Features Extraction to Differentiate of Spinal Curvature Types using Hue Moment Algorithm

by Yessi Jusman

Submission date: 19-May-2020 01:11PM (UTC+0700)
Submission ID: 1327567998
File name: atures_Extraction_to_Differentiate_of_Spinal_Curvature_Types.pdf (1.18M)
Word count: 2917
Character count: 14805

Features Extraction to Differentiate of Spinal Curvature Types using Hue Moment Algorithm

IOP Conf. Series: Journal of Physics: Conf. Series **1471** (2020) 012060 doi:10.1088/1742-6596/1471/1/012060

Features Extraction to Differentiate of Spinal Curvature Types using Hue Moment Algorithm

Muhammad Ainzulhafiz Mat Salleh[1], Siti Nurul Aqmariah Mohd Kanafiah[1], Yessi Jusman[2*], and Mohd Imran yusof[3]

[1]School of Mechatronic Engineering, Universiti Malaysia Perlis, Pauh Putra Campus, 02600 Arau, Perlis, Malaysia
[2]Department of Electrical Engineering, Faculty of Engineering, Universitas Muhammadiyah Yogyakarta, Bantul, Daerah Istimewa Yogyakarta, Indonesia
[3]Orthopedic, University of Science Malaysia, Malaysia

*yjusman@umy.ac.id

Abstract. Nowadays, diagnosing the spinal problems is very important to medical field. The objective of this research is to develop feature extraction technique to obtain the features, which automatically differentiate images of normal and abnormal (scoliosis) spinal curvatures. The process to extract features of spinal image start with image acquisition, image processing (i.e. enhancement, filtering, and segmentation). For image processing method, the most important part in this phase is the segmentation using manual threshold method. After the segmentation, hue moment for size and parameter are used to extract features that should be considered based on probabilistic to classify the spine images. The final experimental result shows that the developed features extraction technique can differentiate between normal and scoliosis spine images.

1. Introduction

There are several types of modalities used to capture the image in the medical field which Magnetic Resonance Imaging (MRI), Ultrasound Tomography (PET), Computed Tomography (CT) scan and X-ray Radiography [1]. Each of medical images having its own specialties only views using an appropriate modality to capture the medical images. Spinal curvature image is one of the most famous in the medical field vision system processing. By captured the images of the spinal, the doctor will know the condition of spinal whether it is normal or not. There are several types of abnormal spinal curvature which scoliosis, lordosis and kyphosis. Most of spinal curvature image captured using an X-ray modality. Diagnosis is an important element to get the image to continue an acquisition process. The modality that common used for diagnosis which is X-ray radiography. 33 individual bones consist by the spine that stacked on of each other. The spine keeps aligned by ligament and muscles connect to the bone. The spinal column is necessary for body to provide stand upright, bend and twist movement function. The movement of arms and legs is affected when the spinal cord connect to the body. Then, actually it protected deep inside the bones. Active life without any back problem will face when keep spine in good health.

Figure 1 shows the region of spinal column. The cervical and lumbar region has a slight concave curve while sacral and thoracic region having convex curve in gentle condition. The simple coil spring functions to maintain balance and absorb shock. It looks same like spinal column. Then, it allows

range of motion throughput the spine. Cervical consists of 7 vertebras which represent C1 to C7. This cervical plays a vital role to support weight of the head. The head's weight is around 10 pounds. When the skull is connect with two desired vertebrae, so neck part which cervical region has the greatest range of motion. Thoracic consists of 12 vertebras which numbered T1 to T12. Protect the hearts and lungs also hold the rib cages are the main function of thoracic spine. In thoracic spine, motion has its own limitation.

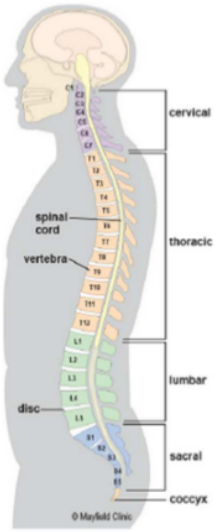

Figure 1. Five regions of spinal column [2].

Lumbar consists of 5 vertebras which represented L1 to L5. This thoracic spine plays a role to bear the weight of the body. Absorb the stress of lifting and carrying heavy objects as these vertebras are much larger in size. Sacrum consists of 5 sacral vertebras and it fused together. Pelvic or ring is formed girdle when spine is fused with hip bones. Connect the spine with the iliac is the main function of the sacrum. Coccyx consists of 4 fused bones or tailbone. It will help an attachment for ligaments and pelvic floor's muscle [2]. By going detail in each parts of the spinal region, so take good care of spinal postures to maintain the natural spines curve. The muscle in weak condition, weight of body over the limit and other related forces will affect the spine. 3 types of abnormal spinal curvature which is lordosis represents an abnormal curve of lumbar spine), kyphosis represents an abnormal curve of thoracic spine) and scoliosis represents an abnormal curve from side to side.

The angle of normal spine's cervical is 20 to 40 degrees, at thoracic between 20 and 40 degrees and 40 to 60 degrees at lumbar vertebra. Lordosis happens at lumbar and cervical spine. It exaggerate inward curve on the spine involved [3]. The patients who face this problem should have more than 60 degrees in lumbar and more than 40 degrees in cervical. Lordosis will be caused by osteoporosis, achondroplasia and others. For kyphosis, the thoracic part of the spine is normal for this problem to take place [4]. When the angle of curve on the thoracic is identify more than 40 degrees, so kyphosis occur. It exaggerate outward curve. Osteoporosis and spinal fracture are lead to kyphosis problem.

Sko-lee-oh-sis, is the word from Greek whose meaning crooked. Lateral curvature of the spine is called scoliosis. The large number of degrees of lateral curvature can cause postural imbalance while smaller curves does not cause any medical problem. Someone who having this deformity, the spines may look like "S" and "C" shape than a straight line which is normal spine [5]. There are some caused of this disease which genetic condition, osteoporosis, neuromuscular problem, unequal limb length and others. About 2 to 3% of the world population was effect by scoliosis. According to it severity, it

can be categorized into 3 types. Mild (cobb angle is between 10 and 20 degrees), moderate (cobb angle is between 20 and 40 degrees) and severe (cobb angle is above 40 degrees).

In this research, there are 3 phases to classify the spinal image such as image acquisition, image processing and classification process. Acquisition of spinal image is get from primary source. Different modalities use will result the different input image. Image processing is divides into three which are filtering process, segmentation of image and feature extraction. Filtering will undergo process to eliminate the unwanted noise contain in the spinal curvature image. For segmentation, system that achieve good segmentation quality of spinal's image is created given the Cobb angle which an angle between the lines passing through the margins of the vertebrae at the end of the curve. Radius, angle and shape elements are need to extract in this vital feature extraction methods. There are numerous ways and a lot of modalities to obtain the medical images. Medical images are diagram that visualize inside human part of body. It purpose to diagnosis and analysis project. In the emerging technology, Magnetic Resonance Imaging (MRI), Ultrasound Imaging, Computed Tomography (CT), Microscopic Imaging, Position Emission Tomography (PET) and X-ray Radiography are including as the different imaging modalities.

For contrast enhancement, remove noise and increase contrast by using histogram equalization. By applying this method, the quality of the image is improved. In histogram, the better gray intensities distribute on it provided by contrast adjustment process. Several studies has applied the contrast enhancement for the biomedical images [6], [7].

Image filtering is a pre-processing method. The function of the image filtering or denoising is to remove noise in the image. The diagnostic of disease step will be easy and help to get best analysis after remove noise [8].

Segmentation is one step of image processing. After denoising the image, this process will take place. It functions to identify a particular workspace [9]. Researcher (Ramakrishnan & Sankaragomathi, 2016) uses Sparse Deep Neural Networks (SDNN) technique to segment the brain images [10]. Researcher (Pereira et al., 2016) uses Random Forests and Conditional Random Fields to segment the brain tissue images [9].

2. Methodology

The image is captures using X-ray radiography image. The data image is collected from the Hospital Universiti Sains Malaysia (USM), Kubang Kerian. The normal and abnormal (scoliosis) images was taken from subjects age 8 to 20 years old. The location of X-ray radiography took the image is not same in each image data. The images of normal spine and scoliosis spine used in this paper consist of 130 images which 65 image per class. Several image processing techniques are applied to the images (i.e. enhancement, filtering, segmentation, and feature extraction).

Enhancement technique which histogram equalization is applies in this process. Image is not in better views and contained some noise that effected image to be process. The unwanted noise in this spinal image should be removed. Then, the image's contrast will increase by using this method. The gray intensity should be increase. As this paper, both background and foreground of spinal curvature present bright and dark color, it suitable to be applied with this method. The contrast enhancement image still present the noise affected the quality of the image. So, median filter should be applied to remove the unwanted noise. Although the noise was removed, the detail of the images still presented. It will help the image could be segmented in the next process.

Threshold method is proposed to be undergoing in this process. The change from intensity image to the binary image is the function of this method. [0, 1] is the range of intensity value's normalize into it. It shows the manual threshold properties. The image of spinal curvature consists of white and black color is helps this threshold method become more efficient to reduce variance of intra-class of each image pixels. As the histogram equalization done before, compute the manual threshold method directly.

Features extraction technique applied in this paper is hue moment technique to extract shape (i.e. size and perimeter). The features are extracted from total 130 spine images. The results of size and perimeter are tabulated in the result section.

IOP Conf. Series: Journal of Physics: Conf. Series **1471** (2020) 012060 doi:10.1088/1742-6596/1471/1/012060

3. Results and Discussions

This section will discuss detail results for each of the process from image acquisition until extracted feature from the spines image. Figure 2 shows sample for normal image: (a) original image, (b) gray scale image, (c) contrast enhancement image, and (d) filtered image. While figure 3 shows sample for scoliosis image: (a) original image, (b) gray scale image, (c) contrast enhancement image, and (d) filtered image.

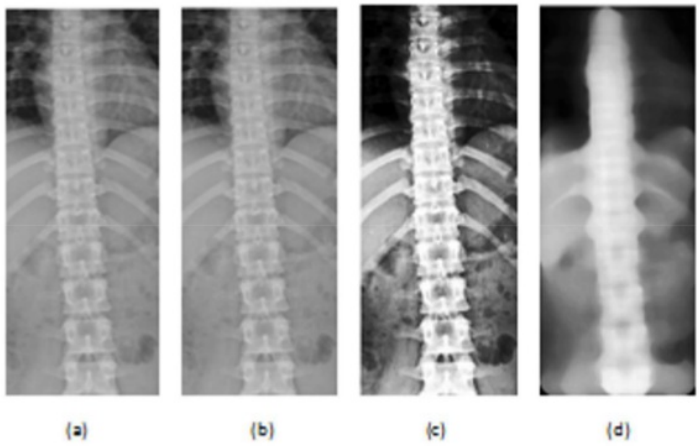

Figure 2. Result of normal spine sample.

After the filtering technique, the feature extraction is applied to both classes (i.e. normal and scoliosis spine images). The shape features (i.e. size and perimeter) calculated and tabulated in tables 1 and 2. In table 1 shows those values for normal and scoliosis in size features. As a reference, using M1 of Hue Moment feature, as one of the shape extracted from the images. Scoliosis images only give 0.23 for the highest value for its size, while normal achieves 0.37 values. In figure 4 was clearly shown that normal size of spines at the top area of the graph compared to scoliosis problem that have lower in size.

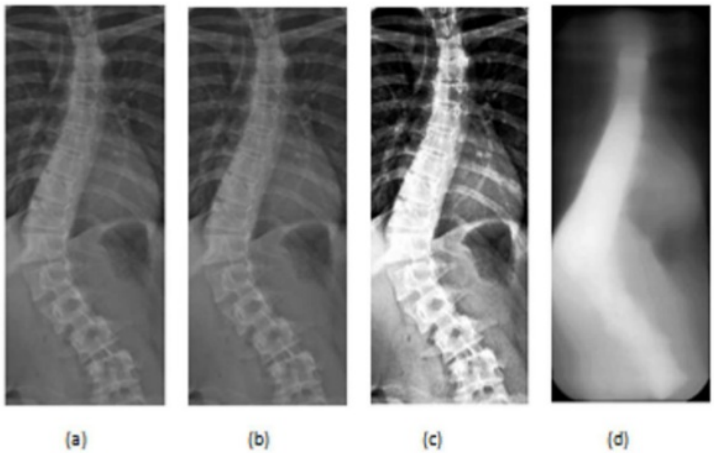

Figure 3. Result of scoliosis spine sample.

Table 1. Result 6 samples for normal and scoliosis (size)

Sample	M1	M2	M3	M4	M5	M6	M7
NS01	0.34	0.09	0.01	0.01	0.00	0.00	0.00
NS02	0.37	0.11	0.01	0.01	0.00	0.00	0.00
NS03	0.30	0.05	0.01	0.00	0.00	0.00	0.00
SS01	0.20	0.03	0.00	0.00	0.00	0.00	0.00
SS02	0.20	0.04	0.00	0.00	0.00	0.00	0.00
SS03	0.23	0.02	0.00	0.00	0.00	0.00	0.00
Average	0.27	0.06	0.01	0.00	0.00	0.00	0.00

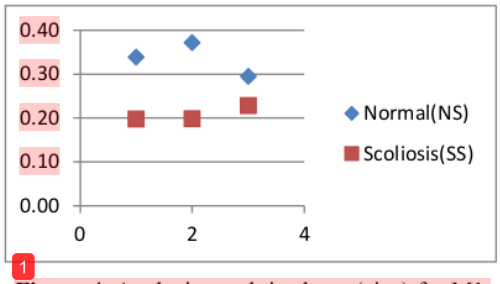

Figure 4. Analysis result in shape (size) for M1.

In table 2 shows the perimeter result in normal and scoliosis images. As references, M11 was selected as the feature to be analyzed. NS01 until NS03 give the range values from 19.35 until 20.73 while 9.92 to 12.43 perimeter values for SS01 to SS03 spines. The differences of normal and scoliosis will be viewed clearly in figure 5. It shows that blue bar charts represent normal have high values while scoliosis in red slightly in lowest values.

Table 2. Result 6 samples for normal and scoliosis (perimeter)

Sample	M11	M22	M33	M44	M55	M66	M77
NS01	20.02	264.42	618.04	37.16	55.94	-452.35	-565.79
NS02	20.73	170.94	2024.35	25.78	2314.88	219.57	-1668.98
NS03	19.35	264.53	740.33	55.43	8235.40	614.50	-4119.87
SS01	9.92	76.68	44.64	1.87	13.91	0.32	-0.34
SS02	11.00	186.71	27.07	1.93	-13.77	-14.58	2.01
SS03	12.43	125.58	297.59	7.97	-68.36	-56.34	-119.07
Average	15.57	181.48	625.34	21.69	1756.33	51.85	-1078.67

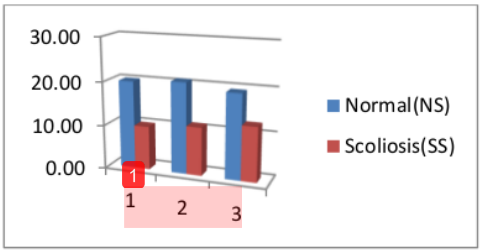

Figure 5. Analysis result in shape (perimeter) for M11.

4. Conclusion

Extraction of features in normal and scoliosis spine images is important to develop the automatic system. Image processing techniques are applied to develop the features extraction purpose. The processes are enhancement, filtering, and segmentation. After segmentation process, hue moment technique is used to extract features of spine images. The features are shape-size and shape perimeter of the images. The features can be used to differentiate between normal and scoliosis spine images. The developed features extraction can be developed to be used for the future research to build the automatic system of spine classes.

5. References

[1] R. S. Hadi, K. H. Ghazali, I. Z. Khalidin, and M. Zeehaida, "Human parasitic worm detection using image processing technique," in *2012 International Symposium on Computer Applications and Industrial Electronics (ISCAIE)*, 2012, no. Iscaie, pp. 196–201.

[2] J. Eck, C. DiPaola, and J. Eck, "Anatomy of the Spine," *Essentials Spinal Disord.*, pp. 1–1, 2014.

[3] E. Been and L. Kalichman, "Lumbar lordosis," *Spine J.*, vol. 14, no. 1, pp. 87–97, Jan. 2014.

[4] O. Yaman and S. Dalbayrak, "Kyphosis: Diagnosis, classification and treatment methods," *Turk. Neurosurg.*, vol. 24, no. SUPPL, pp. 62–74, 2014.

[5] T. Janumala and K. B. Ramesh, "A Review of Different Analysing Methods to Detect Spinal Deformity," *Int. J. Adv. Res. Comput. Commun. Eng.*, vol. 4, no. 8, pp. 352–355, 2015.

[6] A. De Rosa, M. Fontani, M. Massai, A. Piva, and M. Barni, "Second-Order Statistics Analysis to Cope With Contrast Enhancement Counter-Forensics," *IEEE Signal Process. Lett.*, vol. 22, no. 8, pp. 1132–1136, Aug. 2015.

[7] J. Liu, C. Zhou, P. Chen, and C. Kang, "An Efficient Contrast Enhancement Method for Remote Sensing Images," *IEEE Geosci. Remote Sens. Lett.*, vol. 14, no. 10, pp. 1715–1719, 2017.

[8] S. Bhargava and A. Somkuwar, "Estimation of Noise Removal Techniques in Medical Imaging Data—A Review," *J. Med. Imaging Heal. Informatics*, vol. 6, no. 4, pp. 875–884, Aug. 2016.

[9] S. Pereira, A. Pinto, J. Oliveira, A. M. Mendrik, J. H. Correia, and C. A. Silva, "Automatic brain tissue segmentation in MR images using Random Forests and Conditional Random Fields," *J. Neurosci. Methods*, vol. 270, pp. 111–123, Sep. 2016.

[10] T. Ramakrishnan and B. Sankaragomathi, "A Professional Analysis and Evaluation of Computed Tomography Brain Tumor Images using SDNN for Segmentation and SOM-LS-SVM for Classification," *J. Med. Imaging Heal. Informatics*, vol. 6, no. 6, pp. 1426–1429, Oct. 2016.

Acknowledgments

The authors would like to thank to Hospital Universiti Sains Malaysia, USM, Kubang Kerian, Kelantan for providing a huge information during this research study. The authors also would like to thank to Universiti Malaysia Perlis and Universitas Muhammadiyah Yogyakarta due to support to authors.

Features Extraction to Differentiate of Spinal Curvature Types using Hue Moment Algorithm

ORIGINALITY REPORT

89%	%	89%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Muhammad Ainzulhafiz Mat Salleh, Siti Nurul Aqmariah Mohd Kanafiah, Yessi Jusman, Mohd Imran yusof. "Features Extraction to Differentiate of Spinal Curvature Types using Hue Moment Algorithm", Journal of Physics: Conference Series, 2020 Publication	89%

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	Off		