and to make sure that its consistency remains stable [8].

A SDLC has mainly 3 objectives. *i.e.* to ensure the delivery of systems of high quality, to provide a strong control for the management over the project and to maximize the productivity of staff engaged with the systems development [6].

SDLC-2013 Model: The SDLC model of 2013 is developed in such a way that the customers can interact with each other's freely for better understanding. Hence it is very important to implement the needs in a way so as to develop software of high quality that fits the budget and schedule. When the SD process starts as per the needs of the customer, the model tries to uncover the needs of the customer. The customer's satisfaction level is dependent on the assurance of the systems while in the SDLC. Also requirements that comprehends problems, leads to re-work, loss of money and time as well as a bad customer relationship, all of which will be inevitable results. Customer satisfaction depends entirely on the needs of the client. As such the 2013 SDLC focuses on the initial stages [9].

System Development and Biological Mechanisms: With humans, the biological mechanisms offer a solution for the system movement and development. This is based out of on an engineering and official correctness paradigm into a repair paradigm which is of more flexibility in adapting. Hence a wide array of biological phenomena need to be explored and the concept of designs implemented on SD. [2] showed the path in human development based on SDLC which is illustrated in Table 1.

Table 1: Path in Human Development Based SDLC

Human	System
Decision-making and planning for a baby	Feasibility Study
Agreement (Before Pregnancy/Conceive)	Analysis & Design
Prenatal Period	Design & Implementation
Delivery/Labour (Newborn/Infant)	Implementation
Toddlerhood Adolescence/Young	Maintenance (Operations /
adulthood Middle adulthood/	Risk analysis)
Older adulthood	
Family/Marriage	Expansion (Adding Modules)
Society	Networking (Client-server
	Environment/Internet)
Dead	Prepare for System
	Termination

Table 2: An Overview of periods of the Life Span

Period of Life	Age Range
Prenatal Period	Conception to birth
Infancy	Birth to 18-24 months of age
Toddlerhood	12-15 months to 2-3 years of age
Early childhood	2-3 years to 5-6 years of age
Adolescence	6 years to approximately 12 years of age
Young adulthood	Approximately 12 years to 18-21 years of age
Middle adulthood	40 years to 60-65 years of age
Older adulthood	60-65 years of age to death

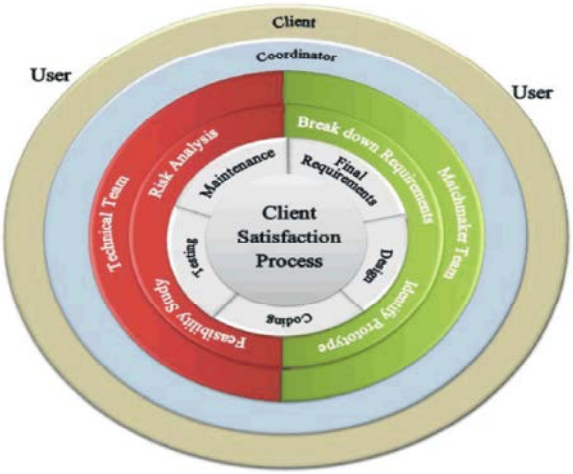

Fig. 1: sNew Proposed SDLC-2013 Model (Naresh Kumar, 2013)

Biologically Inspired Computing: Computer and related technology systems has developed dramatically over the years. Despite all of these advancement, the study here is humbled by the flexibility, adaptability and sophisticated nature of our surroundings. It is clear to most of us that biological systems computes. There are many research papers being done in the field. [10] did the paper titled 'Computation in neural systems and neurons'. [10] did the title 'Information processing and social insects'. In 2004 [11] came up with the work 'Evidence for complex, emergent, collective, dynamics and distributed computing in plants'.

From the very beginning, nature always inspired computing. From then there developed a divided thought among scientists. There were two schools of thoughts. One was on the point whether to continue developing faster and better algorithms which has central control. The second was whether to give less emphasis on efficiency and speed than on aspects-robustness, adaptability and the organization that emerges as a result of the interaction between various processes that are loosely coupled.

These approaches are collectively known as computing that is inspired biologically, which is relatively a new field for research. It is not much of a link of various disciplines such as-AI, Bio-Robotics, computation that is evolutionary, artificial life and systems that are agent based [10].

Biologically Human Development: In the first 2 decades of human life growth is an essential part. This also includes the 1st 9 months of life that is prenatal. Nurturing of the individual happens while growing. In other words, growth is characterized by an increase is the size of the individual's body or the size of a particular part of the body. [12] described growth as an essential characteristic of all organisms. There are mainly four types of theories in this context-Biological, Behavioral, Cognitive and Psychodynamic. The study here is focused on biological study. In Table 2 we have the periods of Lifespan- an overview shown [13].

Stages of Growth: Table 2 illustrates the stages of growth in humans and the development.

Prenatal Period: On an average the prenatal period is comprised of ten lunar months, nine months in a calendar or about forty weeks. Lunar calendar has 28 days. In a multi cellular organism, a fertilized egg gets transformed to an embryo via cell division, cell growth and cell differentiation. This growth of the embryo is termed as prenatal growth. Rudiments of all organs and rudiments of all systems comprise the mass of an embryo in the prenatal period.

This has three varying stages: Egg- the fertilized ovum or zygote as it is called in the first 2 weeks, Embryo- fertilized ovum as it is called in between 2 and 8 weeks and the fetus- the fertilized ovum, as it is called when 2 to 10 lunar months old.

Postnatal Period: The period of postnatal growth is segregated into the age period as follows. The first year of life is infancy. This period sees the rapid growth in most of the systems in the body, its dimensions, etc. There is also a rapid advancement in the neuromuscular system of the organisms.

Upon birth the growth is directed towards a functional part of life. There is an increase in the protoplasm or addition of cells which constitutes growth. In general we can say that catabolic processes are exceeded by processes that are anabolic. Size, shape and body mass increases during this stage. All of these together characterize the stage of infancy [14].

Childhood: From the end period of infancy, it's the beginning of childhood. It extends till the beginning of adolescence. Childhood is further divided as early, middle and late childhood. The period that sees the eruption of milk teeth is termed as early childhood. Seven to ten years old is middle childhood where eruption of permanent teeth takes place, though not all teeth are seen at once. From the time of pre-puberty to puberty it's the late childhood. It continues till the individual reached puberty. During childhood, the progress related to growth and maturity will be steady and there will be rapid advancement in motor development and in neuron-muscular development.

Adolescence: Adolescence is the period that comes after childhood. Adolescence is the period that extends up to twenty years since puberty. Sexual maturity is attained during this period and hormones have a significant influence in attaining this. The growth spurt is the accelerated growth rate seen during adolescence. The spirit is a usual process that happens to all children going through adolescence. It might vary in its intensity and duration among different children. On an average adolescent growth spurt takes place in boys between the age group 12-15. Whereas in the case of girls this has happened two years before that in boys. There exists secondary and primary sexual characteristics and the differentiation between these two indicates the period of adolescence. Changes happen in the shape of body, in reproductory organs, size, muscle sizes, bone weight, fat and in many other physical functions.

Human and Information Technology: [15] explained the profound difference between biological organisms and information technology systems, where the former is based on principles of design. The differences are stated below.

Biological Organisms Exploit Physics and Chemistry: The biological organisms and their communities' functioning exploits a great set of highly particular mechanical and chemical interactions (a typical example is how proteins form complicated structures. The bone and muscle growth as a result of the mechanical tension is another example). This need not necessarily be programmed in the genetic code of the organisms.

Organisms Grow and Develop: A If we take a piece of the organism's genome (*i.e*. the code), it specifies the function and structure of numerous cells. In the development stage, the biological organisms gain new info from its environment (an example is the behavior patterns in the brain, muscle strength etc). This information volume is considerably big than the info stored explicitly inside the organism's brain. Thus various environments generate various behaviors and structures. Also minor changes in genome can cause major changes in phenotype [11].

New Biological Organisms Are the Product of Evolution: Light changes to designs (previous ones) results in the novel abilities of the organism. Evolution of human kind from primates is an example. Modifications might have happened to small portions of the genome code. In certain situations this can be rapid.

Biological Organisms and Communities Are Multi-Level Systems: In evolution while competition is heavy among there may be combined pressure favoring lower level collaboration among organisms

DISCUSSION

Existing research has dealt extensively with the Biologically Inspired Computing: Toward Human-Friendly System Development Life Cycle [12]. Relatively, the amount of research that have considered Biologically Inspired Computing: Toward Human-Friendly System Development Life Cycle literature in the area by integrating different models from past studies. The results from this study indicate that the all the factors identified in the study infleunce the relationship between human development and systems development life cycle through Biologically Inspired Computing.

The outcome of this research not only corroborates some of the findings of prior studies, but is also an advance over many as the integrated model explains a greater amount of variance in the relationship between human development and systems development life cycle

through Biologically Inspired Computing than any previous model. As such, the integrated model is more helpful in understanding the relationship between human development and systems development life cycle through Biologically Inspired Computing.

Contextually, this document represents some form of contribution to the literature on the subject in Malaysia.While there has been a recent increase in research on Malaysia, the quantum and quality is still a far cry relative to the amount of work done in many of its Asian counterparts. Besides its contribution to research in Malaysia, practitioners can avail the knowledge and information unveiled in this study, especially in strategy decision.

CONCLUSION

The main objective of the research study here is to examine the biologically inspired computing effect on the biological human development's implementation, based on SDLC. Also the research conducted here shows that there is a relationship among the SDLC and biological human development. The field of inspired computing is relatively new and is an exciting one for research studies. In this study of inspired computing, principles of biology are utilized in the designing and implementation of new and improved methods of computing. Most of these computing methods are being used successfully and can be used in future to provide solutions to tough problems. This can be applied to an array of problematic areas such as – combined optimization, decision making, segregation and recognition of patterns, modeling, data mining, computer systems security, biometrics and many such application areas. Hence this study here can be useful for researchers in the future and they can also improvise the study via further empirical investigation. Also requirements that comprehends problems, leads to re-work, loss of money and time as well as a bad customer relationship, all of which will be inevitable results.

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