Review on Neural Network Classifier for Kidney Stone Detection in Image Processing Using Deep Learning

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Abstract:

In the Western world, kidney stone disease is quite common. Small kidney stones often pass quickly. In many cases, patients in this category don't need any more care. However, certain nephrolithiasis patients develop very large stones that, if left untreated, may lead to severe complications and chronic disorientation. Our suggested wavelet technique avoids log and noteworthy change, accounting for the fully developed dot as additional material signal-subordinate turmoil with zero mean, which is a counterargument to the idea that intensive therapy and countermeasures can eradicate the disease entirely. In order to consolidate data from multiple recurrence groups, measure local consistency among image components, and enhance image quality via watershed calculation, the proposed wavelet transformation strategy is characterized by a Neural network. Therefore, we'd want to learn more about its picture-handling capabilities. The next step in identifying kidney stones is to locate the cycle that does it. This is why we blindly adhere to the prevailing ideas of our day. Our venture's first steps are these. Take use of the completed data set by taking Computed Tomography (CT) scans of the kidney for use in creating informative photographs. Because of these methods, which involve spotting the ailment and its stages. Consuming wasteful foods, like as tomatoes on a regular basis, may lead to renal problems and increase the likelihood of developing kidney stones. To prevent this, we will use pre-processing, partitioning, highlight extraction of GLCM, and brain network grouping calculations with a specific place in mind right from the start.

Keywords: kidney stones, GLCM, Multi-class Support Vector Machine, nephrolithiasis patients Computed Tomography.

I. Introduction

Minerals in urine crystallize and create what is known as a kidney stone. Both hereditary and environmental variables have a role in the development of these stones. Causes include being overweight, consuming an unhealthy diet, regularly taking certain medications, and dehydration. Kidney stones are not discriminatory in terms of race, culture, or location. This kidney stone may be diagnosed by a variety of means, including a blood test, a urine test, or a scan. CT scans, ultrasounds, and dopplers all do scanning in somewhat different ways. Recently, a branch of automation emerged and has found use in the medical sector. In fact, many widespread issues emerged as a direct consequence of autonomous diagnosis, including the use of right algorithms and the utilization of accurate and correct results. The process of medical diagnosis is inherently convoluted and imprecise. The benefits of a soft computing technique known as a neural network in diagnosing sickness by first learning about it and then detecting it partially stand out among other approaches. In this study, we use the feature extraction and watershed neural network methods to the problem of kidney stone detection. The first step is to train the data using two separate methods. Information useful to hospitals and labs is collected from the blood results of people with kidney stones. Minerals in urine crystallize and create what is known as a kidney stone. Both hereditary and environmental variables have a role in the development of these stones. Causes include being overweight, consuming an unhealthy diet, regularly taking certain medications, and dehydration. Kidney stones are not discriminatory in terms of race, culture, or location. This kidney stone may be diagnosed by a variety of means, including a blood test, a urine test, or a scan. CT scans, ultrasound scans, and Doppler scans all provide different images. Recently, a branch of automation emerged and has found use in the medical sector. In fact, many widespread issues emerged as a direct consequence of autonomous diagnosis, including the use of right algorithms and the utilization of accurate and correct results. The process of medical diagnosis is inherently convoluted and imprecise. The benefits of a soft computing technique known as a neural network in diagnosing sickness by first learning about it and then detecting it partially stand out among other approaches. Feature extraction and watershed are two neural network techniques utilized in this article to help identify a kidney stone. The first step is to train the data using two separate methods. Information useful to hospitals is collected from blood results on patients diagnosed with kidney stones. Concretion disease, which causes kidney stones, is on the increase worldwide, and most people with it are unaware they have it since it causes damage to organs over time before causing noticeable symptoms. The kidneys, which are sometimes found on both sides of the spine, may have the form of a bean. The kidneys' primary job is to regulate the concentration of electrolytes in the blood. Kidney stones form when urine flow is restricted due to a birth defect such as a cyst. Kidney stones of varying compositions, including struvite, stag horn, and renal calculi, were studied. Kidneys may generate a solid concretion or crystal from the minerals in the urine. In order to help avoid this unpleasant disease, CT scans are used to identify urinary calculus, and subsequently surgical procedures, such as breaking the stone into tiny pieces, are used to remove the calculus. The ureter will get obstructed if the stone grows to be at least 3 millimeters in diameter. The pain is severe, originating in the lower back and spreading to the groin. Urinary stones may be categorized according to their chemical make-up, their location in the urinary tract (nephrolithiasis, ureterolithiasis, or cystolithiasis), or both. The kidney calyces (both minor and major) and the ureter are other potential locations for the stone. C.A.T. is preferred over other medical imaging modalities due to its low noise levels, which allow for more precise diagnoses. Kidney failure is a potential killer as well. Therefore, it is essential to look for calculus early on. Accurate diagnosis of urinary calculus is crucial for the outcome of any necessary surgical procedures. As a result, picture filtering is one of the most crucial stages of automated detection in order to provide an effective stone detection system. Automatic stone identification is accomplished by pre-processing, segmentation, and morphological analysis, with the goal of reducing human error due to differences in expert knowledge. Researchers have made significant advancements in the area of nephrolith identification by offering many techniques for locating kidney stones in MRI scans. Strong and effective segmentation is a focus of certain researchers. For precise stone identification, several have stressed the need of robust and efficient segmentation. After the CT image has been cleaned up and enhanced, the area of interest may be extracted. Typically composed of calcium and acid, kidney stones are a hard accumulation of salt and minerals. Most people with kidney stones don't feel any different in the early stages, and the condition gradually worsens over time.

II. Existing works

To automatically identify and classify kidney stones in medical photographs, researchers in [1] adopted a deep learning-based strategy. The scientists utilized a dataset consisting of 108 kidney stone pictures taken from patients undergoing CT scans. Eighty percent of the photos in the dataset were utilized for training, while the remaining twenty percent were used for testing. Images are pre-processed, features are extracted, and then they are classified as part of the suggested method. The photos are pre-processed to improve contrast and eliminate noise. After the photos had been preprocessed, the scientists extracted features using a convolutional neural network (CNN). Finally, a support vector machine (SVM) classifier was employed to divide the kidney stones into four groups according to their composition and size. Compared to standard machine learning methods, the suggested method improved upon accuracy in the classification of kidney stones, as shown by experimental data. In [2] Non-contrast computed tomography (NCCT) image-based automated method for kidney stone identification and localisation. A total of 419 NCCT pictures from 91 individuals with verified kidney stones were gathered and preprocessed to standardize for size and intensity by the authors. They then utilized a convolutional neural network (CNN) based deep learning technique to build a model to identify and pinpoint kidney stones in the provided photos. The suggested approach included two phases: the first involved using an RPN to propose possible areas of interest (ROIs) in the pictures. The second step included classifying the ROIs as kidney stones or non-stones using a convolutional neural network-based classifier. Machine learning methods for spotting kidney stones on CT images are discussed in [3]. It is possible to diagnose kidney stones, a frequent medical issue, using imaging tests like CT scans. CT scans can identify kidney stones, but it takes time and a trained eye to do so. Convolutional neural networks (CNNs) are suggested by the authors for automated kidney stone detection in CT images. Convolutional neural networks (CNNs) are a form of deep learning algorithm that can learn characteristics from photos and categorize them automatically. The scientists created a convolutional neural network (CNN) based model that, given a CT image, can classify the presence or absence of a kidney stone. The scientists employed a dataset of 100 CT images, 50 of which had kidney stones for training and evaluation purposes. When gauging the model's efficacy, the authors used a 10-fold crossvalidation strategy. The findings demonstrated the CNN-based model's success. Additionally, the authors compared their model's results to those of other machine learning techniques including decision trees and support vector machines, and concluded that the CNN-based model was superior. Using deep convolutional neural networks (CNNs) and transfer learning, an automatic technique was developed to identify kidney stones on CT images [4]. There are two phases to the suggested procedure. First, CT image characteristics are extracted using a convolutional neural network (CNN) model that has already been trained. The authors used the VGG16 model, a popular CNN architecture that was pretrained using the ImageNet data set. A fully connected neural network is given the characteristics retrieved from the pre-trained model to determine whether or not a picture depicts a kidney stone. The second step involves the authors applying a transfer learning approach to fine-tune the pre-trained CNN model. They used a dataset of 200 CT pictures (100 of which had kidney stones) to train the CNN model, and then used a dataset of 20 images (10 of which contained kidney stones) to fine-tune it. After making adjustments to the model, it was put to the test on a new batch of 100 CT scans (50 of which had kidney stones and 50 that did not).The results demonstrated the effectiveness of the recommended approach. In [5] Kidney stone diagnosis system using deep learning on medical photos. Millions of individuals throughout the globe suffer with kidney stones, making early diagnosis and treatment all the more important. The scientists used CT scan pictures of kidney stones to train deep learning models using the Convolutional Neural Network (CNN), Residual Neural Network (ResNet), and InceptionV3 methods. They used a dataset of 3,000 renal CT scan pictures from different Indian hospitals to train the algorithms. Accuracy, sensitivity, specificity, and F1 score are only few of the criteria used to evaluate these models. The authors compared the performance of three models and concluded that InceptionV3 was the most accurate.

Methodology

When it comes to training neural networks, the most common approach is called Back Propagation Network. It is used in conjunction with other processing steps to enable fully automated concretion categorization. Human inspection is now the gold standard for medical resonance renal image categorization and stone identification. This approach is flawed because it cannot effectively manage massive amounts of data. operator mistake may introduce noise into magnetic resonance (MR) images. In image processing, this leads to serious errors in classifying characteristics as illnesses. In this study, we used a Back Propagation Network to look for kidney stones.

To conduct the search, we have eliminated any terms that are beyond the purview of this analysis. You may begin your search for kidney stone detection with the terms "kidney stone detection," "diagnosis of kidney stones," "imaging for kidney stones," and "renal calculi detection." In addition, I would search online databases for relevant medical publications and studies.

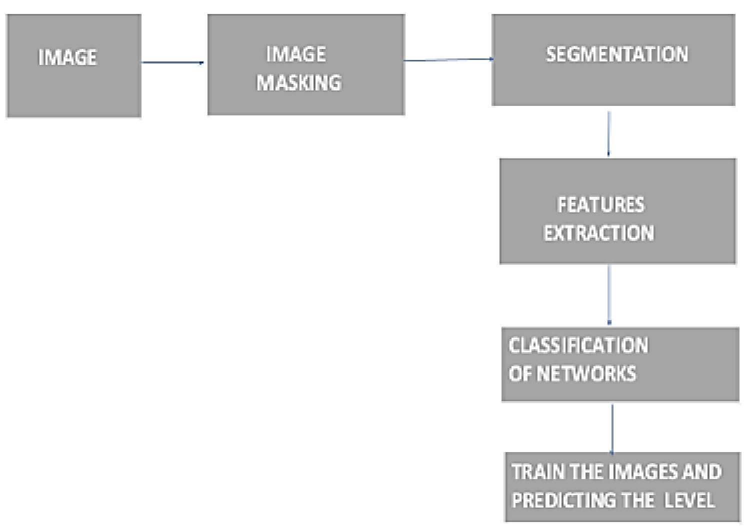

Figure 1:Overall flowchart of Image segmentation and Classification

1. Image: An abdominal CT or MRI scan is used as the input image for kidney stone identification.

2. Image Making: It is a technique used in Kidney stone detection to isolate and highlight the stone region of interest while suppressing other parts of the image. This helps in accurately identifying and measuring the size of the stone.

3. Segmentation: It is process of identifying and separating Kidney stones from other structures in medical imaging.

4. Feature Extraction: It is used for identifying and selecting relevant characteristics or patterns from medical images or patient data that can be used to differentiate between Kidney stones and other structures or anomalies.

5. Classification of Networks: It refers to the use of deep learning algorithms to classify Kidney stones based on their features and characteristics.

6. Train the Models and predicting the levels: Train deep learning models using labeled data to detect the presence of Kidney stone in patients based on relevant features and use these models for accurate prediction of kidney stone levels in new patients

Conclusion

Kidney stone detection using deep learning. However, deep learning's application to medical imaging is a promising method with the potential to significantly improve diagnostic precision and efficiency. Due to the increasing incidence of kidney stones and the health hazards they pose, prompt and precise diagnosis is crucial for successful treatment. In order to reliably identify kidney stones, deep learning models may be trained using large datasets of medical pictures. In addition, the size and location of kidney stones may be estimated using deep learning models, which aids in treatment planning and management. With further research and development, deep learning has the potential to greatly enhance kidney stone detection and treatment, and it will also save us time compared to conventional approaches.

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