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Prediction of Abnormalities in Fetal Brain with Autism Classification using Radial Basis Function

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Abstract: Altered trajectories of brain growth are often reported in Autism Spectrum Disorder (ASD), particularly during the first year of life. However, less is known about prenatal head growth trajectories, and no study has examined the relation with postnatal autistic symptom severity. Propose the system to predict the autism in fetal brain using features extraction and classification techniques using Radial basis function. The main scope of project is to identify autism in fetal brain images using radial basis function with improved accuracy rate. MRI imaging is one of the most popular medical imaging technologies that can help a physician evaluate, diagnose and treat medical conditions. Present an accurate detection of Autism Disorder from fetal MRI. Identify grey matter composition in the brain. Assessed the relation between repeatedly measured fetal brain and autistic traits using latent growth curve modelling based on radial basis function.

Keywords: Magenetic resonance imaging, fetal brain classification, fetal brain segmentation, active countor, CNN.

I. INTRODUCTION

A. Image Processing

In imaging science, image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Images are also processed as three-dimensional signals with the third-dimension being time or the z-axis. Image processing usually refers to digital image processing, but optical and analog image processing also are possible Closely related to image processing are computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans). In modern sciences and technologies, images also gain much broader scopes due to the ever growing importance of scientific visualization (of often large-scale complex scientific/experimental data).

Examples include microarray data in genetic research, or real-time multi-asset portfolio trading in finance. Image analysis is the extraction of meaningful information from images; mainly from digital images by means of digital image processing techniques. Image analysis tasks can be as simple as reading bar coded tags or as sophisticated as identifying a person from their face. Computers are indispensable for the analysis of large amounts of data, for tasks that require complex computation, or for the extraction of quantitative information. On the other hand, the human visual cortex is an excellent image analysis apparatus, especially for extracting higher-level information, and for many applications — including medicine, security, and remote sensing — human analysts still cannot be replaced by computers. For this reason, many important image analysis tools such as edge detectors and neural networks are inspired by human visual perception models. Image editing encompasses the processes of altering images, whether they are digital photographs, traditional photochemical photographs, or illustrations. Traditional analog image editing is known as photo retouching, using tools such as an airbrush to modify photographs, or editing illustrations with any traditional art medium. Graphic software programs, which can be broadly grouped into vector graphics editors, raster graphics editors, and 3D modelers, are the primary tools with which a user may manipulate, enhance, and transform images. Many image editing programs are also used to render or create computer art from scratch. Raster images are stored in a computer in the form of a grid of picture elements, or pixels. These pixels contain the image's color and brightness information. Image editors can change the pixels to enhance the image in many ways. The pixels can be changed as a group, or individually, by the sophisticated algorithms within the image editors. However, vector graphics software, such as Adobe Illustrator, CorelDRAW, Xara Designer Pro, PixelStyle Photo Editor, Inkscape or Vectr, are used to create and modify vector images, which are stored as descriptions of lines, Bézier curves, and text instead of pixels. It is easier to rasterize a vector image than to vectorize a raster image; how to go about vectorizing a raster image is the focus of much research in the field of computer vision. Vector images can be modified more easily, because they contain descriptions of the shapes for easy rearrangement. They are also scalable, being rasterizable at any resolution.

B. Steps of Image Processing

Image Acquisition: This is the first step or process of the fundamental steps of digital image processing. Image acquisition could be as simple as being given an image that is already in digital form. Generally, the image acquisition stage involves pre-processing, such as scaling etc.

Image Enhancement: Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image.

Image Restoration: Image restoration is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

Color Image Processing: Color image processing is an area that has been gaining its importance because of the significant increase in the use of digital images over the Internet. This may include color modeling and processing in a digital domain etc.

Wavelets and Multi-Resolution Processing: Wavelets are the foundation for representing images in various degrees of resolution. Images subdivision successively into smaller regions for data compression and for pyramidal representation.

Compression: Compression deals with techniques for reducing the storage required to save an image or the bandwidth to transmit it. Particularly in the uses of internet it is very much necessary to compress data.

Morphological Processing: Morphological processing deals with tools for extracting image components that are useful in the representation and description of shape.

C. Segmentation

Segmentation procedures partition an image into its constituent parts or objects. In general, autonomous segmentation is one of the most difficult tasks in digital image processing. A rugged segmentation procedure brings the process a long way toward successful solution of imaging problems that require objects to be identified individually. Segmentation is a classifier which helps to fragment each character from a word present in a given image or page. The objective of the segmentation is to extract each character from the text present in the image. After performing Segmentation, the characters of the string will be separated and it will be used for further processing. Different character segmentation techniques has been proposed until like, Dissection Techniques, Recognition Based Hidden Markov Models and Non-Markov Approaches, Holistic Strategies. By dissection is meant the decomposition of the image into a sequence of sub images using general features. The structure consists of a set of states plus transition probabilities between states. A method stemming from concepts used in machine vision for recognition of occluded objects. A holistic process recognizes an entire word as a unit.

D. Classification

Classification includes a broad range of decision-theoretic approaches to the identification of images (or parts thereof). All classification algorithms are based on the assumption that the image in question depicts one or more features (*e.g.*, geometric parts in the case of a manufacturing classification system, or spectral regions in the case of remote sensing, as shown in the examples below) and that each of these features belongs to one of several distinct and exclusive classes.

The classes may be specified *a* priori by an analyst (as in supervised classification) or automatically clustered (*i.e.* as in unsupervised classification) into sets of prototype classes, where the analyst merely specifies the number of desired categories. (Classification and segmentation have closely related objectives, as the former is another form of component labeling that can result in segmentation of various features in a scene.) Image classification analyzes the numerical properties of various image features and organizes data into categories. Classification algorithms typically employ two phases of processing*:* training and testing. In the initial training phase, characteristic properties of typical image features are isolated and, based on these, a unique description of each classification category, i.e. training class, is created. In the subsequent testing phase, these feature-space partitions are used to classify image features.

II. RELATED WORK

"AUTOMATIC BRAIN LOCALIZATION IN FETAL MRI USING SUPERPIXEL GRAPH" by AMIR ALANSARY , 2015 the paper contributes Fetal magnetic resonance imaging (MRI) has significantly improved in the last two decades, and is emerging as a novel, non-invasive tool for diagnosis and planning of surgical interventions. It provides higher contrast and larger field of-view than ultrasound. Thus, it provides better structural information of the different fetal organs such as the brain, spine and body. Fetal brain localization is important for assessing the fetal brain development and maturation. It is also the primary step for most of the current automatic motion correction techniques for fetal MRI. In this paper we propose a fully-automated framework for localizing the fetal brain in fetal MRI scans. Rather then working on individual pixels we make use of super pixels for a faster and more efficient detection algorithm. Because of the nature of superpixels that most likely represents the rigid regions in the image, using superpixels neighbour's instead of pixel neighbors can reduce the effect of motion artifacts. Therefore, we have developed a new superpixel graphical model based on both spatial and intensity distances in 3D.Then each superpixel's histogram is normalized with its neighbour's in the graphical model. During the fourth step, we use a random forest to generate a probability map of the brain for every superpixel. Finally, this probability map is refined using another auto-context classifier followed by selecting the largest 3D component.

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"**A REVIEW ON AUTOMATIC FETAL AND NEONATAL BRAIN MRI SEGMENTATION"** by ANTONIOS MAKROPOULOS, 2017Automated morphometric analysis of the perinatal brain is essential to quantitatively assess normal brain development and investigate the neuroanatomical correlates of cognitive impairments. Several neurological deficits have been associated with abnormalities in the developing brain, presenting a window for therapeutic intervention. In recent years, a variety of segmentation methods have been proposed for automatic delineation of the fetal and neonatal brain MRI. These methods aim to define regions of interest of different granularity: brain, tissue types or more localised structures. Different methodologies have been applied for this segmentation task and can be classified into unsupervised, parametric, classification, atlas fusion and deformable models. Brain atlases are commonly utilised as training data in the segmentation process. Challenges relating to the image acquisition, the rapid brain developments as well as the limited availability of imaging data however hinder this segmentation task. In this paper, we review methods adopted for the perinatal brain and categorise them according to the target population, structures segmented and methodology. We outline different methods proposed in the literature and discuss their major contributions. Different approaches for the evaluation of the segmentation accuracy and benchmarks used for the segmentation quality are presented. We conclude this review with a discussion on shortcomings in the perinatal domain and possible future directions.

"MULTIVARIATE ANALYSES APPLIED TO FETAL, NEONATAL AND PEDIATRIC MRI OF NEURODEVELOPMENTAL DISORDERS" by JACOB LEVMAN, 2015The developing brain is a distributed processing machine undergoing rapid change. Basic functional tasks require the coordination and cooperation of neurons in multiple brain regions all of which are in a state of rapid growth. Multivariate analysis (MVA) is a class of statistical and pattern recognition methods that involve the processing of data that contains multiple measurements per sample. MVA can be used to address a wide variety of medical neuroimaging-related challenges including identifying variables associated with a measure of clinical importance (i.e. patient outcome), creating diagnostic tests, assisting in characterizing developmental disorders, understanding disease etiology, development and progression, assisting in treatment monitoring and much more. Compared to adults, imaging of developing immature brains has attracted less attention from MVA researchers. However, remarkable MVA research growth has occurred in recent years. This paper presents the results of a systematic review of the literature focusing on MVA technologies applied to neurodevelopmental disorders in fetal, neonatal and pediatric magnetic resonance imaging (MRI) of the brain. The goal of this manuscript is to provide a concise review of the state of the scientific literature on studies employing brain MRI and MVA in a pre-adult population. Neurological developmental disorders addressed in the MVA research contained in this review include autism spectrum disorder, attention deficit hyperactivity disorder, epilepsy, schizophrenia and more.

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III. PROBLEM FORMULATION

Existing works, related to Using deep learning approach to categorize the abnormal tissues in earlier stages Implement active contour method to segment the brain regions to remove the outliers in brain tissues Convolutional neural network can be used as deep learning algorithm for abnormal tissue prediction

A. Objective: The main scope of project is to identify autism in fetal brain images using radial basis function with improved accuracy rate

IV. PEDECTION OF ABNORMALITIES

A. Image Acquisition

Important neurodevelopmental changes occur in the last trimester of pregnancy, i.e., between 30 and 40 weeks of gestation, including volumetric growth, myelination and cortical gyrification. Magnetic Resonance Imaging (MRI) is widely used to non-invasively assess and monitor the developmental status of the fetal brain in utero. The cornerstone of volumetric and morphologic analysis in fetal MRI is the segmentation of the fetal brain into different tissue classes, such as white and gray matter. Performing this segmentation manually, however, is extremely time-consuming and requires a high level of expertise. The reasons are not only the complex convoluted shapes of the different tissues, but also the limited image quality due to imaging artifacts. Fetal MR imaging is particularly challenging in this regard because the receiver coils can only be positioned on the maternal body and not closer to the anatomy of interest. Furthermore, movements of the fetus relative to the mother can only to some extent be controlled and predicted. Especially, fetal motion therefore negatively affects the image quality and causes artifacts such as intensity inhomogeneity. In this module, admin can upload the MRI image of pregnant ladies. Magnetic Resonance Imaging (MRI) is an important tool for medical investigation of the brain and is considerably enhanced in uterus fetal brain imaging. Images can be any type and any size.

B. Preprocessing

Pre-processing is necessarily for to correct and adjust the image for further study and processing. To improve the image in ways that increases the chances for success of the other processes. The gray scale conversion operation is to identify black and white illumination. Different types of filtering techniques are available for pre-processing. These filters normally used to improve the image quality, suppress the noise, preserves the edges in an image, enhance and smoothen the image. And have used various filters namely, median filter, adaptive median filter, average or mean filter, and wiener filter used for MRI brain image pre-processing. From this observation median filter is better while compare with other filters. The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below), also having applications in signal processing. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors' is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighbouring pixels. The pattern of neighbours is called the "window", which slides, pixel by pixel over the entire image pixel, over the entire image. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value.

C. Segmentation

Morphological filters were originally developed for binary images but soon they were extended to gray-scale images. These filters use the most basic operator such as dilation and erosion by means of which other more complex operator such as opening, closing and hit or miss transform can be derived. Whenever mathematical morphology is used in the image processing, the basic assumption is that image can be represented by a point set. Language of mathematical morphology is a set theory. Mathematical morphology represents object in an image by sets of pixels. After that implement Guided active contour method with automatic descriptors. Unconstrained active contours applied to the complex natural images we aim at dealing with would produce unsatisfying contours, that would try and make their way through every possible gap and aw in the border of the brain tissues. With an iterative process similar to active contours, the initial model will undergo a series of deformations, whose goal is to minimize an energy functional based on described dissimilarity map. The internal energy term that traditionally appears in the energy formulation can be considered as implicit here, as it is included in the construction rules of our model. The solution we propose is to use the polygonal model obtained after the first step not only as an initial brain contour but also as a shape prior that will guide its evolution towards the brain outer boundary.

D. Features Extraction

Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. Texture tactile or visual characteristic of a surface. Texture analysis aims in finding a unique way of representing the underlying characteristics of textures and represent them in some simpler but unique form, so that they can be used for robust, accurate classification and segmentation of objects. Though texture plays a significant role in image analysis and pattern recognition, only a few architectures implement onboard textural feature extraction. In this module implement color and texture features are implemented. HSV color features are extracted and Texture features include statistical features.

E. Classification

The classification is the final step of the system. After analyzing the structure, each section individually evaluated for the probability of true positives. The classification is the final step of the system. After analyzing the structure, each section individually evaluated for the probability of true positives. Brain regions are classified using Convolutional neural network algorithm. CNNs represent feed-forward neural networks which encompass diverse combos of the convolutional layers, max pooling layers, and completely related layers and Take advantage of spatially neighbourhood correlation by way of way of imposing a nearby connectivity pattern among neurons of adjacent layers. Convolutional layers alternate with max pooling layers mimicking the individual of complex and clean cells in mammalian seen cortex. A CNN includes one or extra pairs of convolution and max pooling layers and ultimately ends with completely related neural networks. The hierarchical structure of CNNs is steadily proved to be the most efficient and successful manner to analyze visible representations. In this module, we can classify the features to predict the abnormal tissues. CNN algorithm is to construct the layers for classification. Finally categorize the features to predict the abnormality in earlier stage.

F. Performance Evaluation

Different performance measures such as accuracy, sensitivity, specificity can be derived for analyzing the performance of the system.
True positive (TP): number of true positives - perfect positive prediction
False positive (FP): number of false positives - imperfect positive prediction
True negative (TN): number of true negatives - perfect negative prediction
False negative (FN): number of true negatives - imperfect negative prediction
Accuracy (ACC) is found as the fraction of total number of perfect predictions to the total number of test data. It can also be represented as 1 – ERR. The finest possible accuracy is 1.0, whereas the very worst is 0.0.

$$\text{ACC} = \frac{\text{TP+TN}}{\text{TP+TN+FN+FP}} \text{ x } 10$$

V. METHODOLOGY

A. RADICAL BASIC FUNCTION

Radial basis functions are means to approximate multivariable (also called *multivariate*) functions by linear combinations of terms based on a single univariate function (the **radial basis function**). This is radialised so that in can be used in more than one dimension. They are usually applied to approximate functions or data (Powell 1981,Cheney 1966,Davis 1975) which are only known at a finite number of points (or too difficult to evaluate otherwise), so that then evaluations of the approximating function can take place often and efficiently. Primarily in computational applications, functions of many variables often need to be approximated by other functions that are better understood or more readily evaluated. This may be for the purpose of displaying them frequently on a computer screen for instance, so computer graphics are a field of practical use. Radial basis functions are one efficient, frequently used way to do this. Further applications include the important fields of neural networks and learning theory. Since they are radially symmetric functions which are shifted by points in multidimensional Euclidean space and then linearly combined, they form data-dependent approximation spaces. This data-dependence makes the spaces so formed suitable for providing approximations to large classes of given functions. It also opens the door to existence and uniqueness results for interpolating scattered data by radial basis functions in very general settings (in particular in many dimensions).

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VI. CONCLUSION

Segmentation and classification of the fetal and neonatal brain is increasingly gaining interest with the acquisition of better-quality images and the increased focus on fetal and neonatal development. An automatic method is presented for brain tissue segmentation in fetal MRI into seven tissue classes using convolutional neural networks. In the proposed method learns to scope with intensity inhomogeneity artifacts by augmenting the training data with synthesized intensity inhomogeneity artifacts. To better understand the relevance of our predictive CNN to fetal development, sensitivity analysis is used to isolate regions critical for CNN performance, and discovered that our most sensitive regions were regions that are high in metabolic activity in early human brain development. In this proposed system morphological operations, guided active contour method and CNN based classification are implemented. This can potentially replace or complement pre-processing steps, such as bias field corrections, and help to substantially improve the segmentation and classification performance

VII. FUTURE WORK

Future work explores extracting diagnostic features in the segmented brain regions of the MRI image and integrates these methods in the developed CAD system for autism. In order to enhance the diagnostic accuracy, future work will investigate integrating other diagnostic features that will be extracted from other brain structures.

REFERENCES

1. A. Alansary et al., "Automatic Brain Localization in Fetal MRI Using Superpixel Graphs," in Machine Learning Meets Medical Imaging, 2015, pp. 1322.
2. G. Ball et al., "Machine-learning to characterise neonatal functional connectivity in the preterm brain," Neuroimage, vol. 124, no. Pt A, pp. 267–275, Jan. 2016.
3. M. Havaei et al., "Brain tumor segmentation with Deep Neural Networks," Med. Image Anal., vol. 35, pp. 18–31, Jan. 2017.
4. Y. Jin et al., "Identification of Infants at High-Risk for Autism Spectrum Disorder Using Multiparameter Multiscale White Matter Connectivity Networks," Hum. Brain Mapp., vol. 36, no. 12, pp. 4880–4896, Dec. 2015.
5. J. Levman and E. Takahashi, "Multivariate analyses applied to fetal, neonatal and pediatric MRI of neurodevelopmental disorders," NeuroImage Clin., vol. 9, pp. 532–544, Jan. 2015.
6. A. Makropoulos, S. J. Counsell, and D. Rueckert, "A review on automatic fetal and neonatal brain MRI segmentation," NeuroImage, Jun. 2017.
7. NeuroImage Clin., "Early prediction of cognitive deficits in very preterm infants using functional connectome data in an artificial neural network framework," vol. 18, pp. 290–297, Jan. 2018.
8. M. Sanz-Cortes et al., "Automatic Quantitative MRI Texture Analysis in Small-for-Gestational-Age Fetuses Discriminates Abnormal Neonatal Neurobehavior," PLOS ONE, vol. 8, no. 7, p. e69595, Jul. 2013.
9. M. Sanz-Cortés et al., "Fetal brain MRI texture analysis identifies different microstructural patterns in adequate and small for gestational age fetuses at term," Fetal Diagn. Ther., vol. 33, no. 2, pp. 122–129, 2013.
10. C. D. Smyser et al., "Prediction of brain maturity in infants using machine-learning algorithms," NeuroImage, vol. 136, p. 1, Aug. 2016.