

# **A Review on the Segmentation of Brain Haemorrhage Images Using Brain MRI and Ct Scan**

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**ABSTRACT:** The main objective of this study is to look up on various segmentation techniques used on haemorrhage images of both MRI and CT scan, further analyzing the classification performance of various existing algorithms. Segmenting and classifying of haemorrhage images are done efficiently by various image processing and machine learning techniques. Reason of using image processing techniques was to denoise the image and further apply various techniques of classification, clustering to clearly portray the existence of haemorrhage whereas Machine learning technique was to focus on issues that manipulate the prediction performance. Generally used methods are Decision Tree classifiers, Support Vector Machine, K-Nearest Neighbours, Thresholding techniques, Fuzzy C Means, Voxel based outlier detection, Multilayer Perceptron. Currently, cerebro-vascular diseases are the third reason of fatality in the world after cancer and heart diseases. This made us to review the literature pertaining to the occurrence of haemorrhage amongst the people. As there are a number of algorithms which give some amount of average results, there can still be a better model which incorporates the methods to give the best and accurate result.

**KEYWORDS:** Haemorrhage, Support Vector Machine, Decision Tree Classifier

## **I. INTRODUCTION**

Brain haemorrhage is the bleeding caused due to the leakage by rupturing of blood vessels within the brain substance or simply haemorrhage is any internal or external bleeding from the blood vessels. The main cause of haemorrhage is trauma or damage of blood vessel by accident. The quantity of internal blood loss that occurs depends on the severity of the force applied to the blood vessel that is wounded, and the circumstance of the patient before injury. Brain haemorrhage is classified into 4 types, namely: Intracerebral haemorrhage (ICH), Subdural haemorrhage (SDH), Epidural haemorrhage (EDH), Subarachnoid haemorrhage (SAH). On the other hand, haemorrhage can also occur due to aneurysm, where there occurs a bulging in the wall of an artery; which is responsible to supply blood to the brain. Over time, at the site of an aneurysm, the blood vessels tend to become thinner and bulge out like water balloons as blood passes through make them to rupture and more likely to leak.

Most of the time brain aneurysm is ignored because there are no symptoms seen. Whereas in other cases, this brain aneurysm ruptures to such an extent that it releases blood into the skull further leading to stroke. Studies [1] showed that about 15% of patients suffering from aneurysmal subarachnoid haemorrhage (SAH) pass away before reaching the hospital. Mostly the deaths caused by subarachnoid haemorrhage are because of prompt and immense brain injury from the initial bleeding which is not repairable with the help of medical and surgical involvements. And a count of 4 out of a group of 7 people who get recovered from bulgy aneurysm will have disabilities.

According to research conducted by Dr. K.B. Shankar [2], Assistant Professor of Neuro Surgery at Safdarjung Hospital, New Delhi, usually brain strokes occurred only to elder age group who have high blood pressure and diabetes, but in the current scenario lifestyle modifications, escalating work pressure, unhealthy and untimely eating habits, over-commitment, insufficient sleep are leading to rise in brain haemorrhage amid the age group of 20-30. These apparently lead to hypertension and diabetes at an early age that causes brain strokes. Further according to an epidemiological survey done in India, there are about 100-150 per 1, 00,000 people who suffer from strokes annually.

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In short, the rate of the cases of strokes is about 1-1.5 million of which about 15 - 20% cases belong to the age group of less than 30 years. Adding to Dr.Shankar's analysis, Dr. Vikas Dikhav, a Senior Research Officer, Department of Neurology, Ram Manohar Lohiya Hospital, said hypertension is the major reason of bleeding caused in the brain. He further added that, patients are unaware of high blood pressures and hence they might not know that they are harbouring a ticking time bomb that is waiting to burst. Sometimes the high blood pressure counts don't even reflect the high level stress and it may be spiking serious when they are worried or exerting themselves.

There are other special circumstances where babies born before 32 weeks of gestational age are at higher risk of developing Intracranial bleeding, this happens because of the immature blood vessels. A major percentage of premature babies might develop some amount of Intracranial haemorrhage. This can direct to Hydrocephalus, an enlargement of the fluid-filled spaces of the brain, and can be very severe. If delivery cannot be postponed, few medications can be arranged to the mother to attempt in avoiding this situation.

## II. LITERATURE REVIEW

Generally a radiology test such as CT scan MRI is necessary to analyse the location and features of brain bleeding. If bleeding inside or around the brain is identified, then next testing may be assigned to attempt to decide the cause of bleeding with the indication of abnormal blood vessels that are present. Existing algorithms that are used to perform such determination, identification and segmentation tasks are discussed below.

Bhadauria, et al.,(2013) [3] proposed a method in order to utilize the features of both the Fuzzy C Means Clustering and region based active contour model for the segmentation of region that are haemorrhagic in brain CT images. The main advantage here was the usage of fuzzy membership function, which provided the strength and accuracy for the detection of haemorrhagic areas.

Mahmoud et al.,(2013) [4] focussed on segmentation, where Otsu's method is used to extract the haemorrhage region from the image. In the next step, features of the region of interest are extracted followed by the classification stage where the image is classified based on the computed features of the region of interest. The results in this work showed that after pre-processing of the CT Scans, the binary classification problem solution gave 100% accuracy. Also, the implemented system achieved 92% accuracy for classifying the 3 types of haemorrhages using neural networks as a classifier. Further for good accuracy the article suggested ensemble classifier can be used.

Shahangian et al.,(2013) [5] presented a segmentation method, where even a tiny haemorrhage was detected. The features were extracted from each detected regions to decide on the finest in them; in the classification step the haemorrhage regions were classified using two classifiers, of them the neural network based classifier; Multilayer Perceptron gave an accuracy of 93.3 %,which was elevated and more successful than the K-Nearest Neighbour classification technique, which gave only 60% accuracy.

Soltaninejad et al.,(2014) [6] segmented the haemorrhage regions using a hybrid method comprising of Simple Linear Iterative Clustering for superpixel or supervoxel segmentation partitioning, grouping and Distance Regularized Level Set Evolution (DRLSE) for level-set boundary detection. The model was evaluated in both 2D and 3D spaces. The results showed that the segmentation accuracy in the case of small haemorrhage regions was not acceptable; yet it was solved by decreasing the initial superpixel /supervoxel size.

Gillebert et al.,(2014) [7] incorporated a method where lesion of stroke patients has to be automatically recognized using a voxel based outlier detection method based on Crawford-Howell parametric t-test for case control comparisons. The advantage of the proposed methods were the accurate normalization of CT images from stroke patients into template space and the subsequent voxel wise comparison with a group of control CT images for significant areas with hypo- or hyper-intense signals. Limitation here is in the relative to manual delineation phase; there is condensed sensitivity of the automated model in areas close to the ventricles and the brain contours. Nevertheless, the automated model provides a number of profits in conditions of contribution to considerable time savings and the exclusion of the inter-operator differences innate to manual tracing approaches.

Boers et al., (2014) [8] model started with an atlas based segmentation for classifying different brain structures, followed by a compensation for biased volume outcome in the surrounding area of the skull. After which the assessment of density was measured to set a tissue specific threshold for density-based segmentation of blood. A

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region-growing algorithm incorporated delicate attenuated portions of the hemorrhagic areas. Their main objective was to develop a fully automatic process for blood volume and density quantification in Non-Contrast CT scans of patients with Subarachnoid Haemorrhage.

Oleg et al.,(2015) [9] formulated a process where classifier is used as a two-tier classification incorporated with additional methods of fuzzy logic and neural networks. On the same time focused on the detection of brain haemorrhage and its classification. The results suggested that the prospect of using this approach has to be modified in order to process a much larger training sample.

Alyaa Hussein, et al., (2015) [10] has projected the detection and segmentation of haemorrhage stroke from brain CT images by means of textural analysis. In the study, the thresholding segmentation procedure is used to extract stroke section from CT images of brain. The median filter was used to eradicate noise from image and the statistical feature was intended using first order histogram. The results as mean value indicates white colour in the image. The higher mean indicates that there is an abnormal area in the brain. When the energy value is low, this means that there is low number of grey-levels and study area is not homogeneous. Entropy is inversely relative to energy. So the higher entropy indicates non-homogeneous texture. The skewness symbolizes evenness of texture around mean. For the abnormal part, its value has more evenness than normal part. Their method gave fine result for the detection and segmentation of brain stroke.

Vijaya Kumar et al.,(2016) [11] chose 4 classes of brain haemorrhage and hematomas, 5 classes of brain tumors and 2 classes of ischemic stroke. Decision Tree classifier was used to check the best features in the data set. The attributes of features are image contrast, entropy, variance, cluster prominence and cluster shade. All of the features were trained to the classifier to significantly categorize the tumor type. The work is carried out using CAD system. The results were verified for brain haemorrhage, hematoma, ischemic stroke and brain tumor with Decision tree classifier. The model of the 3 diseases showed, 92%, 93% and 96% accuracy.

Scherer, Moritz, et al.,(2016) [12] developed a segmentation algorithm using the first- and second-order statistics, texture of the image, and threshold features. All of them were trained on manual segmentations with the help of random-forest method so as to get better segmentation outcome when compared with ABC/2. As with the ABC/2 method, it precisely and rapidly approximates smaller, ellipse shaped Intraparenchymal haemorrhage but is imprecise for outsized, complex-shaped Intraparenchymal, Intraventricular, and Subdural haemorrhages. Hence the developed quantization of Intra cerebral Haemorrhage using the segmentation algorithm offered a tool for assessment of the clot volume.

### III. INFERENCES FROM THE REVIEW WORK

There are a number of challenges in distinguishing and categorizing brain haemorrhages; such as the presence of noise and unnecessary components like the skull, brain ventricles and edema that are present in brain CT images, the indecisive location of haemorrhage in a few category, the resemblance of shape and texture among some haemorrhage types (the EDH and SDH happen to occur with matching texture in the equivalent intracranial space), which may direct to extracting redundant or ineffective features and as a result gives low classification accuracy. This leads to improper diagnosis of the patient at the time of emergency situations by the Physicians, which eventually causes the death of the patient.

### IV. CONCLUSION

With the intensifying situations of the occurrence of haemorrhages, there is a demand for an automated system that gives complete detailing about the haemorrhage. Medical Physicians completely rely on the fastest method that justifies their expectations so as to provide immediate medication or perform surgery. There are a wide variety of new algorithms that pop up every now and then; therefore every new algorithm is proved to be better than the previous one. The importance of the research brings to light the haemorrhage types and the areas based on the region of interest. Segmenting the areas and classifying them based on their types automatically will provide high-quality and speedy result to the Physicians, so as to handle the patients quickly.

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## REFERENCES

- [1] <https://www.bafound.org/about-brain-aneurysms/brain-aneurysm-basics/brain-aneurysm-statistics-and-facts/>
- [2] <http://www.news18.com/news/india/lifestyle-work-pressure-causing-brain-haemorrhage-among-youngsters-632299.html>
- [3] Bhadauria, H. S., Annapurna Singh, and M. L. Dewal. "An integrated method for hemorrhage segmentation from brain CT imaging." *Computers & Electrical Engineering* 39.5 (2013): 1527-1536.
- [4] Al-Ayyoub, Mahmoud, et al. "Automatic detection and classification of brain hemorrhages." *WSEAS transactions on computers* 12.10 (2013): 395-405.
- [5] Shahangian, Bahare, and Hossein Pourghassem. "Automatic brain hemorrhage segmentation and classification in CT scan images." *Machine Vision and Image Processing (MVIP), 2013 8th Iranian Conference on*. IEEE, 2013.
- [6] Soltaninejad, Mohammadreza, et al. "A Hybrid Method for Hemorrhage Segmentation in Trauma Brain CT." *MIUA*. 2014.
- [7] Gillebert, C. R., G. W. Humphreys, and D. Mantini. "Automated delineation of stroke lesions using brain CT images. *Neuroimage Clin.* 4, 540–548." (2014).
- [8] Boers, A. M., et al. "Automatic quantification of subarachnoid hemorrhage on noncontrast CT." *American journal of neuroradiology* 35.12 (2014): 2279-2286.
- [9] Avrunin, Oleg G., et al. "Classification of CT-brain slices based on local histograms." *16th Conference on Optical Fibers and Their Applications*. International Society for Optics and Photonics, 2015.
- [10] Ali, Alyaa Hussein, Shahad Imad Abdulsalam, and Ihssan Subhi Nema. "Detection and Segmentation of Ischemic Stroke Using Textural Analysis on Brain CT Images." *International Journal of Scientific & Engineering Research* 6.2 (2015): 396-400.
- [11] Kumar, D. Vijaya, and VV Jaya Rama Krishniah. "An automated framework for stroke and hemorrhage detection using decision tree classifier." *Communication and Electronics Systems (ICCES), International Conference on*. IEEE, 2016.
- [12] Scherer, Moritz, et al. "Development and Validation of an Automatic Segmentation Algorithm for Quantification of Intracerebral Hemorrhage." *Stroke* 47.11 (2016): 2776-2782.