Artificial Intelligence (AI) Using Natural Languages (NPL) with Operational Research (OR)

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Abstract

Artificial intelligence (AI) has been defined comprehensively as of making the any device such as computer to think, do and behave as human beings. AI embraces many areas of study, namely: Robotics and sensory systems, Natural Languages Processing (NLPSs), semantic web, Fuzzy logic, speech reorganization, handwriting recognition, User Systems (US), Neural Networks systems (NNS), Expert Systems (ES), Intelligent Agents (IA), Genetic algorithm (GA), and Visual (image) Systems. Although the application of using AI is diverse, ranging from helping of statistical experiment design to routine help desk, the paper focuses attention on only one branch of AI: natural languages processing systems(NLPSs) using operational research(OR) technique. Albeit some visualize AI as a separate entity from NLPSs and OR, the paper, however, confirms and reports that AI is interlocked within NLPSs and OR.

The research also provides a synopsis of real world applications of AI using NLPSs with operational research. Some of these results are applicable in database management systems and many other computing areas for the support of human beings for problem solving and decision making in many spheres of life.

The paper justifies the integration of AI using NLPSs with operational research as suitable candidates for management support systems (MSSs) and decision support systems (DSSs) tools..

NLPSs is considered as a branch of AI which is associated with using software application tools to enable computers recognize to communicate with all types of end users environments in natural languages such as: Swahili, English, Spanish, German, French, or Japanese and many other world human spoken languages. Though developments in NLPSs have not developed fast, experimentations in the area has produced significant results which are potentially useful for (MSSs).

Key Words: Artificial Intelligence (AI), Natural Programming Language Systems (NPLSs), Operational Research (OR), Expert systems (ES), Neural Networks Systems (NNS), Robots, User Systems (US), Genetic Algorithm (GA), management support systems (MSSs), database management systems(DBMS), DSSs.

<u>Introduction</u>

Artificial Intelligence (AI) is an intelligent decision support systems (IDSSs) and intelligent management support systems (IMSSs). Scholars such Chase, et. [2006], concur that AI is an operational research (OR). OR an integrated tool which includes many disciplines of study used for the problem solving and decision making process. NLP is considered as subset within OR technique using software.

The term Intelligent Decision Support System (IDSSs) continue to attract scholars and researchers: Kroeber and Watson [1984]; Parker [1992]; Parker and Case [1993]; Keen and Scott [1978]; Nunamaker, et al [1991]; Cheeseman and Stutz, J [1996]; Reynold [1995]; Dutta and Basu [1984]; Dutta and Mitra [1993]; Turban [2006, et. al]; Keen [1978]; Tembe [1999].

Turban [1996] concurs that DSS is a content free expression that is viewed to mean different things to different people and that there is no universally accepted definition of DSS. Fidler and Rogerson [1995] however define, further DSS as Management Support Systems (MSSs). This definition places DSS into a broader view of its functionalities which are characteristically intertwined. Decision Support Systems (DSS) has gone through several changes consequently several terms have originated and developed [Vella 1998]. This research concentrates on Intelligent Decision Support Consultant (IDSC) which is a sub set and new developments from DSSs [Vella 1990]. IDSC is a part of DSS which takes the form of an expert consultant with a knowledge of many Operation Research (OR) and Management Science (MS) techniques. IDSC also "integrates the tools from the recognition of the need for a decision through the presentation for both the decision itself and the justification for it "[Vella 1990]. The purpose of IDSC is the use of Information Technology (IT) for the support of human decision making process and problem solving without usurping the power of human being.

Problem Statement.

The potential integration NLP as Artificial Intelligence systems (AI) and operational research (OR) have not been examined as IDSS and IMSS for problem solving and decision making process.

Purpose of the Study.

The man purpose of this research is to find out if integration of Artificial Intelligence, using Natural language processing with operational research using Visual programming language, Visual Studio.NET and Excel has potentials for intelligent management support tools and decision support systems.

Hypothesis of the Research

The hypothesis of the research is summarized as follows:

H$_o$:
There are no potential merits for the integration of NLP as AI Systems with Operational research (OR) using visual programming languages, Visual Studio.NET and Excel for intelligent decision support systems and intelligent management support systems

 H$_1$: There are potential merits for the integration of NLP as AI systems with operational research (OR) using visual programming languages, Visual Studio.NET and Excel for intelligent decision support systems and intelligent management support systems

Significance of the Study.

This section of the study is devoted to the justification of the research.
The following are considered the rational for integrating of AI using NLP with OR techniques using Visual programming language and Excel.
From scholarly viewpoint, this research can be utilized in many ways:.
  - A conceptual framework by which all types of end users such as scholars, researchers, teachers, programmers, command level, data Processing programmers, and functional support, non- programming end users (Reynolds, 1995) for management and decision support systems. In this study such an automated intelligent decision tools is refereed as intelligent decision Support Systems (IDSSs) and Intelligent Management Support Systems (IMSSs).
  - A useful tool for solving the main six operative functions, thus procurement, development, compensation, integration, maintenance and separation within enterprise. A tool for business reengineering.
  - To identify the potential merits of using of using NLP as AI with OR has
  - To enrich the one of the most widely encountered programming tasks, and certainly the most thoroughly studied computing areas: sorting algorithms [Savitch, 2005,].

Assumptions of the study.

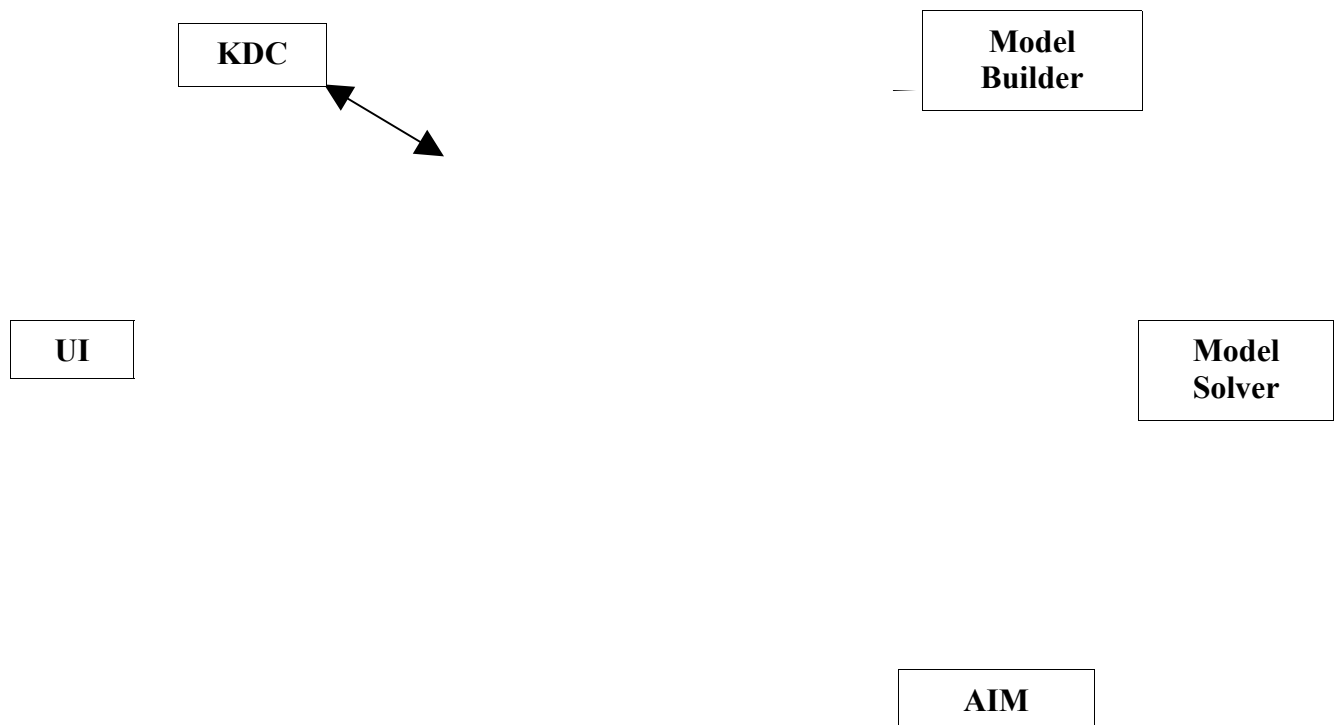The study assumes the following:
  - It is assumed that the primary and secondary sources are accurate
  - It also assumes that the study is worth conducting for problem solving and decision making within operational research and AI computing
  - It assumed the software: visual programming language used in the study is appropriate technology
  - It assumed that the hardware used for this research is appropriate technology
  - It is assumed that this prototype as case study is accurate and appropriate fit.

Conceptual Framework.

Almost all studies within the area of AI using NLP have concentrated on languages such as Chinese, [Russell and Norvig, 2003, Fisher, 1984).]. This research, however, has a new dimension within the area of NLP of AI using OR technique with visual programming and Visual Sudio.NET languages and Excel.

This research utilizes the Conceptual Framework developed by Vella [1990,1998] referred to as" An Intelligent Decision Support Consultant (IDSC)". This was modified by Tembe[1999]. Figure 1 shows the six main architectural components of the conceptual framework:

Figure 1

| KDC | | Model Builder |

| UI | | Model Solver |

| | AIM | |

The conceptual framework (Figure 1)

The following section of the research describes the six main elements of the Intelligent Agent systems (IAS)

Intelligent User interface (IUI).

Intelligent User Interface: is used for identifies that words, characters.

Knowledge and Data Capture (KDC).

The Knowledge Data Capture is fundamentally (KDC) used as depository and gathering of internal and external knowledge

Model Builder (MB)

The Model Builder is a component of IDSC with a capability to build a number of alternative models of the problem. The Model Builder builds appropriate model incorporating all the essential features. The mathematical manipulation is also handled by MB using queuing a OR technique.

Model Solver (MS)

The Model Solver determines the software for the task. It translates the model into a suitable data in the correct format for the tool. It runs the tool using the result from MB via the Black Board. If it can solve more than one model it compares the output for consistency and reliability. It has also the functionality of collecting the resulting output. The software tool used for Model Solver is Visual Studio.NET and Visual programming languages using Java. Excel is also used as one of the simplest tool for computation but not recognition.

Analysis and Interpretation Module (AIM)

The Analysis and Interpretation Module (AIM) takes both the garbage in and the garbage out of the earlier subsystems of the Intelligent Decision Support Consultant (IDSC) and makes decision about their performance. IAM might interprete intrinsically (black box concept) the accuracy model builder and model solver [Ullah 1998 and Tembe1999].

Presentation Controller (PC)

The Presentation Controller (PC) takes its input from all of the inputs and outputs of the other components of the IDSC. The functionality of the PC is for report generating system. For the PC to operate effectively and efficiently it has to understand the kind reports the end user requires. Tools used in Microsoft office and Visual programming languages are can be appropriate tools to use.[Ullah, Tembe, Vella, 1998)

Focus of Research within Conceptual Framework.

The research study concentrates on two main elements of the conceptual framework.
The two part are repeated here for clarity purpose and emphasis.

Model Builder (MB)

Model Solver (MS)

The Model Builder (MB) is a component of the IDSC with a capability to build a number of alternative models of a problem. The Model Builder builds an appropriate model incorporating all the essential features. The MB using OR techniques also handles the mathematical manipulations. In this research one OR technique: Queueing Theory is used [Curwin and Slater 1996, Dennis and Dennis 1991, Pidd 1994; Ullah and Tembe 1998, Vella, 1990, 1998].

The Model Solver (MS) determines the software for the task. It translates the model into suitable data in the correct format for the tool. It runs the tool using the result from MB via the Black Board (A Black Board is an area of shared memory where different agents (programs if you like) leave messages for each other. This allows for asynchronous communication between independent software agents). If the MS can solve more than one model it compares the output for consistency and reliability. It has also the function of collating the resulting output.[Ullah and Tembe 1998].

These two parts useful AI, NLP, OR and Visual programming, Excel and Visual Studio. NET systems for calculation, identification, recognition, classification, collection, interpretation, analysis, interpretation, summarization, sorting, searching, iterating, recurring, looping, simulation using algorithms and presentation of data and information for problem solving and decision making automatically, dynamically and intelligently.

Limitations of the Study.

This research has been limited to the following:
1. Primary and secondary sources
2. The conceptual framework used
3. AI, NLP and OR, visual programming and Excel use
4. The case study using analytic OR technique: queing mathematical problem
5. Model Builder (MD) and Model Solver(MS)of the Conceptual framework (figure 1)

Software Used.

The software tool used for Model Solver is Visual programming language: Java and Excel. Visual programming and Visual Studio.NET languages has used in the research because [Deitel and Deitel, 2005]: (1) current computing trend, (2) user friendliness consideration (3), (4) The researcher has used the visual programming languages for more than decade.

Among the visual programming and Visual Studio. NET languages, Java was considered the suitable language to be used. The following synopsis provides the main attributes for justification for utilizing of Java as a programming language [Bradley and Millspaugh, 2002, Deitel and Deitel, 2005, Wu, 2006, Savitch, 2004, Liang, 2005, Horstmann, 2002, Johnson, 2007]: (1) Suitable for web based applications, (2) Safety and security, (3) robustness (4) just in time programming (5) portable and interpreted language (6) Architecturally neutral (7)multithreaded and multiple platform (8) evolving and dynamic

Stevenson [2002] states that OR continues to gained popularity. The rationale for dynamic growth of OR is the use of computer systems with user friendly software applications such as Visual programming and Visual Studio.NET languages and Excel.

Hardware.

The Experimentation was conducted using Pentium IV because it the most current powerful hardware system.

Methodology and Procedure.

The methodology used in this research is a case study approach.
The OR technique used in this research is queuing (waiting line).The main rationale for selecting queing are [Curwen and Slater 1996, Russell and Taylor 2003]: (1) simple OR mathematical technique to compute algorithmically (2) Can be simulated as the last resort to verify the answer, (3)Almost everyone one earth is associated with queuing. Camm and Evans [2000] concur that nearly everyone experiences waiting line."

The following example has been adopted from a case study using analytic queuing as OR technique using Java as Visual programming language and Excel.

Case Study: Queuing Mathematical Problem.

The following is the mathematical queuing problem used for experimentation:

A petrol station has customers arriving at the rate of 48 customers per hour. There are 6 identical service pump points and each can handle 22 customers per hour. Determine the operating characteristics of a queue.

Solution: ***Intelligent User Interface***: identifies that words like 'arrive', 'rate' and 'service' indicate that the queueing problem is being presented. The IUI needs to extract data such as

Arriving at the rate of   48
Service Rate   22
Service Pumps   06

Model Builder (MB).

The Model Builder determines that a multiple server queue, which is M/M/s, is being described. Consequently a queuing model or a simulation model can solve such a problem. This question is straightforward for queuing, while for simulation it might take time to solve.

Model Solver (MS).

The Model Solver uses software tools for solving the queueing problem. The Model Solver prepares the correct data in the appropriate format then runs the model. In this case study, the following is sent to the using Excel and computes the symbols and notations used for queuing.

Output:

48
22

No. of Servers	2	3	4	5	6	7
Average No. of customer in the queue	-13.66008	1.42124	0.21775	0.02195	0.00941	0.00213	0.0
Average No. of customer in the system	-11.47826	3.60305	2.39957	2.20377	2.19123	2.18394	2.1
Average time in the queue	-17.07510	1.77654	0.27219	0.02744	0.01176	0.00266	0.0
Average waiting time in the system	-14.34783	4.50382	2.99946	2.75471	2.73903	2.72993	2.7
Probability system is empty	-0.04348	0.08397	0.08736	0.03879	0.06993	0.06921	0.0

Note: The unit measurement for the above outputs in the table are in minutes. It is important to point out that since $= 48$ and $= 22$, the ratio of $/ > 1$ indicating that up to two servers cannot handle the volume of demand without the queue growing indefinitely. This is shown in column 2 of the above table with negative values for the operating characteristics. The minimum number of servers, s, must satisfy $< s$. in this case at least three servers are required to meet the demand. As the number of servers increases the operating characteristics improve [Camm & Evans 1996].

Research Questions.

The following general research questions were addressed in this investigation.
1. What is operational research (OR)?
2. What is the meaning of Artificial intelligence(AI)
3. What is the main conceptual framework to use with NPL and OR
4. What are the tangible benefits of using AI using NLP with operational research (OR)
5. What are the intangible benefits of using AI using NLP with operational research (OR)
6. Which operational research is the most suitable technique candidate for to used NLP
7. What is the meaning and application of natural language processing?
8. Which software is appropriate technology for using NLP with operational research
9. What kind of hardware is appropriate technology for NPL?
10. How do operational research techniques interlock with AI using NLP types?

11. What the braches of AI?
12. What are the potential merits of Natural processing language?
13. What are the constraints demits, issues, constraints associated with of using Natural language processing?
14. What is the future of prospects of natural language processing?
15. What are the philosophical: ethical and moral issues associated with AI using NLP with operational research?

Literature Review.

1. Natural language Processing

Natural language processing (NLP) is a classification of AI which is devoted to software application tools that enable computers automatically identify, recognize, cluster, categorize, group, and classify and to communicate with all types of end users environments in human spoken languages on earth such Swahili, Urdu, Lingala, Arabic, Aramaic, Spanish, French, English and many other languages used in the globe.
Turban , et. al [2006] indicate that the application of AI using NLP has significantly increased since September 11/2001. Many commercial applications have been developed within these areas for intelligently and automatically recognizing and automatically words, symbols, algorithms, iterators, and containers (collections) while the systems is executing, operating and running. This study views NLP with the following propensities:

1. Ability to recognized , cluster, parse, identify, group, classify, detect, inspect, modify, debug thin characters words, symbols, notations, intelligently and automatically and give feedback to the end user.
2. Ability to classify characters automatically while the program is running or running
3. The ability of being able to talks to computers and robots in conversational human languages and have them " understand " us easily as we understand each other is the goal of AI
4. Ability to identify, recognize, simulate, generate, encapsulate, aggregate, interface, couple classify, thin, simply, clarify, signal symbolically, cluster, parse, separate, merge, group, sort , search automatically using algorithm, containers(collections) and iterators using visual programming languages.
5. Ability to thin (remove) even the noisy words used in programs [Pratt, and Zelkowitz, 2001].
6. Ability to help merge and normalize data, thus eradicating redundancy.
7. Allows all types of end users to access data and interact with the computer using natural or ordinary words so that the computer is extremely easy to use
8. Has the propensity to interpret and request that the end user provide clarification when words, symbols, phrases are not clear to the interpreter
9. The ability to teach the computer to respond to spoken words
10. Identification of words numbers (integers) and strings from other languages used within computer science and not encoded in UNICODE.
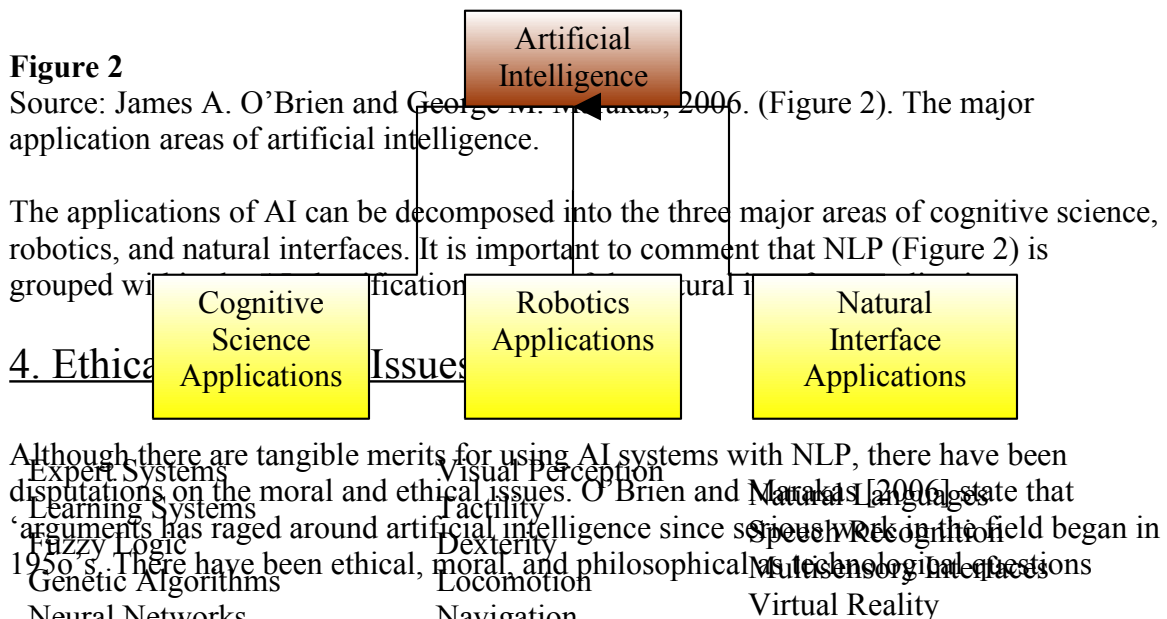
2. Operational Research (OR).

Operational research (OR) which is also referred to as operations research (OR), management science (MS) and decision science(DS) is hub which integrates many science and art fields. Camm and Evans, 2000, Vella 1990, 1998]. OR functionalities are used in disciplines such as: computer science, logistics, supply chains, manufacturing, service industry, business decision, simulation, forecasting ,budgeting, project management, modeling, optimization, probability, morphological analysis, game theory, engineering. OR is a tool for collection, analysis, experimentation, observation, summarization and presentation of data and information for the real world application [Stevenson, 2002, Camm and Evans, 2000, Vella 1990, 1998]. OR is attractive approach because it incorporates the decision making process which include human intangible human elements. The justification is that making Using NLP is concerned and interlocked the human elements, consequently that gives OR aura prestidge over other techniques used for solving problems. For instance, languages used for NPL are difficult to quantify mathematically. OR in the century has therefore become the state of the art for problem solving and decision making process.

The research brings the attention that OR is also a discipline which incorporates all types and major of applications of AI as IDSS and IMSS for problem solving and decision making process (O'Brien and Marakas, 2006, 345): cognitive science, robotics, and natural interfaces.

3. Artificial Intelligence (AI)

AI is a broad science which treats computers to behave and think like human being. The following the three classifications of AI.(figure 2): cognitive science, robotics, and natural interfaces:

Figure 2
Source: James A. O'Brien and George M. Marakas, 2006. (Figure 2). The major application areas of artificial intelligence.

The applications of AI can be decomposed into the three major areas of cognitive science, robotics, and natural interfaces. It is important to comment that NLP (Figure 2) is grouped with one of the classification as one of the natural interface application.

4. Ethical Issues

Although there are tangible merits for using AI systems with NLP, there have been disputations on the moral and ethical issues. O'Brien and Marakas [2006] state that 'arguments has raged around artificial intelligence since serious work in the field began in 1950's. There have been ethical, moral, and philosophical as technological questions

Artificial Intelligence

Cognitive Science Applications

Robotics Applications

Natural Interface Applications

Expert Systems
Learning Systems
Fuzzy Logic
Genetic Algorithms
Neural Networks
Intelligent Agents

Visual Perception
Tactility
Dexterity
Locomotion
Navigation

Natural Languages
Speech Recognition
Multisensory Interfaces
Virtual Reality

about the probability and propensity of intelligent, thinking machines." The other issues addressed in ralation to the use of NLPis that of privacy of individual and cultures.

Findings from the Study:

The following are the findings from this study

- Premilanary reports from programming demonstrate that analytic and simulation
- Queuing theory was the most suitable candidate analytic technique among operational research techniques. The rationale choosing queuing theory is that everybody on earth is involved every day with queuing directly or directly.
- The result demonstrated that Visual programming language and Visual Studio.NET can be useful for creating programming that can create intelligent decision support systems and (IMSSs) tool for decision making. The results from the case study indicate that using AI using NLP approach with OR techniques yield significant results such in the area s of database management systems, Object oriented design, networking, wire computing, distributed computing, computer security (information assurance, cryptography, DNA, encryption)and forensic, computer simulation (stochastic and probabilistic compuationality. The distinguished researchers such as [Turban, 2006, Nerving 2002, Casey 1998] all agree that AI and its branches which includes NLP are for dual purposes: (1) to study humans beings thoughts processes and (2) represent human thoughts intelligently using technology.

- The findings demonstrate that the since September/11/01, the use of AI with integration of NPL using visual programming and Visual Studio. NET languages has had an impact and many application such airport security

- The NLP intelligence system can act as support, advise, consultant and provide information on specific need of the user to human beings.
- NPL can be automated identification of symbols which can be used by disgruntled people that tamper with sensitive data such as transportation systems: airlines, railroads, waterways.
- The ingration of AI with OR techniques can be an advantage in research in search areas as multisensory devices human that use variety of body movements to operate computers–computer . This is interlocked applications such as virtual reality.
- The results demonstrate that using AI based on NLP technology with OR , in responses to English language base mathematical problems has the capability to retrieve any sort, search, copy, merge, thin, cluster, interact, compute, classify, distill, categorize, monitor, evaluate of online data and information , from text to pictures, videos, audio and audio clips and maps
- A pontential to help identify in sensitive areas such as computer security: cryptography, biometric, DNA, forensic interpratation, identification of terrorist via the web attempting to use a foreign symbol signs, signals, notations, word, characters, strings, dialect, to communicate with each other virus and bombs types and how to prevent.

- The result if developed and implemented can be a tools to add the word, symbols which have not been encoded into UNICODE for computing programming and dictionaries (lexicons, glossary) for use in the world today.

The experiment has had the propensity to automatically separate, classify, recognize, group, parse the all characters. They languages provided the capability to recognize that: that is queuing mathematical problem and can be used with other OR techniques. . This result emulates the true characteristic intelligent decision support systems (IDSSs) tool and intelligent management support Systems (IMSSs), hence vital for problem solving and decision making process.

Recommendations.

The study recommends that other OR techniques such simulation, linear programming etc; to be tested using a similar instrument in order to add more notations, symbols, operators, special characters, characters and other data types used within programming. The investigation further recommends that native languages, dialects used and not used officially in such areas as UNICODE to be also used in order to identify the notations, symbols, objects, mathematical equations, special characters and any other data type that needs to be made learned. This is crucial because unknown symbols, objects that exist among other tribes, dialects, and subdialects or nationalities can used against security, integrity and safety of people such as sending virus, terrorist activities for the abuse of mankind.

Future Prospects of NLP With OR Techniques

Paramilitary results on AI show that there are many prospects. This is succinctly concurs to the statement that " following September 11, 2001, AI has been getting lots of attention due to its capability to assist in fighting terrorism (Turban, et al, 2006). Turban further cites Rivlin [2002] that "another development that helps AI to get attention is the large number of intelligent devices in the marketplace. Such strong statements from distinguished scholars and prolific writers confirm that the future of AI using NLP with OR using visual programming languages and Excel is positive and dynamic prospect.

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