International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Agentic AI with Dynamics and Kinematics Control Incorporated with RPA Attributes in a Humanoid Robotics with Predictive Machine Learning Over Edge Computing

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Abstract

Artificial Intelligence or AI gives robots a computer vision to navigate, sense, plan act and calculate their reaction accordingly. Humanoid Robots mimic human behaviour , learn to perform their tasks from humans through machine learning is a part of computer programming and AI.Machine learning enables robots to adapt their manipulation strategies to unexpected changes or disturbances through continuous monitoring of the manipulation process. Humanoid Robots can then adjust their movements accordingly to maintain control,prevent errors, Quantization in non monotone neural schema.Machine learning algorithms enable Humanoid robots to learn from data and adapt to dynamic environments. These algorithms allow robots to identify patterns, make predictions, and improve their performance over time, making them more versatile and effective in a wide range of applications, Even if the robot is trained in a local environment for module learning, it is needed to arrive an objective point with no collision with obstacles in the static or dynamic environment ,Adaptive fusion strategy in needed for selecting sensor information.To achieve this Neural networks are to be improvised for incorporating neural weights and for this the study of neural schema is required for choosing humanoid robot for the analysis.

Keywords: NMNS, GenAI, NN, SVM, KNN, Fuzzy behaviour, BNNM, Fusion unit, MLP

Introduction

A concept of adaptive fusion unit in the fuzzy behaviour –based control system has been described for an objective (or goal) tracking problem with an obstacle in a mobile robot. Although the robot was trained only in a local environment for the module learning, It should be arrived at the objective point without any collision with obstacles in the static or dynamic environment for e.g., in stair climbing, The adaptive fusion strategy proposed should consist of adaptively selecting a cooperative unit or competitive unit, [1-8] depending on the external sensor information.It was proved from some

simulations that such control systems were flexible against the change of environments or unstrained environment's, compared to those with a conventional (i.e., fixed-type) priority. Based fusion unit.Present research completed in a nutshell- for complex taskFuzzification of humanoid robotic system by quantization using non-monotone neural schemaBoltzmann Neural Network model , To perform COMPLEX TASK with training of data to come out with a predictive outcome with a decision like Object recognition of humanoid robot, with range detection and navigation[9-12].

1. Implementation based on Back propagation algorithm

First we note that axes zi and zi+1 are fixed in links i and i + 1, respectively

The fixed geometrical parameters that define the mutual disposition between frames i and i + 1 for i = 1,2,…,n − 1 are as follows: -

1) the distance li between axes zi and zi+1 measured along the axis xi

2) the distance di+1 between points Oi,i+1 and Oi+1 measured along the axis zi+1

3) the angle αi+1 between axes zi+1 and zi measured in the positive direction of axis xi

4) the angle βi+1 between axes xi+1 and xi measured in the positive direction of axis zi+1.

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The fixed geometrical parameters that define the mutual disposition between frames i and i + 1 for i = 1,2,…,n − 1 are as follows: -

It's a mathematical tool that helps improve the **accuracy of predictions** by adjusting the weights in a neural network based on the error signal .

2. Significancein Research

Fuzzy models or fuzzy sets are mathematical means of representing vagueness, unclear and imprecise information (fuzzy). Robots make decisions based on this imprecise, unclear and non-numerical information called fuzzification which is the process of converting a crisp input value to a fuzzy value that is performed by the use of the information in the knowledge base**,**Although various types of curves can be seen in literature [13-19], triangular, and trapezoidal. Gaussian was used in the fuzzification process .A washing machine is a great example [20] of understanding how fuzzy logic in AI works. Consider a basic fuzzy control system that regulates a washing machine's water intake, wash time, spin speed, and washing process [21,22].

3. Quantization

Refers to the process of converting floating-point parameters in a neural network to a lower precision format, such as fixed-point or integer, leading to reduced memory storage and computational requirement.Quantization of Clear data are quantized segmented and then input along with algorithm like back propagation algorithm (a supervised learning method used in artificial intelligence (AI) and machine learning to train neural networks train data in neural schema to come out with a decision). [23].

4. **MLP** – Used multi layer perception that processes information step by step using quantization (a technique) used to reduce , Computation demands, Increase power efficiency, Activate nodes,Connection between nodes, Neural weight parameters and calculations [24-28].
5. **Artificial Nonmonotonic Neural schema** or Networks (ANNNs), a kind of hybrid learning systems that are capable of nonmonotonic reasoning.

Nonmonotonic reasoning plays an important role in the development of artificial intelligent systems that try to mimic common sense reasoning, as exhibited by humans in slow and steady but the error is minimized unlike in monotonic where the decision is fast but with more errors.On the other hand, a hybrid learning system provides an explanation capability to trained Neural Networks through acquiring symbolic knowledge of a domain, refining it using a set of classified examples along with Connectionist learning techniques and, finally, extracting comprehensible symbolic information

6. Outcome of Research

Alpha Ramda humanoid robot was in the trajectory robot paths. In this case of locomotion of robot paths, the path itself had a substantial impact on the result thus making the robot to predict and come out with a decision to turn back after recognizing the obstacles in patterns.

1. CNN – Convolutional neural network – Image recognition – scenario: humanoid identifyees objects and faces in an open environment
2. RNN – Recurrent neural network – Sequencing – scenario : finding next word in a sentence while humanoid speaking
3. GAN – GENERATIVE ADVERSIAL NETWORK- scenario: Generates new data and schemas with neural schema by training large sensory data in outdoor environment and generate realistic objects like faces, images it captures - trajectory movement.
4. DBN – Deep belief network used with unsupervised algorithm to identify patterns in unlabelled unclassified data sets scenario in complex environment(military).
5. Navie Bayes : Training the data and prediction with a decision is fast scenario : Remote robotic surgery

7. Incorporating Edge Computing

During the training of data , in deep learning to enhance making prediction faster, I have to use distributing computing where I can bring data analysis (which I used in ANN) and data processing (which I used in deep learning) closer to the source of data, so that I can reduce latency (delay in time) and still improve decision making so that it can operate independently.Benefits achieved: Reduced latency(10-100x faster),Improved real time decision making,Enhanced security (less data transmitted),Better Data Analysis,Cost effective (reduced bandwidth and storage needs), Humanoid Robot Software frameworks, Some popular software frameworks for robotics include ROS (Robot Operating System), Arduino, and Raspberry Pi. Python,ROS is a flexible framework that supports a variety of languages, algorithms, and hardware platforms

8. Humanoid Robot Simulation tools

Some tools used for simulating humanoid robot dynamics include:Gazebo,ARGoS,ODE,Bullet,V-Rep Webots,OpenRave,Robotran, XDE

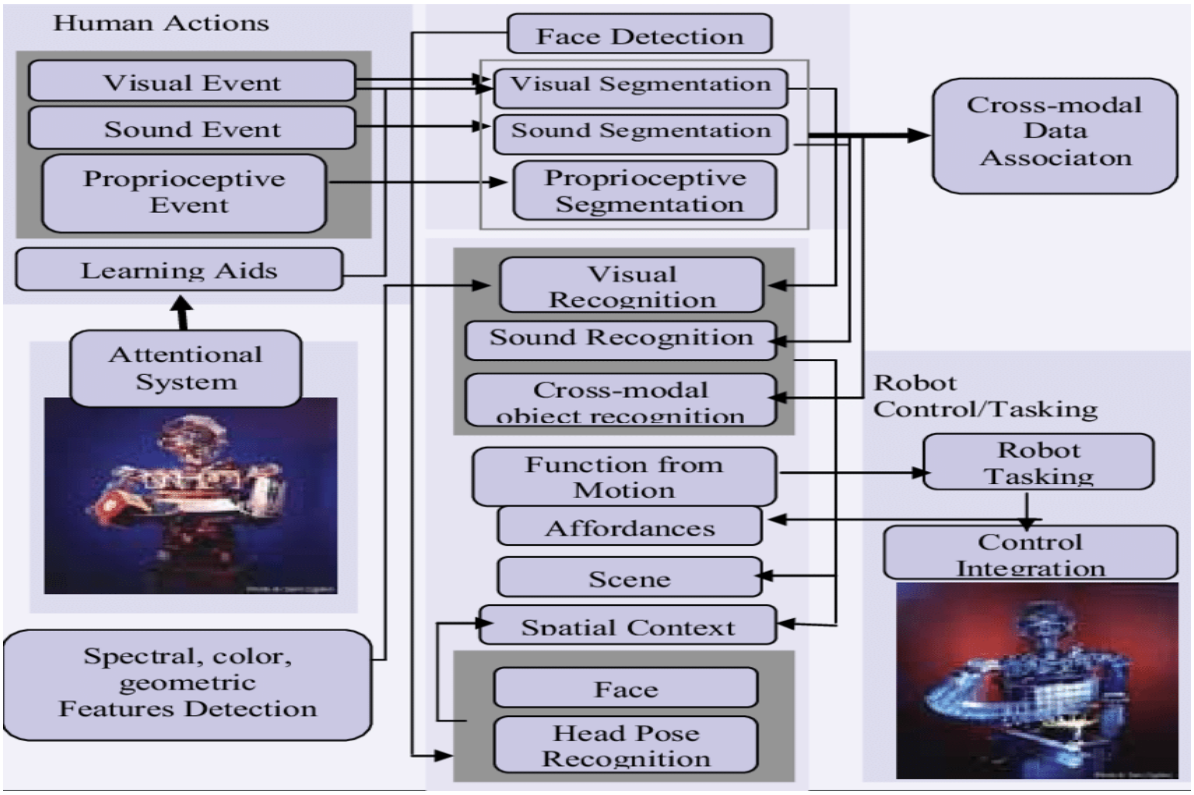


Figure 1 Design Architecture of AI system

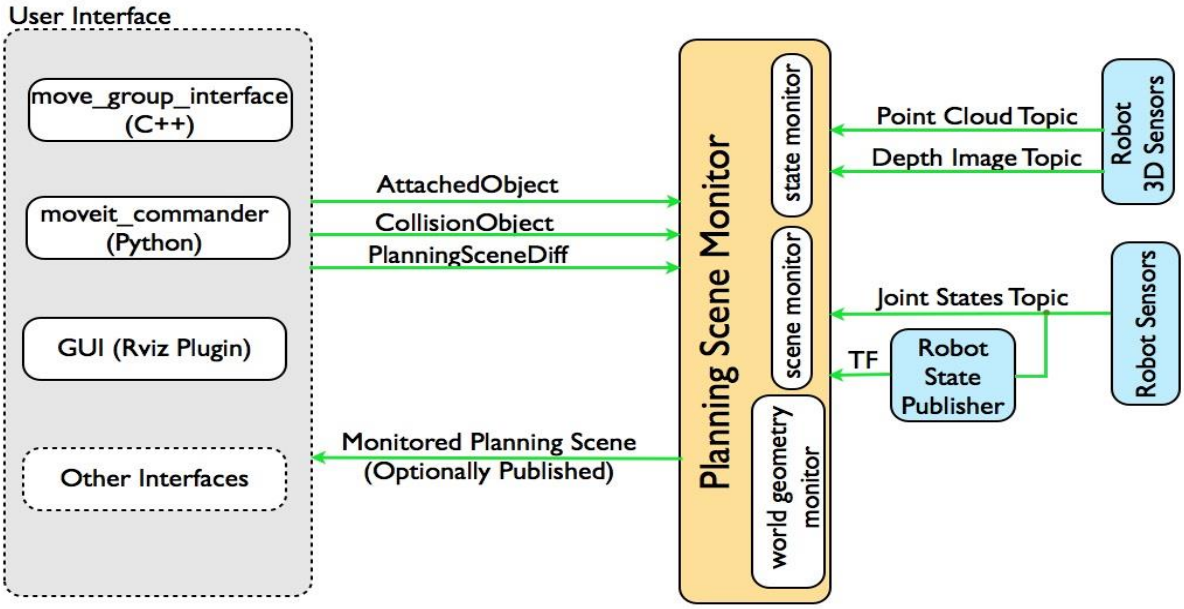


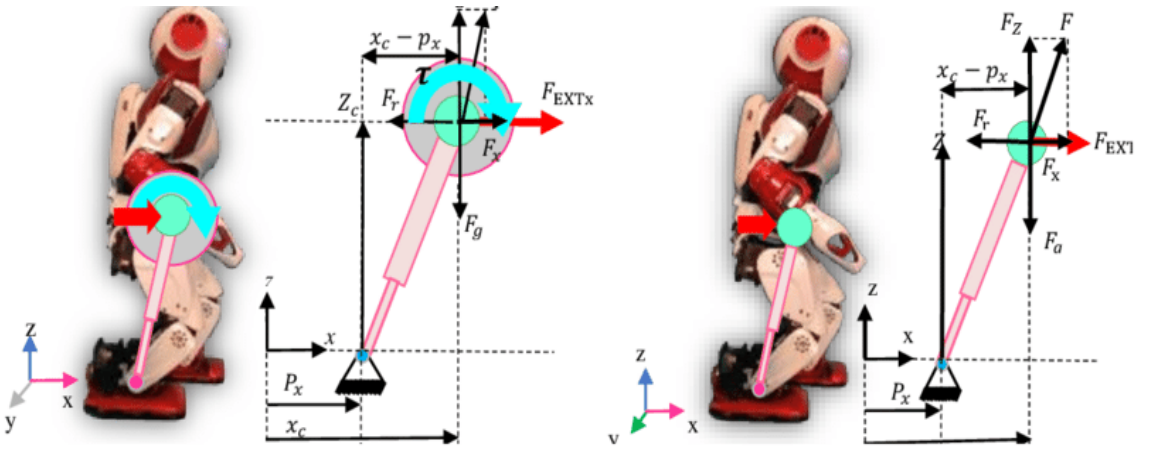
Figure 2 Control Architecture of an Agentic AI

9. Protocol in Motion Control : Mathematical Model for Motion Control of Redundant Robot Arms

To make it short, robotics is an area where many disciplines come together, in particular, it is an ideal field where AI and symbolic mathematical computation and mathematics in general can interact and cooperate in a variety of ways. With that in mind, we want to discuss in this contribution applications of mathematical and symbolic computational modeling in robotics from different perspectives like: geometry ('geometric reasoning'), The minimum dof needs to have in order to locate its end effectors at an arbitrary point with an arbitrary orientation in space in 6 dof. The topology ('topological reasoning'), and 8 Degrees of Freedom Robotic Arm: This is the highest degree of freedom ever built in a robot so far, and it provides the most flexibility as it can turn and twist and rise in any direction to the maximum range..logical aspects, more precisely, a geometric-logical view namely the use of "logical fiberings" in robot multi-tasking.

9.1 MAXIMUM DOF a robot has 8 Degrees of Freedom Robotic Arm: This is the highest degree of freedom ever built in a robot so far, and it provides the most flexibility as it can turn and twist and rise in any direction to the maximum range.

9.2 MINIMUM DOF 3 Three of them are for the position: motion along the x, motion along the y, and motion along the z, and three are fororientation: rotation around x or roll, rotation around y or pitch, and rotation around z or yaw: A rigid body in a 3D space has three translational and three rotational DOFs.The kinematics solution of any robot manipulator consists of two sub problems 1) forward and 2) inverse kinematics.kinematics (the hub angle, tip position, and deflection) and dynamics (the control torque input of the link) of the robot arm model.Forward Kinematics = to get co-ordinate of end effector(OUTPUT) from given angles of all joints (INPUT)Inverse Kinematics = to get all joints angle from given co-ordinate(s), path trajectory planThis model provides an efficient procedure for the computation of the motion in the joints that makes the end- effector motion to trace a given geometrical curve with prescribed linear and angular velocity



(a) Linear inverted pendulum+Flywheel model (b) Linear inverted pendulum model

Figure 3. Dynamics incorporated in Agentic AI with edge computing

10. Methodologies

Linear centroidal dynamics of humanoid robotics system, Select your robot , Access an extensive library of robots directly from RoboDK. The RoboDK library includes:,Over 500 industrial robot arms from 50 different robot manufacturers, including: ABB, Fanuc, KUKA, Yaskawa/Motoman, Universal Robots, etc.External axes such as 1, 2 or 3 axis turntables and linear rails, Easily model and synchronize additional axes, Find your robot in the RoboDK library. Ankle strategy and hip strategy are equivalent to Center of Pressure (CoP) and Centroidal Moment Pivot (CMP) regulation respectively. For controlling the CMP and CoP we need a torque-controlled robot

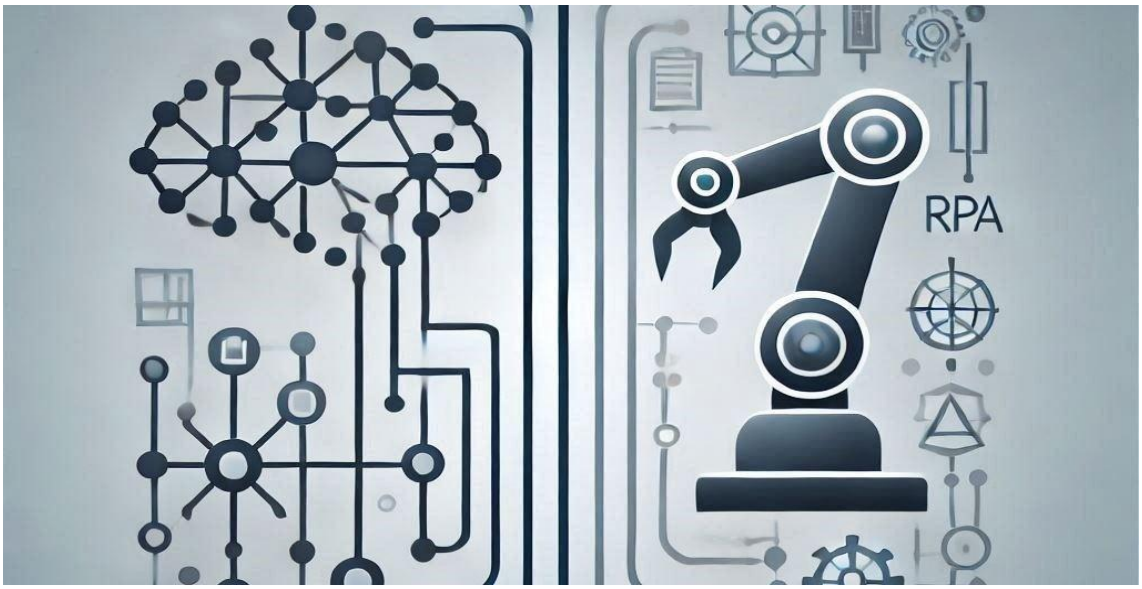


Figure 4. A combination of Agentic AI strategy is used for push recovery of a position-controlled humanoid robot in controversial for RPA

11. Significant applications of Agentic AI from Robotic Process Automation

Now, let's dive into the main difference between Agentic AI and RPA (Robotic Process Automation).RPA refers to the automation of repetitive tasks through predefined rules. It's essentially a "scripted" automation where a robot or software carries out tasks based on a set sequence. Think of it as a tool that performs high-volume tasks like moving data between systems, filling out forms, or sending emails—tasks that require no decision-making or problem-solving.Agentic AI, on the other hand, is much more advanced. It not only automates tasks but also learns and adapts to new situations. While RPA follows a strict set of rules, Agentic AI can modify its approach as it encounters new information, making it more flexible and capable of handling complex scenarios.Agentic AI in a Smart applications,Imagine you have a smart home system powered by Agentic AI. This system can not only control your lights, security cameras, and heating but also learn your preferences. For example, it might notice that you typically turn on the lights at 7 PM and adjust the room temperature to 22°C. Over time, it learns your patterns and can automatically adjust the settings without you needing to give a command.If the AI detects that the weather outside is colder than usual, it might preemptively raise the

temperature in the house at 6:45 PM to ensure comfort when you arrive home. It's not just following a set of instructions; it's actively learning and making decisions on its own to improve your daily life.

12. RPA- robotics process automation - implementation

RPA is a form of business process automation that allows anyone to define a set of instructions for a robot or 'bot' to perform.

13. Agentic AI in work flow

While RPA is a powerful tool for automating repetitive tasks.The typical benefits of robotic automation include reduced cost; increased speed, accuracy, and consistency; improved quality and scalability of production. Automation can also provide extra security, especially for sensitive data and financial services.Angular acceleration α is definedas the rate of change of angular velocity. In equation form, angular acceleration is expressed as follows: α=ΔωΔtie., $\alpha = \Delta\omega \Delta t$, where Δω is the change in angular velocity and Δt is the change in time.**Force** = Mass x Acceleration. Angular Velocity : Angular velocity is the rate of change of the position angle of an object with respect to time, so w = theta / t, where w = angular velocity, theta = position angle, and t = time.

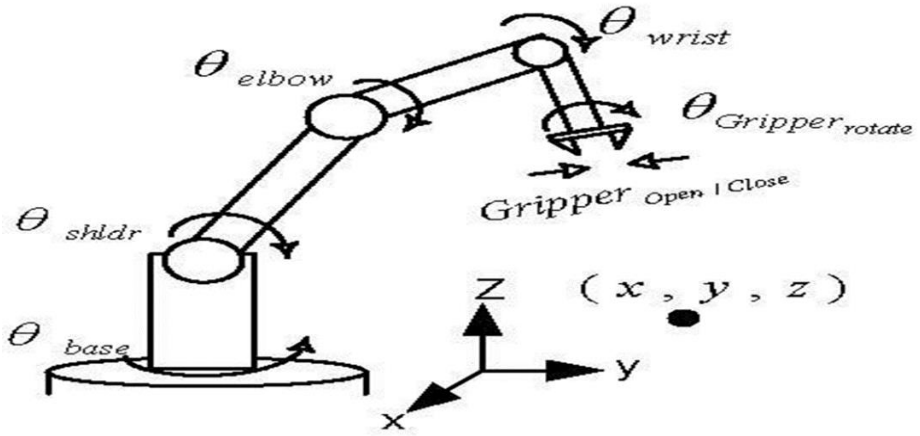
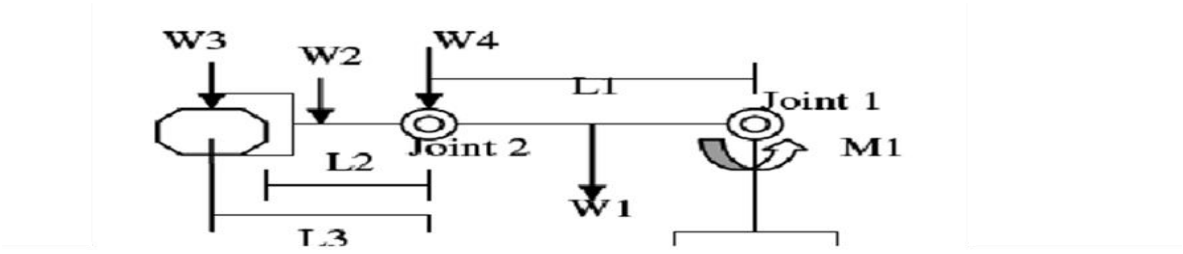


Figure 5. RPA angular acceleration



Torque about joint 1:

$$M1 = \frac{L1}{2} * W1 + L1 * W4 + (L1 + \frac{L2}{2}) * W2 + (L1 + L3) * W3$$

Torque about joint 2:

$$M2 = \frac{L2}{2} * W2 + L3 * W3$$

Figure 6. Kinematics in Agentic AI joint angle

Table 1. Calculating torque balance in Agentic AI over RPA

D_{max}	D	Ψ	d	Error	correction factor
0.96	0	0.0	9.28	11.55	-2.27	-0.035325991
0.98	0	0.0	9.29	1.02	8.27	0.008685611
1	0	0.9	9.59	1.92	7.67	0.123902216
1.02	0	0.3	9.68	7.21	2.47	0.133862348
1.04	0	0.1	9.72	11.68	-1.96	-0.079061224
1.06	0	0.5	9.76	4.17	5.59	0.09954025
1.08	0	0.8	9.79	3.21	6.58	0.129554711
1.1	0	0.7	9.81	3.39	6.42	0.11982243
1.12	0	0.7	9.85	4	5.85	0.133842735
1.14	0	0.2	9.89	11.12	-1.23	-0.220544715
1.16	0	0.7	9.92	4.19	5.73	0.126623037
1.18	0	1.0	9.98	1.92	8.06	0.125143921
1.2	0	0.9	10.2	3.02	7.2	0.137397222
1.22	0	0.8	10.3	4.28	6.07	0.143143328
1.24	0	0.9	10.4	3.16	7.24	0.130976519
1.26	0	0.6	10.4	4.39	6.09	0.110518883
1.28	0	0.2	10.5	1.28	9.24	0.031917749
1.3	0	0.5	10.6	11.5	-0.81	-0.652419753
1.32	0	1.2	10.7	1.85	8.86	0.144319413
1.34	0	1.0	10.7	2.99	7.8	0.137284615
1.36	0	0.5	10.8	10.5	0.38	1.463657895
1.38	0	1.3	10.9	2.59	8.33	0.156465786

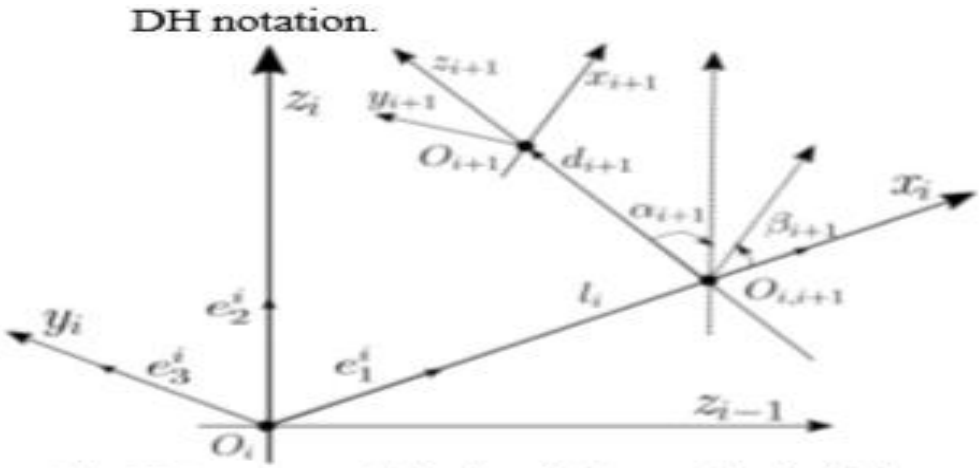


Fig.2 Structure of the local frames in the links.

Figure 7. DH Notations

First we note that axes *zi* and *zi*+1 are fixed in links i and $i + 1$, respectively, The fixed geometrical parameters that define the mutual disposition between frames i and $i + 1$ for $i = 1,2,\ldots,n - 1$ are as follows**,** Forward kinematics can help you evaluate the cost and feasibility of a path, while Inverse kinematicscan help you generate the path and control the robot. Some applications of robot motion planning include industrial robotprogramming and simulation, autonomous navigation and manipulation, and human-robot interaction.Inverse Kinematics is the process of obtaining joint angles

from known coordinates of end effector. For example, if wrist/fist Cartesian coordinates are known, the goal is to decipher shoulder and elbow joint angles for arm in sagittal plane

14. Results and Discussions

Agentic AI Implementation in a genetic Implementing Agentic AI into your organization requires a few key stepsUnderstand the Problem: Start by identifying areas of your business that can benefit from more intelligent decision-making. These could be areas like customer service, supply chain management, or sales predictions.Gather Quality Data: Agentic AI thrives on data. Ensure you have access to high-quality, diverse data to train the AI system. The more data it can learn from, the better its decision-making abilities will be.Choose the Right Tools: You'll need the right AI platforms and machine learning algorithms to build your system. Many tech companies offer Agentic AI solutions, or you can develop a custom AI model tailored to your needs.

14.1 Train the AI: Like any AI system, Agentic AI needs to be trained. This means feeding it data, monitoring its decisions, and tweaking the model to improve its accuracy over time.

14.2 Optimization: Once the AI is in place, it's important to monitor its performance. Even though Agentic AI can learn autonomously, human oversight is necessary to ensure it is making the right decisions and achieving the desired outcomes.

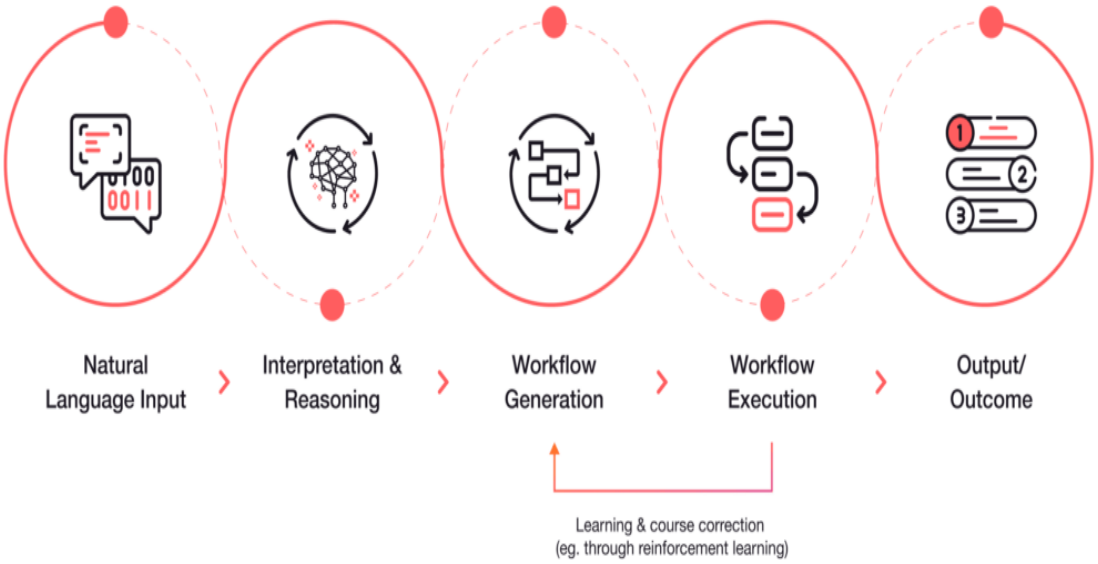


Figure 8. Learning Behaviour in Agentic AI

15. AI takes automation to the next level by allowing systems to make decisions and adapt to changing environments. Whether it's optimizing financial decisions or handling customer service requests, Agentic AI is a game-changer for businesses seeking smarter, more flexible automation.Agentic AI is a type of artificial intelligence (AI) that can act independently and autonomously to achieve goals. It uses a combination of AI techniques, such as machinlearning, deep learning, and reinforcement learning, to enable AI agents to learn, adapt, and collaborate with humansAgentic AI refers to an advanced AI

system that autonomously takes actions, adapts in real-time, and, solves multi-step problems based on context and objectives. Enterprises today navigate a complex landscape marked by escalating costs, fierce competition, and rapid technological evolution.

16. Graphical Results of various Genetic Agentic AI Algorithms

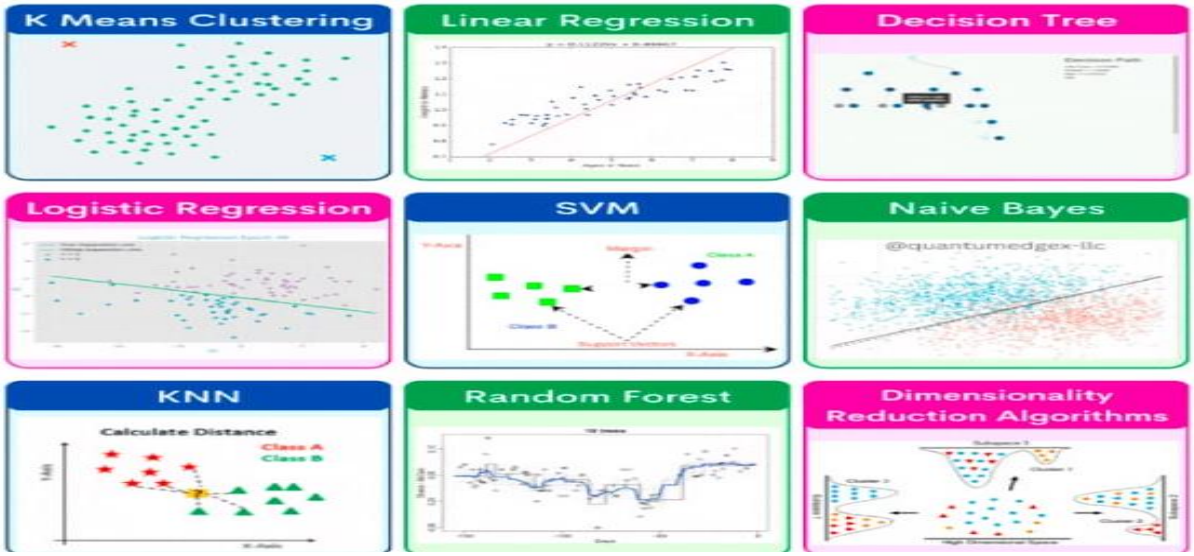
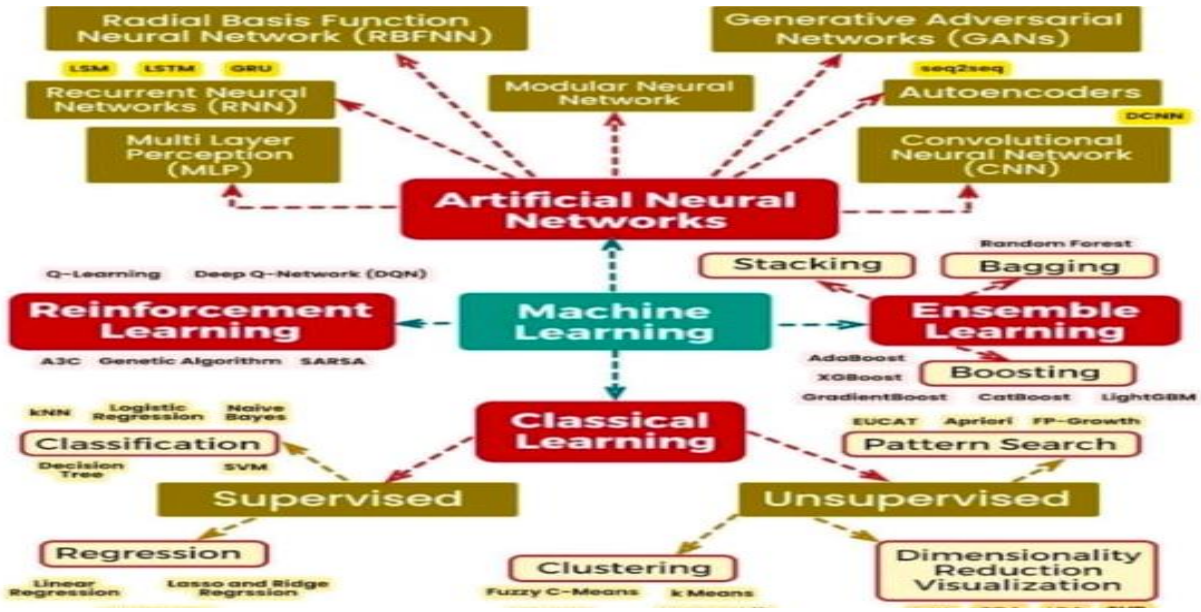


Figure 9. Illustrations of various AI models

Future work

The data can be brought still closer to the analysed data and the predicted data very closer towards the source data by incorporating the following work flow which makes the efficient decision making with the following classifications.

Classification in fusion of Agentic AI with edge computing



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