Advanced Applications of Neural Networks and Artificial Intelligence: A Review

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***Abstract*— Artificial Neural Network is a branch of Artificial intelligence and ithas been accepted as a new computing technology in computer science fields. This paper reviews the field of Artificial intelligence and focusing on recent applications which uses Artificial Neural Networks (ANNs) and Artificial Intelligence (AI).Artificial Neural Networks is considers as major soft-computing technology and have been extensively studied and applied during the last two decades. The most general applications where neural networks are most widely used for problem solving are in pattern recognition, data analysis, control and clustering. Artificial Neural Networks have abundant features including high processing speeds and the ability to learn the solution to a problem from a set of examples. The main aim of this paper is to explore the recent applications of Neural Networks and Artificial Intelligence and provides an overview of the field, where the AI & ANN"s are used and discusses the critical role of AI & NN played in different areas.**

Keywords*— *Artificial intelligence, Neural Networks

I. INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is defined as intelligence exhibited by an artificial entity to solve complex problems and such a system is generally assumed to be a computer or machine [1]. Artificial Intelligence is an integration of computer science and physiology Intelligence in simple language is the computational part of the ability to achieve goals in the world. Intelligence is the ability to think to imagine creating memorizing and understanding, recognizing patterns, making choices adapting to change and learn from experience. Artificial intelligence concerned with making computers behave like humans. AI tries to solve the complex problems in more human like fashion and in much less time then a human takes. Hence it is called as Artificial Intelligence [2]. Artificial intelligence can be divided into parts according to philosophy of AI.

a) Strong AI

b) Weak AI

Strong AI

The principle behind Strong AI is that the machines could be made to think or in other words could represent human minds in the future. Thus Strong AI claims that in near future we will be surrounded by such kinds of machine which can completely works like human being and machine could have human level intelligence. If that is the case, those machines will have the ability to reason, think and do all functions that a human is capable of doing. Current research is nowhere near creating strong AI, and a lively debate is ongoing as to whether this is even possible [3].

Weak AI

The principle behind Weak AI is simply the fact that machines can be made to act as if they are intelligent. Weak AI simply states that thinking like features can be easily added to computer to make them more useful tools and this already started to happen. For example, when a human player plays chess against a computer, the human player may feel as if the computer is actually making impressive moves. But the chess application is not thinking and planning at all. All the moves it makes are previously fed in to the computer by a human and that is how it is ensured that the software will make the right moves at the right times. More examples of Weak AI are witness expert systems, drive by wires cars and speech recognition systems [4].

II. INTRODUCTION TO NEURAL NETWORKS

Neural Networks basically aim at mimicking the structure and functioning of the human brain, to create intelligent behavior. Researchers are attempting to build a silicon-based electronic network that is modeled on the working and form of the human brain!

Our brain is a network of billions of neurons, each connected with the other. At an individual level, a neuron has very little intelligence, in the sense that it

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operates by a simple set of rules, conducting electric signals through its network. However, the combined network of all these neurons creates intelligent behavior that is unrivaled and unsurpassed.

How the human brain works , it learns to realize patterns and remembers them. Similarly, the neural networks developed have the ability to learn patterns and remember. This approach has its limitations due to the scale and complexity of developing an exact replica of a human brain, as the neurons number in billions! Currently, through simulation techniques, people create virtual neural networks [5].

III. APPLICATIONS OF NEURAL NETWORKS

1. FAULT DETECTION-

Neural Networks can result in such devices which are able to detect faults in those areas where fault detection is difficult for human beings. Eg: fault detection in tracks of Railways, Metros and Roller coasters. And fault detection in mechanical parts of machine.Neural networks can detect patterns so it can detect faults when the railway track donot resemble its original shape i.e. having distorted shapes or having gaps, cracks or bents in it. These neural can be combined with a gps to locate their position as well as the position of crack. Also Thehealth of tracks can be checked by measuring their width, inclination and condition of screws. This in turn can be of great use to avoid accidents. Visual fault detection of large or broad machine parts is difficult for human beings and it is time consuming too but neural networks can do this job with high accuracy because the can easily detect patterns, so even a little crack in the part will be visible to them.

Figure.1Railway Track Defect

Figure.2 Small crack in a mechanical part

2. MEDICATION-

Neural networks can assist doctors by suggesting the type of medication and treatment required for the patients. It can analyse the symptoms either by listening to the patients using CBR (case based reasoning) or by visual detection of wounds, skin infections, or swelling. Simultaneously It can provide an overall fitness level of the patient by analysing weight, heart rate, blood pressure, blood sugar levels, temperature and shivering (vibration). By analysing the above parameters on a combined level neural networks can suggest the best medication and treatment without consuming much time. This is possible because neural networks work by considering the probability of symptoms. The more the probable symptoms of a disease the more severe it is. Neural networks can also report new disease by checking the symptoms from a database. Moreover in case of known diseases neural networks can also suggest all the required precautions, diet plans and amount of dose of medicines.

Figure.3 Skin Infection

Figure.4Wound

3. OBJECT SEARCHING-

The ability of recognising the patterns can be further extended to recognise 3D objects. Recognition of 3D objects can help us in finding the objects. We can implement this technique in robotics so that the robots could identify objects. It will be very helpful in industries where robots can work as assistants for humans. Not only this, object recognition will make robots smarter. Object search using robots can be used in Under-sea Search Projects, and locations where some natural hazard has taken place and we want to search any person or some important material. Using this technique we will be able to search useful objects from trashes. The same can also be used to filter the non recyclable waste from recyclable waste in garbage treatment plant. Robots which are able to search 3D objects can also search humans during a rescue mission. Human rescuers are limited to identify other humans by vision but robots can identify humans by using ultrasound and can be proved as better rescuers.

IV. APPLICATIONS OF ARTIFICIAL INTELLIGENCE

1. ARTIFICIAL INTELLIGENCE IN GAMES:

Modern computer games usually employ 3D animated graphics (and recently also 3D sound effects) to give the impression of reality. The AI found in most computer games is no AI (in the academic sense), but rather a mixture of techniques which are although related to AI mainly concerned with creating a believable illusion of intelligence [6]. The phrase “game AI” covers a diverse collection of programming and design practices including path finding, neural-networks, and models of emotion and social situations, finite state machines, rule systems, decision-tree learning, and many other techniques.

Figure.5 FIFA (video game)

2. UNDERSTANDING AND DESCRIPTION OF OBJECT BEHAVIORS:

This is one of the hot topics in computer vision. Trajectory analysis is one of the basic problems in behaviour understanding. The learning of trajectory patterns can be used to detect anomalies and predict object trajectories. Trajectory analysis is the basis of scene understanding. The basic problem of behaviour understanding is the target motion trajectory analysis. Currently the most common trajectory analysis methods focus on the geometric characteristics of the whole trajectory and neglect the semantic information related to the common sub-trajectories [7]. Here the task is all about the modelling or creating representation of object behaviours using detailed, learnt statistical models. A statistically based model of object trajectories is presented which is learnt from the observation of long image sequences. Trajectory data is supplied by a tracker using Active Shape Models, from which a model of the distribution of typical trajectories is, learnt [8]. The techniques being developed will allow models of characteristic object behaviours to be learnt from the continuous observation of long image sequences. It is seen that these models of characteristic behaviours representation will have a number of uses, particularly in automated surveillance and event recognition without the need for high-level scene/ behavioural knowledge. In automatic method for learning model of semantic region by analyzing the trajectories of moving objects in the scene or frame should be done in following manners. First the trajectory is encoded to represent both the position of the object and its instantaneous velocity, and then hierarchical clustering algorithm is applied to cluster the trajectories according to different spatial and velocity distributions. In each cluster, trajectories are spatially close, have similar velocities of motion and represent one type of activity pattern. Based on the trajectory clusters, the statistical models of semantic region in the scene are generated by estimating the density and velocity distributions of each type of activity pattern [9].

The model is learnt in an unsupervised manner by tracking objects over long image sequences, and is based on a combination of a neural network implementing Vector Quantization and a type of neuron with short-term memory capabilities. The distribution patterns of trajectories are learnt and recognized using a hierarchical self-organizing neural network. Models of the trajectories of pedestrians have been generated and used to assess the typicality of new trajectories (allowing the identification of incidents of interest' within the scene), predict future object trajectories, and randomly generate new trajectories [10]

3. RADIOSITY FOR VIRTUAL REALITY SYSTEMS (ROVER):

The synthesis of actual and computer generated photo-realistic images has been the aim of artists and graphic designers for many decades. Some of the most realistic images were generated using radiosity techniques.Unlike ray tracing, radiosity models the actual interaction between the lights and the environment. In photo realistic Virtual Reality (VR) environments, the need for quick feedback based on user actions is crucial.It is generally recognized that traditional implementation of radiosity is computationally very expensive andtherefore not feasible for use in VR systems where practical data sets are of huge complexity.

There are two new methods and several hybrid techniques to the radiosity research community on using radiosity in VR applications. On the left column, flyby, walkthrough and a virtual space are first introduced and on the left. On the right, one method using Neural Network technology is shown.

Figure.6Radiosity for Virtual Reality Systems:

4. LEARNING FROM EXAMPLE

Autonomous Walker & swimming Eel: The research in this area involves combiningbiology, mechanical engineeringandinformation technologyin order to develop the techniques necessary to build adynamically stable legged vehicle controlled by a neural network. This wouldincorporatecommand signals, sensory feedback and reflex circuitry in order to produce the desired movement.

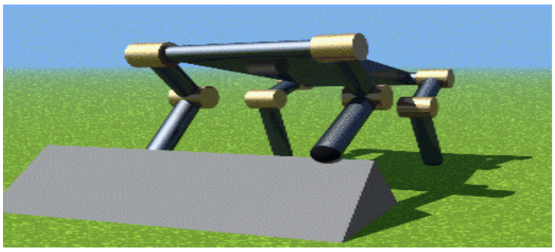

Figure 7 Autonomous walker.

5. FACIAL ANIMATION:

Facial animations created using hierarchical B-spline as the underlying surface representation. Neural networkscould be use for learning of each variation in the face expressions for animated sequences. The (mask) model was created in SoftImage, and is an early prototype for the character "Mouse" in the YTV/ABC televisions series "ReBoot" (They do not use hierarchical splines for Reboot!).

The original standard bicubic B-spline was imported to the "Dragon" editor and a hierarchy automatically constructed. The surface was attached to a jaw to allow it to open and close the mouth. Groups of control vertices were then moved around to create various facial expressions. Three of these expressions were chosen as key shapes, the spline surface was exported back to SoftImage, and the key shapes were interpolated to create the final animation

Figure8Facial animations usingbicubic B-spline

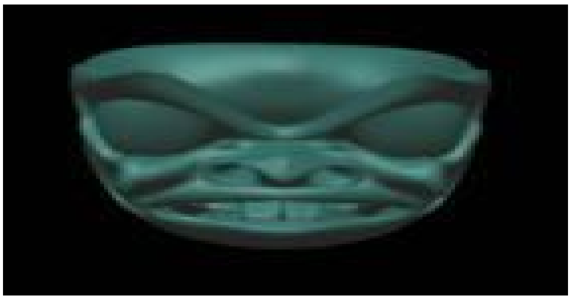

Figure 9 Facial animations using hierarchical B-spline.

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