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IMPACT OF EXPERT SYSTEM IN OUR GLOBAL WORLD

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Abstract: Use of computing equipment together with telecommunication infrastructure brings novel capabilities in our global world. An expert system is a computer program that uses artificial intelligence technologies to simulate the judgment and behavior of a human or an organization that has expert knowledge and experience in a particular field. An expert system is made up of three primary components. These are the inference engine, the knowledge base, and the user interface. Agricultural production system has progressed in to a complex business that requires the incorporation of knowledge and information from many various sources. The modern often depends on advisors and agricultural specialists to obtain information for the purpose of decision making. This research work centers on expert system as an off shoot of artificial intelligence, branches of artificial intelligence such as video game, hybrid intelligent systems, intelligent agent, machine learning, robotics, expert system etc., the historical background of expert system, application of expert system in education, auditing, agriculture, smart computing, virtual reality etc. it further discusses software tools needed.

Keywords: *Expert system, Software, Hardware, Agriculture, Artificial intelligence.*

Introduction

1.1 Background to the Study

In artificial intelligence, an expert system is a computer system that emulates the decision-making ability of a human expert. (Magdalena Les, 2015) Expert systems are designed to solve complex problems by reasoning through bodies of knowledge, represented mainly as if–then rules rather than through conventional procedural code. The first expert systems were created in the 1970s and then proliferated in the 1980s (Yang Liu, 2018). Expert systems were among the first truly successful forms of artificial intelligence (AI) software (Ryan, 2014).

Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans. Some of the activities computers with artificial intelligence are designed to include speech recognition, Learning, Planning, monitoring Problem solving, Robots.

1.2 Branches of Artificial Intelligence

1.2.1 Video Game Artificial Intelligence

In video games, artificial intelligence is used to generate responsive, adaptive or intelligent behaviors primarily in non-player characters (NPCs), similar to human-like intelligence. The techniques used typically draw upon existing methods from the field of artificial intelligence (AI).

A **video game** is an electronic game that involves interaction with a user interface to generate visual feedback on a video device such as a TV screen or computer monitor.

The term "game AI" is used to refer to a broad set of algorithms that also include techniques from control theory, robotics, computer graphics and computer science in general, and so video game AI may often not constitute "true AI" in that such techniques do not facilitate computer learning or other standard criteria, only constituting "automated computation," or a predetermined and limited set of responses to a predetermined and limited set of inputs. (Geoffrey, Peter & Andrew, 2009).
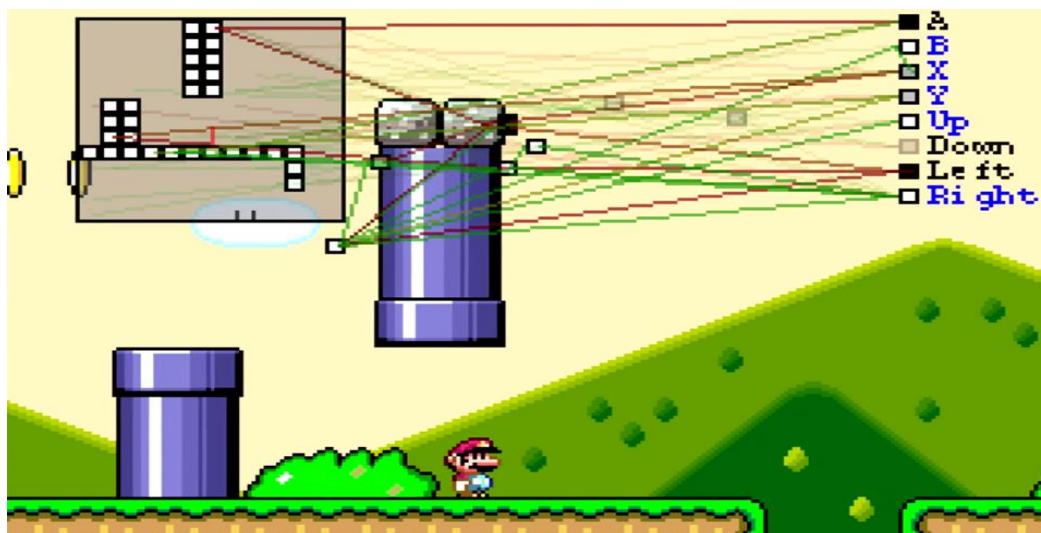
Fig 1.1. A screenshot showing artificial intelligence game with machine learning: AI learns Mario level in just 34 attempts (source engadget.com)

1.2.2 Hybrid Intelligent System

Hybrid intelligent system denotes a software system which employs, in parallel, a combination of methods and techniques from artificial intelligence subfields as Neuro-fuzzy systems, hybrid connectionist-symbolic models, Fuzzy expert systems, Connectionist expert systems, Evolutionary neural networks, Genetic fuzzy systems, Rough fuzzy hybridization, Reinforcement learning with fuzzy, neural, or evolutionary methods as well as symbolic reasoning methods.

1.2.3 Intelligent Agent

In artificial intelligence, an **intelligent agent** (**IA**) is an autonomous entity which observes through sensors and acts upon an environment using actuators (i.e. it is an agent) and directs its activity towards achieving goals. Intelligent agents may also learn or use knowledge to achieve their goals. They may be very simple or very complex. A reflex machine, such as a thermostat, is considered an example of an intelligent agent.

1.2.4 Machine Learning

Machine learning is a field of artificial intelligence that uses statistical techniques to give computer systems the ability to learn (e.g., progressively improve performance on a specific task) from data, without being explicitly programmed.

The name machine learning was coined in 1959 by Arthur Samuel. (Nishith & Anurag, 2018) Machine learning explores the study and construction of algorithms that can learn from and make predictions on data (Manohar, 2017) such algorithms overcome following strictly static program instructions by making data-driven predictions or decisions, (Bishop, *2006*) through building a model from sample inputs. Machine learning is employed in a range of computing tasks where designing and programming explicit algorithms with good performance is difficult or infeasible; example applications include email filtering, detection of network intruders, and computer vision.
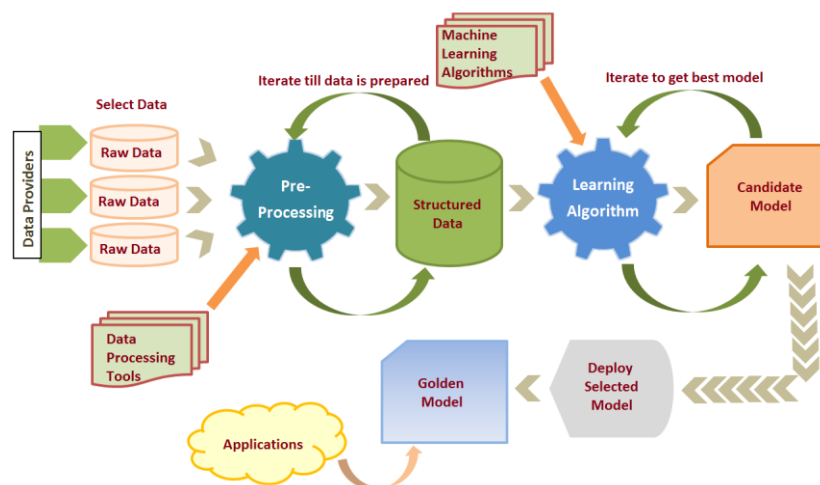
Fig 1.2. A diagrammatic representation of machine learning process (source imarticus.org)

1.2.5 Natural language processing

Natural language processing (**NLP**) is a subfield of computer science, information engineering, and artificial intelligence concerned with the interactions between computers and human (natural) languages, in particular how to program computers to process and analyze large amounts of natural language data.

Challenges in natural language processing frequently involve speech recognition, natural language understanding, and natural language generation.

1.2.6 Robotics

Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electronics engineering, information engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing.

These technologies are used to develop machines or systems that can substitute for humans and replicate human actions. Robots can be used in many situations and for lots of purposes, but today many are used in dangerous environments (including bomb detection and deactivation), manufacturing processes, or where humans cannot survive (e.g. in space). Robots can take on any form but some are made to resemble humans in appearance. This helps in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech,

cognition, and basically anything a human can do. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

Fig. 1.3. A diagram showing how robot is used in a surgery (source ecancer.org)

1.3 Expert System

Expert systems are computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise.

This new era of information and communication technology has played a pivotal role in the field of expert systems. Web technologies allow knowledge engineers and domain experts to build expert systems that are having dynamic knowledge-base capabilities. Domain experts could update the knowledge at the central servers and users have an access to recent knowledge through web interface. Once the expert system is developed the domain experts require minimal intervention of programmer.

Nigeria as a sovereign state is naturally endowed with abundant resources, including both human and material resources (Olajide, Akinlabi & Tijai, 2012). The nation's resources need to be fully developed in such a manner that is possible with the mineral deposits of the nation as a whole, which can only be harnessed by rational and efficient utilization of the natural resources. Thus, the importance of resources in any given economy depends on the roles such resources play in economic growth and development of the nation. In developing economies like Nigeria, agriculture constitutes backbone and critical sector of the economy, as the contributions of the sector to the growth and sustainable development of the country cannot be overemphasized.

It contributes immensely to economic growth and development of the economy in various ways, such as creation of employment opportunities for the country's workforce, provides food requirement of the economy and industrial raw materials to industries, generates foreign exchange earnings and revenue to the government, and as well eradicates extreme poverty in the country. More so, Abayomi O., while explaining the nexus between

agriculture and economic growth in his book "The Agricultural Sector in Nigeria: The Way Forward" in 1997 revealed that poor performance of economic growth in an economy especially, in the developing economies is due to slump in agricultural sector performance (Erokhin, 2017). Agricultural sector in Nigeria has overtime become an important sector of the economy. It has remained the main sector of Nigerian economy despite the discovery of oil in commercial quantities and its attendant boom since 1970s. For example, despite agricultural sector neglect by government at the emergence of oil in 1970s, the sector remained the major employment segment of the economy thereby employing over 60% of the unemployed workforce in country, reduces extreme poverty and as well promotes economic growth of the economy (Oji-Okoro, 2011). In the same view, Oluwasanmi H.A. in 1966 argued that efficient and strong agricultural sector strengthens countries to provide for its fast growing population, create jobs for their workforce, eradicate absolute poverty, feed industries with the required industrial raw materials, generates foreign exchange earnings and revenue to government. (Richard & Ehimika, 2018)

This means that agriculture is growth-led factor, which has multiplier effect on socio-economic and industrial development of any economy due to its various contributions to the growth of domestic economy. The sector's contribution to total real gross domestic product (RGDP) ranges from 30% to 42%, and has as well engaged over 65% of the country's total workforce. Agriculture constitutes the major occupation in the country. For example, nearly 70% of Nigerian population depend on Agriculture as a means of livelihood. As a result of this, research efforts are consciously directed toward the development of agriculture in Nigeria. Traditionally, developed agricultural innovations are dispersed to the farmers through field visits and on-farm demonstrations by the research and extension personnel (Blessing, 2012). Hence, a business or an industry employs the knowledge of various sciences in the production of food, feed, fiber and fuel. The definition therefore, recognizes the fact that plants and animals were originally grown and developed in an economy without human interference. But with the evolvement of agriculture, human quest to increase food production for the growing population emerged. In that, people began to exploit the growth of plants and animals to produce the type and quantity of food and other products that would meet needs of human population in the society. According to Ernest S.O. (2014), agriculture contributes to growth and development of an economy in four main ways, and these include product contribution, factor contribution, market contribution, as well as foreign exchange contribution.

1.4 Historical Background of Expert System

Expert systems were introduced by the Stanford Heuristic Programming Project led by Edward Feigenbaum, who is sometimes termed the father of expert systems; other key early contributors were Bruce Buchanan and Randall Davis (Van de Gevel & Charles, 2013). The Stanford researchers tried to identify domains where expertise was highly valued and complex, such as diagnosing infectious diseases and identifying unknown

organic molecules. According to Edward Feigenbaum, (1977) the idea that intelligent systems derive their power from the knowledge they possess rather than from the specific formalisms and inference schemes they use was at the time a significant step forward. Expert systems became some of the first truly successful forms of artificial intelligence (AI) software (Van de Gevel & Charles, 2013).
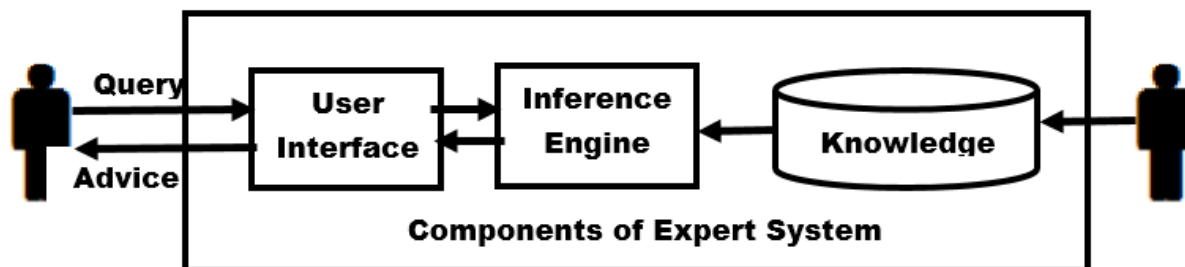
Architecture of Expert System

Fig. 1.4. A diagram depicting how expert system works

Need of Expert System in Agriculture

Expert system as an information support
Technological advancement increased the degree of availability of information and it continues to grow at a phenomenal rate. Information is primarily required in agriculture, researches are carried out on daily basis and new results are revealed at research institutions and documented as reports and dissertations. Most of these results and recommendation do not reach farmers at implementation level. This is because there is a huge gulf between researchers and farmers as a result of lack of decision support system to disseminate on time pertinent farming advice. Advances in information communication technology provides good working framework for the dissemination of agricultural information, hence an expert system which can give personalized expert advice to a large community of farmers, according to their need considering various knowledge bases, since it is virtually impossible for any human expert to consider every piece of available information before arriving at optimal decisions (Yelapure et al, 2012).

Expert system for making decisions
The conventional decision support have predefined set of input data, after that they begin analysis. They precede the data, on a step by step procedure as directed by algorithm, to arrive at a conclusion. Here the algorithm plays important role since knowledge is represented in the form of algorithm. If knowledge of problem got changed then algorithms need to be changed or rebuilt. Also solving new problem in the same domain requires the development of a new system. In contrast to this, human expert tend to follow cognitive approach rather than algorithm. They rely on extensive knowledge base which may contain facts, assertions, past mistakes, trial by error method. Expert systems

are the machine equivalent of human experts. The expert system works with cognitive approach and stress the knowledge in knowledge base which is a separate component. So that changes in knowledge do not change whole structure of expert system. Another advantage is reasoning capability. They can explain reasons for arriving at particular decision (Yelapure et al, 2012).

1.5 Software tools Used in Expert System

The expert system developed by various experts clearly indicate that different software were used to develop computer based expert system for different applications. There are two ways of building expert system: one is to develop from scratch, that is, to code the expert system as a normal computer program for each domain using programming languages like CLIPS, PROLOG, LISP, VB 6.0, VB.Net, ASP.Net, PHP, Java, C#, Python etc as frontend, MS Access, MySQL, ORACLE etc as backend and the other is to use an expert system shell, that is, to build an expert system with the help of specially designed programs that are commercially available which may be used for a particular domain. The shell enables the user to build their own expert system with or without the help from knowledge engineers. Thus shells can make considerable saving on programming time. Because of this, building expert system can be faster and more commercial.

In the recently developed expert system, many programming languages are used. The Schematic representation for the languages used in expert system is given in figure 2.2.
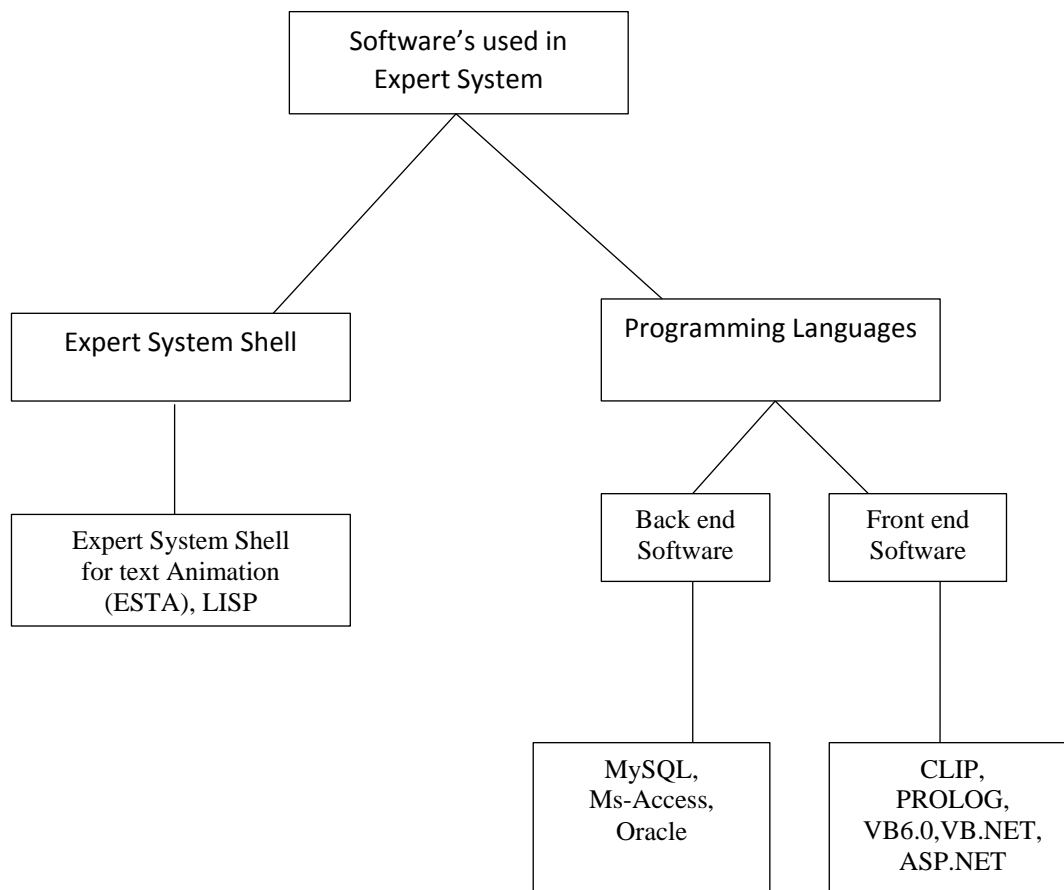
Fig 1.5. A flow diagram showing a Schematic representation for the languages used in expert system.

1.6 Applications of Expert System

Smart Computing

Self-Monitoring, Analysis, and Reporting Technology (SMART) is a monitoring system for computer hard disks to detect and report on various indicators of reliability, so as to anticipate failures. It is a system BIOS and hard disk feature that monitors its performance, disk spin up time, temperature, distance between the head and the disk, and other mechanical activities of the hard disk so as to predict when the disk is likely to fail (Jean, 2009).

The idea behind SMART is that many hard disk are predictable, and that computer users, given a heads-up that their hard disk is on the verge of failing, will be able to recover data before the failure actually happens (Chris, 2009).

It is estimated that over 94% of all new information produced in the world is stored on magnetic media, most of it on physical disks. The drive vendors builds a logic into the

drives to make them smart so that the user gets warning signal as a predictive failure whenever the drive is about to go bad. The drive monitors the number of error checking and correction (ECC) and based on the data analyzed, it can predict failures (Venugopal & Patnaik, 2011).

In recent years, with the first development of smart transport system and data collection technology, a large amount of transit smart card has been accumulated. The transit smart card data has the advantage of detecting residents travel activities. It is computerized without human input like household survey, and it records travelers travel data in daily, monthly and yearly period and could reflect many travel details (Meikang, 2018).

Networking devices such as routers, brouters and switches have been made smart. Routers have the ability to learn addresses of computers and store them in their routing tables and determine the best part to send packets. More so, network switches learn and store mapping relationship between mac addresses and switch port in their mac table, this enable the switches to make decisions with respect to which computer to forward data (Navaid et al, 2015).

Virtual Reality

Virtual reality is a system that enables one or more users to move and react in a computer simulated environment. The term virtual reality was initially coined in 1989 by Jaron Lanier. Originally the term referred to immersive virtual reality in which the user becomes fully immersed into an artificial, 3D world that is completely generated by a computer. Through immersion the user can gain a deeper understanding of the virtual world's behavior and functionality. A wide range of virtual reality based application such as immersive education, real-time visualization of complex data (such as medical, engineering, weather), telemedicine (such as drug design, medical imaging, and remote surgery), immersive multiplayer games, and vehicle and aircraft design and simulation (Ralph & George, 2013).

Virtual reality simulations require special interface devices that transmit the site, sound and sensations of the simulated world to the user. These devices can also record and send the speech and movements of the participant to the simulation program, which enable users to sense and manipulate virtual object much as they would to real objects. This natural style of interaction gives the participants the feeling that they are immersed in a simulated world. For instance, an auto manufacturer can use virtual reality to help it simulate and design factories (Stair & Reynolds, 2013).

Virtual reality can also refer to applications that are not fully immersive, such as mouse controlled navigation through a 3D environment on a graphics monitor, stereo viewing from the monitor through stereo glasses and stereo projection systems. For instance, Boeing used virtual reality and computer simulation to help design and build its Dreamliner 787. The company used 3D models from Dassault systems to design and manufacture the new aircraft (Ralph & George, 2012).

The World Wide Web (WWW) has been a revolution on the computing field since 1990. Expert system developers realize the value to be gained by connecting their knowledge bases to the WWW interface. At the simple end, an expert system uses text-based WWW interfaces to replace a text based interface that would be delivered in some other more proprietary way. For example, a lymph node expert system was developed in a class project and it is accessible on the WWW. At the other end, researchers are developing virtual reality interfaces on top of the WWW that allows the user to be immersed in the environment upon which the expert system is giving advice. For example, in ship emergency handling with expert system support, a virtual reality interface supported on the WWW can be valuable.

Agriculture

Agricultural production system has been progressing into a compound business system that requires the incorporation of knowledge and information from many various sources. In order to remain competitive, the modern farmer often relies on agricultural specialists and advisors to get information for decision making. Unfortunately, assistance of the agricultural expert is not always available when the farmer needs it. In order to assuage this problem, expert systems which emulates the decision making ability of human experts (Kumar, 2014) were identified as a powerful tool with extensive potential in agriculture.

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