IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 3, March 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.488

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |

|| Volume 9, Issue 3, March 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0903202|

Polyp Detection in Gastrointestinal Track UsingMachine Learning

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ABSTRACT: Machine Learning (ML) has attracted a lot of attention in the field of medical image analysis because of its higher performance in image classification when compared to previous state-of-the-art techniques.In this scenario, a lot of research using ML for polyp detection and classification have been published showing promising results in the last five years. Automated polyp detection in endoscopy videos has been demonstrated to be a promising way for Gastrointestinal (GI) cancer prevention and diagnosis. Traditional manual screening is time-consuming, operator-dependent and error-prone; hence, automated detection approach is highly demanded in clinical practice. Automated polyp detection is very challenging due to high intra-class variations in polyp size,color, shape and texture and low inter-class variations between polyps and hard mimics. Video endoscopy is the most used diagnostic modality for gastrointestinal polyps. In typical video endoscopy, a small camera is entered and directed through the GI tract to detect and remove polyps and it takes long period of time generating a long video. So, as an operator dependent procedure, it is not possible for a medical person to examine it with sufficient attentiveness during such long and back-to-back endoscopy. Our work aims to review the most relevant studies from a technical point of view, focusing on the low-level details for the implementation of the ML models to detect and locate the polyps in GI track by using the prerecorded endoscopic videos of the patient in an efficient way to help doctors to detect GI cancer.

KEYWORDS: Convolutional Neural Network, Machine Learning, GastroIntenstinal

I. INTRODUCTION

To create a ML models to detect and locate the polyps in GI track by using the prerecorded endoscopic images and videos of the patient in an efficient way to help doctors to detect GI cancer. Gastrointestinal cancer has a great incidence rate worldwide, but its early detection significantly increases the survival rate. Endoscopy is the gold standard procedure for diagnosis and removal of lesions with potential to evolve into cancer. Computer-aided detection systems can help gastroenterologists to increase the adenoma detection rate, one of the main indicators for endoscopy quality and predictor for gastrointestinal cancer prevention. The recent success of Machine Learning (ML), Artificial Intelligence (AI) and Deep Learning (DL) approaches in Computer Vision (CV) has also reached this field and has boosted the number of proposed methods for polyp detection, localization and segmentation. Recently, the success of deep learning has also boosted the applications on medical imaging analysis, achieving expert performance in several cases. Automatic Polyp Detection in endoscopy Videos challenge proved that Convolutional Neural Networks (CNNs) are the state-of-the-art regarding polyp detection methods.

II. LITERATURE SURVEY

[1] In the year 2020 Xiayoung yang,Qianxing Wel has proposed colon polyps have a greater chance of developing into colon cancer, and colonoscopy is one of the most commonly used methods to detect colon polyps. However, the effectiveness of colonoscopy depends largely on the technical level of the physicians, and there arefewer experienced physicians. Besides, traditional artificial intelligence methods cannot obtain a unified model with good results for all patients. To solve these problems, a colon polyp detection and segmentation method based on mask regions convolutional neural network (MRCNN) with precise region of interest (PrROI) pooling is proposed in this article.

[2] In the year 2020 Samira Lafraxo,Mohamed El Ansari has proposed The human gastrointestinal (GI) tract may be infected by various diseases. If not detected at early stages, these abnormalities have the possibility to progress into

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gastric cancer, which is a common type of malignancies with yearly global cases exceeding one million. Endoscopy is a routinely used strategy for the examination of gastrointestinal tract diseases. During the examination, and due to many reasons like irregular morphologies, a huge number of frames, and exhaustion, gastrologists can miss some abnormalities. The results of our CNN approach compared to other well known pre-trained models showed important improvement and achieved 96.89% in terms of accuracy. The experiments demonstrated that the system can perform a high detection level without any human intervention.

[3] In the year 2019 Wenju Du,Nini Rao,Dingyun Liu,Hongxiu Jiang,Chengsi Luo,Zhengwen Li,Tao Gan,Bing Zeng has proposed Gastrointestinal (GI) disease is one of the most common diseases and primarily examined by GI endoscopy. Recently, deep learning (DL), in particular convolutional neural networks (CNNs) have made achievements in GI endoscopy image analysis. This review focuses on the applications of DL methods in the analysis of GI images. We summarized and compared the latest published literature related to the common clinicalGI diseases and covers the key applications of DL in GI image detection, classification, segmentation, recognition,location, and other tasks. At the end, we give a discussion on the challenges and the research directions of GI image analysis based on DL in the future.

[4] In the year 2019 Ming Liu,Jue Jiang,Zenan Wang has proposed A major rise in the prevalence and influenceof colorectal cancer (CRC) leads to substantially increasing healthcare costs and even death. It is widely acceptedthat early detection and removal of colonic polyps can prevent CRC. Detection of colonic polyps in colonoscopy videos is problematic because of complex environment of colon and various shapes of polyps. Currently, researchers indicate feasibility of Convolutional Neural Network (CNN)-based detection of polyps but better feature extractors are needed to improve detection performance. In this paper, we investigated the potential of the single shot detector (SSD) framework for detecting polyps in colonoscopy videos.

[5] In the year 2019 Yacheng Ren,Jingchen Ma,Junfeng Xiong,Yi Chen,Lin Lu,Jun Zhao has proposed Computer-aided detection (CAD) systems can assist radiologists in reducing the interpretation time and improving the detection results in computed tomographic colonography (CTC). However, existing false positives (FPs) impair the advantages 2of CAD systems. This study aims to develop new morphological features for the FP reduction while maintaining high detection sensitivity. Volumetric feature maps are computed for each polyp candidate byusing three-dimensional (3-D) geodesic distance transformation, circular transformation (CcT), and quantized convergence index (QCI) filters. Then, new morphological features are developed based on the curvature, fractaldimension, and volumetric feature maps.

III. EXISTING SYSTEM

Polyps have a greater chance of developing into colon cancer, and endoscopy is one of the most commonly used methods to detect polyps. Besides, traditional artificial intelligence methods cannot obtain a unified model with good results for all patients. To solve these problems, a colon polyp detection and segmentation method based on Mask Regional Convolutional Neural Network (MRCNN) with Precise Region of Interest (PrROI) pooling.

The proposed method is constructed in two parts:
1. An image filter is used to filter the initial image, filtering out the low-quality image data.
2. The screened images are divided into multiple groups according to patients and sent to the improvedMRCNN for training to obtain the corresponding private model of each patient.

Limitations of the Existing system

- Clarity of images and videos are not clear enough to detect polyps.
- Technical assistance is needed for doctors if there is a system failure.
- Polyp detection patterns and architecture are not time efficient for detection.
- Time consumption is maximum.

IV. PROPOSED SYSTEM

Our work aims to review the most relevant studies from a technical point of view, focusing on the low- level details for the implementation of the ML models to detect and locate the polyps in GI track by using the prerecorded endoscopic videos of the patient in an efficient way to help doctors to detect GI cancer.

Automatic Polyp Detection in Colonoscopy Videos challenge proved that Convolutional Neural Networks (CNNs) are

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the state-of-the-art regarding polyp detection methods. Using this state-of-the-art approach, the following objectives through endoscopy are shown in figure 1 describes the architecture diagram.

- Detection: Identifying whether a polyp is shown or not in the frame, but information on the polyp locationis not given.
- Localization: Identifying the position of the polyp within a given frame, but exact shape of the polyp isnot relevant.
- Segmentation: Marking the exact polyp area in a given frame.

Interpretation using CNN

- To detect and predict polyp in GI track, I have used convolutional neural network (CNN) and fastai package and implemented using python programming language.
- A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in aninput image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other shown in figure 2.
- Fastai is a deep learning library which provides practitioners with high-level components that canquickly and easily provide state-of-the-art results in standard deep learning domains, and provides researchers with low-level components that can be mixed and matched to build new approaches
- The dataset contains images from inside the gastrointestinal (GI) tract. The collection of images isclassified into three important anatomical landmarks and three clinically significant findings. In addition, it contains two categories of images related to endoscopic polyp removal.
- This analysis is mainly done in order to know how well the dataset is being trained and to know thetime consumption of the dataset trained with CNN**.**

Image segmentation of dataset

- Here image segmentation is done with the dataset. The dataset contains both polyp and non polyps.Itshown in figure 3.
- From the original dataset we are extracting the polyp and non polyps as a folder and saving it directlyin the drive.
- The images are converted into array format in order to divide between polyps and non polyps
- During image segmentation, we are cropping the images to get a clear clarity of images whether it is apolyp or not.

Localization of polyps

- Here the data are trained using both ResNet34 and ResNet50 from which the training model iscompared and saved.
- ResNet34 was quick but the accuracy did not exceed beyond 90 % where as ResNet50 took a longertime to train initially and later gave a good result with great accuracy.
- By comparing the accuracy of both Resnet34 and Resnet50, Resnet50 gives more accuracy thanResnet34 which is 97.5%.

Polyp detection and prediction

- Here the ResNet50 model is loaded with the test and training dataset. A random gastrointestinal imageis given as an input and tested.
- Using the trained model ,the input is tested and gives the result with accuracy based on the classes“polyps” and “non-polyps”.

User- Interface to detect and predict polyps and non-polyps

- Here, a user interface is created to detect polyps and non polyps
- The user interface is created using a python library – flask framework to deploy the model on localhost.

International Journal of Innovative Research in Computer and Communication Engineering

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- The front end is created using HTML and CSS.
- An input image is given here and after clicking on the predict button it will give a result whether it is a polyp or not shown in figure 4.

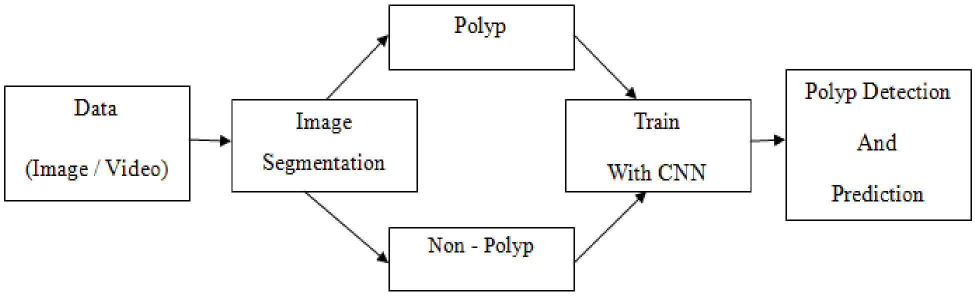

Figure 1. Architecture diagram

Advantages

- The proposed system has more accuracy for detection
- A machine learning model is created that is quick to train the dataset
- A clear image is given as an output after detection.

V. EXPERIMENTAL RESULTS

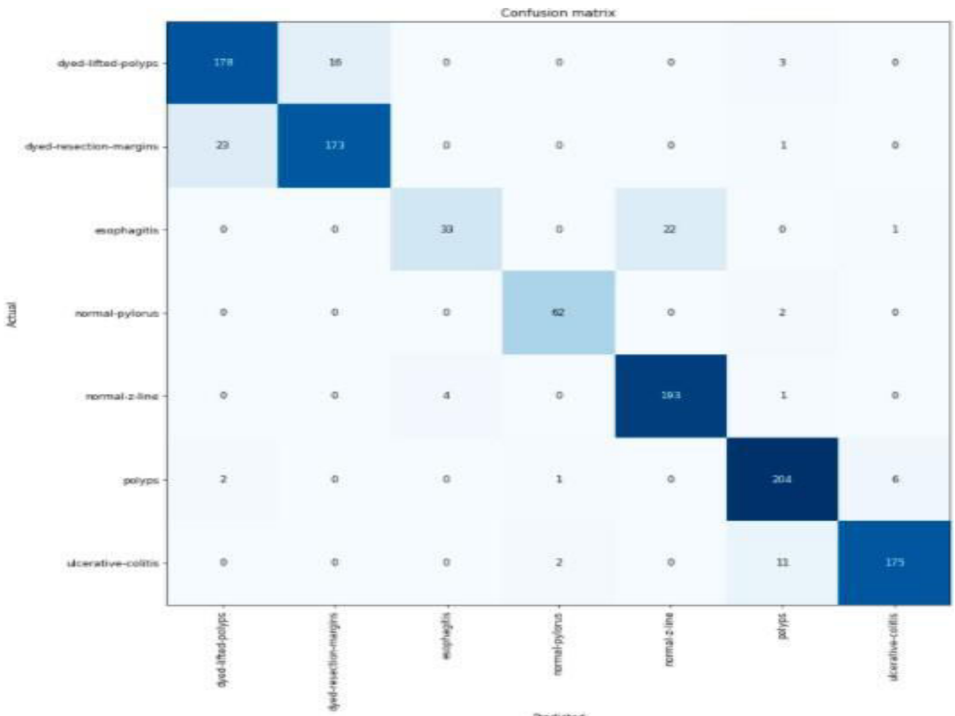

Figure 2. Confusion matrix

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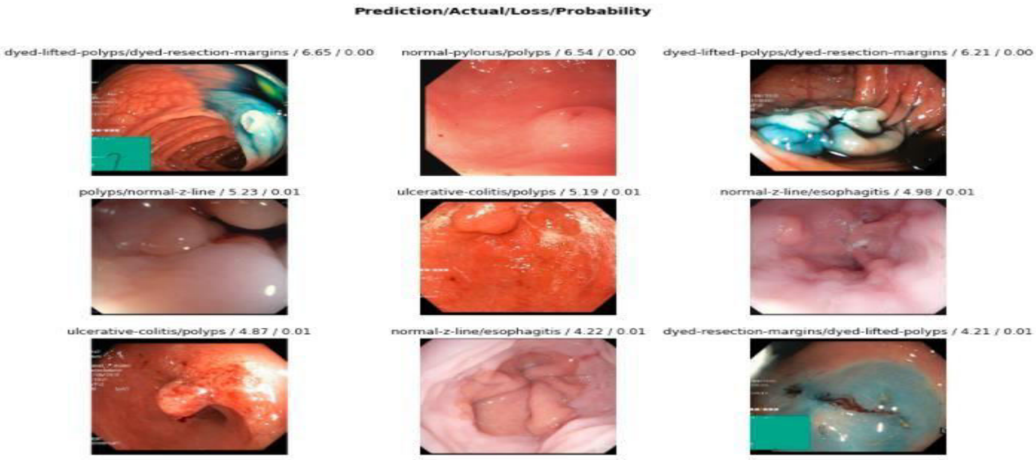

Figure 3. Polyps Prediction and Probability

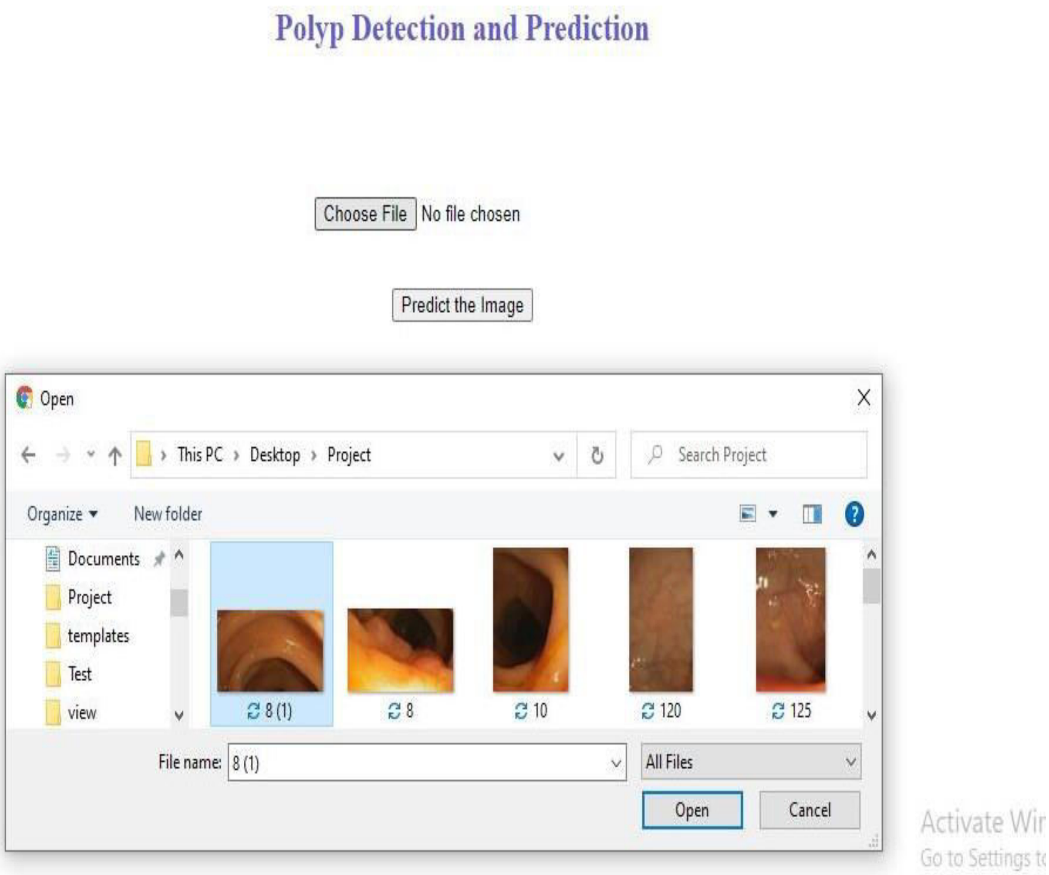

Figure 4. Polyp Detection and Prediction

VI. CONCLUSION

We can detect polyps in gastrointestinal track with the help of CNN – ResNet50 model. This system can be implemented to locate and detect polyps based on a given input image. The given image is trained using CNN –

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ResNet50 model and finally gives an output whether it is a polyp or non polyp. This system will help the doctors to detect polyps using which the doctors can predict it is a cancerous polyp or not.

VII. FUTURE ENHANCEMENT

In future work, we can improve our approach based on the new benchmarks such as that the accuracy and efficiency of the CNN – ResNet50 model increases, using which this model can be deployed on a Google Coral USB accelerator. This USB accelerator can be connected to the endoscopic system to immediately detect polyps both in presence and absence of the patient and it would be helpful for the doctors to keep a track on the record of the patient.

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Impact Factor:
7.488

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