Integrating Big Data With Measuring Liver Volume Using Algorithms Bank Removing Noise and MRI Modality

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ABSTRACT

Big data is massive amount of information that work wonderfully. Due to the great potential that it has for the last two decades this topic is taking a special interest. In any analysis scientists, the way in which it leverages, manage and analyze can change. The most promising field in which big data use for making the change is measuring soft organs in the human body such as a liver organ. For measuring organ and medical imaging informatics research it increasingly used the technologies of big data. For certain advanced big data analytics methods, predictive analytics, and user behavior analytics the term big data used. At an unprecedented scale and speed huge amount of medical imaging and visual informatics data have been collected and generated. in big data in measuring liver volume, several sources incorporate medical examination results, hospital records, devices, and patient's medical records that are a piece of the internet of things. In medical imaging, it also finds its usages. In order to treat, diagnose or monitor medical conditions to view the human body the various technologies that are used referred to as medical imaging.

Keywords: Big data, medical imaging, visual informatics, Internet of things.

INTRODUCTION

The medical images can be classified into three types that are an anatomical image, physiological image, and pathological image (Xiang et al., 2017 & Maya Eapen, Reeba Korah 2019). Anatomical model; this type of medical imaging used in information pertains to the location and extent of organ structures. While the physiological model is used to give data deals with the function of the body and the Pathological image is used to provide information applies to the abnormalities related to or produced by diseases that manifest in the medical images. From the context of the medical image types, the anatomical image is used to determine the measure liver volume. This research focuses on the anatomical image from MRI modality. Those who sought to achieve accurate results for the liver volume to the results reached through the use of different methods, as well as different algorithms. According to prior studies and to calculate the liver volume, has been using different algorithms for the calculation of the liver volume, Table 1 shows the algorithms, development, and results over the previous period.

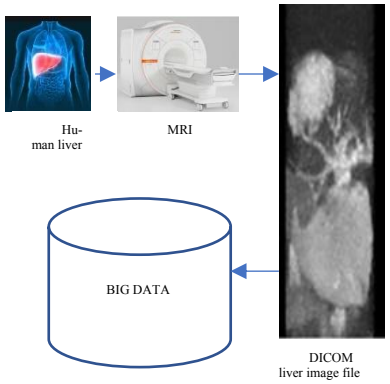

Figure. 1. Workflow of measuring liver volume

Table 1 Comparison between algorithms and Gold standard based on the liver volume and accuracy

No	Researcher	Year	Algorithm	Result
1	AJR Am J Roentgnol	2019	Level-set couple with Geodesic active contour.	Developed an automatic liver segmentation scheme for MRI
2	Cheng et al.	2012	Mote Carlo	Improved method to segment calcified vessels in
3	Kenji Suzuki et al.	2019	Geodesic active contour	Kenji Suzuki et al.
4	Cheng, et al.	2007	Mote Carlo	Merge and split methods are also shown to be very effective to demarcate objects of interest

5	Jones et al.	1997	Region-based	Integrated region-based and physics-based modelling techniques to significantly improve the boundary detection results.
6	Chang et al.	1994	Region-growing	Process on local feature space without the need of parameter tuning or requirement of prior knowledge.
7	Adams et al.	1994	Region growing	(Merge and split methods are also shown to be very effective to demarcate objects of interest) A method to achieve robust, rapid, and free of tuning parameters image segmentation. The method, however, requires the input of some seeds, either individual pixels or regions, from users.

MEDICAL IMAGE MODALITIES

Several imaging modalities provide specific types of information regarding the morphology, physical, metabolism, molecular, composition, or molecular pathways within biological tissues, and provides the information in a particular spatial and temporal that information on sensitivity for detection. No one imaging modality can approach all measurements of interest related to the biological system; therefore, it can be beneficial to acquire images of the same subject using different patterns. Multi-modalities imaging involves the simultaneous or sequential acquisition of imaging data using two or more imaging modalities. A typical example would be functional, structural imaging using molecular medicine techniques such as (PET/SPECT). To measure some aspect of biology or molecular function, combined with X-Ray, Computed tomography (CT), or magnetic.

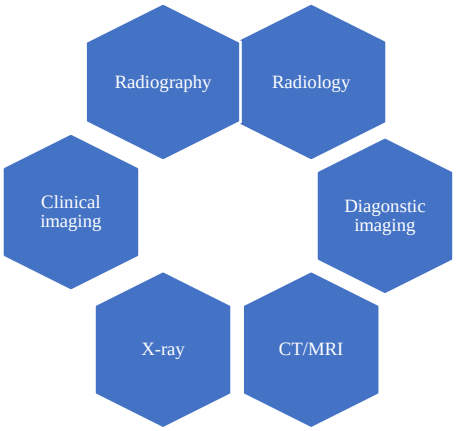

Figure2. Medical imaging modalities platform (Book. Encyclopedia of Diagnostic Imaging (Baet, 2019).

Magnetic Resonance Imaging (MRI) imaging initially researched, and the first MRI imaging prototypes tested on clinical patients in 1980. Countless scientists have involved in the innovation of magnetic resonance. The development of MRI imaging attributed to Paul Lauterbur and scientists at Thorn-EMI Laboratories, England, and Nottingham University, England. (http://www.imaginis.com/ct-scan/brief-history-of-CT).

ALGORITHMS BANK

The Algorithms Bank term is intended that the seven algorithms used in the completion of the tasks assigned to it, where a particular function for each algorithm. The Algorithms Bank has been classified into three broad classifications, as it represents the first classification algorithms that remove noise affecting the images, whether this noise was external or internal, these algorithms are Anisotropic diffusion filter and a Median filter. The second classification is the algorithms that enhance and purify the outer boundaries of the non-geometric shape and represented by the liver volume; these algorithms are A scale – particular gradient magnitude filter and Gaussian filter. The third classification described by algorithms that process complete measurements of non-geometric shapes, the non-geometric shape is a liver organ, where the liver is one of the soft organs in the human body, these algorithms are Fast marching, Geodesic Active Contour & Level set. Figure 3 shows the Algorithms Bank diagram.

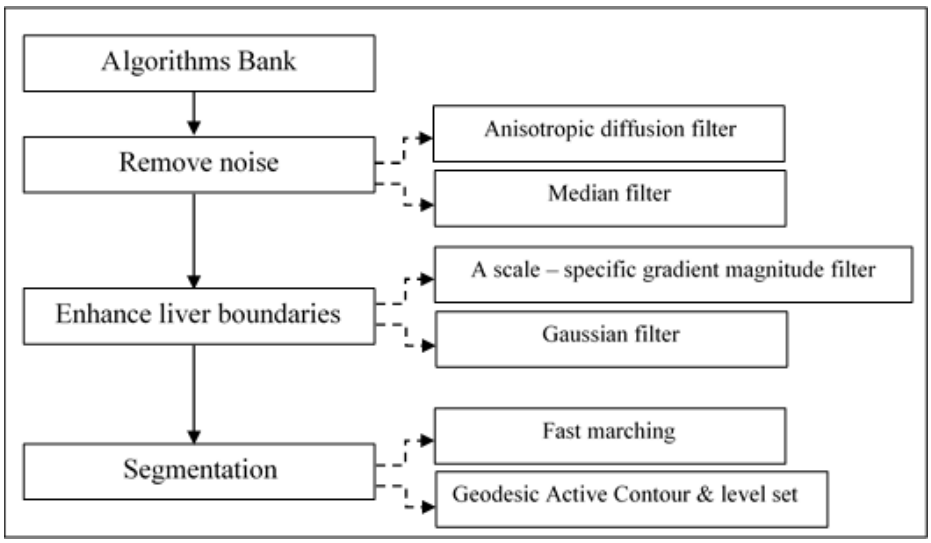

Figure.3. the algorithms Bank diagram

Referring to figure3, the Algorithms Bank depends on seven algorithms, these algorithms divided into three stages, each stage includes specific algorithms. The next part clarifies the algorithms. In the proposed framework, precise and suitable elements from measuring non-geometric methods are selected to form the framework for programming, measuring non-geometric soft organs in the human body. This structure illustrated in figure3

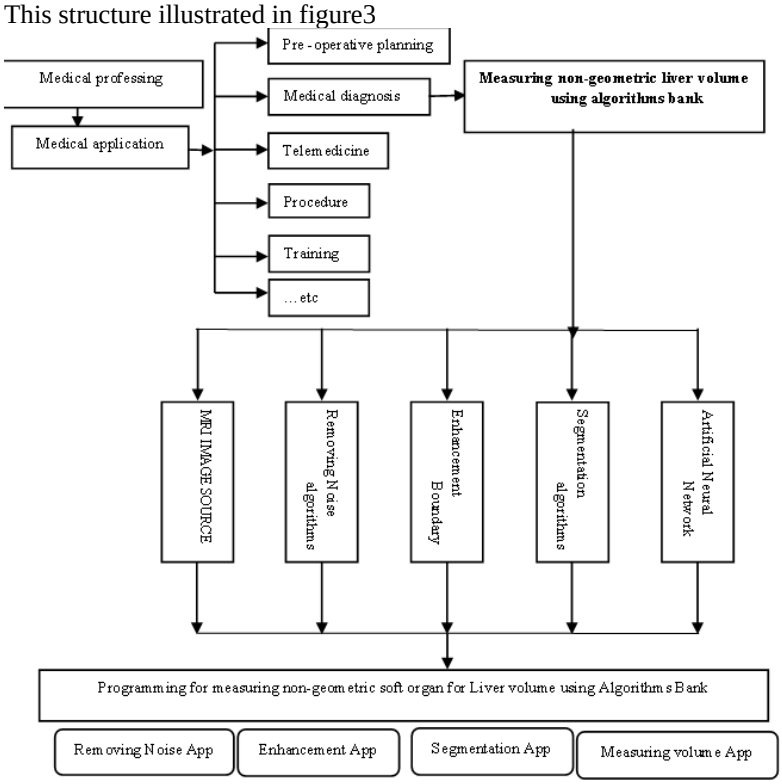

Figure. 4. Framework for Programming, Measuring Non-Geometric Soft Organ

In figure 4, the service offered in the programming, measuring non-geometric soft organs includes removing noise, enhancement, segmentation, and measuring volume. This figure shows the framework for measuring the liver volume, the framework includes four sub-program, each of them generates results, where the results of removing noise application, enhancement application, and segmentation application with measuring liver volume application. The comparison includes two measures, these measures are accuracy and error rate.

SYSTEM ARCHITECTURE FOR MEASURING NON-GEOMETRIC SHAPE SOFT ORGAN IN HUMAN BODY- LIVER VOLUME

The system architecture for measuring non-geometric shape delicate organ- liver volume- divided into three sections so that each section has a particular role. The first section is the user, who is using the prototype application. The second part represents the medical application, this section divided into three sub-applications, these applications are removing a noise application, enhancement application, and segment application. The previous sub-applications controlled by the artificial neural network to reduce the error rate with more accuracy. The third section is called a template section, which linked to the previous medical application. The purpose of this section measuring the new image after manipulating it for medical use, the new image compares with the previous templates in the template section. When the image is new, the template section creates a new template and store it. The following flow chart, figure 5, shows the creation of a new template using the medical application.

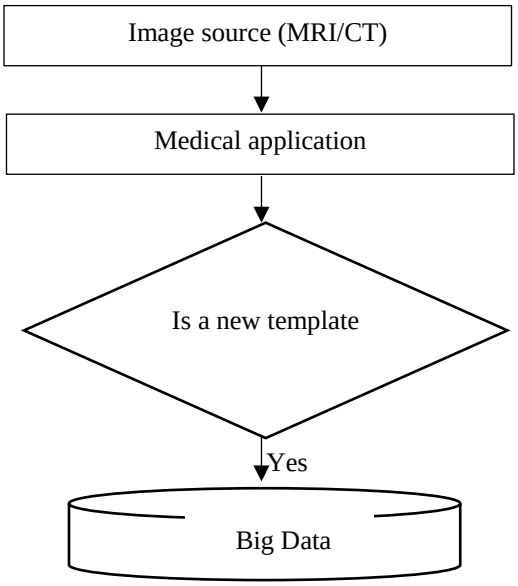

Figure. 5**.** Create a new template

In figure 6, Illustrates the removing noise from the image, in this case, the images from two modalities sources MRI. Also, the figure 6 Illustrates the measuring liver volume histogram by the Template using the Algorithms Bank and measuring liver volume histogram by removing noise method using two algorithms, and these algorithms are Anisotropic diffusion filter algorithms and Median filter algorithm.

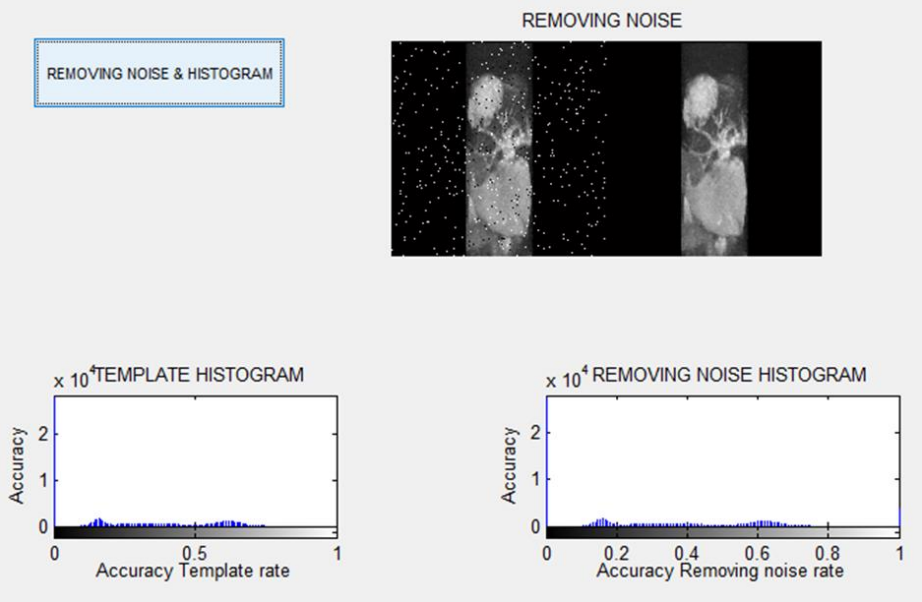

Figure. 6. illustrates the removing noise and comparison the measuring liver volume Histogram between Algorithm's bank's Template method and removing method

Regarding the removing noise method and Algorithms Bank method, the prototype application has been given the results from two modalities; these modalities are MRI.

MRI MODALITY

When implemented the removing noise method and Algorithms Bank method using the MR modality resources, the system gave the results in Table 5.1. In Table 5.1 Illustrates the comparison between removing noise method and Algorithms Bank method, the comparison includes the two parameters, accuracy and error rate. The source of this case from the MRI modality, from this modality, has gotten representative images, six male, and four females, the age ranging between 42 and 55 years. The comparison results between two methods represented in the following table 2.

Table 2 The comparison results between Removing Noise Algorithms method and Algorithms Bank Template method using MRI modality

				Removing noise algorithms method		**Algorithms bank hybrid method**	
No	**Modality**	**Gender**	**Age**	**Accuracy (100%)**	**Error rate (100 %)**	**Accuracy (100%)**	**Error rate (100%)**
1	MRI	Male	45	99.40	3.60	99.7	3.20
3	MRI	Male	40	99.40	3.60	99.8	3.10
4	MRI	Male	55	99.50	3.60	99.8	3.10
7	MRI	Male	44	99.30	3.80	99.8	3.10
9	MRI	Male	40	99.40	3.60	99.8	3.00
8	MRI	Male	52	99.20	3.60	99.7	3.10
5	MRI	Female	55	99.50	3.60	99.7	3.20
2	MRI	Female	50	99.20	3.70	99.6	3.20
6	MRI	Female	49	99.40	3.60	99.7	2.90
10	MRI	Female	42	99.50	3.60	99.8	3.10

In Table 2, the high accuracy value using the Remove noise method is 99.5, this value repeated three times, while that the high-efficiency value using the Algorithms Bank is 99.8, this value repeated five times. For the error rate, the lowest error rate value using the Remove noise is 3.6, this value repeated eight times, while that the lowest error rate using Algorithms Bank is 3.00, this value happens one time. Through the previous readings, which were monitored in table 2, it is clear that the algorithms bank hybrid method is more high accuracy and less error rate than removing noise algorithms. To present the data in Table 5.1 using the bar chart, diagram, figure 5 illustrates the data in columns. In figure 7 Illustrates also the comparison between the removing noise method and Algorithms' Bank Hybrid method using MRI modality source, this comparison regarding accuracy and error rate with two factors, age, and gender. Figure 6 Comparison Remove noise method and Algorithms Bank hybrid method using MRI modality.

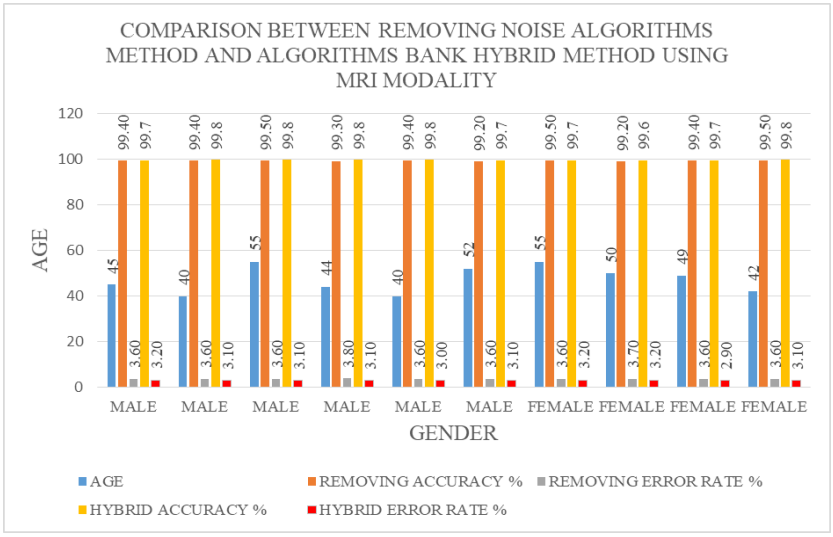

Figure. 7. Illustrates the number of six male and four female cases under the studying the measuring liver volume.

In figure 7, the bar chart illustrates the number of six male and four female cases under the studying the measuring liver volume, the age of the male and female between 40 years to 55 years. Each case the chart illustrates four figures, that figures are age, measuring liver volume by removing noise method, measuring volume by the Algorithms Bank hybrid method and the two error rates by the previous methods. In Table 3 calculated the average results from the two approaches, these methods removing noise and Algorithm Bank Hybrid method. The table illustrates the comparative average for age, accuracy and error rate.

Table 3 Illustrates the comparison, average results between removing noise method and Algorithms Bank using MRI modality

		Removing noise		**Algorithm's bank**	
	Age	**Accuracy**	**Error rate**	**Accuracy**	**Error rate**
Average	47	99.38	3.63	99.74	3.10

When examining the results in Table 3 in the bar chart, figure 8 illustrates the high accuracy average results for the previous methods in the bar graph. In this graph, It can saw that the accuracy average of the liver volume by the removing noise method is 99.38%, while that the accuracy of the liver volume by the Algorithms Bank Hybrid method is 99.74%, this means the accuracy in Algorithms Bank is higher than removing noise by 0.36%.

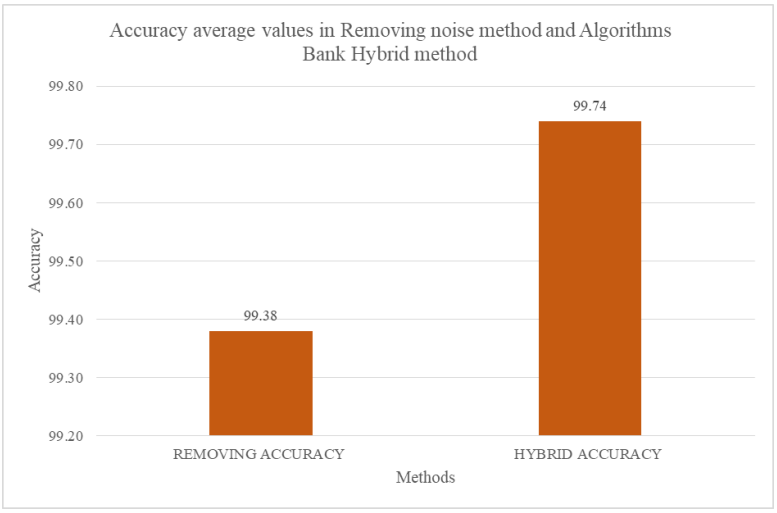

Figure. 8. llustrates the comparison averages values between removing noise method and Hybrid method in accuracy and error rate using MRI modality

Referring to table 3, figure 9 displays an error rate in two methods, these methods are removing noise and Algorithms Bank Hybrid method. The removing error rate is 3.63 and the Algorithms Bank Hybrid error rate is 3.1 when they examine the two error rate values; the Algorithms Bank Hybrid error rate is less than the removing error rate by 0.53. The bar chart shows the number of six male and four female cases under the studying the measuring liver volume, the age of the male and female between 40 years to 55 years.

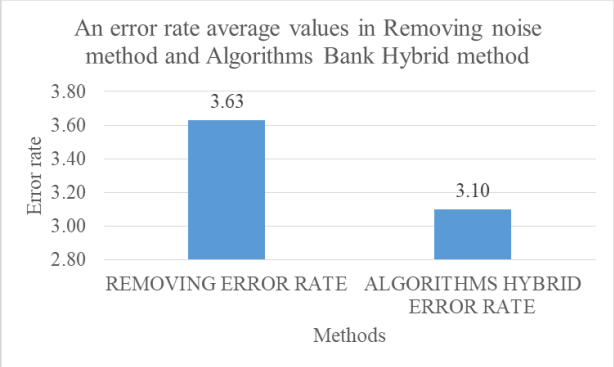

Figure 9. Illustrates the comparison averages values between removing noise method and Algorithms Bank Hybrid method in an error rate using MRI modality

FUTURE WORK

In order to produce a better system and improve the research, future works that can be undertaken are as follow It necessary to collect more images related to the prototype application liver volume with high definition to obtain high accuracy with reducing the error rate. It is better to develop the source image from another different source such as PET, X-ray A. The images convert under the DICOM extension file and testing by the prototype application to get the measurement organ.

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