

DETECTION OF KIDNEY STONES USING MACHINE LEARNING

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ABSTRACT: To detect the kidney stones in ultrasound images using median filters to improve the detection rate in terms of accuracy and sensitivity. **Materials and Methods:** The accuracy and sensitivity of median filter (n=114) was compared with rank filter (n=114). The median filter is used to detect the kidney stone in ultrasound images. 114 is the sample size taken with the p-value 0.8 and has been used to improve detection rate of kidney stones in terms of accuracy and sensitivity using MATLAB simulation tool. **Results:** According to the results obtained Median filter has accuracy (86.4%) and rank filter has accuracy (82.2%) and also sensitivity of median filter (87.7%) and sensitivity of rank filter is (82.5%). Median filter has a significantly higher accuracy ($p=0.018$). The applications of image processing are used in Image sharpening and restoration, Medical field, Color Processing, Pattern Recognition. The disadvantage of ultrasound images is that they have low contrast and speckle noise. It is a challenging task for detection of kidney stones. Speckle noise is an inherent property of medical ultrasound imaging, and it generally tends to reduce the image resolution and contrast, thereby reducing the diagnostic value of the imaging modality (Karthick 2019). The proposed algorithm is median filter, it works by moving through the image pixel by pixel replacing each value with the median values of neighboring pixels

Keywords: kidney stones, median filter, rank filter

1. Introduction

Ultrasound imaging is one of the imaging techniques used for diagnosis of kidney abnormalities. The kidney abnormalities such as formation of stones as shown in Fig. 1 (Akkasaligar, Biradar, and Kumbar 2017). During surgery it is very hard to recognize the precise location of the kidney stone. Kidney stone disease is one of the most life threatening diseases in the world wide. The main function of the kidney is to regulate the balance of electrolytes in the blood. Kidney is a bean shaped organ and present on each side of the spine (Akkasaligar and Biradar 2016).

The main application of detection is used in brain tumor detection and thyroid segmentation. The applications of image processing are used in Image sharpening and restoration, Medical field, Color Processing, Pattern Recognition. The disadvantage of ultrasound images is that they have low contrast and speckle noise. It is a challenging task for detection of kidney stones.

Speckle noise is an inherent property of medical ultrasound imaging, and it generally tends to reduce the image resolution and contrast, thereby reducing the diagnostic value of the imaging modality (Karthick 2019). The proposed algorithm is median filter, it works by moving through the image pixel by pixel replacing each value with the median values of neighboring pixels. It is particularly effective at removing noise while preserving edges. The median

filter is calculated by initial sorting all the picture element prices from the window in numerical order then exchanging the picture. Ultrasound imaging is a process in which high frequency sound waves are used to monitor or to capture the internal organs in the body. Through this technique we can find the damaged parts inside the body. Hence ultrasound imaging is used to detect the stones in the kidney

2.Scope of Project

Scope of this project is to provide is to provide efficient solution for doctors to provide machine learning based solution to analyze and predict the data immediately ,because timely results will always help save lives of people

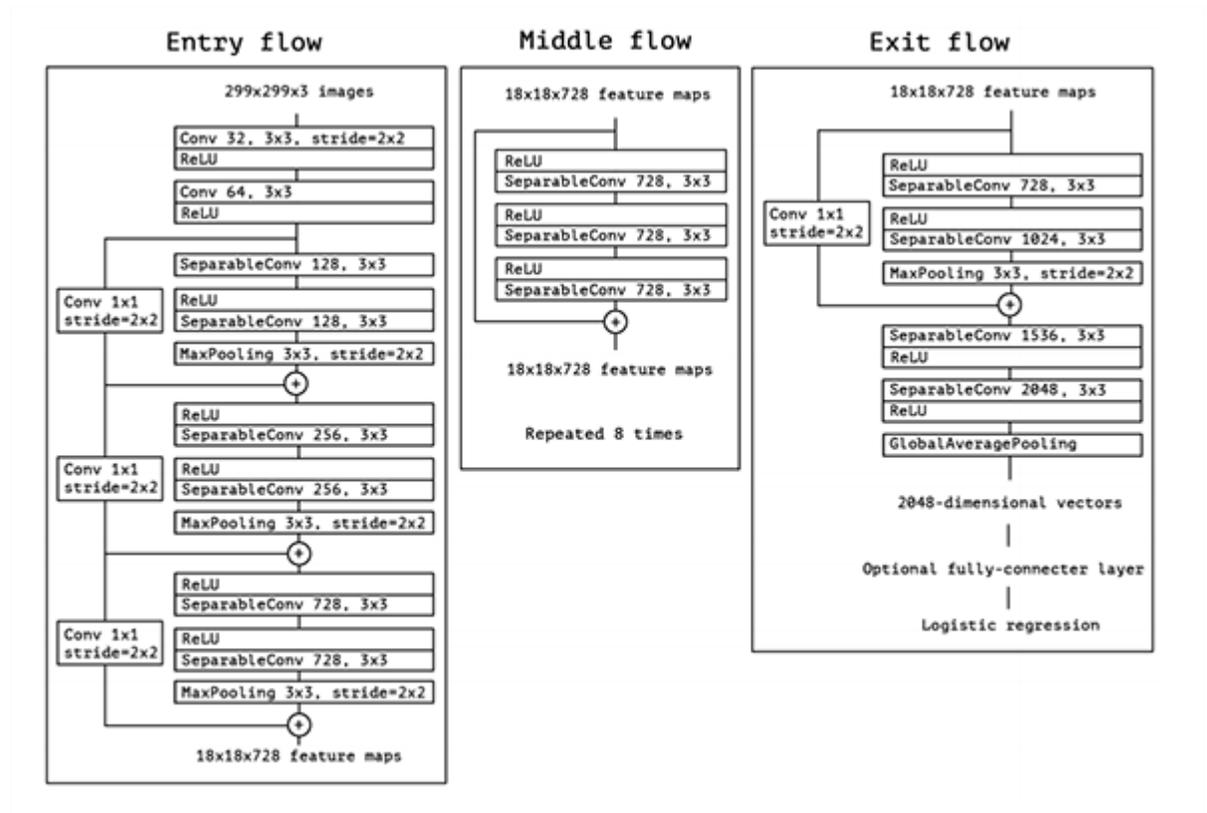
3.Proposed Methodology

The development of technology, a lot of computer-aided systems has been evolved for diagnosing the presence of disease with an important emphasis on system accuracy.In proposed system, we develop an automated detection of kidney stones using coronal computed tomography (CT) images was proposed with deep learning (DL) technique which has made significant progress in the field of artificial intelligence

The development of imaging techniques, diagnosis using Computed Tomography (CT) images has become widespread because of its low cost, reliable and non-invasive procedure. Feature extraction, analysis, and pattern

recognition techniques for these images are used for finding the abnormality like a tumor, cyst, stone etc,

4. System Architecture



4. Module Description

- (i) Median Filter
- (ii) Rank Filter

4.1 Median Filter

Accuracy and sensitivity of the median filter are analyzed by varying different ultrasound images in the MATLAB simulation tool. Matlab(2014a) will be used for simulation with required add-ons installed, these are predefined functions in the matlab for the image processing. Open matlab software and open new m.file. Write the code for the median filter and save the file in the desired location. Store the input images in the location using the median filter algorithm. Then extract kidney images and find the stone in the ultrasound image. After processing the code the output image will be displayed in the command window and repeat the experiment for different kidney ultrasound images and get the output and find the detection rate using the formula. Kidney stone ultrasound images are taken as input images which are independent variables. Accuracy and sensitivity will be as output variables. By comparing the results a better algorithm has been decided.

4.2 Rank Filter

Accuracy and sensitivity of the rank filter are analyzed by varying different ultrasound images in the MATLAB simulation tool. Matlab (2014a) will be used for simulation with required add-ons installed, these are predefined functions in the matlab for the image processing. Open matlab software and open new m.file. Write the code for the rank filter and save the file in the desired location. Store the input images in the location using the

rank filter algorithm. Then extract kidney images and find the stone in the ultrasound image. After processing the code the output image will be displayed in the command window and repeat the experiment for different kidney ultrasound images and get the output and find the detection rate using the formula. Kidney stone ultrasound images are taken as input images which are independent variables. Accuracy and sensitivity will be as output variables. By comparing the results a better algorithm has been decided. Detection rate of the algorithms will be calculated using the formula.

$$\text{Detection rate} = (\text{No. of output images} / \text{Total input images}) * 100$$

Rank filters are non linear filters that use the local gray level ordering to compute the filtered value as shown in Fig. 4. Rank filters can be used for several purposes such as image quality enhancement, image preprocessing, feature extraction and post processing.

5. Convolution Neural Network:

A convolution neural network is a special architecture of artificial neural network proposed by Yann Lecun in 1988. One of the most popular uses of the architecture is image classification. CNNs have wide applications in image and video recognition, recommender systems and natural language processing. In this article, the example that this project will take is related to Computer Vision. However, the basic concept remains the same and can be applied to any other use-case!

CNNs, like neural networks, are made up of neurons with learnable weights and biases. Each neuron receives several inputs, takes a weighted sum over them, pass it through an activation function and responds with an output. The whole network has a loss function and all the tips and tricks that we developed for neural networks still apply on CNNs. In more detail the image is passed through a series of convolution, nonlinear, pooling layers and fully connected layers, then generates the output.

In deep learning, a convolutional neural network (CNN, or ConvNet) is a class of deep, feed-forward artificial neural networks, most commonly applied to analyzing visual imagery. Convolutional networks were inspired by biological processes in that the connectivity pattern between the organization of the visual cortex. CNNs use relatively little pre-processing compared to other image classification algorithms. CNN is a special kind of multi-layer NNs applied to 2-d arrays (usually images), based on spatially localized neural input. CNN Generate 'patterns of patterns' for pattern recognition.

Each layer combines patches from previous layers. Convolutional Networks are trainable multistage architectures composed of multiple stages Input and output of each stage are sets of arrays called feature maps. At output, each feature map represents a particular feature extracted at all Each stage is composed of: a filter bank layer, a non-linearity layer, and a feature pooling layer. A ConvNet is composed of 1, 2 or 3 such 3-layer stages, followed by a classification module.

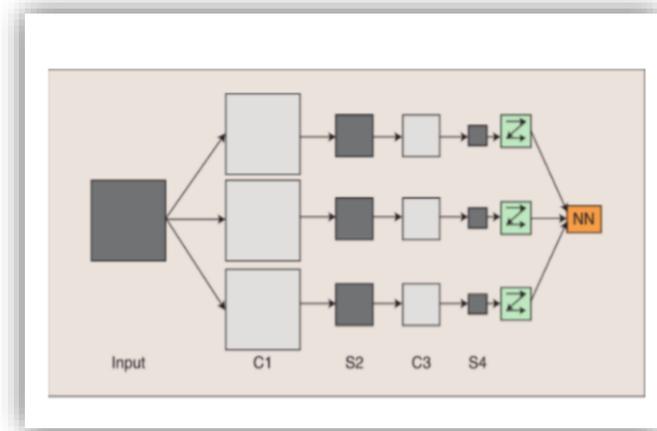


Fig.4 CNN

Basic structure of CNN, where C1, C3 are convolution layers and S2, S4 are pooled/sampled layers.

6. Sample Result:

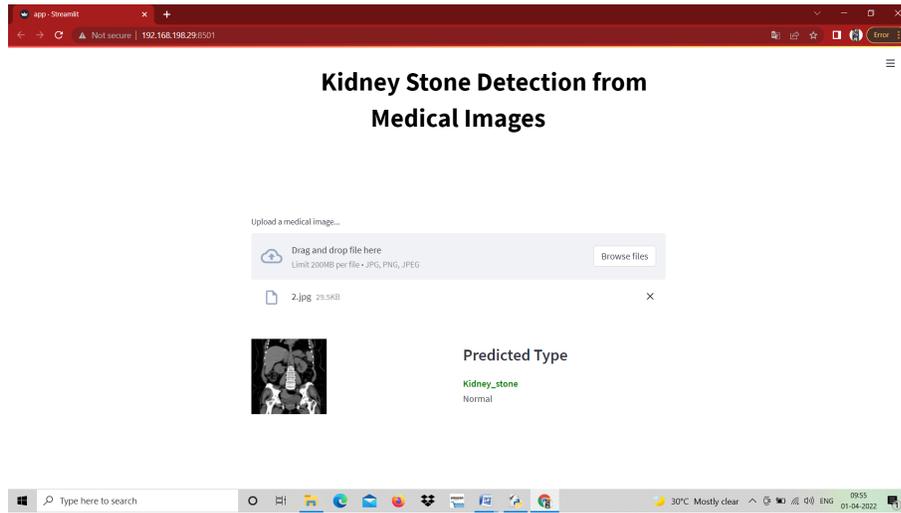


Fig 6.1 kidney stone predicted image

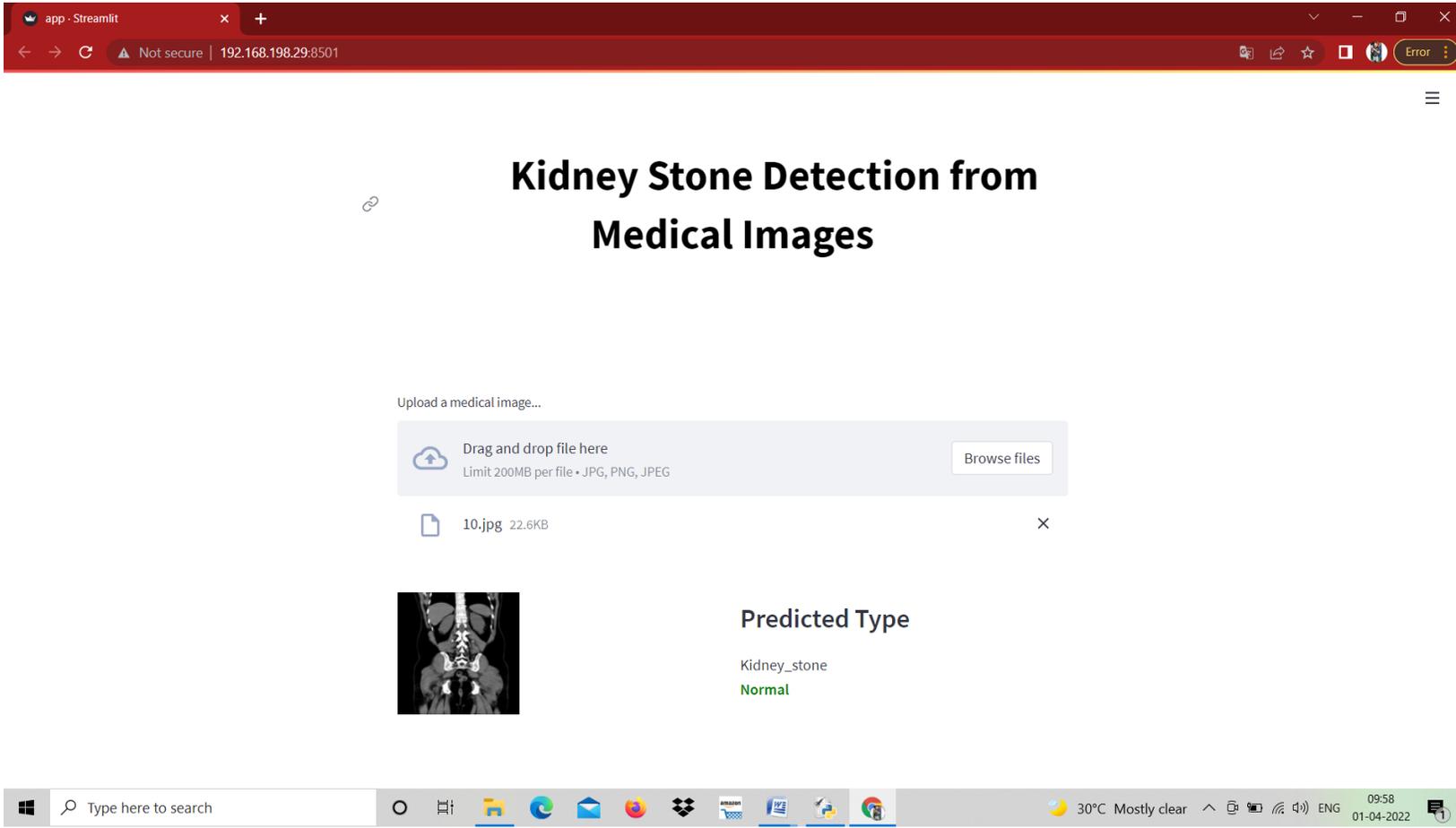


Fig 6.2 normal predicted image

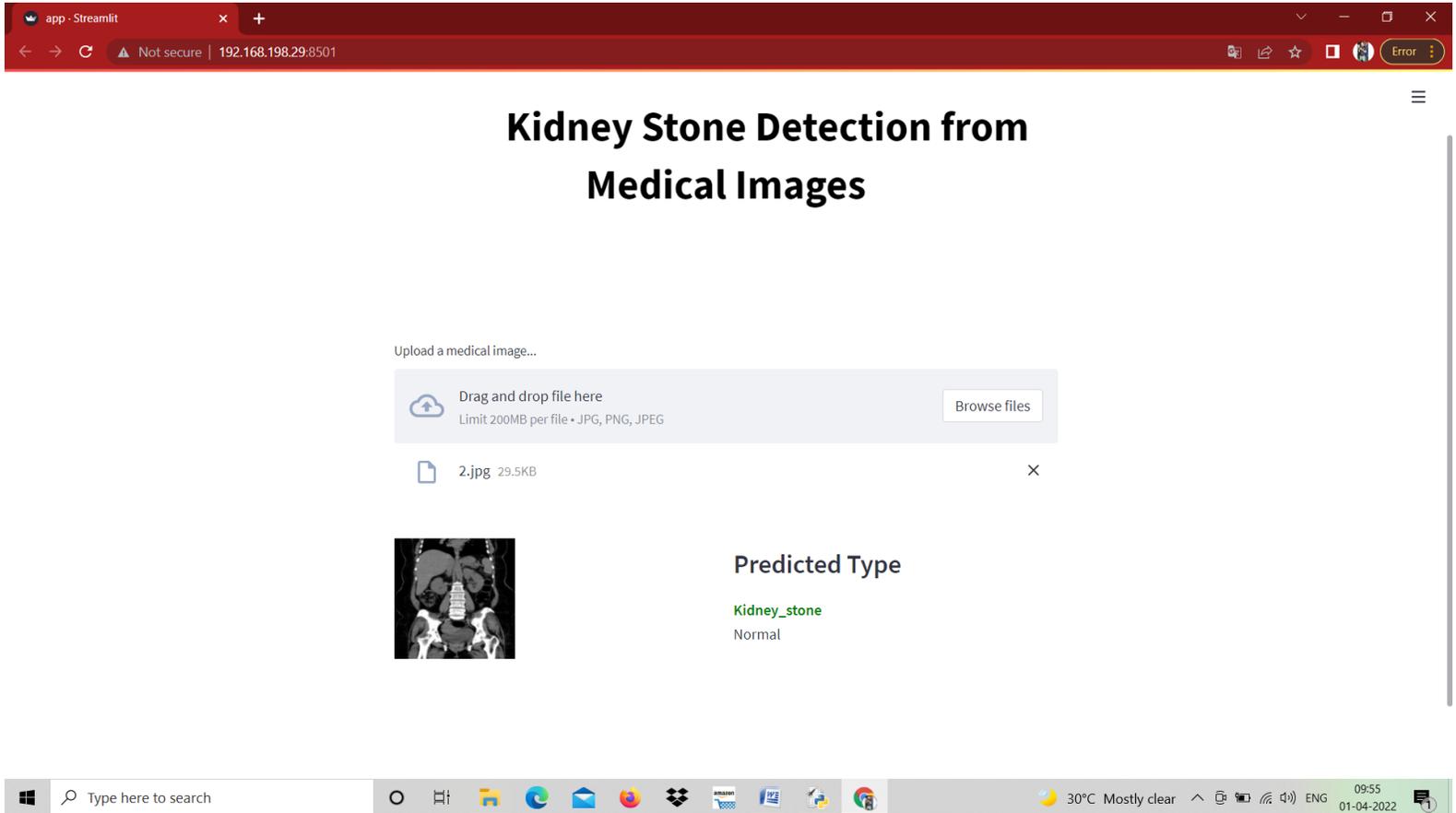


Fig 6.3 kidney stone predicted image

7 Conclusion

This work has explored the possibility of embedding conventional therapy modules into assistive technologies. This step is important in helping to detect kidney stones , The development of imaging techniques, diagnosis using Computed Tomography (CT) images has become widespread because of its low cost, reliable and non-invasive procedure. Feature extraction, analysis, and pattern recognition techniques for these images are used for finding the abnormality like a tumor, cyst, stone etc,

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