Deep-belief networks detect glioblastoma tumors from MRI scans

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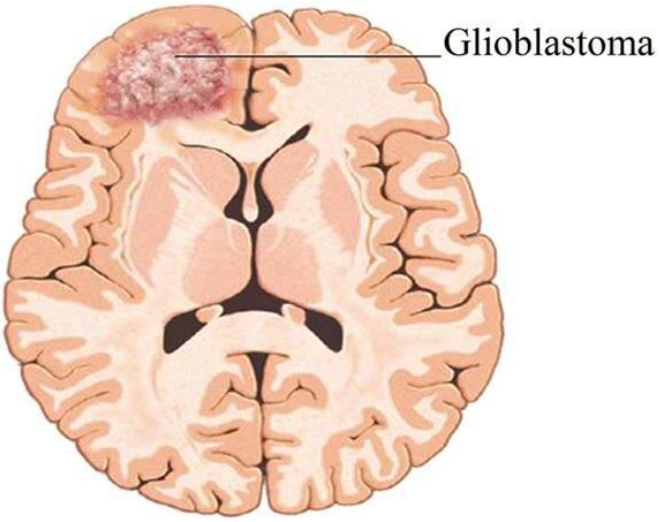

Glioblastoma brain tumor Credit: pixabay.com

Scientists from South Ural State University, in collaboration with foreign colleagues, have proposed a new model for the classification of MRI images based on a deep-belief network that will help to detect malignant brain tumors faster and more accurately. The research study was published in the *Journal of Big Data*, indexed in the scientometric Scopus database.

Deep learning of neural networks for diagnostic accuracy of brain tumors

Glioblastoma (GBM) is a stage 4 malignant brain tumor in which a large proportion of tumor cells are reproducing at any given moment. Such tumors are life-threatening and can lead to partial or complete mental and physical disability.

The study was carried out by an international group of scientists from Indian universities and South Ural State University. Senior researcher of the Department of Computer Science of the School of Electronic Engineering and Computer Science, post-doc Kumar Sachin along with Ph.D., Associate Professor Mikhail Tsymbler developed methods for computer analysis of MRI images (magnetic resonance imaging) to detect glioblastoma tumors based on artificial deep-belief network.

Artificial neural networks (ANNs) are a powerful machine learning approach, handling large amounts of data with high accuracy. Deep learning approaches can also automatically extract the features from the large data sets, although the correctness of the extracted features is not guaranteed because a corresponding mathematical verification procedure has not yet been developed.

"In this study, we have proposed a classification model using hybrid deep-belief networks (DBN) to classify magnetic resonance imaging (MRI) for glioblastoma tumors. We proposed framework for image classification in three stages. The first stage performs the data preprocessing that consists of feature extraction using discrete wavelet transform (a function that allows you to analyze the frequency of data), vectorization and construction of additional features for processing. The second stage deals with dimensionality reduction of the images using principal component analysis, and provides reduced dimensional feature vectors for smooth image classification. The third stage consists of a stack of restricted Boltzmann machines that form a deep-belief network with hidden layers," Kumar Sachin explains.

Deep-belief networks often require a large number of hidden layers that consist of large number of neurons to learn the best features from the raw image data. Hence, computational and space complexity is high and requires a lot of training time. The proposed approach combines a discrete wavelet transform with a deep-belief network to improve the efficiency of existing deep-belief network model. The results are validated using several statistical parameters. Statistical validation

verifies that the combination of discrete wavelet transform and deep-belief network outperformed the other classifiers in terms of training time, space complexity and classification accuracy.

The neural network will help doctors

The methods and approaches proposed in the study can be applied to develop automated systems for diagnosing and detecting cancerous tumors and other cell lesions using MRI images.

"Medical science is equipped with advanced devices and technology. MRI machines are able to capture high-contrast images of the brain and other parts of the body. These MRI scans are very useful to diagnose and detect tumors and other defective cells. However, sufficient knowledge and experience is desirable in order to read and understand these MRI scans. Sometimes, the lack of trained personnel may delay the diagnosis process. Therefore, in order to automate the process, a classification model can be developed using machine-learning methods," Mikhail Tsymbler says.

The study can be expanded in the direction of increasing the efficiency of the classification model when working with a large number of MRI images, which include templates with occlusions. Occlusions generally indicate a blockage of blood vessels in the brain and require special attention for accurate diagnosis. This study did not consider the application of the developed model for tumors with blood vessel occlusion; therefore, the application of deep-learning methods to such data is an interesting direction for future research.

More information: Annapareddy V. N. Reddy et al. Analyzing MRI scans to detect glioblastoma tumor using hybrid deep belief networks, *Journal of Big Data* (2020). DOI: 10.1186/s40537-020-00311-y