Robotics Using Artificial Intelligence

Sanyam Jain[1], Garbhit Jain [2], Tanishka Jain[3] Ritu Sharma[4],Dr. Arpit Jain[5]

College of Computing Science & Information Technology TMU Moradabad 244001, Uttar Pradesh, INDIA
[1]sanyamj999888@gmail.com
[2]garbhit4567@gmail.com
[3]tanishkajain9480@gmail.com
[4]ritusharma1819.rs@gmail.com
[5]dr.jainarpit@gmail.com

Abstract:-

In this paper we are presenting about robotics using artificial intelligence. We are going to discuss on the topics artificial intelligence, robots, robotics and its applications and difference between robot system and other AI programs. Further we will explain the body and brain parts of a robot in essence robot locomotion and AI neural networks.

Keywords:- Robotics, Artificial intelligence, Robots, Robot system, AI programs, Body and Brain parts of robots, Robot locomotion, AI neural networks.

I. INTRODUCTION

Robotics is a branch of AI. Artificial intelligence robot is aimed at manipulating the objects by perceiving, picking, moving, and destroying it. You all must be thinking why we have chosen this topic robotics using AI? As we all are very well aware about the fact that automated machines have taken over the duties of dangerous and mundane jobs from humans, allowing greater productivity. That's possible because of artificial intelligence. The idea of a factory with no human workers has come to fruition. This is only possible with the help of artificial intelligence.

What is artificial intelligence?

In computer science, sometimes Artificial Intelligence is called as machine intelligence. Is intelligence demonstrated by machine humans and animals are displayed in the contrast to the neural network intelligence. In computer science AI research defines as the study of intelligent agents: any device that perceives it is environment and take actions that maximize it is chance of successfully achieving the goals. The term artificial intelligence is describes machines that mimic **'cognitive'** functions which human can associated with other human mind. Like learning and problem solving.

What are Robots?

Robots are machines or we can say artificial agents acting in real world environment.

Objectives:- These are used for manipulating the objects by perceiving, picking, moving, modifying the physical properties of object, destroying it. It is a machine that works automatically and can do some tasks that a human can do.

Aspects of Robotics:- The robots have mechanical construction form and shape to complete a defined task. They use electrical

components which control and powered the machinery.

What is Robotics?

It is a branch of AI, which is designed with the help of electrical engineering, mechanical engineering and computer science for designing, construction and application of robots.

Aspects of Robotics:-

The robots have mechanical construction, form, or shape designed to accomplish a particular task. They have electrical components which power and control the machinery. They contain some level of computer program that determines what, when and how a robot does something.

Difference in Robot System and Other AI Program:-

Here is the difference between the two −

| AI Programs	Robot
1. The input to an AI program is in symbols and rules.	**1.** Input for a robots is analog signal in the form of speech waveform or images.
2. AI program need general purpose computers to operate on.	**2.** Robot need special hardware with sensors and effectors.
3. They are generally operated in computer stimulated worlds.	**3.** They are generally operated in real physical world.

What are Artificial Neural Networks (ANNs)?

The inventor of the first neurocomputer, Dr. Robert Hecht-Nielsen, defines a neural network as −

"...a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs."

- *Basic Structure of ANNs - * The idea of ANNs is based on the belief that working of human brain by making the right connections can be imitated using silicon and wires as living neurons and dendrites. The human brain is composed of 86 billion nerve cells called neurons. They are connected to other thousand cells by Axons. Stimuli from external environment or inputs from sensory organs are accepted by dendrites. These inputs create electric impulses, which quickly travel through the neural network. A neuron can then send the message to other neuron to handle the issue or does not send it forward.
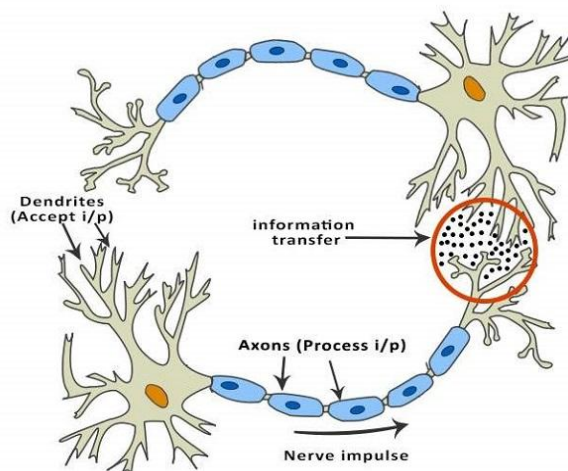
ANNs are composed of multiple nodes, which imitate biological neurons of human brain. The neurons are connected by links and they interact with each other. The nodes can take input data and perform simple operations on the data. The result of these operations is passed to other neurons. The

output at each node is called its activation or node value.

Each link is associated with weight. ANNs are capable of learning, which takes place by altering weight values. The following illustration shows a simple ANN-
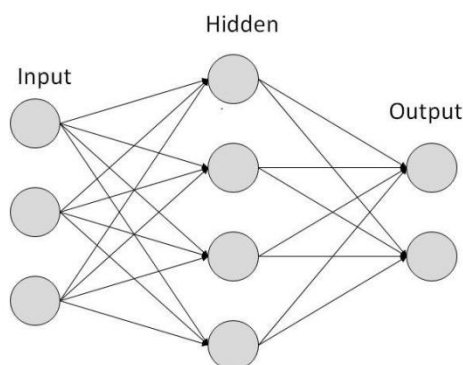

- ### *Types of Artificial Neural Networks*

There are two Artificial Neural Network topologies − FeedForward and Feedback.

FeedForward ANN-

In this ANN, the information flow is unidirectional. A unit sends information to other unit from which it does not receive any information. There are no feedback loops.

They are used in pattern generation/recognition/classification. They have fixed inputs and outputs.
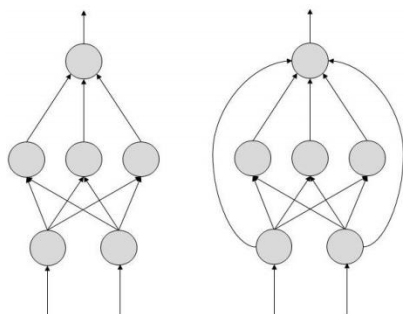
Feedback ANN:-

Here, feedback loops are allowed. They are used in content addressable memories.
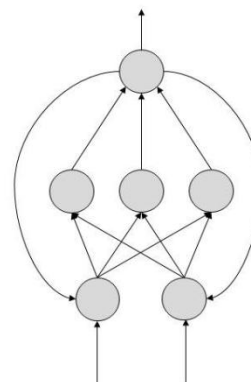
Working of ANNs:-

In the topology diagrams shown, each arrow represents a connection between two neurons and indicates the pathway for the flow of information. Each connection has a weight, an integer number that controls the signal between the two neurons.

If the network generates a "good or desired" output, there is no need to adjust the weights. However, if the network generates a "poor or undesired" output or an error, then the system alters the weights in order to improve subsequent results.

Machine Learning in ANNs-

ANNs are capable of learning and they need to be trained. There are several learning strategies −

Supervised Learning:− It involves a teacher that is scholar than the ANN itself. For example, the teacher feeds some example data about which the teacher already knows the answers. For example, pattern recognizing. The ANN comes up with guesses while recognizing. Then the

teacher provides the ANN with the answers. The network then compares it guesses with the teacher's "correct" answers and makes adjustments according to errors.

Unsupervised Learning:− It is required when there is no example data set with known answers. For example searching for a hidden pattern. In this case, clustering i.e. dividing a set of elements into groups according to some unknown pattern is carried out based on the existing data sets present.

Reinforcement Learning:− This strategy built on observation. The ANN makes a decision by observing its environment. If the observation is negative, the network adjusts its weights to be able to make a different required decision the next time.

- *Back Propagation Algorithm:-*

It is the training or learning algorithm. It learns by example. If you submit to the algorithm the example of what you want the network to do, it changes the network's weights so that it can produce desired output for a particular input on finishing the training.

Back Propagation networks are ideal for simple -

Pattern Recognition and Mapping Tasks.

Bayesian Networks (BN)

These are the graphical structures used to represent the probabilistic relationship among a set of random variable. Robotics is a domain in artificial intelligence that deals with the study of creating intelligent and efficient robots.

Robot Locomotion:-

Locomotion is the mechanism that makes a robot capable of moving in its environment.

There are various types of locomotion's:−

1. Legged
2. Wheeled
3. Combination of Legged and Wheeled Locomotion
4. Tracked slip/skid

- **Legged Locomotion**

This type of locomotion consumes more power while demonstrating walk, jump, trot, hop, climb up or down, etc. It requires more number of motors to accomplish a movement. It is suited for rough as well as smooth terrain where irregular or too smooth surface makes it consume more power for a wheeled locomotion. It is little difficult to implement because of stability issues. It comes with the variety of one, two, four, and six legs. If a robot has multiple legs then leg coordination is necessary for locomotion. The total number of possible gaits (a periodic sequence of lift and release events for each of the total legs) a robot can travel depends upon the number of its legs. If a robot has k legs, then the number of possible events $N = (2k-1)!$. In case of a two-legged robot (k=2), the number of possible events is $N = (2k-1)! = (2*2-1)! = 3! = 6$.

Hence there are six possible different events −

- **Lifting the Left leg**

- **Releasing the Left leg**

- **Lifting the Right leg**

- **Releasing the Right leg**

- **Lifting both the legs together**

- **Releasing both the legs together**

In case of k=6 legs, there are 39916800 possible events. Hence the complexity of robots is directly proportional to the number of legs.

- **Wheeled Locomotion**

It requires fewer numbers of motors to accomplish a movement. It is little easy to implement as there are less stability issues in case of more number of wheels. It is Power efficient as compared to legged locomotion.

Standard wheel − Rotates around the wheel axle and around the contact

Castor wheel − Rotates around the wheel axle and the offset steering joint.

Swedish 45o and Swedish 90o wheels − Omni-wheel, rotates around the contact point, around the wheel axle, and around the rollers.

Ball or spherical wheel − Omnidirectional wheel, technically difficult to implement.

- **Slip/Skid Locomotion**

In this type, the vehicles use tracks as in a tank. The robot is steered by moving the tracks with different speeds in the same or opposite direction. It offers stability because of large contact area of track and ground.

- **Components of a Robot:**

Robots are constructed with the following −

Power Supply − the robots are powered by batteries, solar power, hydraulic, or pneumatic power sources.

Actuators − they convert energy into movement.

Electric motors (AC/DC) − they are required for rotational movement.

Pneumatic Air Muscles − they contract almost 40% when air is sucked in them.

- **Terminology-**

Here is the list of frequently used terms in the domain of AI −

Serial No. Term & Meaning

1. Agent: Agents are systems or software programs capable of autonomous, purposeful and reasoning directed towards one or more goals. They are also called assistants, brokers, bots, droids, intelligent agents, and software agents.

2. Autonomous Robot: Robot free from external control or influence and able to control itself independently.

3. Backward Chaining: Strategy of working backward for Reason/Cause of a problem.

4. Blackboard: It is the memory inside computer, which is used for communication between the cooperating expert systems.

5. Environment: It is the part of real or computational world inhabited by the agent.

6. Forward Chaining: Strategy of working forward for conclusion/solution of a problem.

7. Heuristics: It is the knowledge based on Trial-and-error, evaluations, and experimentation.

8. Knowledge Engineering: Acquiring knowledge from human experts and other resources.

9. Percepts: It is the format in which the agent obtains information about the environment.

10. Pruning: Overriding unnecessary and irrelevant considerations in AI systems.

11. Rule: It is a format of representing knowledge base in Expert System. It is in the form of IF-THEN-ELSE.

12. Shell: A shell is a software that helps in designing inference engine, knowledge base, and user interface of an expert system.

13. Task: It is the goal the agent is tries to accomplish.

14. Turing Test: A test developed by Allan Turing to test the intelligence of a machine as compared to human intelligence

- *Applications:-*

Outer Space Applications:- One of the vastly using technologies or in simple words we can say that the most reliable way of exploring outer space is robots. Robots plays a very important role in exploring because they can be used unnamed are more accurate than human being. Mars Rovers of **NASA** are one of the most famous robots till date. Sojourner is also one of the robots that landed on Martian soil on **1997** and successfully completed its duty.

Military Applications:- In this era army robotics is an its peak as they are now using unmanned drones for surveillance defending and even attacking. One of its example is drones were used to surveillance the longbow of **Osama-Bin-Laden** and not even lifting them notice their drones one of the major use of drone that its use is not harmful to our side meaning which no man or women is charmed during the mission.

Intelligent Home Applications:- Intelligent robotic home systems are specified for monitoring home security, environmental conditions and energy usage. By pre-programming conditions lock opening of doors and windows can be opened automatically, and also applications such as lighting and air conditioning. This assists occupants without depending on their state of mobility as they have dependency on their mobility for this purpose.

Health Service:- These are many types of robots used for medical purpose like surgical robots & rehabilitation Robots and others.

These robots help patients to recover from serious conditions like strokes, and also help in delivering medical supplies and equipment, including medications. some robots remote controlled assist surgeons with performing operations. Biggest advantages of robots are speed & accuracy two features that are very important to pharmacies

Some Examples :-

The quadruped military robot Cheetah, an evolution of Big Dog (pictured), was clocked as the world's fastest legged robot in 2012, beating the record set by an MIT bipedal robot in 1989.
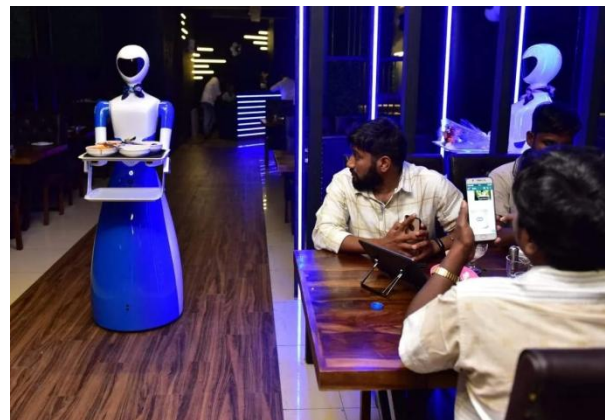
COIMBATORE: A concept seen in "Avengers" and other super hero movies and maybe in restaurants abroad has now come

to Coimbatore. Robots pick up the food from the kitchen and deliver it at the customer's table. Customers can pick up the food from the tray. The robot will also be able to detect someone blocking its way and request them to move out of their way.

Conclusion:- In the growing day-to-day life, importance of robotics is playing a major role in advancement of technology. It is the highest-level of technology, which is rapidly getting more and more advanced. Robotics is a branch of AI. Robotics is impossible without using artificial intelligence. AI has helped in developing new machines that can support the complexity of human thought.

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