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Analysis of brain tumour MRI with stress level using frequency analysis

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***Abstract*---**The Computing science applied to determine the solutions for medical, science and business domain. The Data mining techniques used to identify the features and applied to solve the challenging issues in the domains. This work attempted to fetch the draw brain MRI and converted to computable format. The converted images are used form the frequent wave and classified based on the mode. The relationship between the stress level and affected brain neuron activeness relationship identified and presented as part of the paper . The result shows that the highly affected neurons stress levels are high.

***Keywords*---**frequency analysis, data mining, MRI, neuron activeness.

Introduction

Data mining is a strong method with tremendous potential to support scientific process and businesses to identify critical information hidden within huge databases. Data mining technologies can assist companies to make proactive knowledge-driven decisions by anticipating future trends and behaviours. This work aimed to study the relationship between stressed/relaxed neurons in the tumor-affecting brain MRI and stress level in the tumor. The study analysis the stress level and tumour affected brain MRI. Ch.Venkateswarlu and Abid Hussain[1] defined Data Mining as the mathematical core of the Knowledge Discovery in Database (KDD) process, which includes three key elements: (1) the use of algorithms to find patterns within the data, (2) the application of mathematical models to discovered patterns, and (3) the discovery of knowledge from the patterns and mathematical models. Multitudes of imaging modalities exist, ranging from the more common radiology, nuclear medicine, and optical

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imaging to image-guided intervention[2][3].In W. Frawley et. al. [4], untrivial extraction of implicit, previously unknown and perhaps significant information from data is referred to as the KDD. It may be used to find new information from current datasets. It might be continuous, distinct classifications or quantity. Ordinal or nominal data can be classified as categorical.

Tasks requiring data mining results are handled differently from those that don't. An exploratory analysis assists in the identification and selection of data. Modelling with descriptive distributions describes how variables relate to one another [5]. The use of a predictive model for establishing consent for the value of one variable assumes the assumed values of existing variables. The pattern discovery challenge employed clustering or classification algorithms to uncover hidden patterns. Relevance search (using the content of the supplied dataset) locates the comparable items' pattern of interest.

Medical picture suggestive analysis of knowledge from a big dataset is accomplished using data mining approaches. Data mining is used for finding connections, classifying patterns, and displaying data from many application domains. The DM part of knowledge discovery in databases is named “Knowledge Discovery in Databases”. DM models including as educational, environmental, web, image, medical, and social mining are accessible in the literature [6]. In this work, The data mining techniques used to analysis the frequent item set and aimed to determine the relationship with brain tumour and stress level.

Data source

The MRI brain images are collected from SVDC-Lab Chennai, India. The SVDC Lab medical professionals mark the MRI human brain pictures as normal or abnormalities by using SVDC Lab's data sets. A total of 60 patient samples are retrieved in the NRRD file format for analysis. It is transformed into a succession of pictures, with each image being made up of a range of frames from 122 to 148. MRI is one of the many well-known three-dimensional views of the brain and the accurate spatial connections between brain regions. Although the image resolution is low, the photos nevertheless look clear. On the other hand, there are typically spatial distortions associated with the staining process when stained sections are used. For this assignment, researcher obtained the nrrd file from a medical research facility. N-dimensional raster data visualisation and image processing involving N-dimensional raster data is supported by the nrrd library and file format. The NRRD stands for nearly raw raster data. The ROI is a section of a picture that has a great deal of significance to the issue at hand. The photos might be filtered to obtain an extract, or the images could be operated on in some other way. As a frequency value is applied to every pixel of every slice, a Discrete Wave Transformation (DWT) is used to identify changes and stress levels. Each slice contains dense pixels that are used to pinpoint the afflicted tumor region.

Active neuron determination

Converting the raster data file into a sequence of frames that contains the same number of two-dimensional data yields the result fetched almost raw. The digital value variations of each pixel sequence are utilised to create a wavelet function and to calculate its variations. Neurons must be in continuous varying mode if the variation in the signal is zero, and therefore the neuron is inactive else it is active. The initial and ending frame's high-frequency fluctuation is calculated. Changes in brain frequency are able to anticipate changes in brain activity and stress.

Brain MRI

The MRI is a Magnetic Resonance Imaging (MRI) scanner. It generates strong magnetic rays using powerful magnetic fields and radio frequency pulses, and they pass into the body to analyse the internal organs, soft tissues, bones, and internal structure. Nuclear Magnetic Resonance Imaging (NMRI) is employed to examine the structure and functionality of the body, along with that of the interior organs. Cancer, tumor, musculoskeletal, and cardiovascular imaging are all employed in using this new technology. Hydrogen molecules are dispersed throughout the human body, and an effective magnetic field is used to orientate the nuclear magnetization of hydrogen atoms in water. Using different magnetic fields, it might build up enough information for signal manipulation. Imaging is used during MR to assess the conditions of organs like the abdomen, chest, liver, kidney, pancreas, heart, spleen, biliary tract, blood vessels, breasts, and pelvic organs. Additionally, it can be used to assess testicles and the prostate for males, and the uterus, fallopian tubes, ovaries, and other female reproductive organs for females (ovaries, uterus and cervix). Doctors use MRI scans to help diagnose and monitor the progress of illnesses including pelvic tumors, abdominal mass, and blocked blood vessels, including renal arteries, aorta, and arteries in the legs. Consequently, this may assist diagnose problems such as brain tumors, stroke, infections, developmental abnormalities, hydrocephalus, etc. Many chronic illnesses, such as multiple sclerosis, eye and ear disorders, pituitary gland disorders, vascular issues, and aneurysms, have the potential to worsen and develop into something more serious, such as a more widespread disease, brain lesions, or the aforementioned complications (a blood clot within a vein)[7]. Research included looking up fundamental information about brain atlas, functions, and anatomical components to better understand the brain tumor. For information on the structure of the brain, see the Brain Atlas in Figure 1.

The frontal lobe

The frontal lobe, positioned below the forehead, carries out a large part of the cognitive process, such as planning, visualising, deciding, and reasoning.

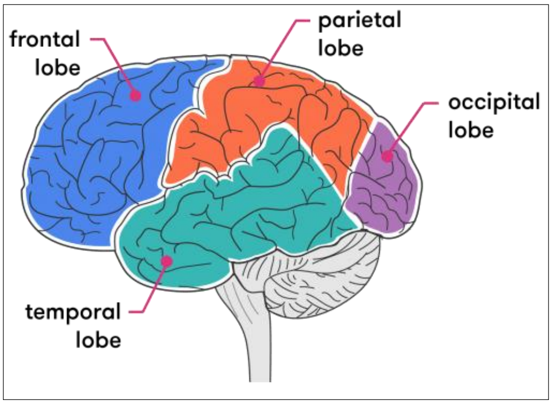


Figure 1. Parts of Human Brain Lobe

The parietal lobe

The parietal lobe is behind the frontal lobe and is responsible for signals pertaining totouch,taste, and temperature.

Occipital Lobe

The occipital lobe handles visual information from the eyes, including light.

The Cerebellum

Cerebellum assists in the coordination and fine-tuning of movement and balance.

Brain tumor types

Brain tumor types include the following: This system not only includes the tumor categorization and fundamental comparison, but it also makes this information accessible for readers. Brain tumors come in many forms. Some tumors have the capability to spread to distant areas of the body, whereas others do not. Tumors are classified according to location, kind of cells, and growth rate.

- Low-Grade vs. High-Grade: In most cases, low-grade tumors develop more slowly than high-grade tumors, and they are either non-cancerous or malignant. High-grade cancers are more likely to metastasis (spread to other regions of the body) following therapy, and this may lead to the tumor coming back in future treatments. In general, higher-grade tumors are linked to a worse prognosis.
- Localized vs. Invasive: An invasive tumor is present across the entire brain, and it is typically far more difficult to remove since it is in the hard-to-reach areas. The more extensive the spread of an invasive tumor, the more difficult or impossible it is to remove the entire tumor.
- Primary vs. Secondary: Cancer of the primary brain originates in the brain. Metastatic secondary brain tumors are composed of cells that have spread from another location in the body to the brain. Tumors that originate in the

brain in children are usually primary. The talk proceeds to show how the MRI data set may be understood.

MRI processing techniques

In MRI, the picture is obtained by the transverse magnetization of the hydrogen nuclei local to the subject. During an MRI scan, protons and neutrons unite to create a nucleus while they are spinning in opposing directions. Spins are inherent in the composition of protons and neutrons as a nucleus, and they contain an intrinsic angular momentum. When there are an even number of protons and neutrons in a nucleus, the overall spin will be zero. It exhibits a net spin with the odd number of protons and nuclei. Due to the proton concentration, the positive charge is the only thing that can conduct, and therefore a current-carrying loop is aligned parallel to the rotation axis and generates a magnetic field. An angular moment joint effect is produced by the self-generated magnetic field, which gives the proton magnetic dipole in parallel to the rotation axis. The MRI supports extensive usage of machine learning techniques, by recording all of the relevant data in a highly efficient manner. Complex operations require complex solutions, which aid in the investigation of problems [8].

To excite hydrogen nuclei in human tissue, MRI scanners employ strong magnets to which are applied a little amount of static electricity to activate the molecules. When this happens, the water molecules in the tissue begin to create electrical signals which are then read and transformed into pictures. MRI generally employs magnetic fields for three different things. A strong static magnetic field was also known as static field in order to increase the energy of the hydrogen nuclei. For spatial encoding, the gradient field requires less time, and is hence referred to as a gradient field. Radiologist perception, image processing, and several phases of reporting are all part of the MR pictures. Magnetic resonance imaging (MRI) is the critical imaging modality for identifying cancerous tumors. Several aspects of the brain, such as location of hypothesised form, size, area, and the presence of white and grey matter, may be determined using the MRI imaging technology.

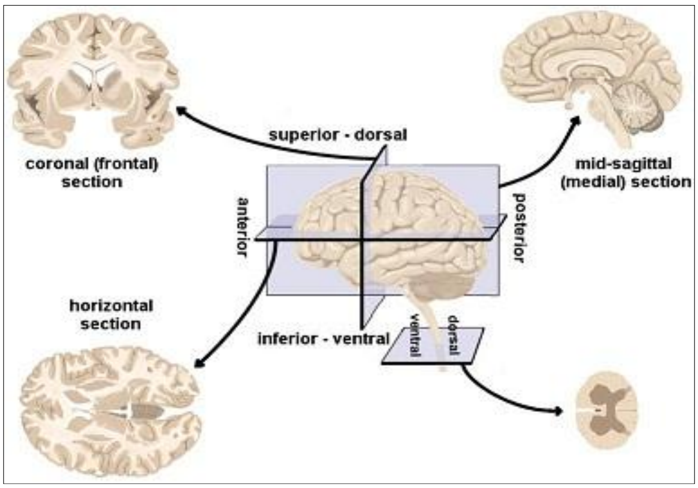


Figure 2. Different Planes of MRI Brain Image.

With the help of the MRI, the bone abnormalities may also be identified. As seen in Figure 2. The scanner had multiple three-dimensional images available at the time of scanning with distinct planes from different orientations for the in-depth explanation. An axial plane, which subdivides the image and delivers information, is used as the primary axis. Also, in the order of the coronal plane, the information is displayed. The various planes depict the brain MRI picture, as illustrated in Figure 2, on the left and right sides of the brain anatomy. Table 1 lists the typical sequences of MRI brain imaging.

Table 1
Different Types of MRI Images

MRI Imaging Types	Description
FLAIR	• Used for lesion detection particularly in white matter. • Standard sequences. • Applied in axial or coronal imaging plane. • In the posterior fossa it's less sensitive.
SWI	• Detection of intracranial calcifications. • Combines magnitude and phase information and forms a sequence. • Used in detecting micro bleeds.
PD/T2	• Uses proton density. • More sensitive in the posterior fossa lesion detection. • Uses first echo concept. • Alternative to FLAIR.
FLAIR+Gd	• Detection of leptomeingeald diseases.
T2-W1	• Detection of micro bleeds. • Staple sequence for T2 lesions • Uses second echo concept
SPGR	• Differentiate gray and white matter. • Isotropic 3D T1-W sequences are used. • Detect migration disorders.
T1±Gd	• Uses all the three image planes. • To highlight contrast in the images it uses gadolinium-chelate injection.

MRI scans of the brain are able to identify anomalies in grey and white matter, which are visible on the scan. White is the colour of myelinated axons in the neuronal tissue. Grey matter nuclei cause the tissues in the brain to be grey. Grey matter is composed of brain cells. Brains may be segmented in many ways, with varied applications, for more in-depth study. Some of the main health problems, including Aneurysm, Stroke, and Vestibular Schwannoma, are diagnosed using the MRI imaging of the brain.

Aneurysm

MRIIA is a sensitive test for finding aneurysms, and it does not involve injection of gadolinium-chelate. It captures the image using the property of blood cell motion.

Identified on the basis of pictures, the blood clot in the brain may be seen with the naked eye [9].

Stroke

MRI can reveal the difference between acute and chronic strokes. Diffusion-Weighted Imaging (DWI) uses contrasted pictures to distinguish different water movements in the muscular tissue. recognise the signs of this condition and quickly identify a hyperacute stroke Tumor demyelination differentiation is also helpful.

Tumor

The abnormal development of the tissue in human organs is referred to as a tumor. The uncontrolled growth of tissues with an abundance of aberrant cells is known as hyperplasia. For locating a tumor, the patient must undertake numerous tests as well as be concerned with the most sensitive part of the body. The MRI, which is utilised to find the tumor, is employed. Malignant and benign tumors can all originate in the brain. Also known as "metastatic" or "secondarily-produced" or "tumor that arises from within the cell and conquers the membranes, nerves, and glands," the primary brain tumor is commonly termed metastatic. Cancerous brain tumors cause brain cells to be directly attacked and harmed. destroyed cell causes a rise in inflammation, stress, and skull injury. When tumors may spread to the human body, these forms of tumor exist.

Construction of cubical database from MRI

MRI (Magnetic Resonance Imaging) is one of the popular and well-known methods for the three-dimensional observation of the brain and structures. It is quite limiting when it comes to image resolution. In stained sections, the resolution is good, but spatial aberrations are inherent in the staining process. Fetching data from the slicer's 3D download data base, the nrrd file is read. The N-dimensional raster data supported by nrrd is utilised in scientific visualisation and image processing. The neural network route analysis was done by Modha, et. al., who studied the MRI three-dimensional coordinated image to find out how far and how quickly the neuron was moving.[10] [11] The procedure to improve the speed of the neuron process utilises a similar method. MRI scans process the pictures, which are obtained, using Matlab, and convert them to two-dimensional images and values shown in figure 3.

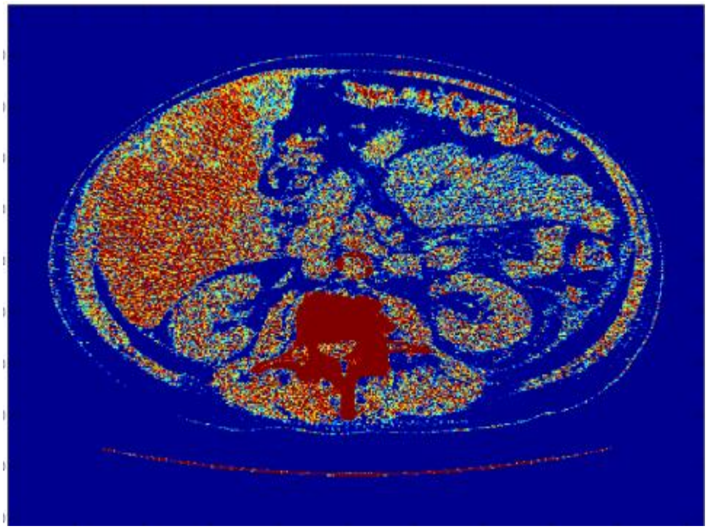


Figure 3. Converted MRI

An MRI-converted nrrd image was obtained from the SVDC lab and uploaded here. It was necessary to transform the data set from the nrrd format to the cubical data format, which was accomplished using Matlab. The cubical data set was transformed into a 256x256x120 representation, which was then shown. Each layer is presented in a two-dimensional manner for ease of viewing. When the three-dimensional axis points of the data are fetched, it is calculated how much the data has changed between each of the 120 pixels, and a graph is formed.

Frequency analysis

All pictures have the same location in this multidimensional array created with Digital Numbers. They each have their own individual values, yet they serve as correlatives for the different levels of neuron density. As each pixel value represents the change in the density of the neuron activations, the neuron densities are represented by the pixel values. Wavelet decomposition is accomplished via a continuous wavelet transform. It is possible to create a time and frequency representation of a signal that gives great time and frequency localisation with the use of the continuous wavelet transform. Completed in the area of numerical analysis and functional analysis. Alfred Haar[12] first suggested this sequence in 1909. To show that an orthonormal system may be given for the space of square integrable functions on the real line, Haar utilised these functions. It is also the simplest conceivable wavelet, known as the Haar wavelet. The data that has been translated can then be sorted at a resolution that corresponds to its scale. Because of the differences in digital values, it is possible to distinguish between little and significant characteristics.

Frame construction

The selected source .nnrd format file contains the following properties.
File name : RegLib_C01_MRMeningioma_1.nrrd

Dimension : 3
Encoding : raw
Sizes : 256 x 256 x 112
Type : uchar

Histograms, joint histograms, and scatterplots are all raster data, just like images, so NRRD can represents them as well. The histogram of the RegLib_C01_MRMeningioma_1. nrrd dataset, for instance, is a 1-D nrrd.

unu histo -i RegLib_C01_MRMeningioma_1. nrrd -b 256 | unu save -f nrrd -e ascii -o RegLib_C01_MRMeningioma_1. nrrd
content: histo(RegLib_C01_MRMeningioma_1.nrrd,256)

type	: unsigned int
dimension	: 1
sizes	: 256
axis mins	: 0
axis maxs	: 255
centers	: cell
labels	: "histo(RegLib_C01_MRMeningioma_1.nrrd,256)"
encoding	: ascii

The selected RegLib_C01_MRMeningioma_1.nrrd file applied with following procedure and converted as a three-dimensional data set.

Procedure for conversion

```
assert(isfield(meta, 'sizes') && ...
isfield(meta, 'dimension') && ...
isfield(meta, 'encoding') && ...
isfield(meta, 'endian'), ...
'Missing required metadata fields.')
dims = sscanf(meta.sizes, '%d');
ndims = sscanf(meta.dimension, '%d');
assert(numel(dims) == ndims);
data = readData(fid, meta, datatype);
data = adjustEndian(data, meta);
% Reshape and get into MATLAB's order.
X = reshape(data, dims');
X = permute(X, [2 1 3]);
```

Conversion images into frames and DNs

The converted frames are used to extract the digital values of each pixel and constructed a macro array as described in the methodology. The above frames are extracted for gray scale image similarly the RGB images also extracted based on the .nrrd file attribute and its structure. Its converted and presented in figure 4. The selected source. nrrd format file contains the following properties.

File name : brain_1. nrrd
Dimension : 3
Encoding : raw

2808

Sizes : 304 x 493x 139
Type : uchar

The Converted sequence of RGB frames for 1 to 56 is.

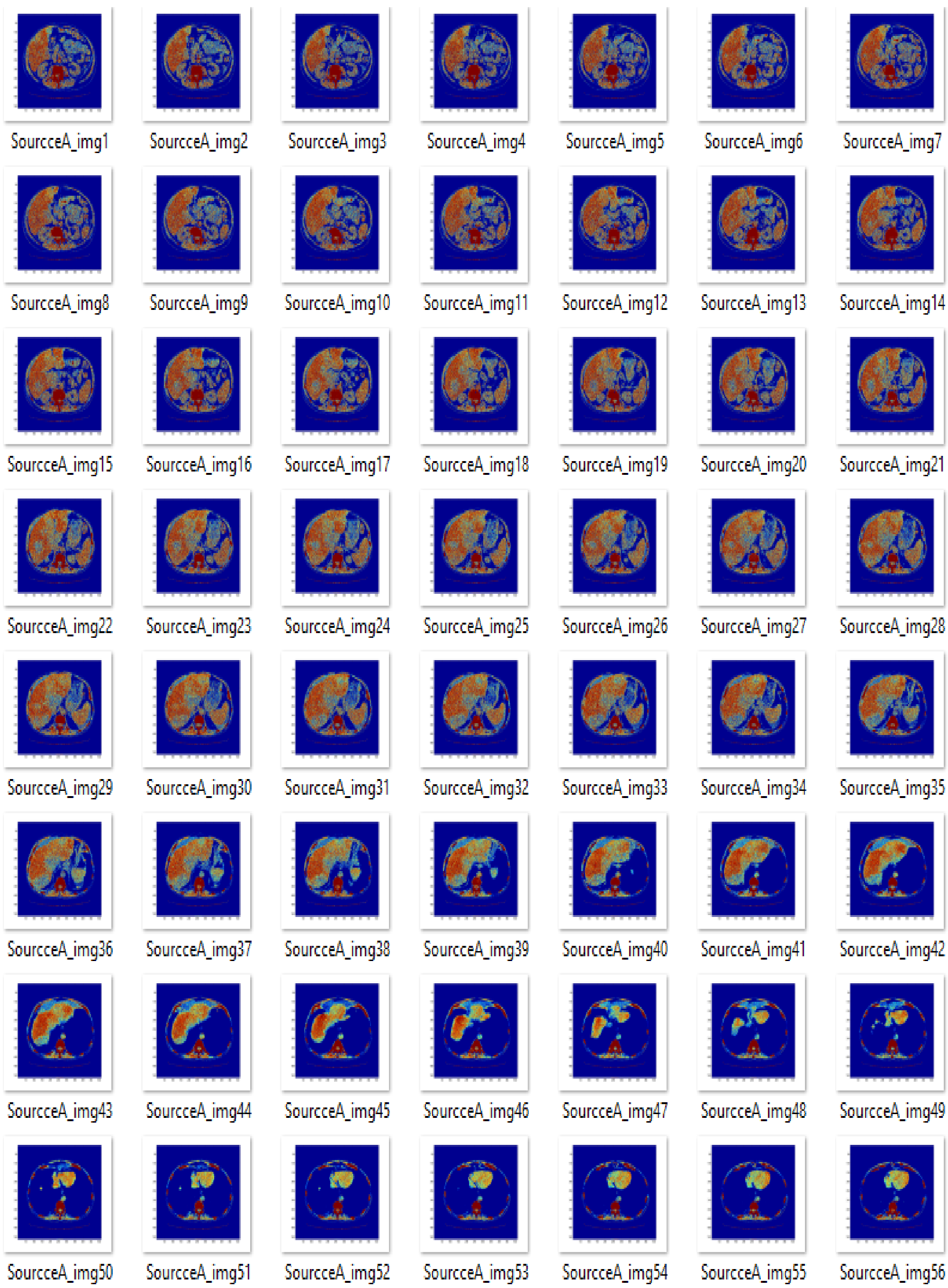


Figure 4. Converted Source Image

The converted image frames are selected one after another to process further to construct a multi-dimensional array. The selected frame image from RegLib_C01_MRMeningiom file presented below in figure 5.

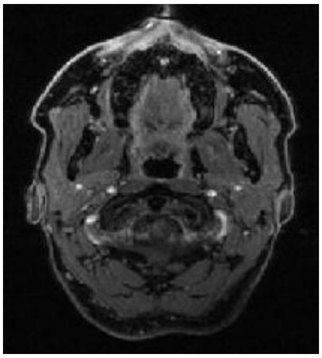


Figure 5. Selected frame for Macro Construction

Generation of frequency wave using DWT from DN values

As per the observation on the converted digital values, it represents the values as per the density of the pixels. The values 0 represent the low level of the density and the value 255 presents the high-level density. The Digital values are presented variation of the neuron process and frequency wave formation processed further. The frames1 consist of 256 rows and 256 columns pixels and the first file has 112 frames. The focal point values selected and constructed as a single dimensional array. Focal point values for 1,1 of sequence frames values are presented in the table 2.

Table 2
Converted DN Values

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	2
Ns	10	10	13	11	13	10	15	18	14	10	11	7	9	12	8	8	9	12	14	1
No	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	4
Ns	16	14	27	15	25	28	11	20	28	12	13	26	12	7	15	9	9	11	14	1
No	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	6
Ns	8	13	11	8	10	9	8	11	10	8	13	11	11	14	6	11	9	6	9	1
No	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	8
Ns	8	6	10	7	9	8	7	10	7	10	11	7	6	8	10	8	7	7	13	9
No	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	1
Ns	12	13	12	11	8	7	6	8	6	11	11	6	8	10	8	9	7	7	8	7
No	101	102	103	104	105	106	107	108	109	110	111	112								
Ns	10	11	7	9	8	8	7	12	9	8	12	11								

The focal point for 50,50 have a non – zero DN values .It shows that the neurons are active . The non-zero elements are used to form the frequency waves and presented in the below figure 6.

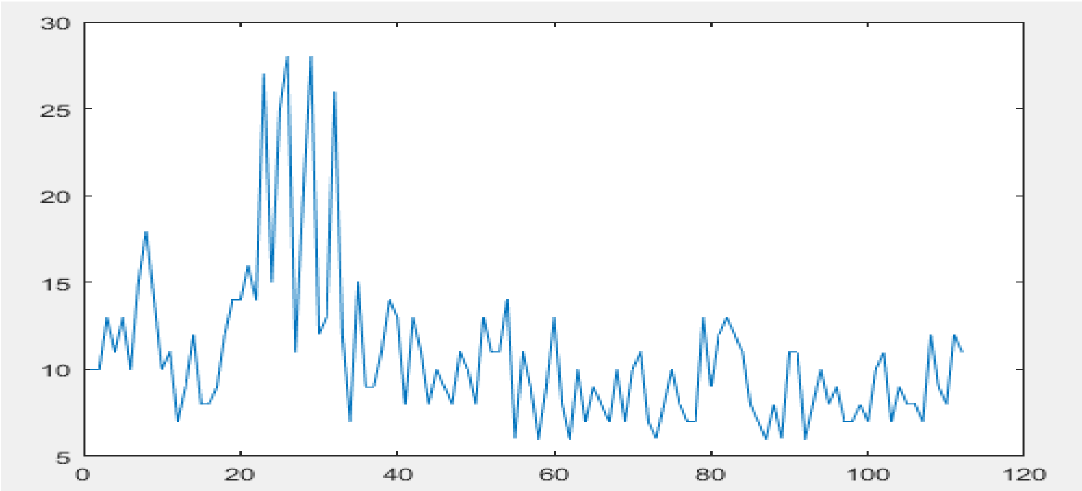


Figure 6. Frequency wave for the focal point 50,50

The frequency chart illustrates the fluctuation in the neuron's activity over the duration of the observation. Neuron activity is separate from other activity patterns and unique from other neurons. To determine the changes and relationship of the entire neuron, the frequency lines are created for all of the focus points. The result of the experiment demonstrates that neuron activity is zero for all values of the specific focused point we're considering. This point we're calling non-active is labelled as such. The apexes, according to the variation of the neuron, are to look for the variances.

Neuron activeness and stress level computation

The stress level of the brain and the activation of the neurons is in direct proportion, which means the total count and its maximum value must be justified, as well as the stress level. In Active, Normal, Low stress, Stress, and High stress are categories used to classify stress levels. If the overall frequency of a particular insight is zero, then the neuron stress level of that neuron is also zero. Between 0 and 13, the overall frequency impression is zero to 13. The stress level is Low when the total frequency intuitions are between 13 and 17. Stress can occur when the overall frequency intuition (above 17, below 25) is above 17 or below 25. The stress level is high if the amount of stress reaches 25 percent. For a better understanding of how the below technique was created and implemented, keep in mind the whole process.

Procedure to compute activeness andstress.
fcount refers the frequency intuition

```
if (neuron sum == 0)
            stat_summary_inactive = stat_summary_inactive+1;
           ss(cc,5)=  "In Active" ;
           ss(cc,6)=  "Not Active " ;
            ss(cc,4)= fcount;
       elseif (fcount>=0) && (fcount< size(data_in,3)/ 8)
```

```
        ss(cc,6)=  "normal" ;
        ss(cc,5)= "Low Frequency";
        ss(cc,4)= fcount;
    elseif (fcount> size(data_in,3)/ 8) && (fcount< size(data_in,3)/ 6)
        ss(cc,6)=  "Low Stress" ;
        ss(cc,5)= "Low Frequency";
        ss(cc,4)= fcount;
        stat_summary_LF = stat_summary_LF+1;
     elseif (fcount> size(data_in,3)/ 6) && (fcount< size(data_in,3)/ 4)
        ss(cc,6)=  "  Stress";
        ss(cc,5)=  "High Frequency";
         stat_summary_HF = stat_summary_HF+1;
        ss(cc,4)= fcount;
    else
        ss(cc,6)=  " High Stress";
        ss(cc,5)=  "High Frequency";
         stat_summary_HF = stat_summary_HF+1;
        ss(cc,4)= fcount;
    end
```

The above procedure executed all the pixel focal points, and its sample results are tabulated in table 3.

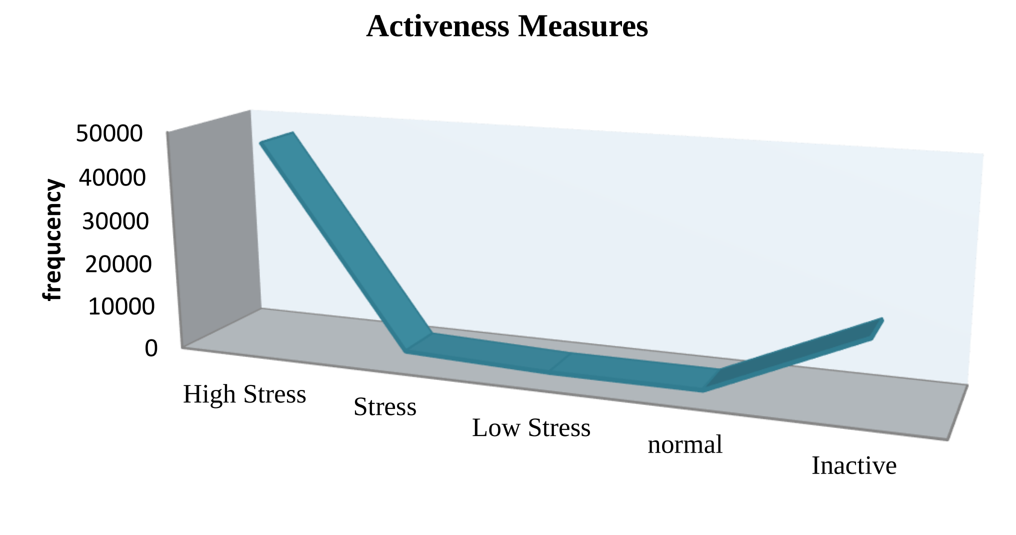
Stress Analysis

In light of the investigation, table 3, summarises the computed pixel's DWT waves and related stress levels.

Table 3
Neuron Measures

Frequency Measures			Activeness Measures		
Frequency	Count	Percentage	Active Stress Level	Count	Percentage
High Frequency	48605	74.17	High Stress	46955	71.65
			Stress	1650	2.52
Low Frequency	1164	1.78	Low Stress	577	0.88
			normal	587	0.90
Not Active	15767	24.06	Inactive	15767	24.06
Total	65536			65536	

As per the observation and the analysis of captured brain image has 74.17 % of High Frequency and 1.78 % of low frequency. The remaining 24.06 % neurons are inactive. The high frequency neurons are generated 71.65 % of high stress level activation and 2.52 % of stress level. At the Low frequency, it is found that 0.88 % on the low stress level and 0.9 % is normal. The variation is presented as curve below figure 7.



	High Stress	Stress	Low Stress	normal	Inactive
Activeness Measures	46955	1650	577	587	15767

Figure 7. Stress level curve

As per the analysis of the fetched neuron activation and the computed stress level, the values show that 46,955 active neurons are at the high level of stress and 1650 neurons are stress level. Out of 1164 low frequency neurons, 577 neurons are at low stress level and 587 neurons are normal level. The In active 15,767 neurons are not in active therefore it does not create any influence of the stress level. As per observation, the high stress level is high therefore the patient is having high stress level. The above stress level is identified from the malignant patient.

Conclusion

The paper identified the stress level from the neuron analysis of the brain tumor image. The .nrrd format cubical image fetched and converted into process able dataset. The discrete digital valued of each neuron formed the frequency wallet and its features are classified into inactive, high frequency and low frequency. The relationship between the frequency and the stress levels are identified. As a result, the high frequency reflects the highly affected images. This process will be validated with huge data set with high level accuracy.

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