“A Study of Artificial Intelligence and its Application in Different Areas”

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Abstract: In the future, intelligent machines will replace or enhance human capabilities in many areas. Artificial intelligence is the branch of computer science concerned with making computers behave like humans. The term was coined in 1956 by John McCarthy at the Massachusetts Institute of Technology. Artificial intelligence in the last two decades has greatly improved performance of the manufacturing and service systems. In artificial intelligence, an expert system is a computer system that emulates the decision-making ability of a human expert. 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. Application areas of Artificial Intelligence is having a huge impact on various fields of life as expert system is widely used these days to solve the complex problems in various areas as science, engineering, business, medicine, weather forecasting. The areas employing the technology of Artificial Intelligence have seen an increase in the quality and efficiency. This paper gives an overview of this technology and the application areas of this technology. This paper will also explore the current use of Artificial Intelligence technologies in Network Intrusion for protecting computer in the medical area, to improve hospital inpatient care, for medical image classification, in Online telephone customer services and in the computer games.

Keywords: Artificial Intelligence, Neural Networks (computer), Power System Stabilizer.

I. INTRODUCTION

Artificial intelligence is playing an increasing role in the research of management science and operational research areas. Intelligence is commonly considered as the ability to collect knowledge and reason about knowledge to solve complex problems. Artificial intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs and perform human-like tasks. Most Artificial intelligence examples that you hear about today – from chess-playing computers to self-driving cars – rely heavily on deep learning and natural language processing. Using these technologies, computers can be trained to accomplish specific tasks by processing large amounts of data and recognizing patterns in the data.

Goals of AI

- **To Create Expert Systems** – The systems which exhibit intelligent behavior, learn, demonstrate, explain, and advice its users.
- **To Implement Human Intelligence in Machines** – Creating systems that understand, think, learn, and behave like humans.

**Programming without AI**

i) A computer program without AI can answer the specific questions it is meant to solve.

ii) Modification in the program leads to change in its structure.

iii) Modification is not quick and easy. It may lead to affecting the program adversely.
Programming with AI
i) A computer program with AI can answer the generic questions it is meant to solve.
ii) AI programs can absorb new modifications by putting highly independent pieces of information together. Hence you can modify even a minute piece of information of program without affecting its structure.
iii) Quick and Easy program modification.

Applications of AI
AI has been dominant in various fields such as –

- **Gaming** – AI plays crucial role in strategic games such as chess, poker, tic-tac-toe, etc., where machine can think of large number of possible positions based on heuristic knowledge.
- **Natural Language Processing** – It is possible to interact with the computer that understands natural language spoken by humans.
- **Expert Systems** – There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users.
- **Vision Systems** – These systems understand, interpret, and comprehend visual input on the computer. For example,
  - A spying aeroplane takes photographs, which are used to figure out spatial information or map of the areas.
  - Doctors use clinical expert system to diagnose the patient.
  - Police use computer software that can recognize the face of criminal with the stored portrait made by forensic artist.
- **Speech Recognition** – Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it. It can handle different accents, slang words, noise in the background, change in human’s noise due to cold, etc.
- **Handwriting Recognition** – The handwriting recognition software reads the text written on paper by a pen or on screen by a stylus. It can recognize the shapes of the letters and convert it into editable text.
- **Intelligent Robots** – Robots are able to perform the tasks given by a human. They have sensors to detect physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure. They have efficient processors, multiple sensors and huge memory, to exhibit intelligence. In addition, they are capable of learning from their mistakes and they can adapt to the new environment.

a) **Why is artificial intelligence important?**
   i) AI automates repetitive learning and discovery through data.
   ii) AI analyzes more and deeper data
   iii) AI adds intelligence
   iv) AI achieves incredible accuracy
   v) AI adapts through progressive learning algorithms
   vi) AI gets the most out of data
b) How Artificial Intelligence Is Being Used

Every industry has a high demand for AI capabilities – especially question answering systems that can be used for legal assistance, patent searches, risk notification and medical research. Other uses of AI include:

i) Health Care

AI applications can provide personalized medicine and X-ray readings. Personal health care assistants can act as life coaches, reminding you to take your pills, exercise or eat healthier.

ii) Retail

AI provides virtual shopping capabilities that offer personalized recommendations and discuss purchase options with the consumer. Stock management and site layout technologies will also be improved with AI.

iii) Manufacturing

AI can analyze factory IoT data as it streams from connected equipment to forecast expected load and demand using recurrent networks, a specific type of deep learning network used with sequence data.

iv) Sports

AI is used to capture images of game play and provide coaches with reports on how to better organize the game, including optimizing field positions and strategy.

c) How Artificial Intelligence Works

AI works by combining large amounts of data with fast, iterative processing and intelligent algorithms, allowing the software to learn automatically from patterns or features in the data. AI is a broad field of study that includes many theories, methods and technologies, as well as the following major subfields:

i) Machine learning

ii) A neural network

iii) Deep learning

iv) Cognitive computing

v) Computer vision

II. AREAS OF ARTIFICIAL INTELLIGENCE

A. Language understanding:

The ability to "understand" and respond to the natural language. To translate from spoken language to a written form and to translate from one natural language to another natural language.

1.1 Speech Understanding

1.2 Semantic Information Processing (Computational Linguistics)

1.3 Question Answering

1.4 Information Retrieval

1.5 Language Translation
B. Learning and adaptive systems:

It is the activity of gaining knowledge or skill by studying, practicing, being taught, or experiencing something. Learning enhances the awareness of the subjects of the study. The ability to adapt behavior based on previous experience, and to develop general rules concerning the world based on such experience. The ability of learning is possessed by humans, some animals, and AI-enabled systems. Learning is categorized as

- **Auditory Learning** – It is learning by listening and hearing. For example, students listening to recorded audio lectures.
- **Episodic Learning** – To learn by remembering sequences of events that one has witnessed or experienced. This is linear and orderly.
- **Motor Learning** – It is learning by precise movement of muscles. For example, picking objects, Writing, etc.
- **Observational Learning** – To learn by watching and imitating others. For example, child tries to learn by mimicking her parent.
- **Perceptual Learning** – It is learning to recognize stimuli that one has seen before. For example, identifying and classifying objects and situations.
- **Relational Learning** – It involves learning to differentiate among various stimuli on the basis of relational properties, rather than absolute properties. For example, Adding ‘little less’ salt at the time of cooking potatoes that came up salty last time, when cooked with adding say a tablespoon of salt.
- **Spatial Learning** – It is learning through visual stimuli such as images, colors, maps, etc. For example, A person can create roadmap in mind before actually following the road.
- **Stimulus-Response Learning** – It is learning to perform a particular behavior when a certain stimulus is present. For example, a dog raises its ear on hearing doorbell.
C. Problem solving:
It is the process in which one perceives and tries to arrive at a desired solution from a present situation by taking some path, which is blocked by known or unknown hurdles. Problem solving also includes decision making, which is the process of selecting the best suitable alternative out of multiple alternatives to reach the desired goal are available. Ability to formulate a problem in a suitable representation, to plan for its solution and to know when new information is needed and how to obtain it.

3.1 Inference (Resolution-Based Theorem Proving, Plausible Inference and Inductive Inference)
3.2 Interactive Problem Solving
3.3 Automatic Program Writing
3.4 Heuristic Search

D. Perception (visual):
It is the process of acquiring, interpreting, selecting, and organizing sensory information. Perception presumes sensing. In humans, perception is aided by sensory organs. In the domain of AI, perception mechanism puts the data acquired by the sensors together in a meaningful manner. The ability to analyze a sensed scene by relating it to an internal model which represents the perceiving organism's "knowledge of the world." The result of this analysis is a structured set of relationships between entities in the scene.

4.1 Pattern Recognition
4.2 Scene Analysis

E. Modeling:
The ability to develop an internal representation and set of transformation rules which can be used to predict the behavior and relationship between some set of real-world objects or entities.

5.1 The Representation Problem for Problem Solving Systems
5.2 Modeling Natural Systems (Economic, Sociological, Ecological, Biological etc.)
5.3 Robot World Modeling (Perceptual and Functional Representations)

F. Robots:
A combination of most or all of the above abilities with the ability to move over terrain and manipulate objects.

6.1 Exploration
6.2 Transportation/Navigation
6.3 Industrial Automation (e.g., Process Control, Assembly Tasks, Executive Tasks)
6.4 Security
6.5 Other (Agriculture, Fishing, Mining, Sanitation, Construction, etc.)
6.6 Military
6.7 Household

G. Games:
The ability to accept a formal set of rules for games such as Chess, Go, Kalah, Checkers, etc., and to translate these rules into a representation or structure which allows problem-solving and learning abilities to be used in reaching an adequate level of performance.
7.1 Particular Games (Chess, Go, Bridge, etc.)

III APPLICATIONS OF ARTIFICIAL INTELLIGENCE

The domain of AI is classified into Formal tasks, Mundane tasks, and Expert tasks.

**Mundane (Ordinary) Tasks**
- Computer Vision
- Speech, Voice

**Formal Tasks**
- Mathematics
- Geometry
- Logic
- Integration and Differentiation

**Expert Tasks**
- Engineering
- Fault Finding
- Manufacturing
- Monitoring

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**A. Artificial Intelligence technologies in Network Intrusion Detection**

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An intrusion detection system (IDS) is a device or software application that monitors a network or systems for malicious activity or policy violations. Any detected activity or violation is typically reported either to an administrator or collected centrally using a security information and event management (SIEM) system. A SIEM system combines outputs from multiple sources, and uses alarm filtering techniques to distinguish malicious activity from false alarms.

Intrusion Detection Systems (IDS) uses the various Artificial Intelligence techniques for protecting computer and communication networks from intruders.

B. Application of Artificial Intelligence Techniques in Medical Area

Artificial Intelligence in Medicine

Fuzzy Expert Systems in Medicine: Fuzzy logic is a data handling methodology that permits ambiguity and hence is particularly suited to medical applications. It captures and uses the concept of fuzziness in a computationally effective manner. The most likely area of application for this theory lies in medical diagnostics and, to a lesser extent, in the description of biological systems. Fuzzy expert systems use the structure of a series of „if – then” rules for modeling.

- If running nose or headache
  Then consult your doctor

They can also characterize MRI images of brain tumours ultrasound images of the breast, ultrasound. Fuzzy logic controllers have been designed for the administration of vasodilators in the peri-operative period to control blood pressure.

C. Using Artificial Intelligence to Improve Hospital Inpatient Care:

Artificial neural networks are used as clinical decision support systems for medical diagnosis, such as in Concept Processing technology in EMR software. Other tasks in medicine that can potentially be performed by artificial intelligence and are beginning to be developed include:

i) Computer-aided interpretation of medical images. Such systems help scan digital images, e.g. from computed tomography, for typical appearances and to highlight conspicuous sections, such as possible diseases. A typical application is the detection of a tumor.

ii) Heart sound analysis

iii) Watson project is another use of AI in this field, a Q/A program that suggest for doctor's of cancer patients.

iv) Companion robots for the care of the elderly

v) Mining medical records to provide more useful information.

vi) Design treatment plans.

vii) Assist in repetitive jobs including medication management.

viii) Provide consultations.

ix) Drug creation

x) Using avatars in place of patients for clinical training

Currently, there are over 90 AI startups in the health industry working in these fields.

Artificial Neural Networks Approach on Diagnostic Science:
The following subsections will discuss how AI is utilized for image classification over generations.

1. Endoscopic Images:

2. MRI Brain Tumor Analysis

Clinical decision support systems (CDSS) were one of the first successful applications of AI, focusing primarily on the diagnosis of a patient's condition given his symptoms and demographic information. Work on CDSS for medical diagnosis began in the early 1970s with Mycin—a rule-based expert system for identifying bacteria that cause severe infections and recommending antibiotics to treat these infections. David Heckerman and his colleagues developed Pathfinder, which used Bayesian networks (a graphical model that encodes probabilistic relationships among variables of interest) to help pathologists more accurately diagnose lymph-node diseases. AI has also been useful for computer-aided detection of conspicuous structures (such as tumors or polyps) in medical images. Such approaches assist in the screening of mammography images, as well as the diagnosis of various forms of cancer, coronary artery disease, and congenital heart defects.

d. Application of Artificial Intelligence in Online telephone customer services:

Artificial intelligence is implemented in automated online assistants that can be seen as avatars on web pages. It can avail for enterprises to reduce their operation and training cost. A major underlying technology to such systems is natural language processing. Pypestream uses automated customer service for its mobile application designed to streamline communication with customers.

Currently, major companies are investing in AI to handle difficult customer in the future. Google’s most recent development analyzes language and converts speech into text. The platform can identify angry customers through their language and respond appropriately. Companies have been working on different aspects of customer service to improve this aspect of a company. Digital Genius, an AI start-up, researches the database of information (from past conversations and frequently asked questions) more efficiently and provide prompts to agents to help them resolve queries more efficiently.

IPSoft is creating technology with emotional intelligence to adapt the customer's interaction. The response is linked to the customer's tone, with the objective of being able to show empathy. Another element IPSoft is developing is the ability to adapt to different tones or languages.

Inbenta’s is focused on developing natural language. In other words, on understanding the meaning behind what someone is asking and not just looking at the words used, using context and natural language processing. One customer service element Ibenta has already achieved is its ability to respond in bulk to email queries.

e. Application of Artificial Intelligence Techniques in the Computer Games:

In the evolution of computer games, game have grown from modest text based to the three dimensional graphical games with complex and large worlds. The systems as graphics rendering, playing audio, user input and game artificial intelligence (AI) when put together provide the expected entertainment and make a worthwhile computer game. Artificial intelligence is the most important part of every computer game and playing the game without artificial intelligence would
not be any fun!. If we remove artificial intelligence from computer games, the games will be so simple that nobody will be interested in playing the computer games anymore!. Without the game AI, the winning would not be difficult at all. Artificial intelligence is used to solve common problems in the computer games and provide the features to the games. The 1990s saw some of the first attempts to mass-produce domestically aimed types of basic Artificial Intelligence for education, or leisure.

This prospered greatly with the Digital Revolution, and helped introduce people, especially children, to a life of dealing with various types of Artificial Intelligence, specifically in the form of Tamagotchis and Giga Pets, iPod Touch, the Internet, and the first widely released robot, Furby. A mere year later an improved type of domestic robot was released in the form of Aibo, a robotic dog with intelligent features and autonomy. Companies like Mattel have been creating an assortment of AI-enabled toys for kids as young as age three. Using proprietary AI engines and speech recognition tools, they are able to understand conversations, give intelligent responses and learn quickly. AI has also been applied to video games, for example video game bots, which are designed to stand in as opponents where humans aren't available or desired.

**Computer Game Problems Solved with AI:** Artificial intelligence solves the three common problems: nonplaying character (NPC) movement, NPC decision making, and NPC learning. The four artificial intelligence techniques used are Path Finding, Bayesian Networks, Fuzzy Logic, and Genetic Algorithms which help a computer game provide non-playing character path finding and decision making as well as learning.

**IV. CONCLUSION**

The artificial intelligence gives the ability to the machines to think analytically, using concepts. Tremendous contribution to the various areas has been made by the Artificial Intelligence techniques from the last 2 decades. Artificial Intelligence will continue to play an increasingly important role in the various fields. This paper is based on the concept of artificial intelligence, areas of artificial intelligence and the artificial intelligence techniques used in the field of the Network Intrusion Detection to protect the network from intruders, in the medical area in the field of medicine, for medical image classification, in the accounting databases, and described how these AI techniques are used in computer games to solve the common problems and to provide features to the games so as to have fun. There is bright future in the analysis of Network Intrusion Detection. We conclude that further research in this area can be done as there are very promising and profitable results that are obtainable from such techniques. While scientists have not yet realized the full potential and ability of artificial intelligence.

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