Brain Tumor Detection and Classification by MRI Using Deep Learning Techniques

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Abstract

A brain tumor is one of the most common problems arising in the medical field all over the world. However, brain tumor recognition was the most complex thing to get determined by physical determination by the doctor. Now the latest technology has evolved to the highest level where the majority of brain tumor detention is done by the deep machine learning technology by the image processing captured via magnetic resonance imaging system. Deep learning technology is developed not only to recognize the problem but also to classify the problem of brain tumors and provide possible solutions for them. The current study is developed to find out the working method for deep learning technology to detect and classify brain tumors using deep learning technology.

Keywords: *Brain tumor detection, deep Learning Technology, Algorithm, MRI, YOLO, CNN.*

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Introduction

Every year almost 190,000 people used got admitted to various hospitals for the problem of different types of tumors in the brain, however, all of them are not related to mortality, there is a huge percentage of people with brain tumors, still living with the brain tumor and the majority of them are not feeling any functional problems in the brain. The problem of brain tumors might occur in anybody of any age or gender or type of body. As the majority of the biological departments have proved that brain tumor doesn't have a relation with mortality, hence the majority of the radiology department has gained prominence in deeply studying brain tumors and their classification with the root cause of the growth of the tumors in the human brain.

The major research about the human brain tumor is been done with the involvement of image processing of the tumors taken by the MRI process, hence the study is developing to a better position without involving any patient. In this process, the key role is to be performed by deep learning technology which is very effective to study the images and provide possible solutions to the problems.

Aims and objectives

The study aims towards the analysis of brain tumor detection and classification with the help of an image processing system taken by the MRI. The deep learning model is going to be implemented to analyze the classification of the tumor in the image along with the possible solution providing the capability of the deep learning method is going to be discussed properly.

The paper's objectives of the study are…

1. To analyze the internal structure of the deep learning technology.
2. To find out the application of deep learning technology for Brain Tumor Detection and Classification with MRI.
3. To find out the challenges faced by users while implementing Deep learning technology in various fields.

Overview of the Deep Learning technology

Deep learning technology is the most important technology developed by advanced modern science and technology regarding the automation of detection of certain patterns in different fields, thus the various internal patterns of different data were determined by different technologies

in earlier times. The process was very complex due to the various upgraded pattern and styles of data interpretation (Jia and Chen 2020). In various fields determination of the pattern is developed to find out the future prediction of the patterns of the data set. For reference, the field like the medical sector has the determination of the brain tumor and the classification of the tumor to find out their exact type. In several types, the majority of the tumors looked the same in the image taken by the MRI, however, deep learning technology has the ability to find out if any non-similarity patterns exist in the image or not.

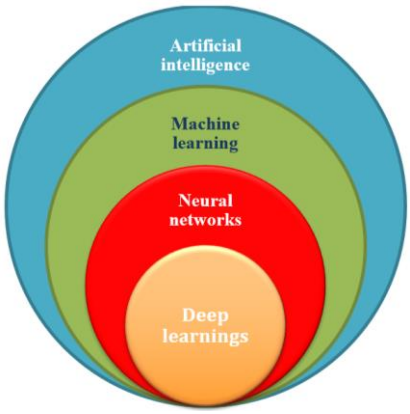

Figure 1: Internal connectivity within learning technologies

(Source: Garg and Garg 2021,p.115)

The majority of the image processing is done by taking the major possible types or details of the images recorded in the algorithm of the technology (Garg and Garg 2021). The planned algorithms are kept one after another to make the technology able to check all the possible outcomes from the image of the tumor (Amin et al.2021). Every possible outcome is entered in the system already at the time of programming so that machine learning can match the possibility of the problem with the sample files and decide which one shows the most percentage of chance of occurring while analyzing the image.

Various applications of the Deep Learning technology

Deep learning technology is a very effective technology developed in the modern generation, where various types of difficult tasks are done within a very short period of time with almost 100% perfect results, hence the demand for deep learning technology is arising to its highest level (Salçin 2019). There are several types of applications that are performed by deep learning technology, like…

- Virtual assistant in various electronic gadgets connected to the Internet is developed with deep learning technology, where the voice nodes are converted to analog or digital format, and then the signals are implemented to perform according to the demand of the voice of the user.
- The majority of the chatbots of different software companies are developed to fulfill all the demands of the user whenever it is ordered by voice command, the chatbots are also pre-programmed with different algorithms, hence the majority of the commands are fulfilled by converting the voice command to the analog or digital format (Nazir et al.2021).

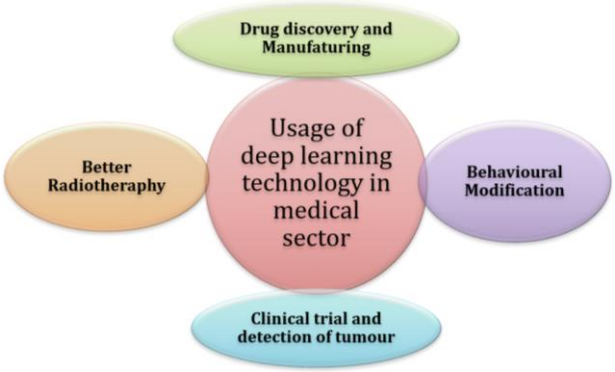

Figure 2: Usage of deep learning technology in the medical sector

(Source: Maqsood et al.2022, p.125)

- In the medical field, the medical image processing system is one of the most important factors of deep learning technology, where different types of images are processed with the preprogrammed possibilities of the problem being captured in the electronic image.
- In the entertainment sector where the majority of the demand of viewers is fulfilled with the voice assistant systems like Google Assistant, Apple Siri, etc (Maqsood et al.2022). This voice-commended technology is also developed with deep learning technology where the possible results are preset as algorithms in the data set and after catching the voice of the user, it follows the command to pay accordingly.

Brain Tumor Detection and Classification with MRI

A brain tumor is a lump of a certain amount of clogged ingredients in the brain, where the possible solution to the problems are predetermination of the tumor using deep learning technology. The tumor and its different forms are shared with the technology to determine the exact type of the tumor so that the technology can identify it with the help of the algorithms and then the possible solution would also be provided to the technology (Bhanothu et al.2020). The challenge with technology is that is not able to find out the newer types of patterns in image processing, as the brain tumor is one of the most complex situations to identify when it is very difficult to find out the newer version of the tumor is formed which is not present in training data in the deep learning technology.

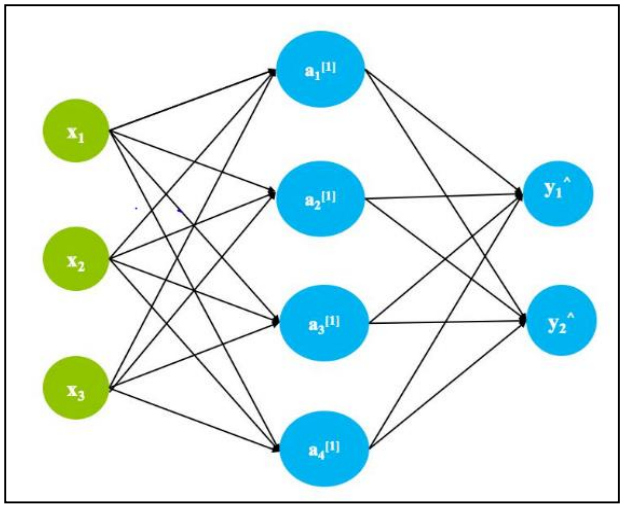

Figure 3: Working of deep learning technology

(Source: Bhanothu et al.2020, p.135)

There are different patterns of images that can be used in the training and testing part according to the shape and position of the brain tumor.

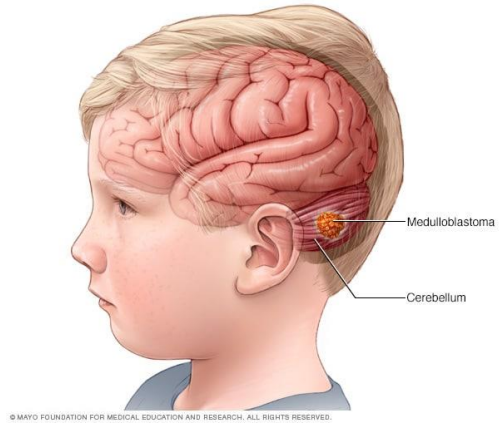

Figure 4. A pattern of brain tumor

(https://www.mayoclinic.org/diseases-conditions/brain-tumor/symptoms-causes/syc-20350084)

Many exceptional varieties of brain tumors exist. Some brain tumors are noncancerous (benign), and a few brain tumors are cancerous (malignant). Brain tumors can start to your brain (number one brain tumor), or most cancers can start in different elements of your body and unfold in your brain as secondary (metastatic) brain tumors.

Different methods of Deep Learning of Brain Tumor

- **Convolutional Neural Network**

The development of a convolutional neural network is a multifaceted feed-forward neural network, made by gathering numerous concealed layers on top of one another in a specific request. The successive plan allow to CNN to learn various leveled credits.

In CNN, some of them are followed by gathering layers and secret layers are ordinarily convolutional layers followed by enactment layers.

The pre-handling required in a ConvNet is fellow to that of the connected example of neurons in the human cerebrum and was roused by the association of the Visual Cortex.

The method followed by the author is shown below with the help of flow diagram.

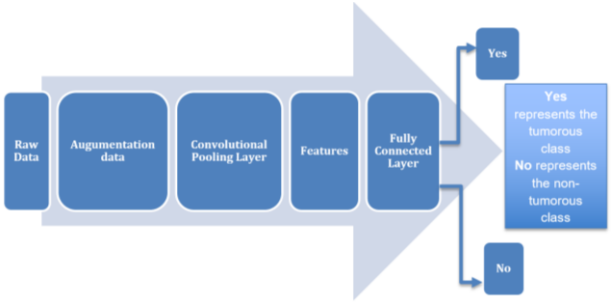

Figure 5. CNN techniques for Brain Tumor.

(D C Febrianto, 2020)

- **fastai**

fastai is a deep learning library that furnishes professionals with significant level parts that can rapidly and effectively give cutting-edge brings about standard deep learning spaces, and gives scientists low-level parts that can be blended and matched to fabricate new methodologies. It plans to do the two things without significant trade-offs in convenience, adaptability, or execution. This is potential because of a painstakingly layered design, which communicates normally hidden examples of profound learning and information handling methods with regard to decoupled deliberations. These reflections can be communicated succinctly and obviously by utilizing the dynamism of the basic Python language and the adaptability of the PyTorch library.

- **YOLO**

YOLO, is another way to deal with object detection. Earlier work on object discovery reuses classifiers to perform location. All things considered, basic objective was object discovery as a relapse issue to spatially isolated jumping boxes and related class probabilities. A neural network predicts jumping boxes and class probabilities straightforwardly from full pictures in a single assessment. Since the entire identification pipeline is a single network, it very well may be upgraded start to finish straightforwardly on recognition execution.

Datasets on Brain tumor

A more modest form of the organization, Quick Consequences be damned, processes a surprising 155 edges each second while as yet accomplishing twofold the Guide of other constant indicators. Contrasted with cutting-edge location frameworks, Consequences be damned makes more restriction blunders yet is undeniably less inclined to foresee bogus identifications where nothing exists.

- **Kaggle Dataset**

It provides 3000 images of with and without brain tumor images, i.e. 1500 Brain MRI Images that are tumorous used for training and 1500 Brain MRI Images that are tumorous used for testing.

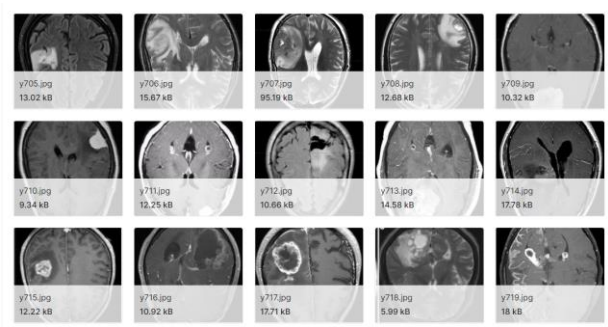

Figure 6. Images with tumor

(https://www.kaggle.com/datasets/ahmedhamada0/brain-tumor-detection)

- **Figshare**

figshare brain tumor dataset has 3064 contrast-enhanced images with three kinds of brain tumors.

The current study is developed by collecting data from different sources like different journals, written publications, books, newspapers, and many more published materials. Thus, the data collection is developed with the secondary data collection method (Rehman et al.2021). However the collection of that was rapid and the entire amount of data was not used in the study, instead, the majority of the data was filtered through the process of the inclusion and exclusion method. The filtration method is used to sort out the current data which is not outdated or the written language other than English or the paper which is not readable, few amounts of data are missing or many data are not present due to other problems that make those data to get excluded from the study.

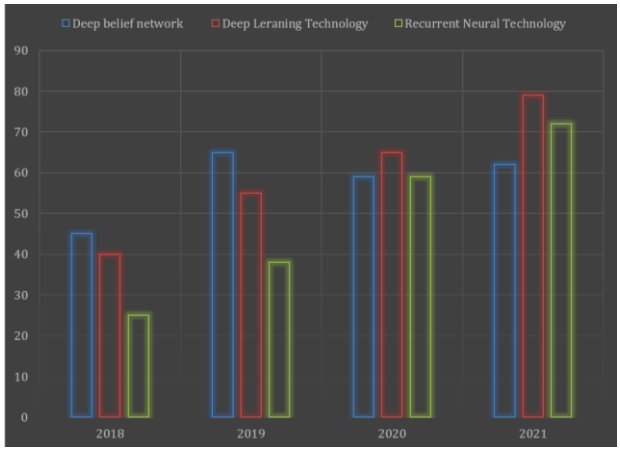

Figure 7: Various use of data per year with different learning technology

(Source: Anil et al.2019, p.135)

After collecting data and sorting them out according to the demand of the study, the data is then studied, and then they are analyzed properly. The analysis of this is done with the process of qualitative data analysis, where the majority of the data is extracted with the best quality and relevant datasets about the fulfillment of the objectives of the study (Anil et al.2019). The data that is used in the study is prominent and taken from fair sources. Qualitative data analysis also has the ability to refresh the old data with the meaning with new factors or the analysis of some abilities of the same topic from a different perspective related to the development of the topic.

	Genomic	Medial and Bio imaging	Biomedical	Fault diagnosis
2018	25	35	45	55
2019	39	49	52	65
2020	48	59	59	69
2021	69	75	68	78

Table 1: Various use of data per year with deep learning technology in the medical sector

(Source: Rehman et al.2021, p.215)

Conclusion

After going through the study it is found that the majority of the deep learning technology is very effective to find out the various problem or the suits of the brain tumor in the human brain. The process is completed by analyzing the images taken by the MRI Scanning. The MRI-scanned image is very effective to find out the various details related to the tumor affecting the human brain. The different algorithms developed in deep learning technology are well-equipped to find out every possible outcome from the images available from the MRI scanning. The current study has developed all algorithms and their effectiveness in deep learning methods to find out their working method to identify the details in the tumors. The study has provided different diagrams or other statistical data related to the deep learning method, which is very effective to find out the exact working method. The ability to classify the types of tumors is also described in various details in it.

Future scope

The current study might be very helpful in the near future for the people who are working to develop deep learning technology for the future development of deep learning usage in the medical sector. The study has provided different important information regarding the deep learning method and its ability to identify the tumors in the brain, then the ability to classify the tumor according to the biological classification. Hence the technological expert might be helped a lot with the existing data about the deep learning method ad nit algorithms to classify the tumors might help them to develop more advanced technology regarding doing the same job. The medical field people might be helpful to understand the possibilities or the accuracy ratio of the working method of the technology to treat patients; hence they would be able to convince the patients to get treated in this way to get better results.

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