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Automatic Renal Defect Classification Using Inception

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***Abstract*—**Deep feature representation is more effective to perform classification of renal ultrasound images. Increases in distance of the features would suppresses the classification accuracy, conventional methods for categorization of renal diseases using medical ultrasound have the lack of accuracy due to restricted way of feature extraction. The main objective of this work is to classify the different renal diseases using ultrasound brightness mode images. Inception is derived with multiple convolutions and down sampling of input image elements in order to produce the deep features for classification. The projection of average pooling with convolution layer makes exacts reduction of unwanted invariants on the input image. The activation function rectified linear units are used for fast computation of the network architecture. The performance metrics for the classification of renal diseases have analyzed using confusion matrix. Inception produces better results than traditional convolution networks. The performance accuracy for the classification of renal diseases are given by 87.43%.

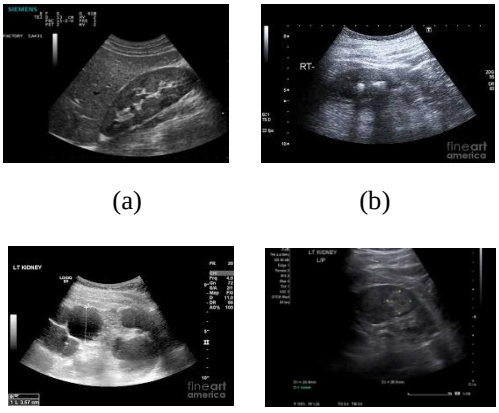
***Keywords*—** Confusion matrix, Deep learning, Inception, Rectified linear units, Renal diseases, Ultrasound B-mode

I. INTRODUCTION

Image processing techniques are playing a crucial role on medical applications, several numbers of diseases are identified and classified using computer-based diagnostics system. It reduces the prevalence of harmful diseases that are infected by the human beings. Diseases identification should be more précised because of the many of the surgical operations are performed based on findings of radiologists. Radiologist may mismatch the anomalies with the anatomic structural objects, Now the researchers would concentrate on computer-based diagnosis of diseases, among the several types of medical imaging, Ultrasound is commonly used modality due to its non-invasive radiation free properties Moreover it is used as emergency diagnostic method due the property of portability. Fig.1. represents ultrasound modality. Renal diseases are widely challenging anomalies that is main reason for stimulate the different deadly diseases such as cardiac diseases hypertension stroke and more. Ultrasound imaging is the best method to diagnose the renal abnormalities

Figure 1. Ultrasound Modality

In this work the various renal defects namely kidney stone cystic kidney and renal cell carcinoma have analyzed. These diseases identified and classified using various ultrasonic features usually renal anomalies using ultrasound have characterized by its echogenic property of the image.



(a) (b)

(c) (d)

Figure 2. Ultrasound views of different kidney diseases (a) Normal kidney (b) Kidney (c) kidney cyst, (d) Renal cell carcinoma

The above Fig. 2(a) represents normal ultrasound kidney fig. 2(b) represents presence of stone in kidney, fig. 2(c) represents the growth of cyst in kidney region and fig. 2(d) represent the presence of cancer cell in kidney region. The kidney stones are characterized by the posterior acoustic

shadow present down to the stone object. Likewise, the cystic kidney is characterized by the fluid filled sac like structure representing a dark walled location. The kidney cancers are little bit differed from cyst on its echogenic property, it has characterized by the walled structure with grained material, conventional learning system have does not meet the accuracy due to lack of features extracted for training and testing. Deep learning techniques have produced the large number of features from its direct convolution operations. Recently different types of convolution architecture have computed for classification problems

The existing systems traditional architecture is used for detection and classification of diseases. In this work the multiple convolutions in single tensor have been computed. The organization of the work is stated as follows, first the section I introduction is followed by section II literature review is given, next section III is pre-processing of ultrasound images, then section IV classification of renal defect using deep learning techniques. Final section V experimental results and performance measures will be discussed.

II. RELATED WORK

Study of renal ultrasound images deal with diagnosing the defect persist on region of kidney A survey [1] for finding the consistency and reliability of the kidney diseases among the diabetic and non-diabetic patients had been analysed. The prevalence of cardiac diseases due to renal failure had studied in the article [2]. Usually the ultrasound images have stimulated the multiplicative noises due to the scattering effect of light on transducer. Speckle noises [3] had reduced using fuzzy based proposed system with significant output. The clustering based medical image segmentation uses the anisotropic diffusion filter [4] for similarity estimation. Deep learning techniques [5] would make the great impact in radiology findings; it has revenge in image pre-processing, segmentation, and classification techniques. Conventional [6] classification needs the predefined features whereas the deep learning generates features as its own. In deep learning number of convolutions is processed with different parameter to increase the effectiveness of features. TensorFlow [7] is the open source machine learning library implemented for both conventional and deep learning architecture Inception v3 [8] is a pre-trained model which is inspired from Inception v1 and Inception v2. The evaluation of deep neural network is analysed in with various architecture namely R-CNN inception and more

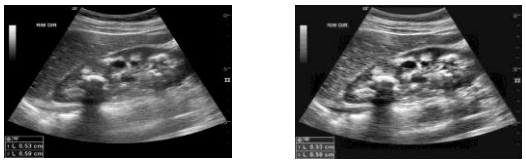
III. METHODOLOGY

A. Pre-processing

Ultrasound images are generally degraded by the speckle noise due to light scattered from transducer and reflected back to the machine. Because of human anatomy has consists of different hill and dale region. From this region the speckle noises have raised and reduces the quality of an output image so the special kind of filter is used to reduce the renal ultrasound speckle in this work. Anisotropic diffusion filter is used to degrade the speckle from the input ultrasound images. Anisotropic diffusion filter [9] is works on principle of diffusing the gradient with coefficient in order to produce the noiseless image. It preserves the edge information. The equation (1) for the diffusion filter is given by

$$\partial_t u = div(g(|\nabla u|2)\nabla u) \qquad (1)$$

Where div is divergence operator, g is denoting gradient, ∇u is diffusion coefficient.



(a) (b)

Figure 3. Preprocessing. (a) Input ultrasound image (b) Diffused output ultrasound image

Above fig 3(a) denotes input ultrasound image and fig. 3(b) denotes de-noised image

B. Transfer learning

Transfer learning [10] is more needful for medical image datasets it augments the real time data into different dimensions without changing its original information. It uses different parameters such as shear orientations rotation and various transformations for replicating the datasets

C. Classification renal diseases using Inception v3

Inception [11] is the main layered structure comprised of sub modules. In this structure, multiple number of convolutions is placed in a single layer. It abstract both minimum and maximum size of the convolutions simultaneously. Inception reduces the time complexity in computing the multiple operations on single layer. In traditional convolution network single convolution is operated at layer whereas the inception v3 operates different type of convolution on single layer. The basic network architecture for inception is given as below

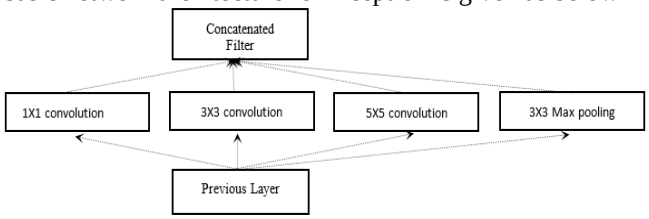


Figure 4. Single Module of Inception

Above figure. 4 represents the single module of the inception module. This module consists of three convolutions and one max pooling operation. Both operations are processed simultaneously in a single layer

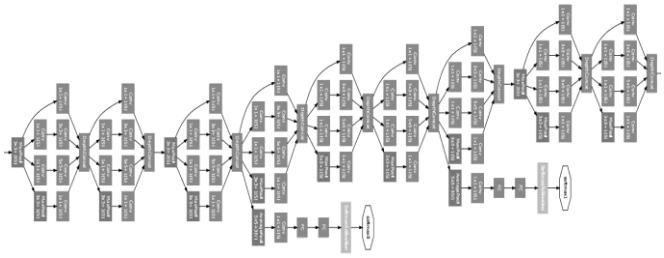


Figure 5. Inception Network model

Above Fig. 5. Inception V3 architecture shows the combination of inception modules which is described earlier in Fig. 4. Fully connected layer is used to categorize the final module of the architecture. After extracting features from inception model, the weights are stored and compiled using tensor flow model the compiled models have then trained with different epochs. The classification of kidney diseases is executed based on tensor flow model predict method. The predicted results have given by

Prediction Matrix = $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

- For kidney stones
- For Cystic Kidney
- For kidney Cancer

IV. Results and Discussion

The renal ultrasound b mode image database containing different category of diseased images is taken for classification. The input images were pre-processed and resized with 150X150 dimensions. The resized images have trained using inception v3 model. For down sampling for convolution, 3X3 max pooling operation is used Rectified Linear Unit (ReLU) is used for normalization. The layer computes three types of convolution operation namely 1X1, 3X3, 5X5 in a layer. Number of epochs for training is set as 30 numbers.

A. Performance measure

The performance measure is calculated based on confusion matrix. The confusion matrix table is given in table 1.

Table 1. Performance Metrics for classification of kidney diseases

Classification Methods	Accuracy (%)	Precision (%)	Recall (%)	F-measure (%)
SIFT vs SVM	82.60	73.80	73.80	73.80
SURF vs SVM	84.30	83.25	83.25	79.63
CNN	85.21	93.70	93.70	93.70
DCNN	86.67	84.30	84.30	84.30
Inception	87.43	78.50	78.50	78.50

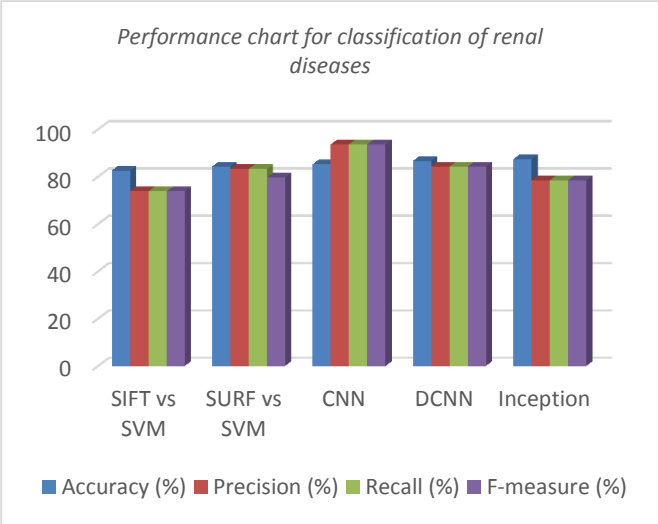


Figure 6. *Preformance chart for classifiction of renal diseases*

The performance chart shows that the inception gives the better performances than other conventional and traditional method.

V. Conclusion and Future Scope

The proposed inception v3 model combined with transfer learning extracts features from renal ultrasound B mode images and predicted using tensor flow model. This paper concludes that the proposed deep learning method overcomes the traditional convolution architecture. Moreover, the inception may be implementing a new parameter to gain a improved results.

References

[1] John D. Peipert, Peter M. Bentler, Kristi Klicko, and Ron D. Hays, "Psychometric Properties of the Kidney Disease Quality of Life 36-Item Short-Form Survey (KDQOL-36) in the United States"Elsevier transaction on American Journal of Kidney Diseases vol 71 issue 4 pp 1-9. April 2018.

[2] Tariq Shafi Eliseo Guallar, "Mapping Progress in Reducing Cardiovascular Risk with Kidney Disease", American society of Nephrology vol 13. Issue 1. pp.1-3. jul, 2018.

[3] Rahul Roy, Susmitha gosh, Ashis gosh, "Speckle Denoising of Clinical Ultrasound Images Based on Fuzzy Spel Conformity in its Adjacency"|, Elsevier transaction on journal of applied soft computing, vol 73, pp. 394-417, dec 2018

[4] Prabha Sathees, Sujatha C. Manoharan "Proposal of index to estimate breast similarities in thermograms using fuzzy C means and anisotropic diffusion filter based fuzzy C means clustering", Elsevier transaction on Infrared Physics & Technology vol 93. 316-325, Sep 2018.
[5] Morgan P. McBee, MD, Omer A. Awan, MD, MPH, CIIP, Andrew T. Colucci, MD, Comeron W. Ghobadi, MD, Nadja Kadom, MD, Akash P. Kansagr', MD, MS, Srini Tridandapani, MD, PhD, MSEE, MSCR, MBA, William F. Auffermann, MD, PhD, "Deep Learning in Radiology" vol 25 issue 11 pp 12-14 Jan 2016.
[6] R. Vasanthselvakumar, M. Balasubramanian, S. Palanivel, "Pattern Analysis of Kidney Diseases for Detection and Classification Using Ultrasound B - Mode Images", International Journal of Pure and Applied Mathematics, Volume 117 No. 15, pp. 635-653, 2017.
[7] Ladislav Rampasek1,2 and Anna Goldenberg, " TensorFlow: Biology's Gateway to Deep Learning?", Elsevier transaction on cell system, vol 2 issue 1 pp. 12-14, Jan 2016.
[8] Christian Szegedy , Vincent Vanhoucke, Sergey Ioffe, Jon Shlens "Rethinking the Inception Architecture for Computer Vision", In the proceedings IEEE Inetrnational Conference on Computer Vision and Foundation (ICVF 2016). pp. 2818-2826, 2016.
[9] Pietro Perona, Jitendra Malik, "Scale-Space and Edge Detection Using AnisotropicDiffusion", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 12. no. 7, pp 629-639, July 1990.
[10] Yin Zhu , Yuqiang Chen , Zhongqi Lu , Sinno Jialin Pan, Gui-Rong Xue, Yong Yu , and Qiang Yang, "Heterogeneous Transfer Learning for Image Classification, In the proceedings AAAI Conference on Artificial Intelligence (2011)"
[11] Xiaoling Xia, Cui Xu"inception-v3 for Flower Classifcation" In proc Image, Vision and Computing, pp 783-787. Jan 2017.

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