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Introduction to Artificial Intelligence

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***Abstract*— This paper covers the introduction, history and applications of Artificial Intelligence. In this paper we have dealt with exact definition of artificial intelligence, its origin and the various theories that approach to get the clear idea of principles of AI. Various applications of artificial intelligence in fields like aviation, finance, medicine, games, etc. have been discussed precisely. A latest application of "SURVEILLANCE CAMERA SYSTEM" is presented. In this camera system principle of AI has been used smartly. The system functions autonomously without any manual input and has provided a base to create more intelligent security systems. The paper concludes that the next big revolution in the field of science will be brought about by artificial intelligence.**

***Keywords*— Artificial Intelligence, Fuzzy Logic, Neural Networks, Expert Systems.**

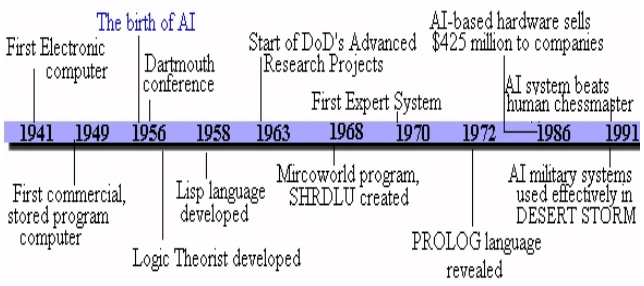
I. INTRODUCTION

Artificial Intelligence, or AI for short, is the science and engineering of making intelligent machines. Intelligent Machines are those which are capable of analyzing situations and taking appropriate decisions.

John McCarthy is known as the Father of Artificial Intelligence. He was the first to initiate research in this field. He coined the term AI in 1949.

AI is a broad topic, consisting of different fields, from *machine vision to expert systems*. The element that the fields of AI have in common is the creation of machines that can "think". In order to classify machines as "thinking", it is necessary to define intelligence. Intelligence consists of many things like solving complex problems, making generalization and relationships, perception, comprehension, etc. Expectations from the intelligent machines are that they should be able to mimic the behavior of the human brain, made up of billions of neurons, and arguably the most complex matter in the universe. Perhaps the best way to gauge the intelligence of a machine is British computer scientist Alan Turing's test. He stated that a computer would deserves to be called intelligent if it could deceive a human into believing that it was human. AI has always been on the pioneering end of computer science. Advanced-level computer languages, as well as computer interfaces and word-processors owe their existence to the research into artificial intelligence. Different applications of AI include automatic cars, washing machines, digital cameras, GPS systems in mobiles, various robots, etc.

II. HISTORY



Time Line Of Major AI Events

The term artificial intelligence was first coined in 1956, at the Dartmouth conference, and since then Artificial Intelligence has expanded because of the theories and principles developed by its dedicated researchers. The invention of computer in 1941 led to the birth of artificial intelligence. Although the computer provided the technology necessary for AI, it was not until the early 1950's that the link between human intelligence and machines was really observed. In late 1955, Newell and Simon developed The Logic Theorist, considered by many to be the first AI program. In this theory, each problem was considered as a tree diagram. These problems were solved by selecting the branch of the tree diagram which would most likely give the correct solution. The impact that the logic theorist made on both the public and the field of AI has made it a crucial stepping stone in developing the AI field. In 1956 John McCarthy organized a conference to draw the talent and expertise of others interested in machine intelligence for a month of brainstorming. This conference served the purpose of bringing all the AI researchers together. In the seven years after the conference, AI began to pick up momentum. In 1958 McCarthy announced his new development; the LISP language, which is still used today. In the 1970's expert systems were introduced which had the capacity of large data storage and could process maximum information. Over the course of ten years, expert systems had been introduced to forecast the stock market, aiding doctors with the ability to diagnose disease, and instruct miners to promising mineral locations. This was made possible because of the system's ability to store conditional rules, and storage of information.

During the 1980's AI was moving at a faster pace, and further into the corporate sector. Other expert systems were designed to find and correct flaws in existing expert systems. In 1986-87 the demand in AI systems decreased, and the industry lost almost a half of a billion dollars. Companies such as Teknowledge and Intellicorp together lost more than $6 million, about a third of the total earnings. The large losses convinced many research leaders to cut back funding. Despite these discouraging events, AI slowly recovered. New technology in Japan was being developed. Fuzzy logic, first pioneered in the US has the unique ability to make decisions under uncertain conditions. Also neural networks were being reconsidered as possible ways of achieving Artificial Intelligence. The 1980's introduced to its place in the corporate marketplace, and showed the technology had real life uses, ensuring it would be a key in the 21st century. The military put AI based hardware to the test of war. AI-based technologies were used in missile systems, heads-up-displays, and other advancements. AI has also made the transition to the home. With the popularity of the AI computer growing, the interest of the public also started growing. Applications for the Apple Macintosh and IBM compatible computer, such as voice and character recognition have become available. Also AI technology has made steadying camcorders simple using fuzzy logic. With a greater demand for AI-related technology, new advancements are becoming available. Inevitably Artificial Intelligence has, and will continue to affecting our lives.

III. APPROACHES

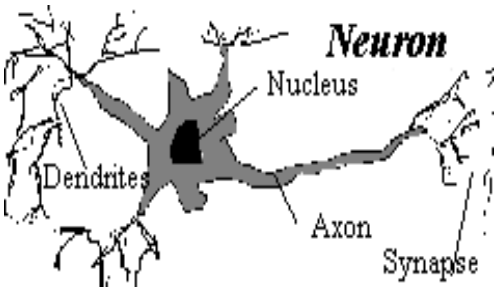
In the quest to create intelligent machines, the field of Artificial Intelligence has several different approaches. There are two basic approaches bottom-up and top-down.

Bottom-up Theory: According to this theory, artificial intelligence can be achieved by building electronic replicas of the human brain's complex network of neurons.

Top-down Theory: According to this theory, artificial intelligence can be achieved by mimicking human brain's behavior with computer programs.

Neural Networks and Parallel Computation: The human brain is made up of a web of billions of cells called neurons, and understanding its complexities is seen as one of the last frontiers in scientific research. It is the aim of AI researchers who prefer this bottom-up approach to construct electronic circuits that act as neurons do in the human brain. Although much of the working of the brain remains unknown, the complex network of neurons is what gives humans intelligent characteristics. By itself, a neuron is not intelligent, but when grouped together, neurons are able to pass electrical signals through networks.

Research has shown that a signal received by a neuron travels through the dendrite region, and down the axon. Separating nerve cells is a gap called the synapse. In order for the signal to be transferred to the next neuron, the signal must be converted from electrical to chemical energy. The signal can then be received by the next neuron and processed.



On experiments with neurons McCulloch and Pitts showed that neurons might be considered devices for processing binary numbers. An important back of mathematic logic, binary numbers (represented as 1's and 0's or true and false) were also the basis of the electronic computer. This link is the basis of computer-simulated neural networks, also known as Parallel Computing. A century earlier, the true / false nature of binary numbers was theorized in 1854 by George Boole in his postulates concerning the Laws of Thought. Boole's principles make up what is known as Boolean algebra, the collection of logic concerning AND, OR, NOT operands. For example according to the Laws of thought the statement: (for this example consider all apples red)

* Apples are red - True
* Apples are red AND oranges are purple - False
* Apples are red OR oranges are purple - True
* Apples are red AND oranges are NOT purple - True

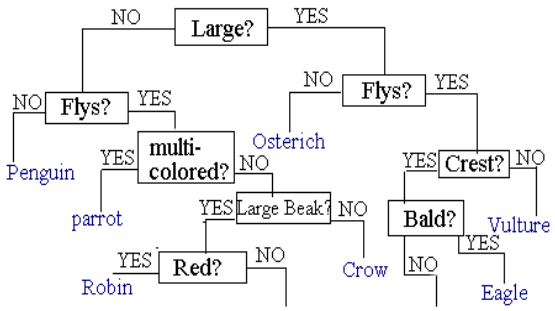
Boole also assumed that the human mind works according to these laws, it performs logical operations that could be reasoned. Ninety years later, Claude Shannon applied Boole's principles in circuits, the blueprint for electronic computers. Boole's contribution to the future of computing and Artificial Intelligence was immeasurable, and his logic is the basis of neural networks. McCulloch and Pitts, using Boole's principles, wrote a paper on neural network theory. The thesis dealt with how the networks of connected neurons could perform logical operations. It also stated that, one the level of a single neuron, the release or failure to release an impulse was the basis by which the brain makes true / false decisions. Using the idea of feedback theory, they described the loop which existed between the senses ---> brain ---> muscles, and likewise concluded that Memory could be defined as the signals in a closed loop of neurons. Although we now know that logic in the brain occurs at a level higher then McCulloch and Pitts theorized, their contributions were important to AI because they showed how the firing of signals between connected neurons could cause the brains to make decisions. McCulloch and Pitt's theory is the basis of the artificial neural network theory. Using this theory, McCulloch and Pitts then designed electronic replicas of neural networks, to show how electronic networks could generate logical processes. They also stated that neural networks may, in the future, be able to learn, and recognize patterns. The results of their research and two of Weiner's books increased the enthusiasm, and laboratories of computer simulated neurons were set up across the country. Two major factors have inhibited the development of full scale neural networks. Because of the expense of constructing a machine to simulate neurons, it was expensive even to construct neural

networks with the number of neurons in an ant. Although the cost of components has decreased, the computer would have to grow thousands of times larger to be on the scale of the human brain. The second factor is current computer architecture. The standard Von Neumann computer, the architecture of nearly all computers, lacks an adequate number of pathways between components. Researchers are now developing alternate architectures for use with neural networks. Even with these inhibiting factors, artificial neural networks have presented some impressive results.

Frank Rosenblatt, experimenting with computer simulated networks, was able to create a machine that could mimic the human thinking process, and recognize letters. But, with new top-down methods becoming popular, parallel computing was put on hold. Now neural networks are making a return, and some researchers believe that with new computer architectures, parallel computing and the bottom-up theory will be a driving factor in creating artificial intelligence.

Top down Approaches: Expert Systems

Because of the large storage capacity of computers, expert systems had the potential of interpreting statistics, and formulating the rules according to it. An expert system works much like a detective solves a mystery. Using the information, and logic or rules, an expert system can solve the problem. For example it the expert system was designed to distinguish birds it may have the following:



Logic of expert systems

Charts like these represent the logic of expert systems. Using a similar set of rules, experts can have a variety of applications. With improved interfacing, computers may begin to find a larger place in society.

Chess:

AI-based game playing programs combine intelligence with entertainment. On game with strong AI ties is chess. World-champion chess playing programs can see ahead twenty plus moves in advance for each move they make. In addition, the programs have an ability to get progress ably better over time because of the ability to learn. Chess programs do not play chess as humans do. In three minutes, Deep Thought (a master program) considers 126 million moves, while human chess master on average considers less than 2 moves. Herbert Simon suggested that human chess masters are familiar with favorable board positions, and the relationship with thousands of pieces in small areas. Computers on the other hand, do not take hunches into account. The next move comes from exhaustive searches into all moves, and the consequences of the moves based on prior learning. Chess programs, running on Cray super computers have attained a rating of 2600 (senior master), in the range of Gary Kasparov, the Russian world champion.

Frames:

On method that many programs use to represent knowledge are frames. Frame theory revolves around packets of information. For example, say the situation was a birthday party. A computer could call on its birthday frame, and use the information contained in the frame, to apply to the situation. The computer knows that there is usually cake and presents because of the information contained in the knowledge frame. Frames can also overlap, or contain sub-frames. The use of frames also allows the computer to add knowledge. It is not accepted by most of the AI developers.

These approaches have been applied to a variety of programs. As we progress in the development of Artificial Intelligence, other theories will be available, in addition to building on today's methods.

IV. APPLICATIONS

AI has applications in the following fields.

[1] Finance:

Banks use artificial intelligence systems to organize operations, invest in stocks, and manage properties. In August 2001, robots beat humans in a simulated financial trading competition. Financial institutions have long used artificial neural network systems to detect charges or claims outside of the norm, flagging these for human investigation.

[2] Medicine:

A medical clinic can use artificial intelligence systems to organize bed schedules, make a staff rotation, and provide medical information. They may also be used for medical diagnosis. Artificial neural networks are used for medical diagnosis (such as in Concept Processing technology in EMR software), functioning as machine differential diagnosis.

[3] Heavy industry:

Robots have become common in many industries. They are often given jobs that are considered dangerous to humans. Robots have proven effective in jobs that are very repetitive which may lead to mistakes or accidents due to a lapse in concentration and other jobs which humans may find degrading. General Motors uses around 16,000 robots for tasks such as painting, welding, and assembly. Japan is the leader in using and producing robots in the world. In 1995, 700,000 robots were in use worldwide; over 500,000 of which were from Japan. For more information, see survey about artificial intelligence in business.

[4] Telecommunications:

Many telecommunications companies make use of heuristic search in the management of their workforces, for example BT Group has deployed heuristic search in a scheduling application that provides the work schedules of 20000 engineers.

[5] Toys and games:

In 1990s Artificial intelligence was first used for education and leisure purposes. This prospered greatly with the Digital Revolution, and helped introduce people, especially children, to a life of dealing with various types of AI, specifically in the form of Tamagotchis and Giga Pets

(digital toys). Later, an improved type of domestic robot was released in the form of Aibo, a robotic dog with intelligent features and autonomy. AI has also been applied to video games.

[6] Aviation:

The use of artificial intelligence in simulators is proving to be very useful for the AOD (Air Operations Division). Airplane simulators are using artificial intelligence in order to process the data taken from simulated flights. Other than simulated flying, there is also simulated aircraft warfare. The computers are able to come up with the best success scenarios in these situations. The computers can also create strategies based on the placement, size, speed, and strength of the forces and counter forces. Pilots may be given assistance in the air during combat by computers. The artificial intelligent programs can sort the information and provide the pilot with the best possible maneuvers, not to mention getting rid of certain maneuvers that would be impossible for a sentient being to perform. Multiple aircraft are needed to get good approximations for some calculations so computer simulated pilots are used to gather data. These computer simulated pilots are also used to train future air traffic controllers.

The Artificial Intelligence supported Design of Aircraft, or AIDA, is used to help designers in the process of creating conceptual designs of aircraft. This program allows the designers to focus more on the design itself and less on the design process. The software also allows the user to focus less on the software tools. The AIDA uses rule based systems to compute its data. This is a diagram of the arrangement of the AIDA modules. Although simple, the program is proving effective.

In 2003, NASA's Dryden Flight Research Center and many other companies, created software that could enable a damaged aircraft to continue flight until a safe landing zone can be reached. The Intelligent Flight Control System was tested on an F-15, which was heavily modified by NASA. The software compensates for all the damaged components by relying on the undamaged components. The neural network used in the software proved to be effective and marked a triumph for artificial intelligence.

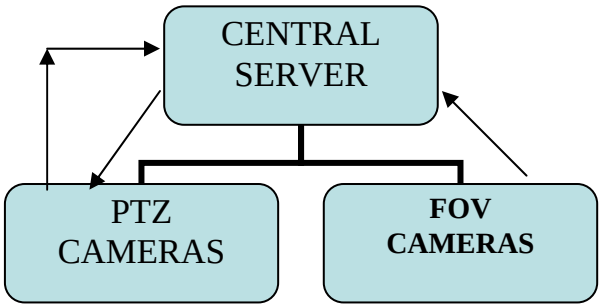
[7] Other:

Neural networks are also being widely deployed in homeland security, speech and text recognition, data mining, and e-mail spam filtering.

V. LATEST APPLICATION

SURVEILLANCE CAMERA SYSTEM

This is the most recent application and interesting application of artificial intelligence. For normal security systems, cameras are deployed in the places of interest (important places, railway stations, airports) and the job of monitoring pedestrians is done by the people in control room by observing the monitors. Continuous observation on monitors is required for observing and tracking the pedestrians and detecting abnormal behavior. But in this surveillance system using artificial intelligence the whole system is programmed and trained in such a way so that without any manual input, keeping a check on pedestrians becomes possible.



This system comprises of three main things:
-CENTRAL SERVER
-FOV (Field Of View) Cameras
-PTZ (Pan/Tilt/Zoom) Cameras

The central server controls the FOV and PTZ cameras. Central server is responsible for receiving information like pedestrian's position, entry time, appearance, etc. from the FOV cameras and providing the same to the PTZ cameras. The FOV cameras are capable of tracking multiple pedestrians while the PTZ cameras can capture high resolution videos of a pedestrian at a time. The central server brings about the coordination between the two and the whole system becomes capable of working autonomously. FOV cameras observe multiple pedestrians and also guide the PTZ cameras to track and capture video of single pedestrian. The PTZ cameras are programmed in such a way so that they track the pedestrians as per the information received from the FOV cameras and capture videos for suitable time. Deployment of sufficient FOV and PTZ cameras at the places of interest makes it possible to track and observe every single pedestrian in the region. The cameras need not be controlled or moved manually. They themselves track the pedestrian by autonomous movements, zooming, etc. If role models of various pedestrians are fed to this system, then on comparison with role models, cameras can detect abnormal or suspicious people. With the FOV cameras, signaling the PTZ cameras for further investigation, the PTZ cameras can capture high resolution videos of the person of interest. Though detection is not successful at all times but the method has served as a base for developing more intelligent security systems. Moreover, manual control which is very tiring and inefficient has found out a good substitute for tracking pedestrians at important places.

VI. CONCLUSION

The theory and insights brought about by AI research will set the trend in the future of computing. The products available today are only bits and pieces of what are soon to follow, but they are a movement towards the future of artificial intelligence. The advancements in the quest for artificial intelligence have, and will continue to affect our jobs, our education, and our lives.

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