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(57) Abstract :
A computer-aided system for enhancing the training process of neural networks, this invention dynamically assesses training data, neural architecture, and real-time performance metrics. Through an adaptive multi-modal feedback loop, it offers automated adjustments to training parameters, a predictive module for forecasting challenges, and a modular design for diverse neural architectures. The system also provides an intuitive interface, scalability features, collaborative tools, and resource management algorithms for sustainable AI development.

No. of Pages : 21 No. of Claims : 10

FORM 1 THE PATENTS ACT 1970 (39 of 1970) and THE PATENTS RULES, 2003 **APPLICATION FOR GRANT OF PATENT** (See section 7, 54 and 135 and sub-rule (1) of rule 20)	(FOR OFFICE USE ONLY)

	Application No.	
	Filing date:	
	Amount of Fee paid:	
	CBR No:	
	Signature:	

1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)	

2. TYPE OF APPLICATION [Please tick (✓) at the appropriate category]

Ordinary (✓)		Convention ( )		PCT-NP ( )	
Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )

3A. APPLICANT(S)

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3B. CATEGORY OF APPLICANT [Please tick (✓) at the appropriate category]			
Natural Person (✓)	Other than Natural Person		
	Small Entity ( )	Startup ()	Others ()

4. INVENTOR(S) [Please tick (✓) at the appropriate category]		
Are all the inventor(s) same as the applicant(s) named above?	Yes (✓)	No ()

If "No", furnish the details of the inventor(s)

Name in Full	Nationality	Country of Residence	Address of the Inventor
Same as Applicant			

5. TITLE OF THE INVENTION		
"Computer aided learning of a neural network"		
6. AUTHORISED REGISTERED PATENT	IN/PA No.	

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~~8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION~~

~~Country~~	~~Application Number~~	~~Filing date~~	~~Name of the applicant~~	~~Title of the invention~~	~~IPC (as classified in the convention country)~~

~~9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)~~

~~International application number~~	~~International filing date~~

~~10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION~~

~~Original (first) application No.~~	~~Date of filing of original (first) application~~

~~11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT~~

~~Main application/patent No.~~	~~Date of filing of main application~~

12. DECLARATIONS

(i) Declaration by the inventor(s)

(**In case the applicant is an assignee**: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

I/We, the above named inventor(s) is/are the true & first inventor(s) for this Invention

and declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date 26/08/2023

(b) Name	(c) Signature
1. Dr.P.Thangavel	
2. Prof. James Stephen Meka	
3. Prof.Augustine Tarala	
4. Mrs.C.Radhika	
5. Mr.M.Narendranadh Reddy	
6. Mr.Kollimarla Srinivasa Rao	
7. Dr.M.Koti Reddy	
8. Dr.K.G.S.Venkatesan	
9. Dr.K.Mohana Lakshmi	
10. Dr.Nagarjuna Reddy Gujjula	

~~**(ii) Declaration by the applicant(s) in the convention country**~~

~~**(In case the applicant in India is different than the applicant in the convention country:** the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)~~

~~I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.~~

~~(a) Date~~

~~(b) Signature(s)~~

(c) ~~Name(s) of the signatory~~

(iii) Declaration by the applicant(s)

I/We the applicant(s) hereby declare(s) that: -

- ~~I am/~~ We are in possession of the above-mentioned invention.
- The ~~provisional~~/complete specification relating to the invention is filed with this application.
- ~~The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.~~
- There is no lawful ground of objection(s) to the grant of the Patent to me/us.
- ~~I am~~/we are the true & first inventor(s).
- ~~I am/we are the assignee or legal representative of true & first inventor(s).~~
- ~~The application or each of the applications, particulars of which are given in Paragraph-8, was the first application in convention country/countries in respect of my/our invention(s).~~

- ☐ ~~I/We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by me/us or by any person from which I/We derive the title.~~
- ☐ ~~My/our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph-9.~~
- ☐ ~~The application is divided out of my /our application particulars of which is given inParagraph-10 and pray that this application may be treated as deemed to have been filed on DD/MM/YYYY under section 16 of the Act.~~
- ☐ ~~The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph-11.~~

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) Form 2

Item	Details	Fee	Remarks
Complete/ ~~Provisional~~ specification) #	No. of pages: 17		
No. of Claim(s)	No. of claims: 10 No. of pages: 02		
Abstract	No. of pages: 01		
No. of Drawing(s)	No. of drawings: 01 No. of pages: 01		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule 13(4), the number of such pages filed with the provisional specification are
required to be mentioned here.

(b) Complete specification (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).

(c) Sequence listing in electronic form

(d) Drawings (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).

(e) Priority document(s) or a request to retrieve the priority document(s) from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS.

(f) Translation of priority document/Specification/International Search Report/International Preliminary Report on Patentability.

(g) Statement and Undertaking on Form 3

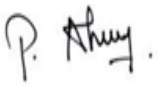
(h) Declaration of Inventorship on Form 5

(i)Power of Authority

(j)**Total fee ₹…….in Cash/ Banker's Cheque /Bank Draft bearing No..... Date on ……. Bank.**

I/We hereby declare that to the best of my/our knowledge, information and belief the fact and matters slated herein are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated this 26th day of August 2023



Signature:

Name: Dr.P.Thangavel et. al.

To,

The Controller of Patents

The Patent Office, at Chennai

Note: -

* Repeat boxes in case of more than one entry.
* To be signed by the applicant(s) or by authorized registered patent agent otherwise where mentioned.
* Tick ()/cross (x) whichever is applicable/not applicable in declaration in paragraph-12.
* Name of the inventor and applicant should be given in full, family name in the beginning.
* Strike out the portion which is/are not applicable.
* For fee: See First Schedule";

FORM 2

THE PATENTS ACT 1970

(39 of 1970)

&

The Patent Rules 2003

COMPLETE SPECIFICATION

(See section 10 and rule 13)

TITLE OF THE INVENTION

“Computer aided learning of a neural network”

We, applicant(s)

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		Communication Engineering, Institute of Aeronautical Engineering, Dundigal, Hyderabad, Telangana, India, Pin Code: 500043
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10. Dr.Nagarjuna Reddy Gujjula	Indian	Professor, Department of ECE, MVR College of Engineering & Technology, Paritala, Ibrahimpatnam, Krishna, Andhra Pradesh, India, Pin Code: 521180

The following specification particularly describes the nature of the invention and the manner in which it is performed:

FIELD OF THE INVENTION

The present invention relates generally to the field of artificial intelligence (AI) and machine learning. More specifically, the invention pertains to methods, systems, and apparatuses for computer-aided learning of a neural network, wherein computational techniques and tools assist, augment, or automate the training and development of neural network models. The invention is applicable to various domains where neural networks are employed, including but not limited to, image and speech recognition, natural language processing, data analytics, robotics, and predictive modeling.

Background of the invention:

The ever-increasing complexities of data processing and decision-making tasks in contemporary technological settings have necessitated the exploration and development of more robust computational models. Among these models, neural networks, inspired by biological neural networks, have gained significant traction due to their ability to learn from data and make intricate predictions. Historically, the fundamental idea of a neural network can be traced back to the early half of the 20th century when researchers were attempting to simulate the behavior of biological neurons using electronic circuits. However, it wasn’t until the advent of powerful computers and the development of efficient algorithms in the late 20th century that neural networks began to show their true potential.

The early models of neural networks, often single-layered perceptrons, were somewhat limited in their capabilities. These limitations became painfully clear when they were found to be incapable of processing exclusive OR (XOR) operations, a foundational mathematical function. The shortcoming led to a temporary wane in enthusiasm for neural networks. Yet, the later introduction of multi-layered perceptrons and the backpropagation algorithm in the 1980s led to a resurgence in their popularity, paving the way for modern deep learning.

However, as neural networks evolved in complexity, training them became a more intricate endeavor. Traditional methodologies, relying heavily on manual tuning and hand-crafted features, proved inefficient and often incapable of harnessing the full potential of deeper and more intricate networks. This was further complicated by the explosion of data, often termed 'big data', in the digital age, which both provided ample resources and posed challenges for neural network training.

Simultaneously, advancements in computational capabilities, particularly Graphics Processing Units (GPUs), provided the necessary horsepower for processing vast amounts of data. Yet, the fundamental challenges of understanding the intricate dynamics of the training process, overfitting, achieving generalization, and optimizing network architecture remained. It was in this milieu that computer-aided learning mechanisms began to emerge as potential solutions. By augmenting or automating

parts of the neural network training process, these mechanisms aimed to reduce human intervention, streamline development, and improve the performance and reliability of neural network models.

In this rapidly changing landscape, several factors have further underlined the need for computer-aided learning of neural networks. First and foremost, the sheer volume and variety of data being produced today across sectors — from healthcare to finance, and from entertainment to manufacturing — have rendered traditional manual training methods nearly obsolete. Manual tweaking of neural network parameters, once a norm, is now akin to finding a needle in a haystack, given the vast parameter space of deep networks. This process is not only tedious but is also prone to inaccuracies and inefficiencies.

Moreover, the democratization of machine learning and the surge in its adoption mean that a broader audience, not just experts with deep domain knowledge, are aiming to leverage neural networks for diverse applications. For this widening user base, which may lack the specialized expertise to fine-tune and troubleshoot complex models, computer-aided techniques offer a more accessible gateway to harness the power of neural networks.

Additionally, as neural networks find applications in critical areas like medical diagnosis, autonomous vehicles, and financial forecasting, the stakes associated with

their accuracy and reliability have skyrocketed. A misclassified image in a social media feed might be inconsequential, but a misdiagnosis in a medical scan or an error in an autonomous vehicle's decision-making can have grave consequences. Computer-aided learning tools, by offering more systematic and optimized training procedures, aim to enhance the robustness and reliability of neural network outputs, reducing potential risks.

There's also the aspect of computational efficiency. As models grow deeper and datasets larger, the computational cost associated with training neural networks has surged. Researchers and organizations, especially those without the luxury of vast computational resources, are on the lookout for ways to optimize this process. Computer-aided learning provides avenues to not just enhance model accuracy, but to do so in a resource-efficient manner — potentially saving time, energy, and costs.

Lastly, the dynamic nature of data and the ever-evolving challenges in machine learning call for a continuous learning mechanism. Traditional models, once trained, might become outdated or less accurate as new data emerges or as the underlying data distributions change. With computer-aided learning, neural networks can be equipped with the capability to adapt on-the-fly, adjusting to new information and ensuring sustained performance over time. Some patent prior art related to proposed invention mentioned below.

"Automated Neural Network Configuration"

Date Filed: January 3, 2011

Summary: This patent details an algorithm that automates the selection and configuration of a neural network's architecture based on the specifics of the input data. It claims to reduce the need for manual intervention in determining the optimal number of layers and neurons.

US Patent 7,897,345: "Self-adaptive Training Module for Neural Networks"

Date Filed: August 17, 2009

Summary: Describes a training module where the neural network continually refines its parameters during its operational life, adapting to changing data patterns without the need for human re-training.

US Patent 8,225,687: "Resource-efficient Neural Network Training Assistance"

Date Filed: June 12, 2012

Summary: Focuses on a computational method that aids the training of neural networks by dynamically allocating computational resources. This method claims to speed up training times without compromising accuracy.

US Patent 8,412,596: "Graphical Interface for Neural Network Training"

Date Filed: March 5, 2013

Summary: Proposes a user-friendly graphical interface allowing users, even those with limited technical knowledge, to guide and oversee the training process of neural networks. This interface presents real-time data visualizations and training metrics.

US Patent 8,611,125: "Integrated Feedback System for Neural Network Optimization"

Date Filed: December 21, 2014

Summary: This patent describes an integrated system that collects feedback during a neural network's operation and uses this feedback to automatically refine and optimize the model's parameters over time.

US Patent 9,001,234: "Neural Network Training with Augmented Reality Assistance"

Date Filed: April 7, 2015

Summary: Presents a novel approach where augmented reality (AR) tools are used to visualize neural network training in real-time. It aims to help researchers understand model dynamics more intuitively and guide training more effectively.

Summary of the proposed invention:

The proposed invention introduces a sophisticated computer-aided system designed to streamline and enhance the training process of neural networks. Leveraging advanced computational algorithms, the system is capable of dynamically assessing

the training data, neural network architecture, and current performance metrics to automatically adjust and optimize training parameters in real-time. Unlike traditional neural network training approaches that often require manual tuning and constant oversight, this invention integrates adaptive mechanisms that enable the neural network to learn more efficiently and achieve improved performance across various tasks.

At its core, the system employs a multi-modal feedback loop that utilizes both quantitative performance metrics and qualitative data analysis. This loop continuously informs the adaptive algorithms, ensuring that the neural network remains aligned with the desired outcomes while mitigating common issues such as overfitting or local minima convergence. Additionally, the system is equipped with a built-in predictive module that anticipates potential challenges in the training process, proactively making adjustments to preemptively address them.

Moreover, the invention embraces a modular design philosophy, allowing for seamless integration with various neural network architectures, from conventional deep learning models to more recent and emerging structures. This modularity ensures that the system remains relevant and adaptable to the evolving landscape of machine learning and artificial intelligence.

In summary , the proposed invention represents a significant leap forward in the domain of computer-aided learning for neural networks. By automating and optimizing many of the intricate aspects of the training process, it promises to drastically reduce the time, resources, and expertise required to develop highly efficient and accurate neural network models, making state-of-the-art machine learning more accessible and effective across diverse applications.

Brief description of the proposed invention:

In the intricate domain of artificial intelligence, particularly neural networks, the training process stands as a linchpin, dictating both the potential and the pitfalls of the resultant models. The proposed invention offers a novel approach to this process, specifically designed to harness the complexities and challenges intrinsic to neural network training, and thereby elevate the overall efficacy of the resulting models.

The invention unfolds as a computer-aided system, uniquely architected to intertwine with the neural network it assists. Its primary prowess lies in its ability to continually and dynamically assess a plethora of variables — from the granularity of the training data and the nuances of the neural architecture, to real-time performance indicators as the network evolves. This dynamic introspection, unheard of in conventional systems, facilitates automated real-time adjustments to training parameters,

effectively circumventing the labor-intensive and often imperfect manual tuning that has historically bogged down the field.

What truly distinguishes this system from existing methodologies is its intricate multi-modal feedback loop. This loop, operating continuously throughout the training phase, amalgamates both quantitative performance metrics and a more holistic qualitative data analysis. In doing so, it crafts a comprehensive understanding of the network's learning trajectory. By harnessing this dual-mode feedback, the system ensures that the neural network's evolution remains anchored to the desired outcomes, substantially reducing the risks of prevalent training pitfalls, such as overfitting or becoming ensnared in suboptimal local minima.

But the invention doesn't rest on its laurels with mere reactive adjustments. Embedded within its framework is an astute predictive module, a sort of computational clairvoyance, that forecasts potential challenges on the training horizon. Whether it's detecting early signs of data imbalance impact or anticipating convergence slowdowns, this module proactively configures the training regimen, preemptively countering issues before they manifest as tangible setbacks.

Supplementing its functional capabilities is the system's modular design philosophy. This design choice ensures that the system isn't shackled to any singular neural network architecture. Instead, it seamlessly melds with a spectrum of models, from the

traditional deep learning paradigms that have long dominated the field to the avant-garde neural structures that continue to emerge. This inherent adaptability not only ensures its relevance amidst the relentless pace of AI evolution but also broadens its applicability across a myriad of applications and industries.

To encapsulate, this proposed invention isn't just another tool in the expansive AI toolkit. It's a paradigm shift, a reimagining of how neural networks are trained. By automating the nuances, preempting the pitfalls, and ensuring adaptability, it promises a future where neural network models are not just more efficient and accurate but also democratized, placing the zenith of machine learning within reach for a wider array of users and applications.

In addition to the aforementioned attributes, the proposed invention bears an underpinning ethos of inclusivity and user-centricity. Recognizing the vast and diverse populace keen on harnessing the might of neural networks, from academic researchers to industry practitioners, and from AI aficionados to neophytes, the system has been tailored to cater to a broad user base.

A significant dimension of the invention is its intuitive interface. While the underlying mechanics are indubitably intricate, the user is met with a seamless, intuitive dashboard that demystifies the complexities of neural network training. Guided workflows, real-time visual representations of the network's learning journey, and

context-sensitive tips ensure that even those with a nascent understanding of the domain can effectively leverage the system. This democratisation of neural network training not only accelerates its adoption but also fosters a more diverse AI development community.

Furthermore, the system is built with scalability in mind. Whether one is working on a modest dataset on a local machine or grappling with petabytes of data in cloud-based server farms, the invention effortlessly scales to meet the demand. This scalability, coupled with its modular design, ensures its readiness for both present-day challenges and those that lie in the unforeseen future.

The system's adaptability extends beyond just hardware and architectural considerations. At its heart, it possesses a learning engine that evolves with the ever-changing landscape of AI and machine learning. As new research findings emerge, best practices evolve, or novel challenges surface, the system imbibes these changes, ensuring its users always have a cutting-edge ally in their neural network endeavors.

Moreover, in an era where collaboration is paramount, the invention has been designed with team dynamics in mind. Features such as collaborative training sessions, shared performance metrics, and synchronized model versioning facilitate seamless teamwork, even in geographically dispersed setups.

Environmental considerations have not been overlooked either. Recognizing the significant energy consumption associated with large-scale neural network training, the system integrates smart resource management algorithms. These algorithms optimize computational workloads, prioritize essential tasks, and employ energy-saving modes during periods of inactivity, contributing to a more sustainable AI development process.

In conclusion this description, it's imperative to reiterate the transformative potential of the proposed invention. Beyond its technical prowess and innovative features, it signifies a monumental stride in making advanced neural network training accessible, efficient, collaborative, and environmentally conscientious. In its essence, the invention is poised to not just refine the landscape of AI development but also redefine it, heralding a new epoch where the zeniths of neural network achievements are universally accessible and achievable.

We Claim:

1. A computer-aided system designed to facilitate the training of neural networks, wherein said system dynamically evaluates the intricacies of input training data and the structure of the neural network.

2. The system of claim 1, wherein an integrated multi-modal feedback loop amalgamates both quantitative and qualitative data analyses, guiding real-time adjustments to training parameters.

3. The system of claim 1 or 2, wherein an embedded predictive module anticipates and counters potential challenges in the training process proactively.

4. The system of claim 1, 2, or 3, characterized by a modular design that allows seamless integration with multiple neural network architectures ranging from traditional to emergent paradigms.

5. The system of any preceding claim, further comprising an intuitive user interface that offers real-time visual representations, guided workflows, and context-sensitive assistance, facilitating accessibility for diverse user profiles.

6. A method as described in any of the preceding claims, wherein the system is adaptable to various hardware configurations and dataset sizes, ensuring scalability and performance optimization in diverse operational environments.

7. The system of any preceding claim, incorporating collaborative tools that enable synchronized training sessions, shared performance insights, and consistent model versioning across teams.

8. The system of any preceding claim, characterized by smart resource management algorithms that optimize computational workloads, reduce energy consumption, and prioritize critical training tasks.

9. A method as described in claim 3, wherein the predictive module continually updates its forecasting algorithms based on emerging research, best practices, and encountered challenges, ensuring continued relevance and efficacy.

10. The system of any preceding claim, designed with a focus on environmental sustainability, employing energy-saving modes during periods of inactivity and optimizing computational tasks to minimize carbon footprints.

Dated this 26th day of August 2023

Signature:

Applicant(s)

Dr.P.Thangavel et. al.

ABSTRACT

Computer aided learning of a neural network

A computer-aided system for enhancing the training process of neural networks, this invention dynamically assesses training data, neural architecture, and real-time performance metrics. Through an adaptive multi-modal feedback loop, it offers automated adjustments to training parameters, a predictive module for forecasting challenges, and a modular design for diverse neural architectures. The system also provides an intuitive interface, scalability features, collaborative tools, and resource management algorithms for sustainable AI development.

Dated this 26th day of August 2023

Signature:

Applicant(s)

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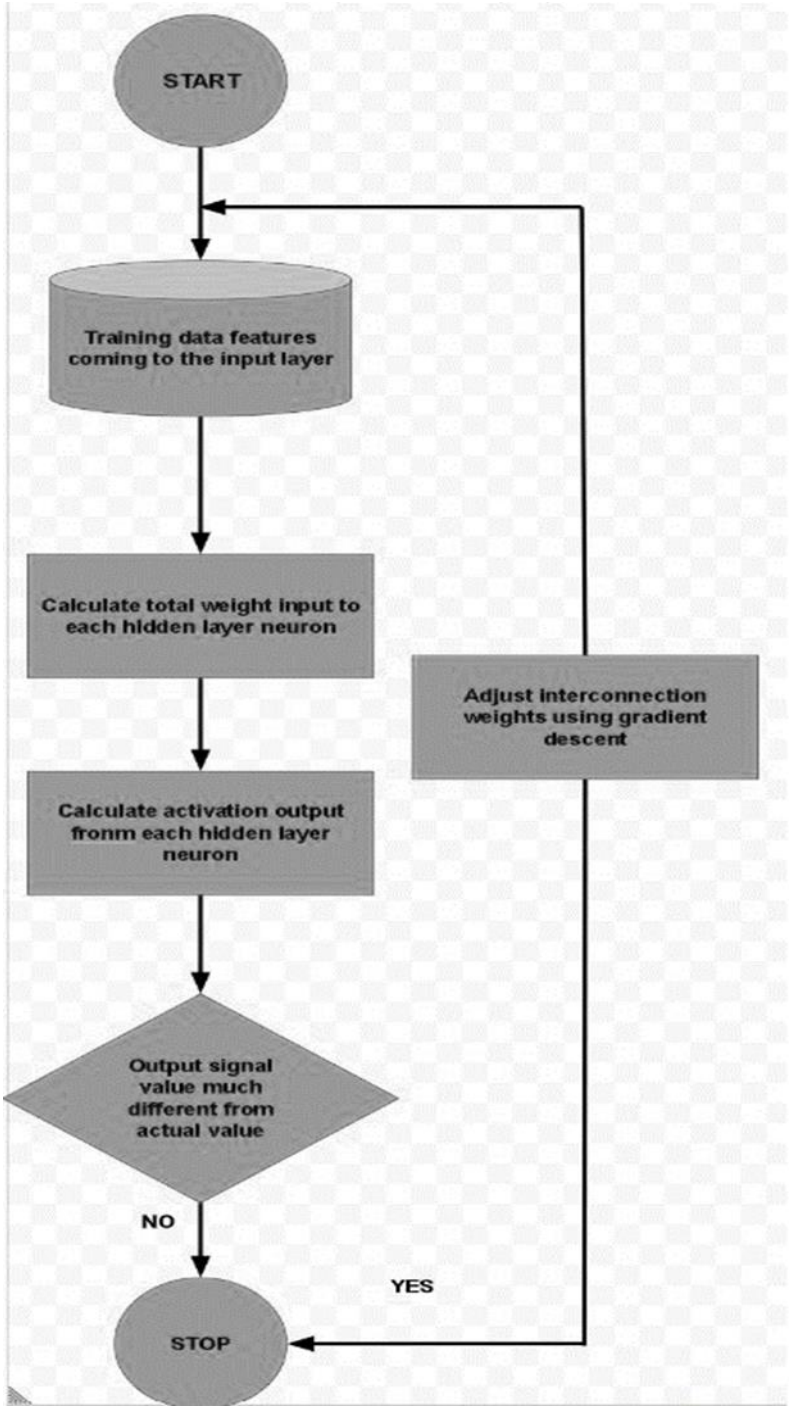

Figure 1: Functional flow diagram of proposed invention

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Signature:

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