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(57) Abstract :
Parkinson's Disease (PD) is an ongoing, degenerative issue, which prompts a scope of motorand mental side effects. PD conclusion is a difficult assignment since its side effects are the same as different sicknesses like ordinary maturing and fundamental quake. Much examination has been applied to diagnosing this illness. This venture plans to mechanize the PD conclusion process utilizing profound learning, Recursive Neural Networks (RNN) and Convolutional Neural Networks (CNN), to separate among sound and PD patients. Other than that, since various datasets may catch various parts of this sickness, this venture intends to investigate which PD test is more viable in the separation cycle by breaking down various imaging and development datasets (outstandingly block furthermore, twisting pentagon datasets). Moreover, this venture assesses which dataset type, imaging or time series, is more powerful in diagnosing PD. Numerical models like Deep Learning (DL) give a reasonable procedure to identify illness side effects. These displaying approaches incorporate geographies particular for some sort of datasets, for example, imaging datasets and time-series datasets (for example a dataset contained of a bunch of arrangements, where each succession contains information focuses that are filed in time request). Consequently, it is qualified to examine the profound learning strategies on the PD, particularly after the late progress of profound learning in various fields.

No. of Pages : 13 No. of Claims : 6

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सत्यमेव जयते

INTELLECTUAL PROPERTY INDIA
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GEOGRAPHICAL INDICATIONS

G.A.R.6
[See Rule 22(1)]
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Docket No 28358 **Date/Time 2022/03/30 10:55:00**

To
Dr. V.V. SUNIL KUMAR, PROFESSOR, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
PBR VISVODAYA INSTITUTE OF TECHNOLOGY AND SCIENCE, KAVALI, ANDHRA PRADESH 524201, INDIA.

CBR Detail:

Sr. No.	Ref. No./Application No.	App. Number	Amount Paid	C.B.R. No.	Form Name	Remarks
1	TEMP/E1/20918/2022-CHE	202241018620	1600	12493	FORM 1	PARKINSON DISEASE DETECTION USING DEEP NEURAL NETWORKS
2	E12/2183/2022/CHE	202241018620	2500	12493	FORM 9	----

Transaction ID	Payment Mode	Challan Identification Number	Amount Paid	Head of A/C No
N-0000938269	Online Bank Transfer	290322000933	4100.00	1475001020000001

Total Amount : ₹ 4100
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"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.	
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1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)	

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

Ordinary (√)		Convention (x)	PCT-NP (x)		
Divisional ()	Patent of Addition ( )	Division ( )	Patent of addition ()	Division ( )	Patent of Addition ( )

3A. APPLICANT(S)

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Natural Person (√)	Other than natural Person		
	Small Entity (x)	Startup (x)	Others (x)

4. INVENTOR(S) [Please tick at the appropriate category]

Are all the inventor(s) same as the applicant(s) named above?	Yes (√)	

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

5. TITLE OF THE INVENTION

PARKINSON DISEASE DETECTION USING DEEP NEURAL NETWORKS

6. AUTHORISED REGISTERED PATENT AGENT	IN/PA No.	- NA-
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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)
NA	NA	NA	NA	NA	NA

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
NA	NA

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
NA	NA

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

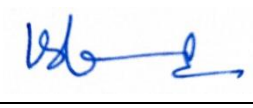
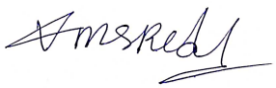
Main application/patent No. : NA	Date of filing of main application : NA

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).

We, the above named inventor(s) are the true & first inventor(s) for this Invention and declare that the applicant(s) herein are our assignee or legal representative.

NAME	SIGNATURE	DATE
Dr. V.V. SUNIL KUMAR		24/03/2022
Dr. G. VIJAY KUMAR		24/03/2022
Dr. V. MADHUSUDHANA REDDY		24/03/2022

(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)

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

(a) Date
(b) Signature(s) -------NA----------
(c) Name(s) of the signatory

(iii) Declaration by the applicant(s)

- We the applicant(s) hereby declare(s) that: -
- 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.

- We are the true & first inventor(s).
- 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 our invention(s).~~
- ~~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.~~
- ~~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 in Paragraph-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 specification	No. of pages :13		
No. of Claim(s)	No. of claims : 06 and No. of pages :01		
Abstract	No. of pages :01		
No. of Drawing(s)	No. of drawings :-- and No. of pages:--		

~~# 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/InternationalPreliminary Report on Patentability.~~
(g) Statement and Undertaking on Form 3
(h) Declaration of Inventorship on Form 5
(j)……..

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

NAME	SIGNATURE	DATE
Dr. V.V. SUNIL KUMAR		24/03/2022
Dr. G. VIJAY KUMAR		24/03/2022
Dr. V. MADHUSUDHANA REDDY		24/03/2022

To,
The Controller of patents, The Patent office at CHENNAI

Form 2

THE PATENT ACT, 1970

(39 of 1970)

&

The Patent Rules, 2003

COMPLETE SPECIFICATION

(Section 10 and Rule 13)

PARKINSON DISEASE DETECTION USING DEEP NEURAL NETWORKS

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The following specification particularly describes the invention and the manner in which it is to be performed**.**

FIELD OF INVENTION

The present invention relates to methods for detecting Parkinson disease using deep neural networks.

BACKGROUND

Parkinson's illness is a long haul and moderate focal sensory system problem that fundamentally influences the engine framework. Engine related side effects start bit by bit, frequently with a scarcely observable quake in only one hand, and slowly deteriorate extra time. At a beginning phase of Parkinson's infection, engine related side effects like quakes, shaking, gradualness of development, unbending nature, and so forth are extremely normal. At later stages, and as the sickness progress, non-engine side effects might happen. A patient might encounter strolling hardships, and thinking and conduct related side effects, for example, tangible troubles, rest jumble, and enthusiastic issues. Momentarily, engine issues are on the whole a principle side effect of Parkinson's illness. The assessment of the illness stages and side effects has been a principle center in the clinical practice.

US6620415B2: The current creation connects with strategies for treating development issues. Specifically, the current development connects with strategies for treating development problems by intracranial organization of a neurotoxin. A technique for briefly reducing an engine issue side effect of Parkinson's sickness, the strategy involving the progression of intracranial

organization of a botulinum poison to a patient, consequently briefly easing an engine issue side effect of Parkinson's illness.

US20060167530A1: Various exemplifications of an organic connection point framework and related techniques are uncovered. The framework might contain a sensor including a majority of cathodes for distinguishing multicellular signs exuding from at least one living cells of a patient and a handling unit arranged to get the multicellular signs from the sensor and interaction the multicellular signs to deliver a handled sign. The handling unit might be designed to send the handled sign to a controlled gadget that is arranged to get the handled sign. The framework is arranged to play out an incorporated patient preparation routine to create at least one framework design boundaries that are utilized by the handling unit to deliver the handled sign.

US20060167371A1: Various exemplifications of an organic connection point framework and related techniques are uncovered. The framework might incorporate a sensor having a majority of terminals for identifying multicellular signs radiating from at least one living cells of a patient, and a handling unit arranged to get the multicellular signs from the sensor and cycle the multicellular signs to create a handled sign. The handling unit might be designed to send the handled sign to a controlled gadget that is arranged to get the handled sign. The framework may likewise incorporate a patient preparation device arranged to get a patient preparation signal that makes the patient preparation mechanical assembly controllably move at least one joints of the patient. The framework might be designed to play out an incorporated patient preparation routine to deliver the patient preparation signal, to store a bunch of multicellular sign information distinguished during a development of the at least one joints, and to associate the arrangement of

multicellular sign information to a second arrangement of information connected with the development of the at least one joints.

CN104127187B: The creation gives a sort of wearable framework and technique for patient's Parkinson cardinal side effect quantitative assurance, the framework incorporates gloves and PC, and both are associated by wired or remote mode ; The gloves incorporate wrist and fingertip module once more, the two modules are worn on's at the tip of persistent's finger and wrist separately, shake identification and its abundancy adjustment state recognition module, solid unbending nature location module are given the PC, slow side effect discovery module is moved, it is individually used to understand that patients with Parkinson infection shudders recognition and its plentifulness adjustment state, strong inflexibility and the discovery for moving sluggish side effect, and testing result will be shown.The present development makes a decision about variation to the side effect of same patient for various neurosurgeons, and the framework has brought together quantization assessment criteria.3 cardinal side effect identifications are coordinated in a framework and can give total and complete condition of an ailment identification.

NON-PATENT LITERATURE STUDY

1.Ahmad J, Muhammad K, Baik SW (2017) Data augmentation-assisted deep learning of handdrawn partially colored sketches for visual search. PLoS ONE 12(8): e0183838.

2.Goetz C. G., B. C. Tilley, S. R. Shaftman, G. T. Stebbins, S. Fahn, P. Martinez-Martin, W. Poewe, C. Sampaio, M. B. Stern, R. Dodel et al., “Movement disorder societysponsored revision of the unified parkinson’s disease rating scale (mds-updrs): Scale presentation and clinimetric testing results,” Movement disorders, vol. 23, no. 15, pp. 2129–2170, 2008.

RESEARCH STATEMENT

AI (ML) is a significant region in software engineering. ML, called here and there robotized learning, is an assortment of calculations, which expect to cause PCs to gain from accessible info (called preparing information or addressing experience) and give us the result as skill. Mostly, We use AI in robotizing a few errands, for example, assignments performed by people and undertakings are over human capacities. PD mostly incorporates motorside effects (a development problem) and non-motorside effects like mental brokenness. For motorside effects, four fundamental signs are considered as cardinal side effects: rest quake, unbending nature, bradykinesia, and some of the time postural insecurity. Around 70% of PD patients have a resting quake which is between 3-5 HZ and it described as hilter kilter quake. The subsequent sign of PD is a sensation of opposition during joints' developments and it is called cogwheel unbending nature. As such, it is the opposite of smooth developments. Dialing back the development is the third sign, called bradykinesia; it grows with straightforward developments like penmanship [1]. The fourth side effect is postural precariousness and this one doesn't occur in the beginning phase of PD, specifically for more youthful patients and it is connected with balance, which makes the patient temperamental on their feet and may prompt falls. A portion of the non-motor side effects of PD, similar to hyposmia, fast eye development (REM), rest conduct turmoil, clogging, and misery might arise before any motor-side effects by years. Numerous patients likewise display mental brokenness, and these reach based on what is called gentle mental impedance (PD-MCI) to PD dementia (PDD). In a few cases, PD-MCI arises in the beginning phase of the sickness, while PDD tends to happen following 20 years of having the PD. PD-MCI is characterized as thinking and memory issues strange to what is generally anticipated with typical maturing, however without keeping the patient from completing

everyday schedule exercises. In addition, PD-MCI conclusion is significant because it would be able be a change to PDD [2]. PDD side effects incorporate weakened present moment memory, leader brokenness, consideration hindrance, visual-spatial deficiency, social or neuropsychiatric side effects like maniacal side effects (mind flights), changes in character and state of mind, tension and lack of care. **Figure 1** shows the different symptoms of Parkinson's disease. Correspondingly, the development over time of PD symptoms was displayed (**Figure. 2**).

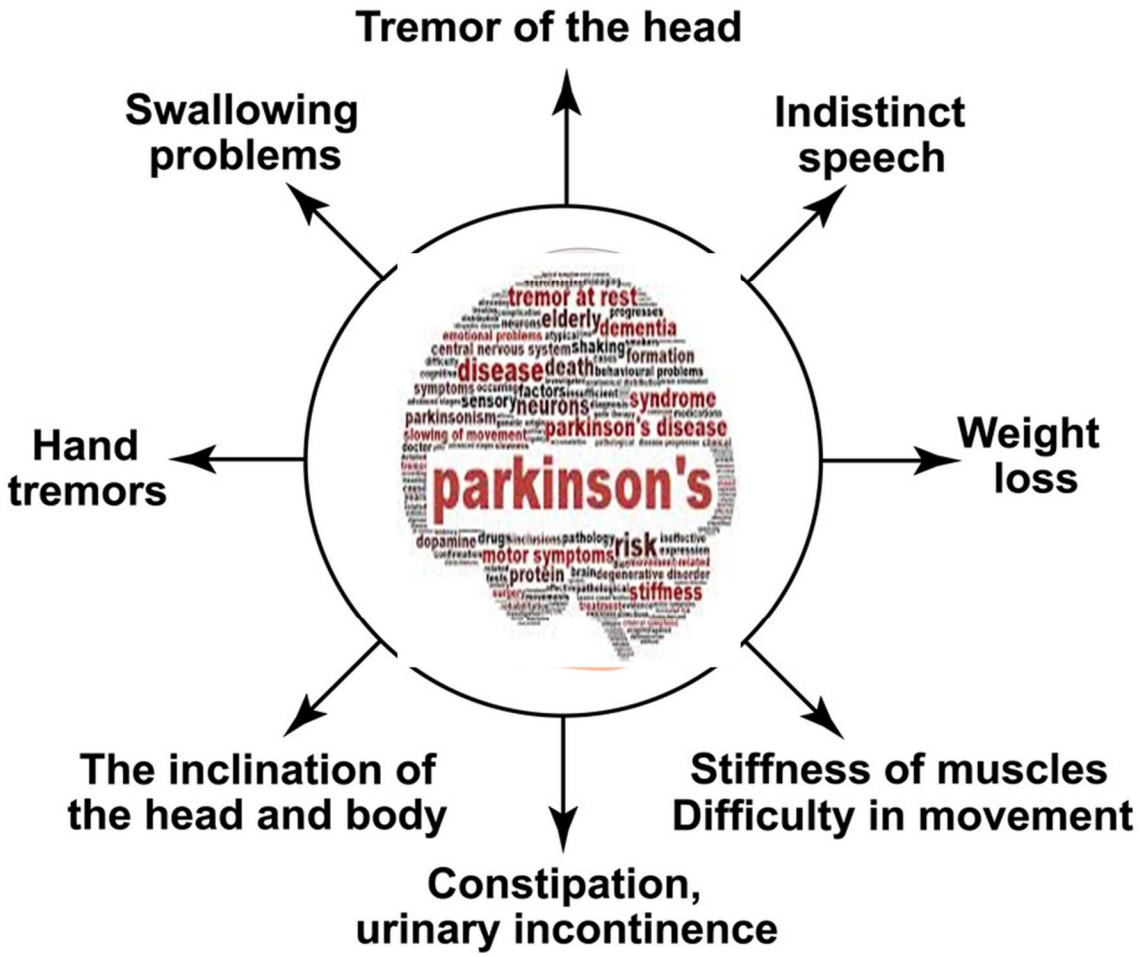

Figure. 1. Schematic view of the different symptoms of Parkinson's disease.

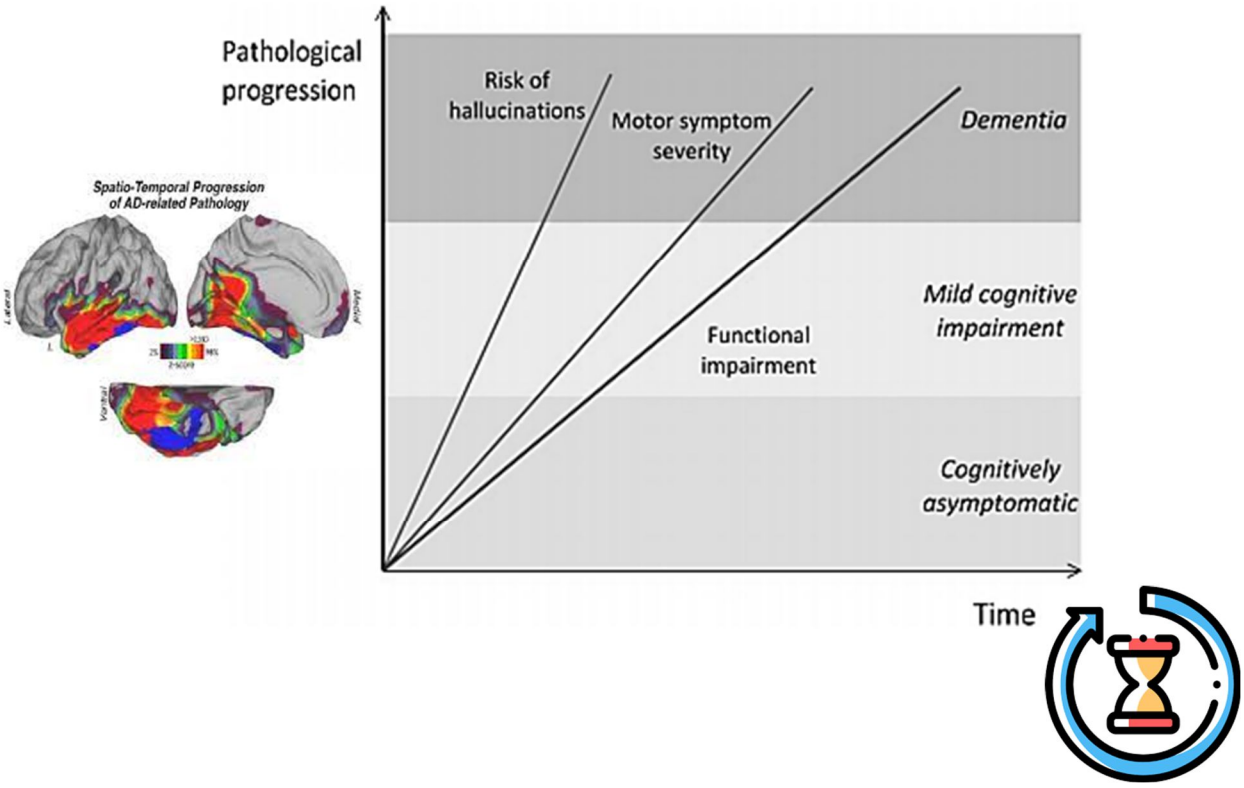

Figure. 2. Schematic view of the development over time of PD symptoms.

Convolutional Auto-Encoder (CAE) is an exceptional sort of CNN. The contrast between them is that the CNN figures out how to channel and consolidate the highlights to characterize the contribution, while the CAE figures out how to channel to remove highlights, which can be utilized to reproduce the input (**Figure. 3**).

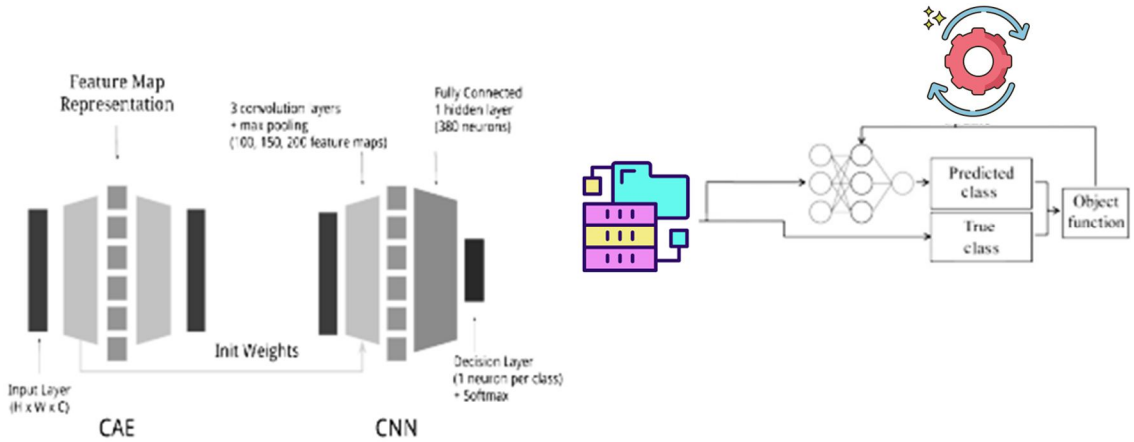

Figure. 3. Schematic view of back-propagation to tune the classification weight using CAE with CNN.

RESEARCH METHODOLOGY

Imaging Dataset

We produce imaging datasets from the time series datasets using a piece of code in the python script. We produce cube and pentagon images after some data preprocessing, described, to the original time series datasets. These imaging datasets have the same number of control and patients as the original time series datasets. We will explain the data pre-processing and images drawing process in detail in section. **Fig 4a** is the spiral pentagon template that subjects were asked to follow**, Fig 4b** is an example of a control (LEEDS_c13010514) drawing from the pentagon time series dataset and **Fig 4c** is an example of a patient (LEEDS_p40310714) drawing from the cube time series dataset. Schematic view of experimental flow of the present research is displayed (**Figure. 5**)

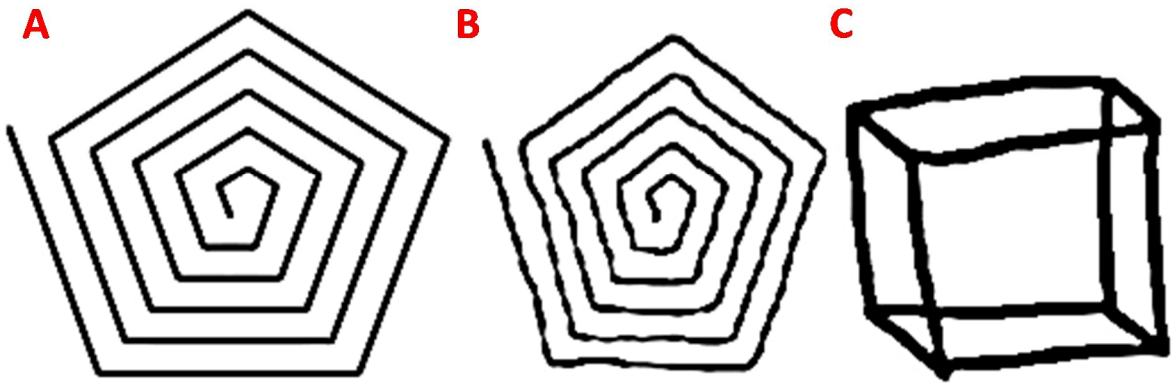

Figure. 4. Schematic view of different forms of series of datasets.

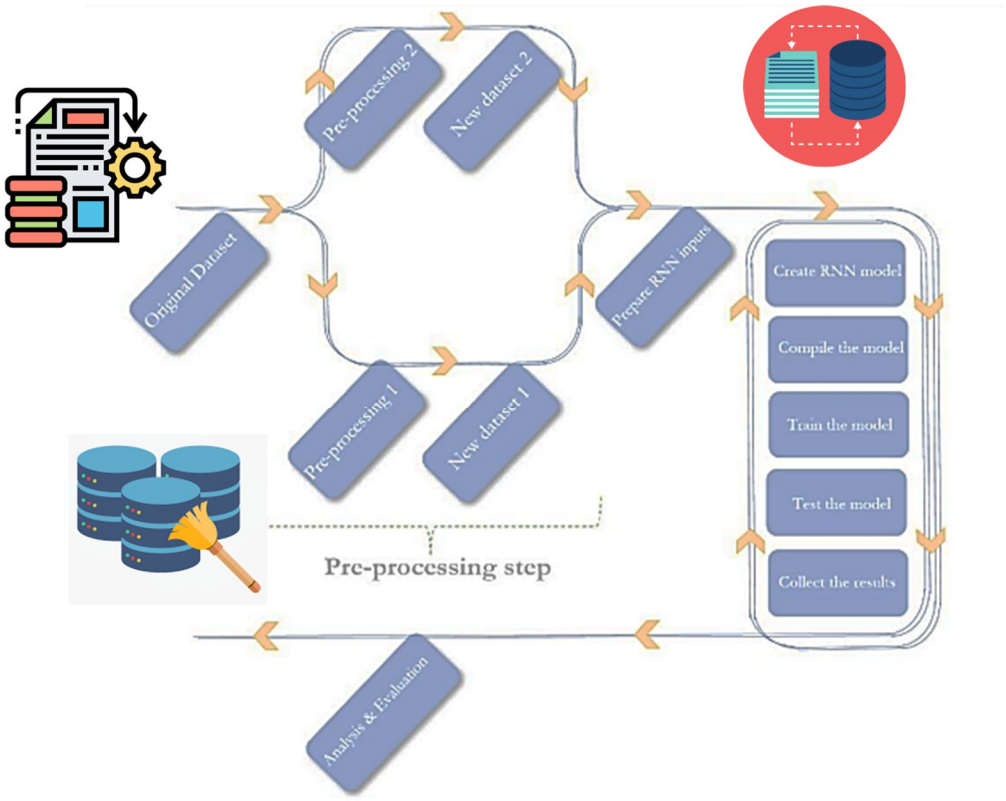

Figure. 5. Schematic view of experimental flow of the present research.

RESULTS

There is a major importance between RNN shape with and without zero strain and it very well may be seen effectively that the aftereffects of the examination RNN block with zero tension were better, recommending that RNN shape with zero strain approach is superior to RNN block without nothing pressure. Mann-Whitney test tracked down no tremendous contrasts in disseminations on the RNN pentagon gatherings so we pick RNN pentagon with no tension since it has better outcomes. Shape with zero strain has preferred outcomes over pentagon one as there is importance between them and the 3D shape analyze has the higher middle. The outcomes exhibit that keeping the zero strain data is significant as far as the separation among patients and sound subjects. The accuracy between different confusion matrix was displayed (**Figure. 6**). The different accuracy between Patients and Healthy in fold 6 was displayed (**Figure. 7**).

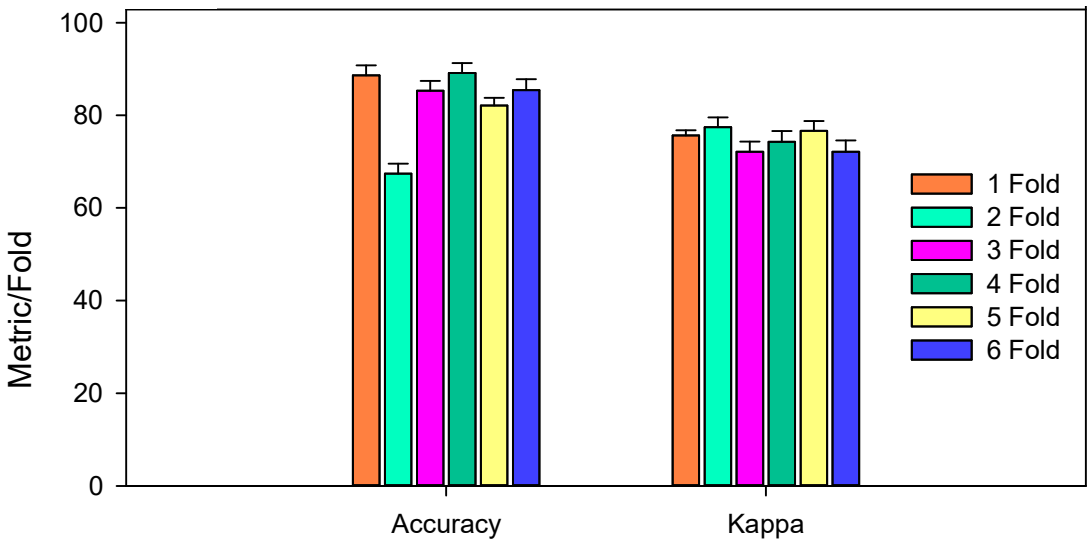

Figure. 6. Graph represents accuracy an Kappa between different confusion matrix.

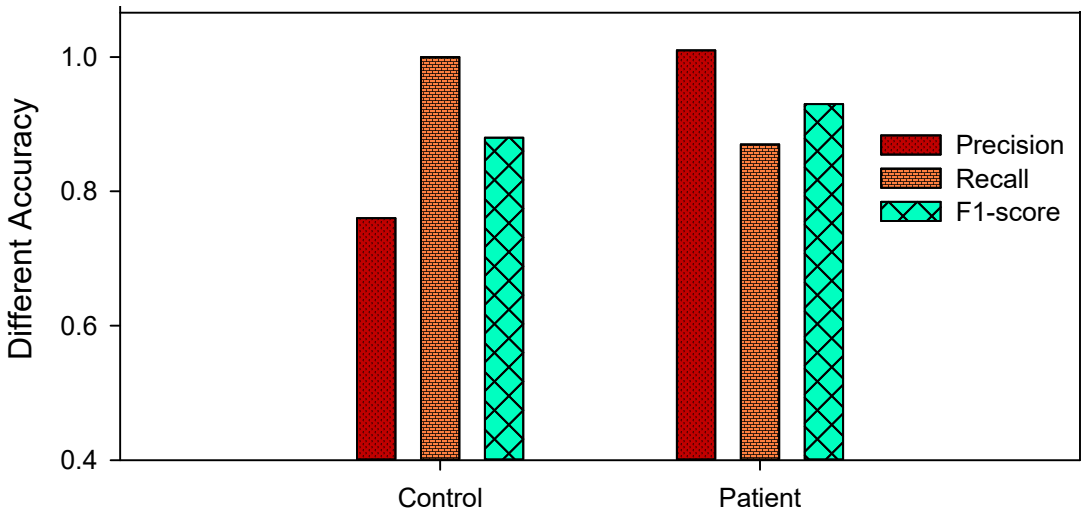

Figure. 7. Different accuracy between Patients and Healthy in fold 6.

CONCLUSION

In this present invention, numerous prescient models were created to separate between sound endlessly individuals with PD. These models were created inside an assortment of trials utilizing two profound learning calculations (RNN and CNN) and two datasets (solid shape and

pentagon). These models present various outcomes and execution. For time series datasets, we examined which dataset accomplished better outcomes and execution involving two distinct investigations for each dataset. For imaging datasets, we did correlations involving 6 unique analyses for each dataset to inspect which one acquired the best outcomes. Arriving at this direct empowered us toward investigate which dataset type is more compelling as a reason for segregation by measurably dissecting the analysis' outcomes dispersion.

CLAIM (S)

1. The Parkinson Disease Detection Using Deep Neural Networks utilizing profound learning, Recursive Neural Networks (RNN) and Convolutional Neural Networks (CNN), to separate among sound and PD patients.
2. According to claim 1,wherein the various datasets may catch various parts of this sickness, this venture intends to investigate which PD test is more viable in the separation cycle by breaking down various imaging and development datasets.
3. According to claim 1,wherein the dataset type, imaging or time series, is more powerful in diagnosing PD. Numerical models like Deep Learning (DL) give a reasonable procedure to identify illness side effects. These displaying approaches incorporate geographies particular for some sort of datasets, for example, imaging datasets and time-series datasets.
4. According to claim 1,wherein the models present various outcomes and execution. For time series datasets, we examined which dataset accomplished better outcomes and execution involving two distinct investigations for each dataset.
5. According to claim 1,wherein the outcomes exhibit that keeping the zero strain data is significant as far as the separation among patients and sound subjects.
6. According to claim 1,wherein the imaging datasets, we did correlations involving 6 unique analyses for each dataset to inspect which one acquired the best outcomes. Arriving at this direct empowered us toward investigate which dataset type is more compelling as a reason for segregation by measurably dissecting the analysis' outcomes dispersion.

ABSTRACT

PARKINSON DISEASE DETECTION USING DEEP NEURAL NETWORKS

Parkinson's Disease (PD) is an ongoing, degenerative issue, which prompts a scope of motorand mental side effects. PD conclusion is a difficult assignment since its side effects are the same as different sicknesses like ordinary maturing and fundamental quake. Much examination has been applied to diagnosing this illness. This venture plans to mechanize the PD conclusion process utilizing profound learning, Recursive Neural Networks (RNN) and Convolutional Neural Networks (CNN), to separate among sound and PD patients. Other than that, since various datasets may catch various parts of this sickness, this venture intends to investigate which PD test is more viable in the separation cycle by breaking down various imaging and development datasets (outstandingly block furthermore, twisting pentagon datasets). Moreover, this venture assesses which dataset type, imaging or time series, is more powerful in diagnosing PD. Numerical models like Deep Learning (DL) give a reasonable procedure to identify illness side effects. These displaying approaches incorporate geographies particular for some sort of datasets, for example, imaging datasets and time-series datasets (for example a dataset contained of a bunch of arrangements, where each succession contains information focuses that are filed in time request). Consequently, it is qualified to examine the profound learning strategies on the PD, particularly after the late progress of profound learning in various fields.

FORM-3
THE PATENTS ACT 1970
(39 of 1970)
&
The Patent Rules, 2003
STATEMENT AND UNDERTAKING UNDER SECTION 8
(See Section 8, rule 12)

NAME OF APPLICANTS& INVENTORS

PARKINSON DISEASE DETECTION USING DEEP NEURAL NETWORKS

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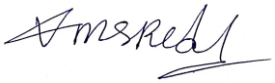
Hereby declare, We have not made any application for the same / substantially the same invention outside India.

NAME	SIGNATURE	DATE
Dr. V.V. SUNIL KUMAR		24/03/2022
Dr. G. VIJAY KUMAR		24/03/2022
Dr. V. MADHUSUDHANA REDDY		24/03/2022

To
The Controller of patents, The Patent office at **CHENNAI**

FORM 5
THE PATENTS ACT, 1970 (39 of 1970)
&
THE PATENTS RULES, 2003
DECLARATION AS TO INVENTORSHIP
(See section 8, rule 12)

1. Name of Applicant & Inventors

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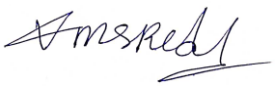
Hereby declare that the true and first inventor of the invention disclosed in the complete specification filed in pursuance of my application numbered _____ dated _____

TITLE OF THE INVENTION: PARKINSON DISEASE DETECTION USING DEEP NEURAL NETWORKS

3.Declaration to be given when the application in India is filed by the Applicant in the convention country: -

I the applicant in the convention country hereby declare that our right to apply for a patent in India is by way or assignment from the true and first inventor.

NAME	SIGNATURE	DATE
Dr. V.V. SUNIL KUMAR		24/03/2022
Dr. G. VIJAY KUMAR		24/03/2022
Dr. V. MADHUSUDHANA REDDY		24/03/2022

To
The Controller of patents, The Patent office at CHENNAI.

FORM 9
THE PATENTS ACT, 1970
(39 of 1970)
&
THE PATENTS RULES, 2003
REQUEST FOR PUBLICATION
(See section 11A(2); rule 24A)

We (state name, address and nationality of Applicant & Inventors)

TITLE OF THE INVENTION:
PARKINSON DISEASE DETECTION USING DEEP NEURAL NETWORKS

Name	Nationality	Address
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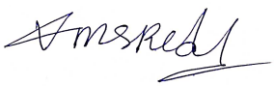
Hereby request for early Publication of our application for Patent No. _____ dated _____ under section 11A(2) of the act.

NAME	SIGNATURE	DATE
Dr. V.V. SUNIL KUMAR		24/03/2022
Dr. G. VIJAY KUMAR		24/03/2022
Dr. V. MADHUSUDHANA REDDY		24/03/2022

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The Controller of patents, The Patent office at CHENNAI.