Gastric Cancer Detection using Deep Learning

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Abstract: Gastric cancer is severe stomach disease that causes millions of death every year. Therefore, it is necessary to early detect the phases of the gastric cancer so that proper measure can be taken to cure it. This paper presents the deep learning based approach for the early detection of the gastric cancer using endoscopic images. Convolutional neural network (CNN) is used as the deep learning architecture for the feature representation and K-Nearest neighbor (KNN) classifier is used for the classification purpose. The performance is assessed based on the percentage accuracy and it is found that increasing the CNN layers increases the recognition accuracy.

***Index* Terms– Deep learning, Gastric cancer, Convolution neural network.**

I. INTRODUCTION

Stomach Gastric cancer (GC) is second most dangerous stomach cancer which brings the higher severity to the human body. It occurred due the improper diet, ulcers in the intestine, chronicle diseases etc. Gastric cancer is common in the countries having meager hygiene and superior Helicobacter pylori (H. pylori) occurrence rates (almost 70%). Previously, the gastric cancers are diagnosed on the basis of the consultation answers obtained from the patients and several chemical reactions. Pre-malignant cancer has the developing stages such as the atrophy, dysplasia and intestinal metaplasia. Manual diagnostic is prone to the inferior knowledge of the person, abnormalities in the chemical reaction, low symptoms of gastric cancer, etc. It is tedious task to find out the primary stage of the person affected from the gastric cancer. If the cancer is detected at the early stage then the proper measure can be taken to cure it or operate it to avoid the severity of the cancer.

Now a day, gastric cancer detection using endoscopic images which are obtained from the endoscopic cameras is becoming popular with the aid of the image and computer vision approaches. Various machine learning (ML) techniques have been adopted for the early detection of the GC using image processing algorithms. Gastric cancer images have the irregularities in the texture because of the ulcers on the stomach surface. These irregularities can be obtained using the texture features. Texture features are good at the describing the homogeneity, irregularity, internal correlation in the different image region. Traditional ML based methods are relying on the hand extracted/crafted features and performance of the system is limited because of the availability of the database. If the database increase then the time and computational complexities of the algorithm increases, this further decreases the performance of the algorithm.

To deal with the drawbacks of the machine learning techniques, deep learning came in to the practice which is lesser dependent on the handcrafted lower order raw features. In deep learning no preprocessing is required for the image enhancement like the noise removal, blur removal and intensity unequal distribution normalization. CNN is the simple architecture of the deep learning which can describe the better representation of the image patches of the gastric cancer images.

In this paper, we present the CNN based gastric cancer detection using endoscopic images. KNN classifier is used for the classification of the gastric and non-gastric cancer images. The effect of the proposed algorithm is measured based on the percentage accuracy.

The paper is organized as follow: section 2 deals with the several methods carried out for the GC detection in the previous years based on the machine learning and deep learning paradigms. Section III describes the detailed flow of the methodology. Section IV gives the description of the deep learning architecture used for the implementation of the proposed method. Section V focuses on the results and the discussion on the obtained results. Finally, the conclusion is given in the section VI.

II. LITERATURE SURVEY

Several techniques have been adopted in the past for the gastric cancer detection. Oikawa et al. described the gastric cancer detection system base on the geometric features and the CNN which resulted in the 14.1 % false-positive-rate. Xu et al. have presented CNN for the segmentation of the epithelial and stromal parts and its classification in histopathological. Wang et al. presented breast cancer detection using a deep learning approach.

III. METHODOLOGY

In this system, features for training images will be extracted. In testing stage, testing stage image is tested on CNN and image is recognized whether it is gastric cancerous or not.

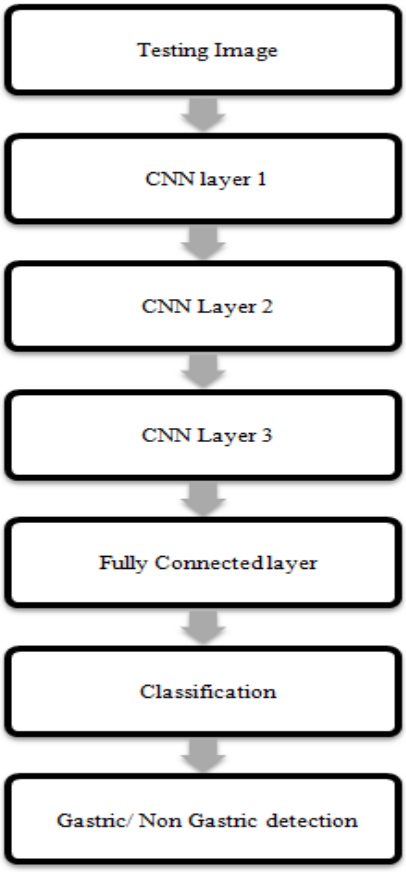


Figure1. Block diagram of proposed system

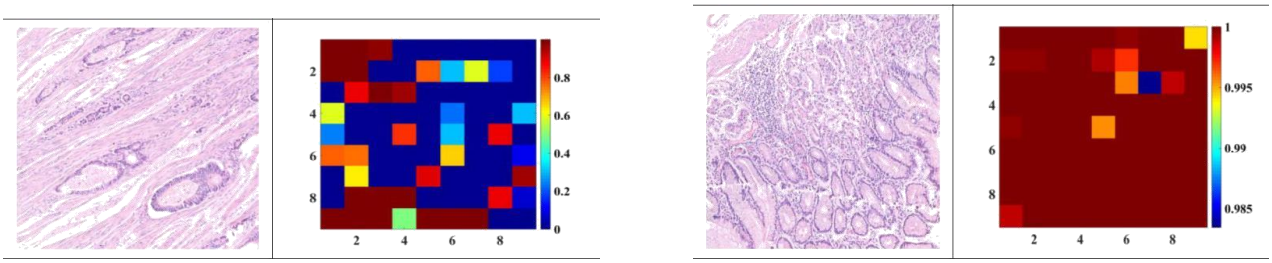
The flow of the proposed scheme is given in the Figure 1. We have proposed the three layered CNN for the gastric and non-gastric image classification. Initially input image is provided to the convolution layer of the first CNN. Each CNN layer consists of the convolution, rectification and maximum pooling processing which gives the internal representation of the local patches of the gastric endoscopic images. We have adopted three layers of CNN as shown in the figure 1. For the gastric cancer image the local patches are having the higher internal variation in the local region compared to the non-gastric images as shown in the figure 2. Fully connected layer converts the multi-dimensional feature map of the third layer of CNN in to the one dimensional vector which is further fed to the KNN classifier. The convolution operation is given by the equation 1.

$$Gastric_{conv} = Image(x, y) * Filter_{conv} \quad (1)$$

The rectification of the convolution layer map can be computed using equation 2.

$$Gastric_{ReLU}(x, y) = \max(Gastric_{conv,}(x, y), 0) \quad (2)$$

Mini-batch gradient descent method is used for the learning purpose.



a) b)

Figure 2 a) Figure Gastric Cancer Positive b) Gastric Cancer Negative

IV. DEEP LEARNING

In this work, CNN is used as the deep learning architecture which consists of stack of the convolution layer (CL), rectified linear unit (ReLU unit) layer, maximum-pooling layer (MP), fully connected layer (FC) and classifier layer. In the convolute ion layer the input gastric image is convolve with the filter bank having six filter kernels. In the RelU layer, negative values are rounded to the zero to increase the non-linear nature of the data. The max-pooling layer removes the unimportant features and decreases the size of the feature vector. In the fully connected layer the multidimensional data vector is transformed in to the single dimensional data vector which is further provided to the classifier layer. For the classification we are suing KNN classifier which is simple to implement and takes very less time for the training. For the matching in the KNN, euclidean distance is used. We have used three stacks of the CNN as the deep architecture. The structural design of the CNN is shown in the figure 3.

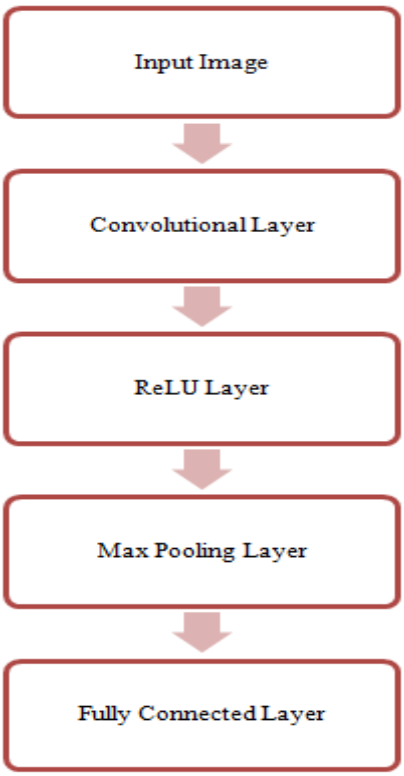
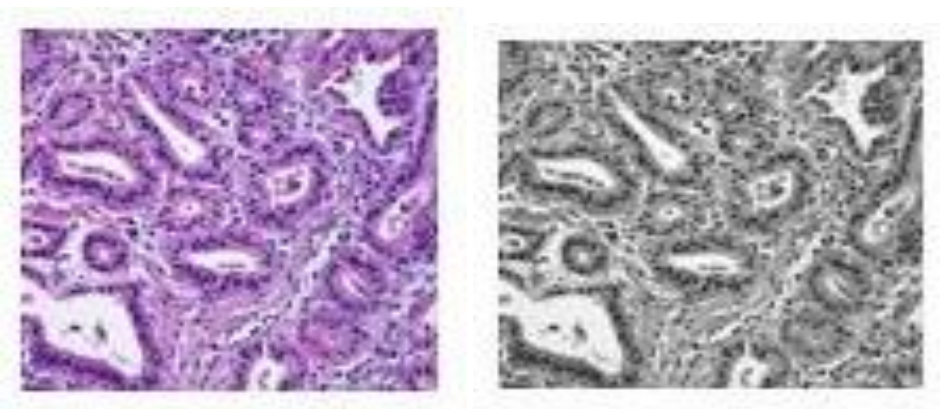


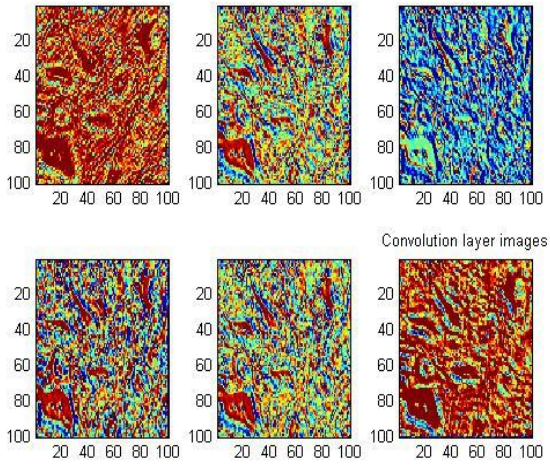
Figure 3 CNN 1 layer architecture

V. RESULTS AND DISCUSSION

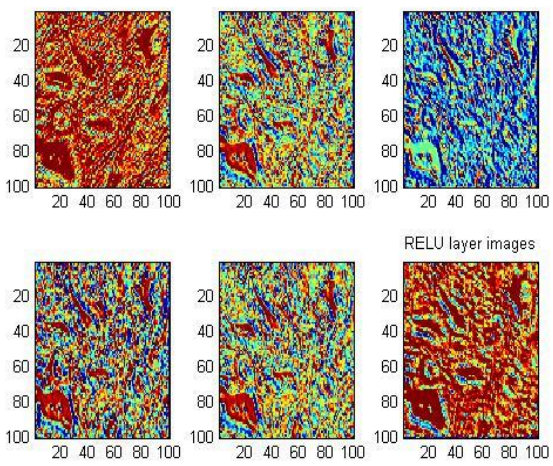
The method is executed using the MATLAB software (Digital image processing toolbox and digital signal processing toolbox) on the windows environment having 4 GB RAM and the core-i3 processor having 2.64 GHz processing speed. For the experimentation we have used BOT gastric slice database (public database) which consist of gastric and non-gastric images.



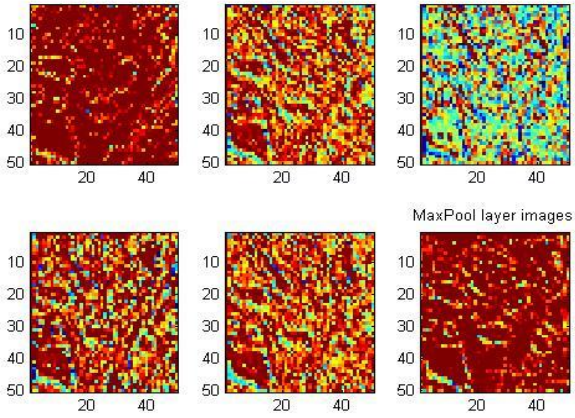
(a) (b)



(c)



(d)



(e)

Figure 4. a) Gastric cancer image b) gray image c) Convolution layer output d) RELU layer output e) Max pooling layer output

Figure 4 shows the input Gastric cancer image taken for the experimentation, gray image conversion of the input gastric image, the CL output which consists of six map of first CNN layer, RELU layer output and the Max pooling layer output along with its .

The percentage accuracy is computed using the equation 3.

$$\%\ Accuracy = \frac{Correctly\ Recognized\ Images}{Total\ Images} \qquad (3)$$

The % accuracy for gastric and non-gastric images is given in following table 1.

Table 1. % Accuracy

Dataset	% Accuracy
Normal Dataset	96.00 %
Gastric Dataset	93.00 %

VI. CONCLUSION

In this paper we have implemented gastric cancer detection in stomach microscopic images. For the implementation we have used BOT gastric slice database. We have used 3 layered deep convolution neural network learning architecture. As we increases the convolution layer, the connectivity of the internal region of the image increases. Internal connectivity map describes the image in better way. from the experimental results it is observed that average accuracy for the dataset is 94.40 %.

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