Gastric Cancer Detection based on Gastroscopic Images using YOLOv5 model

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***Abstract* — One of the most common malignant tumors around the world and the third-leading cause of cancer-related death is gastric cancer. Misdiagnosing for benign and malignant tissue by gastroscopy may be occurred based on the knowledge and experience of endoscopic doctors. One of the most difficult problems encountered in detecting gastric cancer is still the need for a dataset containing gastric cancer features and models that can detect them accurately. This proposed system focuses on detection of gastric cancer based on neural network. Biomedical images concerned with gastric cancer will be collected from Kaggle and GasHisSDB, and use as inputs for further processing. Data augmentation will be processed using image processing techniques. These images will be used in features extraction and classification using YOLOv5. The extracted features will be used in gastric cancer detection and classification (by means of computer vision) for clinical decision support system for further treatments. (*Abstract*)**

Keywords—Gastric cancer, deep learning, detection, classification, YOLOv5 (*key words****)***

I. INTRODUCTION

Gastric cancer is the cancer of the cavity organs with the highest incidence, which is a serious threat to human health. Although the diagnosis and treatments of early gastric cancer helpful to the recovery of the patients, most patients, have been already at an advanced stage. So, the diagnosis and treatment of gastric cancer has become an urgent need and to improve early gastric cancer has become the focus of current researches. The gastric cancer detection rates can be different in various areas and hospital levels due to the endoscopic physicians' varying levels of proficiency. Therefore, many researchers are working hard to come up with better gastric cancer detection methods. With the advancement of computing power in technology, researchers are doing a lot of research using machine learning and deep learning methods.

Deep learning neural networks, or convolutional neural networks, attempts to mimic the human brain through a combination of data inputs, weights, and bias. These elements work together to accurately recognize, classify, and describe objects within the data [1]. Deep neural networks consist of multiple layers of interconnected nodes, each building upon the previous layer to refine and optimize the prediction or categorization [1].

YOLO (You Only Look Once) is the most popular among the one stage object detection and classification model known for its speed and accuracy. It was first introduced by Joseph Redmon et al. [6] in 2016 and has since undergone several iterations, the latest being YOLOv7. In this article, we will propose the gastric cancer detection system using the YOLOv5 model to achieve better accuracy for classification and detection.

II. RESEARCH PROBLEMS AND OBJECTIVES

A. Research Problems

Nowadays, there is a need for more endoscopic physicians who are skillful in the diagnosis of gastric cancer in hospitals. If these endoscopic physicians are helped to predict gastric cancer more accurately and efficiently, patients can be got effective treatment as soon as possible. Due to such accurate detections, the spread of the disease can be controlled and cured effectively.

10% of upper gastrointestinal cancers are missed due to errors by endoscopy and endoscopy physicians. Due to differences in expertise among endoscopic physicians, levels of hospitals and features of gastric cancer, there are many difficulties in the detection of this disease. There are still diagnostic errors due to the errors of endoscopic physicians and the defects of the endoscopes used. The use of only clinical and laboratory data in prediction disease course, the detection and classification results may not be achieved high accuracy.

B. Aim and Objectives

This research aims to improve the endoscopic physicians' ability to effectively diagnose gastric cancer and reduce the disease's rate of death.

The objectives are as follows:

- To convert and manipulate biomedical images using image processing techniques for further object detection and classification.
- To propose the network architecture based on YOLOv5 for gastric cancer detection and classification.
- To enhance the accuracy of gastric cancer detection and classification for clinical decision support system.
- To reduce the endoscopic physicians' errors and improve the detection accuracy.

III. RELATED WORKS

Gonçalves WGE et.al. [2] presented a systematic review of deep learning in gastric tissue diseases. Two stage and one stage detection methods can be used in the detection of gastric cancer and could get superior accuracy over specialists in the classification of gastric cancer. But, deep learning applications are not intended to replace professionals who are directly responsible for the diagnosis. In their review, two terms: 'deep

learning' and 'gastric' were used for searching the related studies, and 83 articles in total were found in four data sources (PubMed, IEEE, ACM and DBLP). Among them 33 articles were selected based on their inclusion criteria to make a systematic review.

They found that deep learning models were built under training with histological (45%) or endoscopic (33%) images. Approximately 76% of articles proposed applications of CNN for the diagnosis of gastric cancer or the detection of lesions in gastric tissue.

They concluded that one of the most commonly used methods in their analyzed works was transfer learning, secondary training, and fine-tuning, as well as comparison with the results of self-designed networks, due to difficulties in obtaining well-annotated training image collections in the medical field.

Huang B et.al. [3] proposed the framework of GastroMIL model to predict gastric cancer. They got 92% accuracy in the prediction of gastric cancer, but the input image size is 224x224 [3].

The aim of their research is to develop deep learning-based models to assist in predicting the diagnosis and overall survival (OS) of GC patients using pathological images [3].

2333 hematoxylin and eosin-stained pathological pictures of 1037 GC patients were collected from two cohorts to develop their algorithms, Renmin Hospital of Wuhan University (RHWU) and the Cancer Genome Atlas (TCGA). Additionally, 175 images of 91 patients were collected as their validation dataset from National Human Genetic Resources Sharing Service Platform (NHGRP) [3].

In their research, the GastroMIL and MIL-GC models were proposed for diagnosing and predicting the gastric cancer based on deep learning. The GastroMIL achieved accuracy 0.920 in the external validation set. Moreover, the risk score output by MIL-GC in the external validation set was proved to be a strong predictor of OS both in the univariate ($HR = 2.414$, $P < 0.0001$) and multivariable ($HR = 1.803$, $P = 0.043$) analyses [3].

Their results showed that the prognostic model based on CNN was equipped to predict OS of GC and might provide a basis for the choice of treatment.

Yao Z et.al. [4] proposed EGC-YOLO based on YOLOv3 in order to recognize and verify gastric cancer. They used two test sets to test the model performance and got more than 80% accuracy.

The aim of their research is to develop an artificial intelligence system using "EGC- YOLO" for the rapid and accurate diagnosis of endoscopic images from early gastric cancer [4].

42,200 images of non-gastric cancer and 945 endoscopic images of early gastric cancer from 1653 patients in Yixing people's Hospital were included in the training set. The test set comprised of 280 early gastric cancer images and 77 non-gastric cancer images from the Hospital of Soochow University, and 159 early gastric cancer images and 77 non-gastric cancer images from Civil Aviation Hospital of Shanghai [4].

They used the general architecture of YOLOv3, with DarkNet53 as the backbone network and a three-layer spatial pyramid as neck. The detection model was divided into the backbone, the bottleneck network, and the detection head. The backbone network was responsible for the feature extraction of the image. The neck network was the feature fusion layer. The detection head used the three spatial pyramid features to output the final target [4].

The accuracy, sensitivity, specificity and positive predictive value for Test Sets 1 were 85.15%, 85.36%, 84.41% and 95.22%, for Test Sets 2 were 86.02%, 83.02%, 92.21%, 95.65%. Optimized Threshold-values were 0.02, 0.16 and 0.17 for their Test Sets 1 and 2.

IV. PROPOSED SYSTEM

The proposed gastric cancer detection system can be divided into training and testing phase as shown in Fig 1 and Fig 2. In this system, we proposed to use the YOLOv5 algorithm, which is a region-based convolutional neural network characterized by high speed, strong versatility and low background error detection rate, for training and testing.

Custom image dataset for gastric cancer will be created by collecting the 245196 gastroscopic images from Kaggle and GasHisSDB sources. Images are divided into 160x160, 120x120 and 80x80 pixels sub datasets, which have two classes – normal and abnormal. After that we need to annotate the objects of interest to create a ground truth for our gastric cancer detection model to learn from. First of all the images from our custom dataset will be preprocessed and uploaded in Google Drive to train our YOLOv5 model [5]. YOLOv5l model will be trained on COCO128 by specifying dataset, batch-size, image size and pretrained "--weights yolov5l.pt" by using transfer learning method. The trained model will be saved in .pt file type.

In the testing phase, the input gastroscopic image will be classified to specific cancer level and objects will be detected by bounding box. The proposed system will be implemented by using Python programming language.

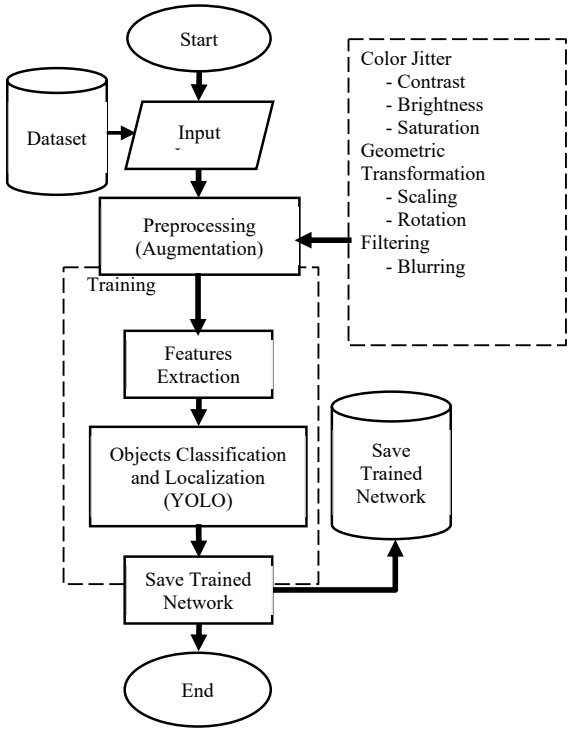

Fig. 1. Training phase of our gastric cancer detection system

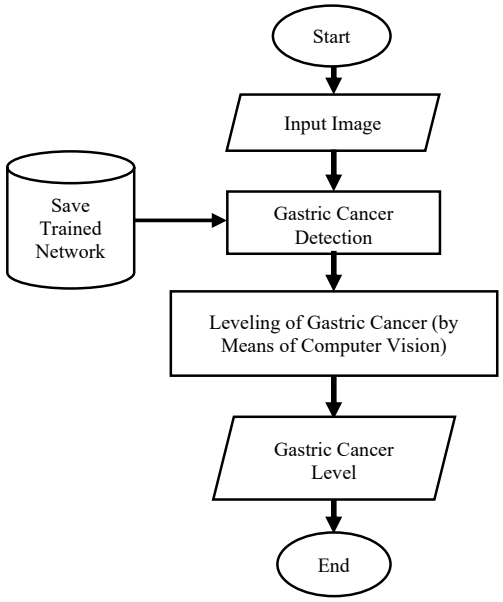

Fig. 2. Testing phase of our gastric cancer detection system

V. CONCLUSION

The development of tools that can lead to accurate and efficient diagnosis based on artificial intelligence has continued in recent years. With the wide availability of graphical processing units, medical researchers are using deep learning methods and getting exciting results.

The recent advances and developments in software based on artificial intelligence will imply methodological requirements that can provide safety, quality and efficiency of AI-based software. Among deep learning models, YOLO series models stand as the best tradeoff models between accuracy and speed. Therefore, research will be conducted to obtain a good gastric cancer detection model based on YOLOv5.

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