

Semi-Automatic Framework for Estimating Intelligence Quotient (IQ) Using MRI

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Abstract- Central Nervous System is the huge database of information, called a well-organized intellectual library. Information storage, retrieval and transfer in neurons is enormously fast and feels like wide and advanced network placed inside our skull. From literature survey we conclude that only some regions of the brain is specifically contributing to intelligence. The central regions are identified and measured in various dimensions for statistical analysis. For analyzing IQ score a popular imaging called MRI(Magnetic Resonance Imaging)is used. The positively associated regions related to intelligence are total brain volume, GM/WM and cortical analysis. This analysis mainly focused in consolidating all the brain variables that are correlated with intelligence. Identifying and measuring only the few particular variables cannot determine intelligence, this motivated us in considering all the variables at once. Brain Morphometric features are measured manually or automatic using volumetric analysis of core regions and sub regions. The some of the morphometric analysis are volumetric analysis and quantification of size and shape of the brain's variables. Here in this proposed framework we used subject's MRI in estimating human's intelligence using MeVisLab and Brainsuite19b. We also presented various graphical network framework using itk and vtk packages of MeVisLab. Our results consolidated the vital regions and considered its overall volumetric measures in improving the intelligence accuracy.Future advancement of this analysis is to define particularly that which region is specifically associated with what intelligence types. To check whether the individual will excel in particular field the corresponding associated region and its measurements will be useful in predicting the intelligence level and also stating whether this subject can be suitable or not for the particular field of interest.

Keywords- Magnetic Resonance Imaging , Intelligence Quotient , Brain Volume, Grey matter and White Matter, Cortical measures

1. INTRODUCTION

Neuroimaging is the imaging of the human central nervous system. It uses multiple techniques and

methodologies either directly or indirectly to build structure and functions of brain anatomy. Neuroimaging studies help us to find various brain related normal and abnormal activities such as disease prediction, region failure, intelligence prediction and various other vital functionalities. This studies help to identify brain structural abnormalities and safeguard future generation from various diseases. Basically all human behaviors directed by brain anatomical structure, whereas this is proven in neuroimaging studies as depending upon the anatomical structure of the brain the every individual's human actions and behaviors differs , this how we able to categorize the people capabilities. Intelligence is one of the primary parameter behind all abilities. This parameter differs in every individual and the measuring of this motivate us to categorize higher or lesser intelligence in individual. It also proven that many central regions in neuro system highly contribute to intelligence. The one identified measure of intelligence level is Intelligence Quotient(IQ).

Brain's intelligence growth starts from childhood and keep increasing till adolescence, after certain age the structural variations remain unchanged. Many positive correlations between anatomical brain structure and intelligence is proven with subject's MRI. Brain morphology and its measures contribute to Cognitive abilities, verbal , non-verbal reasoning and logical thinking of human capabilities. Millions of Neurons are responsible for information transfer and storage, By measuring the Total brain volume the overall neurons in the entire brain is estimated.

IQ level can be predicted by studying the various central regions of the brain and measuring its density. To know the brain imaging structure and its functionalities (Magnetic Resonance Imaging), MRI is used mostly in neuroimaging systems. It shows the detailed anatomical brain structure. Some of the multiple regions identified to show positive correlation with intelligence. This proposed study initiated to identify all the influential region related to intelligence and the various methods followed to measure its proportion or density. To acquire knowledge and greater accuracy in calculating individual's IQ level, the both physical assessment and brain structural study plays essential role. The various parts of brain contributes to different cognitive abilities such as logical reasoning, verbal fluency, abstract thinking , complex problem solving skill.

2. LITERATURE SURVEY

Cortical measurements and brain volume are the parameter reveals the amount and density of neurons in the structures. Cortical thickness computation is efficiently compared between surface based and two voxel based methods on free surfer, Laplacian and registration based methods by [Mathew J. Clarkson](#). The results of this states that FreeSurfer produced reasonable results on same day scan compared to other methods [1]. Processing of information relies on the variations of GM/WM structures. [Stuart J.Ritchie \(2015\)](#)made clear representation in his framework as beyond total brain the some more fine grained measures contribute to intelligence. In his study apart from brain volume the other six of the positively correlated variables are white matter structure and hyperintensity load, microbleeds, iron deposits and cortical thickness are also have positive associations towards intelligence. The results states that brain volume is the most vital parameter responsible for intelligence[3].

[Youngwoo et al \(2017\)](#)The various Brain structures related to intelligence is associated with cognitive abilities and other functions. The studies clearly explained Gray Matter structure network is closely related to intelligence. The central region such as cerebelloparietal component and frontal component is well associated with cognitive abilities. Gray matter structures in this components are identified and measured in this technique .The cerebellum component is associated with visuomotor

ability. The revealed GM structure using multivariate approach proves the intelligence efficiency. Pearson's correlation analysis is used to find the relations between the identified structural connectivity and intelligence. The work says that intelligence is associated with two central region cerebelloparietal component and frontal component[2].

Based on the anatomical variations, The subject wise intelligence analysis is made in existing studies importantly for mathematical knowledge. The framework defined by [Francisco J. Navas-Sanchez \(2014\)](#) is the measurements related to micro structure of White Matter tracts using diffusion tensor imaging. In neuro anatomical connectivity the WM structures are analyzed voxel wise in region of interest based on parameter called fractional anisotropy(FA) [5]. Fractional anisotropy parameter proven to have positive correlations towards intelligence specifically in corpus callosum area. The results showed that the Math gifted adults have increased FA in white matter tracts mainly in the structure and tracts connecting basal ganglia frontal lobes and parietal regions.

The structural and functional brain changes due to aging also contributes to the intelligence variation in each individual. This structural changes and its contribution towards intelligence study analyzed by [C.J.Price\(2013\)](#). The degree in which IQ variations on teenagers is predicted using cross validation procedures) Leave out one procedure 2) split half approach[6]. The results shown that the structural changes are strongly associated only with VIQ (Verbal Intelligence) more than PIQ (performance IQ).

[Ehsan Tadayon\(2020\)](#) examined cortical morphology and its measures related to general and fluid intelligence. The cortical measures such as cortical thickness, cortical gyrification and cortical surface area is well analyzed in young adults towards intelligence. Results shown that the Thinner cortex is positively associated with centralized intelligence and cortical gyrification in the core region is also strongly associated overall intelligence. This study stated Average cortical thickness is not associated with centralized or fluid intelligence whereas Total cortical surface area and average gyrification in the parietal, temporal and frontal lobes showed positive association with centralized and fluid intelligence[8]. Apart from many other variables [Glen N.Saxe et al \(2018\)](#) defined one more parameter as brain entropy and its correlation with intelligence[9].

Existing studies stated clearly positive correlation is strongly associated with Cortical gyrification and intelligence. [Liye wang\(2015\)](#) proposed a framework for IQ estimation using extended dirty model (new feature selection method). Multikernel support vector regression and single kernel SVR are compared and attained the average correlation co-efficient and average root mean square error for analysis. The new feature selection method is used on GM/WM structures for training purpose. The IQ score for the various subjects are obtained using GM/WM features. This extended model method shown less root means square error and higher correlation co-efficient[4]. [Kirsten Hilger\(2020\)](#) investigated dorsal attention network regions and its associations with intelligence, proved to have higher cognitive capability if the individual's network segregation is more stable [10]. [Natalia A Goriounova et al \(2018\)](#). framed theory on neuron's processing and neuron connectivity. The findings of this study conclude IQ level vary with cortical thickness using voxel based morphometry. However the dendrites size of multiple neurons in the associated region is measured and combined to form total dendritic length. This identified length from temporal region is highly correlated with human intelligence [12]. [Donald J Hagler et al \(2019\)](#) presented a study on cognitive development in adults. This study framed a pipeline of analyses and processing such

as cortical variation, segmentation of central region, connectivity and resting state functionalities[11].J.Eric Schmitt et al (2019) studied and proved genetic contribution of cortical intelligence in dominating regions such as dorsolateral prefrontal cortex, orbitofrontal cortices, parietal lobes, superior temporal gyri and left lingual[14].

Hugo G Schnak et al (2015)analyzed the relationship between cortical thickness/thinness with intelligence. Day by day Cortical thickness gets thicker with higher intelligence and decrease in cortical surface area. The technique intended to find cortical measurement in children and adults. Both in childhood and adolescence the variations in cortical thickness influence's IQ level. Cortical thickness measured vertex wise using customized CLASP algorithm and series of image processing pipeline is followed [7]. Different Cortical thickness found in both the hemisphere around the age of 10 and surface area found to decrease in adolescents. The methodology proves that, the childhood with higher IQ has thinner cortex and whereas this relationship become contrary in adults , higher IQ with thick cortex. Coming to cortical surface area: surface area expands in intelligent children(Age: 10) , and this expansion continues and complete at adolescence. The surface area changes greatly in intelligent adult. The study defined the cortex development in various stages as : period 1 expansion of cortical surface during childhood(10-12, higher IQ).James J. Lee et al (2019)presented framework for within family correlation between brain volume and intelligence quotient. Total Brain Volume is used as vital parameter in Full Scale IQ , Performance IQ and Verbal IQ analysis[13].

Heavy neuron accumulation contributes to the wide and variety of information networkstructure in brain's anatomy. This wide network speeds up the information transfer and increase the knowledge storage. Bajaj, Sahil et al (2018)provided framework in proving this association using multiple cortical parameters such as cortical volume (CV), Cortical gyrification and cortical surface area with same subjects[15].Voxel Based Morphometry (VBM)is one of the automated technique for neuroimaging analysis.The VBM works on T1 weighted MRI with necessary pre-processing steps based on intensity variation [16].HerstonNet to analyze and study about various morphometry features. This is the modern optimization network architecture improvising the existing approaches and to address various other discrepancies[17].Gignac et al (2017) extended Pietsching (2015) investigations[18] and proved a true and positive correlation exist between human brain size and Intelligence Quotient [19].

3. PROPOSED FRAMEWORK

Based on all the above surveyit is made clear that, brain's anatomical variation contribute highly to mankind intelligence. In this analysis we proposed a system framework for predicting Intelligence level based on following parameters Total Brain Volume (subtracting from ICV) after skull removal, GM and WM volume and Cortical volume using semi-automated medical image processing analysis tool called MeVisLab integrated with itk and vtkpackages and Brainsuite19b. This volumetric analysis helps us to calculate the overall neurons present in brain , which is responsible for information storage, retrieval and processing. This framework clearly explains the step by step procedure in using different modules for preprocessing and segmentation. After segmentation the statisticson the segmented regions and the total volume is retrieved. From previous studies, All identified parameters contribute to intelligence at different levels. Approximately Brain volume parameter contribute 12% variations to overall intelligence and other variables contribution are lowest towards intelligence variations. The Figure.1 shows us the

general framework for estimating and analyzing the intelligence quotient.

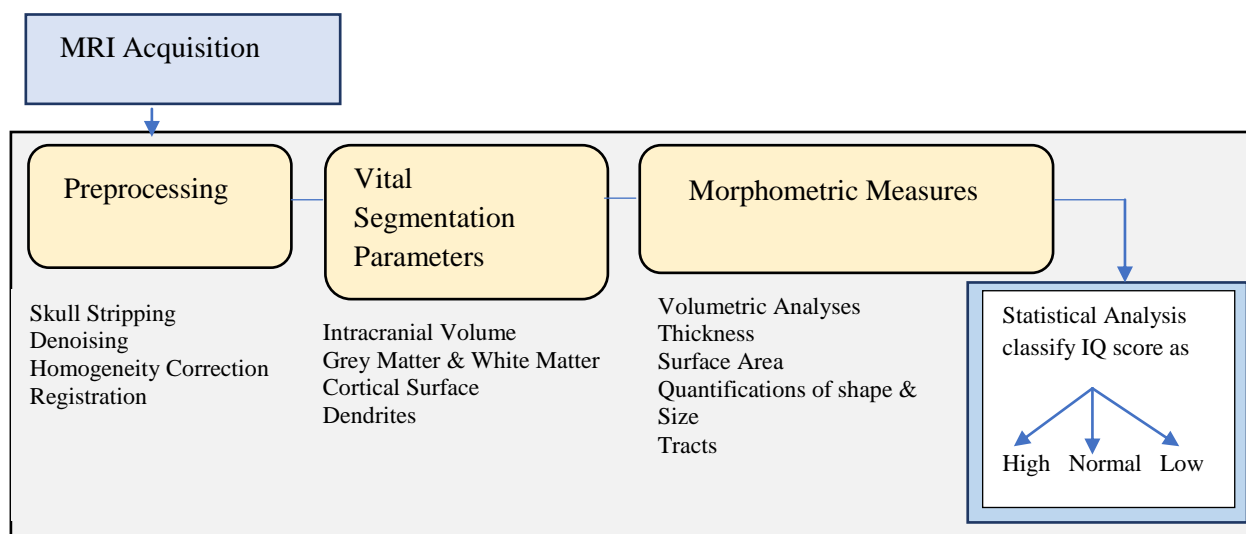


Figure 1: Block Diagram for estimating Intelligence

Framework Steps to be Followed:

Step1: Load structural and functional MRI Scan Images(T1/T2 Weighted).

Step2: Outer Skull removal using Brain Surface Extractor or Brainsuite19b (OpenSource tools). Necessary Preprocessing to improvise segmentation and its accuracy. We followed Brainsuite19b preprocessing steps for skull removal and non-brain tissue classification while retrieving cortical volume. MeVisLab preprocessing modules also followed in extracting volume of the segmented region in voxels.

Step3 : Segmenting Region Of Interest to measure Intelligence. Below Table 1 highlights the positively associated regions towards human's intelligence.

Brain Variables	Intelligence Associated Regions
GM Networks	cerebelloparetal component and frontal component.
GM and WM volume	transverse temporal gyri, left anterior cingulate gyrus, thalamus, left parahippocampal gyrus, right opercular part of inferior frontal gyrus, right amygdala, left lingual gyrus, left superior and right interior parietal lobule, left angular gyrus, left paracentral lobule, left hippocampus and left caudate nucleus.
Grey Matter Density	Verbal IQ - Left Motor Cortex Performance IQ- Anterior Cerebellum
Brain Volume	Cortical Thickness- Prefrontal Area TBV by subtracting ICV WM tracts - Genu and Splenium of the Corpus Callosum,; Bilateral Rostral Cingulum Bundles; Bilateral Anterior Thalamic Radiations and the Bilateral Arcuate, Uncinate and Inferior Longitudinal Fasciculi.

Cortical volume, Cortical Thickness and Cortical Surface area	Whole Hemisphere (GM/WM Interfaces) Parietal, Temporal and Frontal lobe's cortical gyrification
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Table 1: Brain Regions positively associated with Intelligence

Step4 : In MeVisLab, The threshold values adjusted for the MeVisLab networks in segmenting ROI, the values are Lower Threshold Value : 200 and Upper Threshold Value : 600 and for

CSF : Lower Threshold Value : 600 and Upper Threshold Value : 9000

Step5 : Select initial seed points for segmenting, and the region stops growing when threshold matching with seed points are done. Any number of seed points can be selected until our region segments effectively.

Step6 : Add image statistics modules, ROI select modules to display the volumetric status of the segmented volume. The table2 shows the no of voxels retrieved for subject's MRI using MeVisLab.

Step6 : Add Visualizing modules either 2D or 3D.

Step7 : In Brainsuite19b, The cortical inner area, cortical mid area, cortical pial area, Grey Matter volume, White Matter Volume, GM+WM volume and Mean thickness of all parameters are retrieved. The volume is displayed for each registered surface of individual's MRI.

Step8: In every extraction stage, The various iterations parameters are adjusted in retrieving the cortical surface volume. The table3 displays the each surface volume extraction using Brainsuite19b.

Step9: Based on all the volume information retrieved using tools are analyzed and compared to identify the overall greater volume, as the higher in volume is positively associated with Overall higher in intelligence.

Step10: The greater volume contributes to higher intelligence in individual's MRI.

4. METHODS AND IMPLEMENTATION

a) Image Acquisition and Pre-processing Pipeline

The common pipeline followed in this study for MRI preprocessing is modules load, filtering, denoising, 2D/3D visualization and segmenting region of interest data. MeVisLab is the popular prototyping tool for image processing, scripting, visualizing and layout. VTK and ITK are the extended version of this tool with advanced visualizing and segmenting algorithm. Wide variety of the modules are available in MeVisLab, a virtual Network is created using this modules and scripting can be included by using scripting console. Images are acquired using MRI (T1 & T2) and were it needs to be prepared before segmenting the core regions. Image Load is the module for loading different slices or head MRI. We used straight forward preprocessing pipeline from MeVisLab. Macro modules are wrapped up to form network and enhance using GUI. Gaussian smoothing of the loaded noisy image is done along with Median Filtering. The detailed preprocessing steps are skipped in this analysis and we directly analyzed the segmented region with statistics parameters. The module called LoadImage and LocalImage are used for tiff or bmp format whereas for DICOMM files the *DirectDicommImport* module is used. The different slices from individual's MRI are imported under DICOMM tree tag. In MeVisLab The image can

be used after skull stripping stage to improve accuracy and efficiency. The Figure 2 & 3 shows the modules implemented in MeVisLab.



Figure 2: Initial preprocessing modules

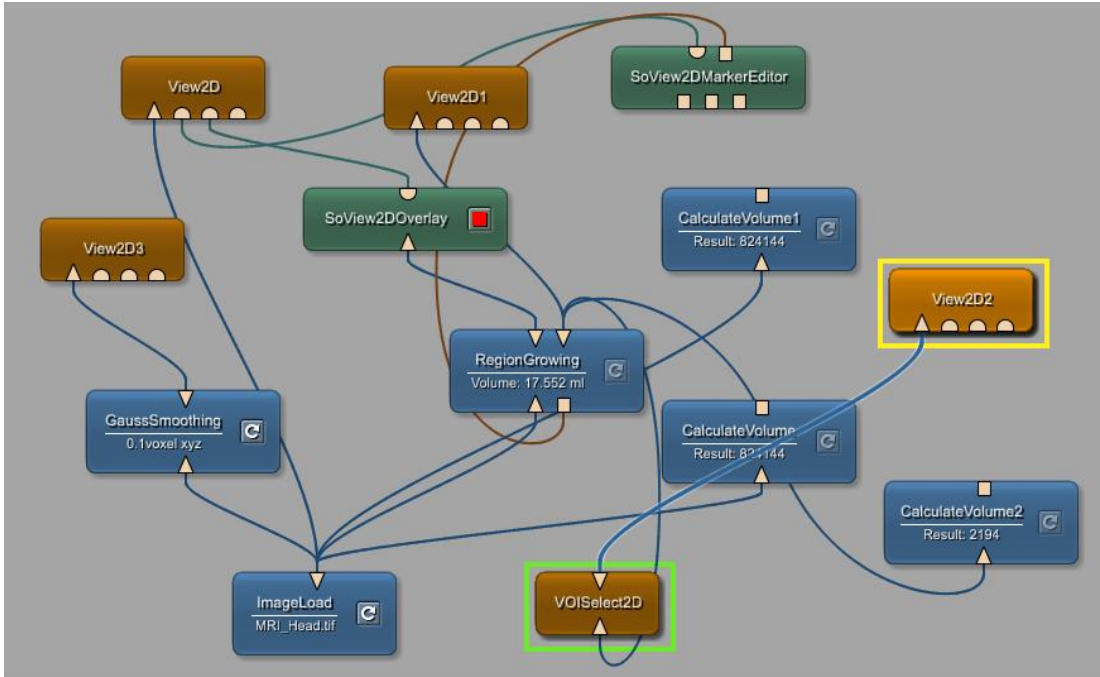


Figure 3: Preprocessing and Visualizing

b) Segmentation and Visualization

Total Brain Volume :

The vital brain variable contributes towards intelligence is the total brain volume. The totality of any variable’sanalysis is that we don’t miss the minor variable contribution too. Overall intelligence of an individual is measured based on the full volume of the brain.*LoadImage* or *LocalImage* module to load every slice of an individual. *MultiloadFile* Module is available to load all slices as single tag. Every individual slice volume is computed either by *calculatevolume* module or *Imagestatistics* module, where it computes the total number of voxels, mean and standard deviation among all the slices. Even the perslice view can be analyzed.Visualize MRI either using *View2D* or *View3D* modules. The below Figure 4 shows us the modules included in MeVisLab for creating network.

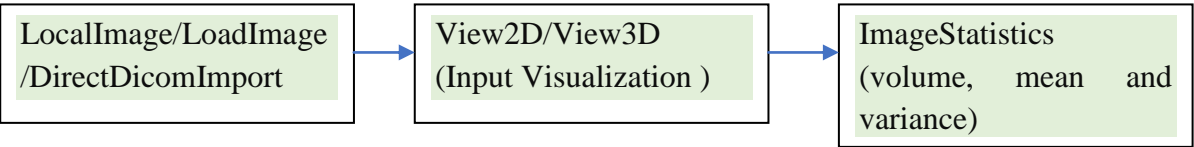


Figure 4: Retrieval of Image statistics

GM/WM volume:

Firm evidence states that GreyMatter and WhiteMatter volume has positive correlation with intelligence. Image Segmentation is the process of retrieving the region of interest from image. Segmented region and its volume is analyzed either per slice view or over all segmented volume from individual's MRI is computed. MeVisLabis integrated with various automatic(Thresholding, Contour based and region growing) and semi-automatic(live wire segmentation)for segmenting and visualizing. Choosing the initial voxel points will segment the intracranial grey matter and white matter from all slices, the mean volume show the total GM & WM volume.Volumetric differences between every induvial highlights the cognitive abilities and disabilities. *RegionGrowMacro* module used to segment based on seed point, regions grow automatically and terminate with, when thresholding mismatches.*MarkerEditor* used to hit marker points when region segments and *View2DOverlay* module to view the segmented region. The volume of the segmented regions can be extracted using *ImageStatistics* and *CalculateVolumemodules*. Figure 5&6 shows the segmentation modules and networkcreated for visualizing the segmented regions using DICOMM files.

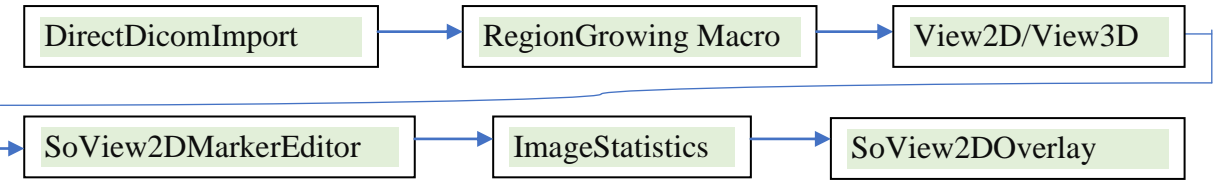


Figure 5: Segmentation Sequence and Visualizing

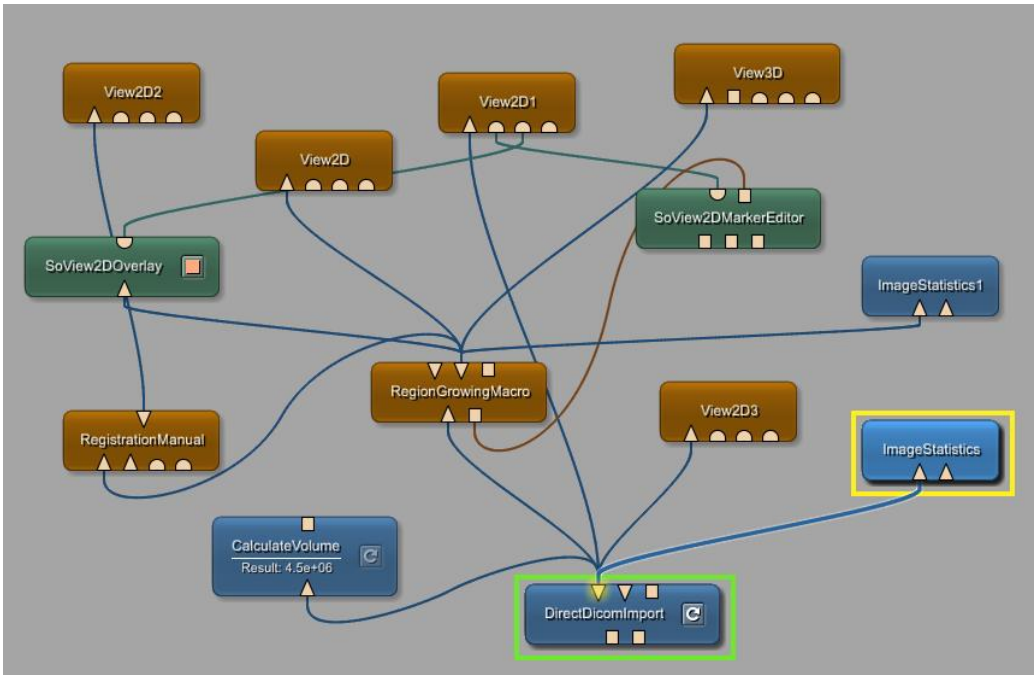


Figure 6: Segmentation Network

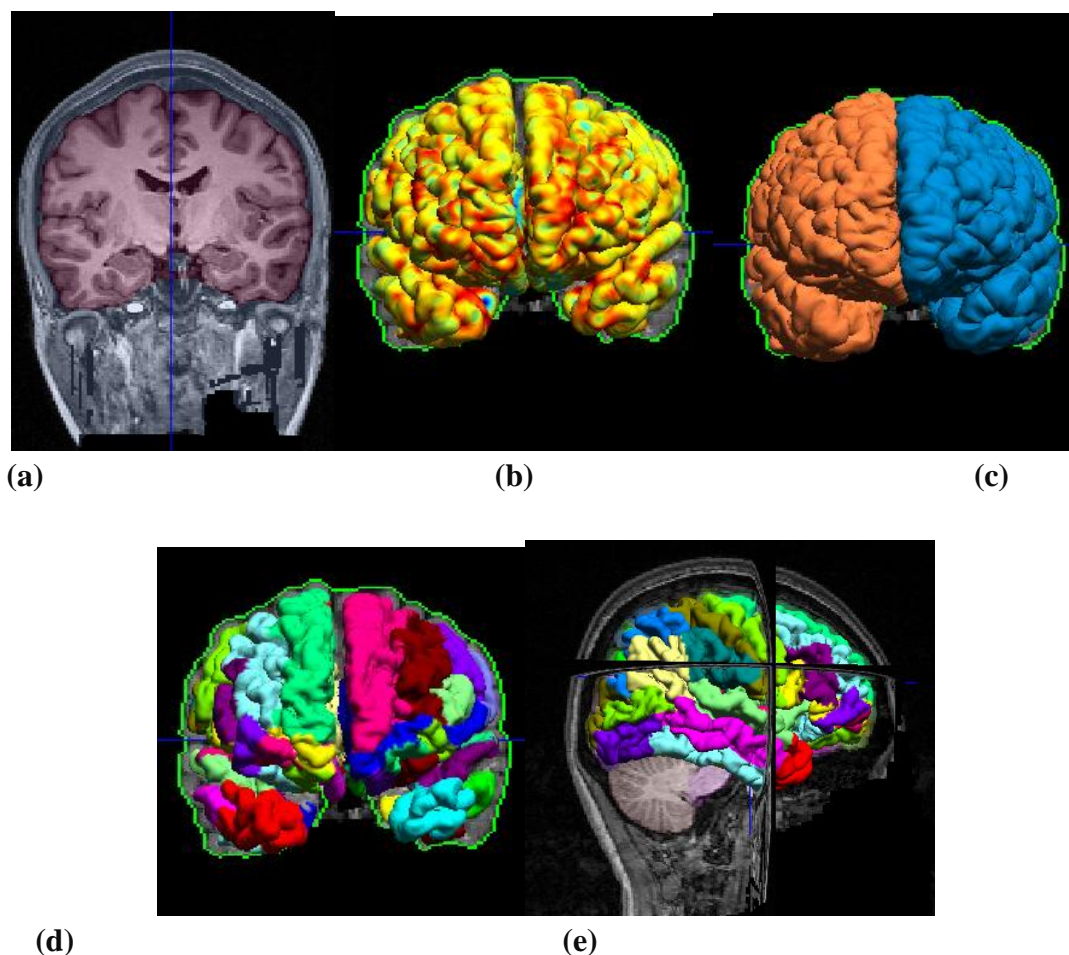


Figure 7: a) Skull Removal b) Pial Surface c) Split Hemisphere d) Surface Registration e) Final 3Dview after extraction

Cortical Volume Analysis:

It is proved in existing analysis that Cortex is positively associated with intelligence variations. Cortical volume and surface area keep varying due to our age factor. This cortical volume shows us the accumulation of overall neurons in the human brain. The larger collection of neurons increases the knowledge storage and transfer rate. Brainsuite19b is used along with this framework for analyzing and extracting cortical surface and its volume, it is the opensource tool readily available with sequence for extracting cortical surface. The overall cortical volume of the brain reveals the collective amount of neurons accumulated. The sequences followed until all the surfaces covered for volume extraction.

The sequence in retrieving cortical volume:

- Skull stripping, Non uniformity correction, Tissue Classification.
- Cerebrum labelling, Inner cortical mask, topology correction.
- Split hemisphere, surface or volume registration, Labelling hemisphere.
- Finally to calculate cortical thickness.

This semi-automatic tool gives us the volumetric measurements of the cortex in terms of voxels. The Figure 7 shows the intermediate stages of brain MRI in retrieving the cortical thickness.

5. RESULTS AND DISCUSSIONS:

In this proposed framework, the major contributing parameters related to intelligence variation is analyzed using semi-automatic tools called MeVisLab and Brainsuite19b to extract volumetric information of an individual’s MRI. The overall volume of the parameters directly relate to the higher intelligence. The higher GM/WM volume, Total brain volume, Cortical thickness states the higher overall intelligence. The publicly available datasets are downloaded to retrieve volumetric analysis.

The various measurement such as size, shape volume, characteristics of the brain’s central regions are associated with intelligence and studied using Magnetic Resonance Imaging(MRI). Morphometry measures requires many pre-processing and correction mechanisms for showing accuracy and exactness of the region. Many manual and automated methods have been established so far on the quantification of different morphometry measures.

Some of the defined morphometric measures are :

- Total Brain Volume
- Grey Matter and White Matter Region Analysis
- Cortex Analysis: Cortical Surface Area, Cortical Thickness , Cortical Gyrification, Cortical Volume

Above are the features identified related to intelligence quotient.

The below is the sample Table 2 volume extraction from the individual’s MRI using MeVisLab. By doing the volumetric comparison the intelligence variation can be identified. Each subject’s volume differs according to the anatomical variation. This framework can be extended to run for huge dataset to improvise the accuracy and performance. The volume computed based on the number of voxels in region of interest. The total voxels says the overall brain volume with inner layer and outer layer voxels. GM and WM are segmented using initial seed points and volume statistics computed for the same. The higher, the overall volume in different parameters , greater the intelligence variation among every subjects. Figure 8&9 is the screenshot of region growing segmentation with initial seed markers using tumor MRI and segmentation of GM/WM region.

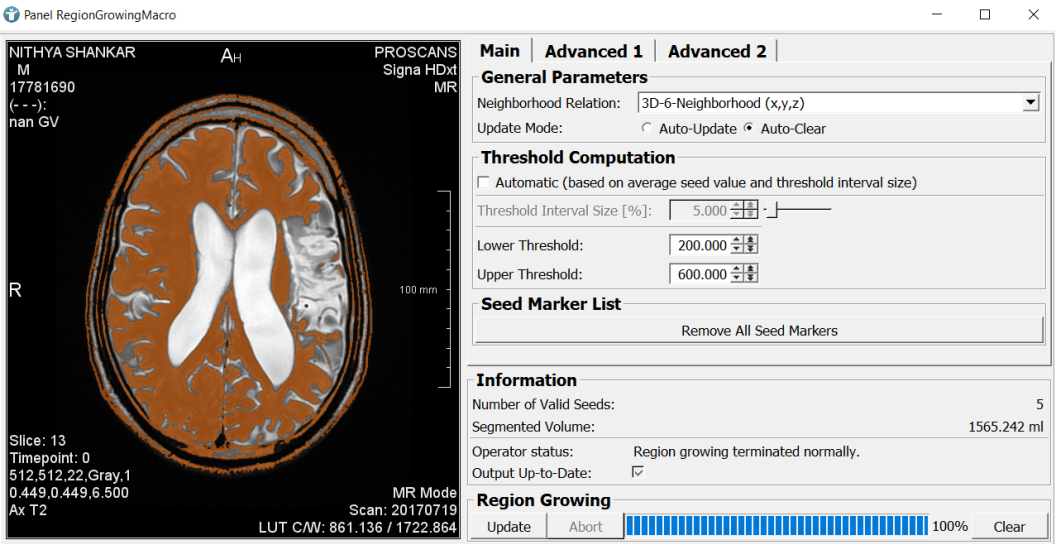


Figure 8: Slice View and its Segmentation

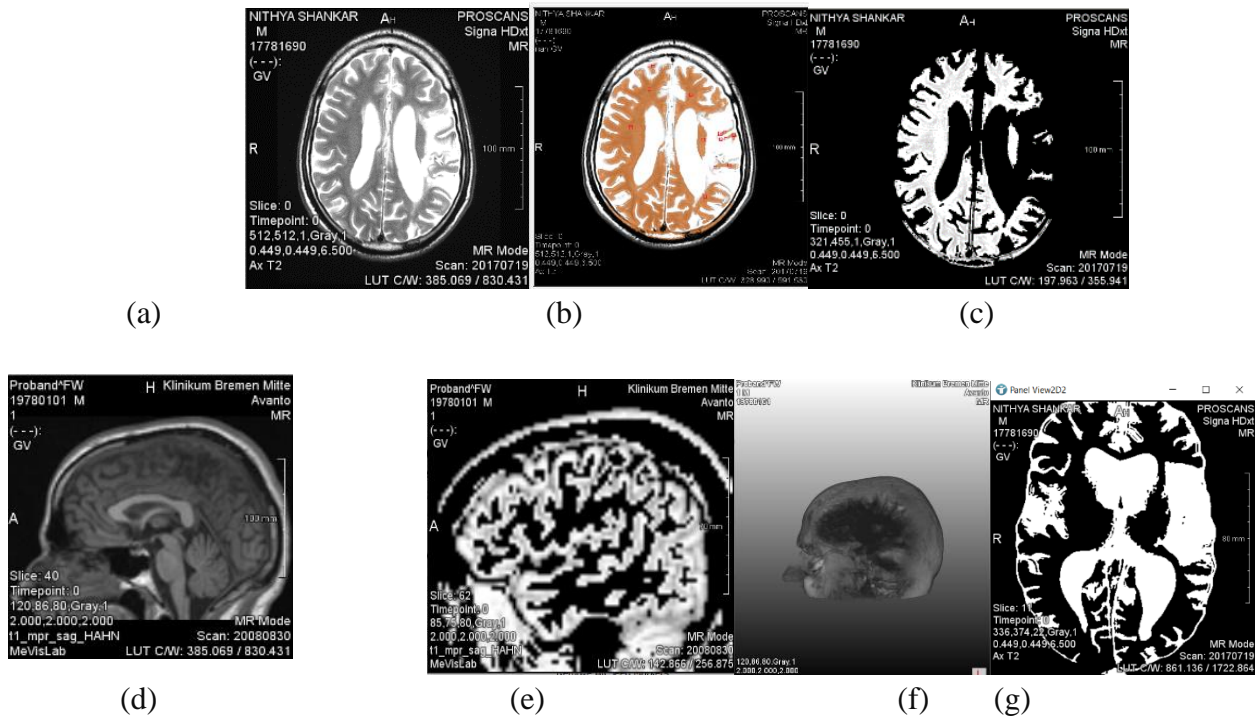


Figure 9: a) MRI scan (Slice) b) GM/WM segmentation c) Segmented region d) Head MRI e) Cortical Surface representation f) Sagittal 3D view(MeVisLab Representation) g) CSF

Value(S1)	Total	Inner	Outer
Voxels	5767168	1286192	4480976
Mean	214.72	0.01	276.35
Std. Dev	331.13	0.11	352.26
Volume mm^3	7.56407	1.68694	5.87713
After Segmentation			
Segmented volume	1565.242 ml	4573760 (Voxels)	1193408 (Voxels)
Mean	85.52	0.01	413.26
Std. Dev	172.56	0.01	100.63
Voxels	825600	2097	823503
Mean	156.89	0.31	157.29
Std. Dev	165.92	0.46	165.95
Volume mm^3	6.6048	16776	6.58802
After Segmentation			
Segmented volume	825600 ml	600883 (Voxels)	224717 (Voxels)
Mean	94.78	0.01	348.23
Std. Dev	160.34	0.01	78.68
Voxels	4854163	1396185	3457978

Mean	114.72	0.01	173.47
Std. Dev	231.13	0.10	272.23
Volume mm ³	6.43576	1.48574	4.95002
After Segmentation			
Segmented volume	1463.34 ml	2114874 (Voxels)	2739289 (Voxels)
Mean	73.73	0.01	448.23
Std. Dev	159.34	0.01	111.23

Table 2: ROI volume in voxels

The human cortex measurements reveals the overall neurons present in the brain. The cortical analysis takes the several parameters such as cortical thickness, cortical curvature, cortical gyrification and overall cortical volume. Here is the below Table 3 has the cortical area and mean thickness of subject's MRI. These values are retrieved using Brainsuite19b for cortical analysis. The cortical area is the mean value of cortical area inner, cortical area mid and cortical area pial. The mean thickness and area is averaged out to find the individual's Cortical thickness and area. This same analysis can be repeated for different dataset to find cortical area and thickness out of which the maximum values are sorted. The higher cortical area and higher thickness contributes to the maximum neuron accumulation in brain. Larger neurons in brain positively correlates with increased storage and fast information transfer rate.

The intelligence quotient (IQ) score is the value from cognitive test conducted on individual's from various subjects. This score can vary according to the anatomical variations of the brain. Thus this anatomical variations includes the volumetric measurements of region of interest. The brain variables are identified for volumetric measurements. The overall volume is averaged out and compared among subjects to find individual higher in intelligence. This measurements also helps in identifying the neurological abnormalities among individual's and in specific brain regions.

Region Of Interest ID	Mean Thickness (mm)	CSF Volume (mm ³)	GM Volume (mm ³)	WM Volume (mm ³)	Total Volume (GM+WM) (mm ³)	Cortical Area (mm ²)
120	4.803169	14168.52	30340.63	15390.06	45730.69	8432.57
121	5.132599	13348.22	32197.21	16640.05	48837.26	8655.47
130	4.676344	6120.46	15240.03	7475.22	22715.26	4418.99
131	4.730200	5582.81	15085.19	7559.92	22645.10	4430.13
142	4.381907	1553.40	4402.16	2238.57	6640.73	1301.08
143	4.454501	1593.05	4940.17	2900.48	7840.63	1497.03

Table3 : Surface wise Volumetric Measurements

6. CONCLUSION AND FUTURE ENHANCEMENTS.

The intelligence differentiate people from one another, in turn, it proves individuals capability as well. Previous studies shown that the brain anatomical structures, functionalities and neurons connectivity reflect knowledge variations and are studied

using fMRI and sMRI. The anatomical structure varies for every human being, By identifying the various regions contributing to intelligence helps to quantify the individual's abilities. The General Intelligence is approximated by estimating the central regions of the brain. The different intelligence variations parameters are identified and consolidated in this work to analyze overall intelligence for an individual. This consolidation on the central regions of the brain explain individual abilities and its area measurement defines how much the individual vary with other human abilities. This area differs not only in adults even among children of age above 10 years. The various framework and methodologies followed by the prior implementations ,created us a clear way of estimating intelligence using MRI.

This framework help's researcher to view all central parameters connected to intelligence and generalized methodology or procedure to calculate IQ. This framework identifies the amount of variation in brain's structure among subjects using opensource tools called MeVisLab and Brainsuite19bin concluding the tested subjects intellectual capability. This proven results makes us clear that anatomical structural changes are positively correlated with intelligence variations. This analysis create a clear idea for any research scholar to know the key areas of intelligence quotient to be measured and analyzed. The various methodologies and framework are too highlighted to identify the basic steps in proceeding with intelligence.

Identifying the unique talent with specific region is the future enhancement of this study. This Enhancement will clearly shows that in what specific field the individual can be excelled. According to multiple intelligence theory the person is intelligent only in specific area and based on that assumption, it is concluded that the particular brain region specific to that field also shows brain structural variations. In turn, this variations measurement will conclude the capabilities of that individual acquired. The intelligence is classified into many types so far they are.

General Intelligence: General Intelligence defines the complete knowledge of an individual. The collective intelligence factor of both fluid and crystalized knowledge.

Fluid Intelligence: It is the type of knowledge deal with creativity and innovation. The individual with this type of intelligence adapt to any current scenario by identifying patterns. It states, how the individual reacts and responds in particular situation. The capabilities of this intelligence are problem solving, analytical, reasoning, puzzles and pattern identification. High in fluid intelligence can handle Situation's efficiently Without any existing knowledge or training from past. Fluid intelligence keep declining after adolescence. Initial intelligence used by any individual to learn new subject is fluid intelligence.

Logical-Mathematical: It is the ability to quantify, solve, calculate , analyze, pattern relationships and connections, reasoning to carry out mathematical operations.

Linguistic: Intelligence related to reading , writing and word usage in the proper context.

Interpersonal skills: Good at understanding and interacting with other people.

Intrapersonal Intelligence: Individual knows to self-motivate themselves, balance their own emotions and feelings.

Visual-Spatial Intelligence: Individual strong in visualizing things such as good with directions, maps, charts, videos, and pictures.

Bodily-Kinesthetic Intelligence: Peoples with skills such as body movement, performing actions, and physical control.

Naturalistic & Musical Intelligence: According to gardner's theory this intelligence is highly interested in environment, species, natural events and adapt to its changes. Excellent knowledge on sounds, rhythm

to recognize its tone and pitch.

Crystalized Intelligence: Crystalized intelligence is based on past experience. Our past knowledge and learning help to handle and solve problem. Improving Vocabulary knowledge by memorizing new phrases ,words and use appropriately. This type of intelligence is more stable and increasing compared to fluid Intelligence.

Human being survival rate depends highly on strong physical and mental ability. The strong individual adapt easily to various environmental factors and challenging situations. Physical and logical abilities differ in all the individuals, and which defines the outstanding nature of them. The human intelligence is the capabilities of individual in solving challenges. The common measure of intelligence is based on IQ test score. This framework can be extended further more for mentally challenging individuals to identify in what area they specifically lacking and how exactly the improvisations can be made.

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