

Diagnosing the Location of Ulcer Cancer by Thresholding Method Using the Image Processing Technique

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ABSTRACT

Although the number of people who suffer from the Gastric Cancer (GC) is decreasing worldwide, especially in developed countries, yet around 15% of Iranian and many people in Asia are suffering from the Gastric Ulcer (GU). Timely diagnosis of both GC and GU can reduce the number of patients and thus, reduce the cost of treatments. Through an intelligent diagnosis, it is possible to distinguish between the GU and GC much earlier, which can expedite the process of curing too. Therefore this research proposes a novel intelligent method to diagnose the illnesses based on the color averaging, optical methods and image classification. The images related to GC possess a high red domain and a low illuminated (white) domain. In contrast, the images related to GU possess low red domain but high white domain. The proposed algorithm can distinguish between these illnesses very fast, and was able to successfully classify the images in 95% of the cases.

KEYWORDS: Gastric Ulcer; Gastric Cancer; Color Domain; Classification

INTRODUCTION

Peptic Ulcer is a kind of benign harm to mucous and sub-mucosal parts of the digestive system. There is usually a relationship between gastric acid secretions and this kind of injury; however, nowadays, Pyloric Helicobacter bacterium's existence and increase is known as the main reason for these ulcers. It can cause Peptic Ulcer through a variety of ways, including harming the protective gastric mucosal layer. Thus, the main cure shall be an Antibiotic one. The prevalence rate of this disease is 6-15% [1].

Gastric Cancer is one the most prevalent kinds of cancer so-called "Adenocarcinoma" or Glands Cancer in the stomach. Gastric cancer can be known as *the non-controlled growth of the malignant cells inside the stomach*. Other forms of gastric cancer which are less prevalent, such as *Lymphoma* (A kind of cancer that involves lymphatic system) and *Sarcoma* (The Cancer involves conjunctive tissues such as muscles, adipose or blood vessels). Gastric cancer causes almost one million death-losses around the world [2].

The most common symptoms of gastric ulcer is a smart pain starts from sternum down to the upper part of the navel. Gastric ulcer will be painful when gastric acid touches the harmed position. Gastric ulcer pain starts an hour after eating and will be continued for hours. Moreover, the pain starts burning at night which may awaken the patient. Gastric ulcer's pain will become worse when the stomach is empty; therefore, one should avoid starving. Gastric ulcer's pain may decrease for a short period of time, but the symptoms of gastric ulcer will start again after few weeks; hence, the patient must definitely go to a doctor to cure the gastric ulcer [3].

The prevalent symptoms of Gastric Cancer can be Decreased appetite, Weight loss, Anemia, Stomach ache, vague symptoms of Indigestion e.g. eructating, Hemoptysis, feeling stomach fullness even after eating a little food, dark stool, Nausea and Vomiting, Severe pain in Epigastrium, smart pain in Abdomen, and symptoms similar to those of Gastric Ulcer [4].

Considering the discussions with specialists in these medical areas including Dr. Dariush Niazi, Gastroenterologist in Bandar Abbas, some information about these diseases were gained. After several investigating and checking the images of these two diseases, it was found that the injuries related to gastric cancer were appeared in red while those related to gastric ulcer are in white; thus, the domain of the two colors in the images of these two diseases might be a lot. Samples of these injuries are shown in figures 1 and 2. By means of this property and calculating the domain of these colors we can differentiate the two diseases.

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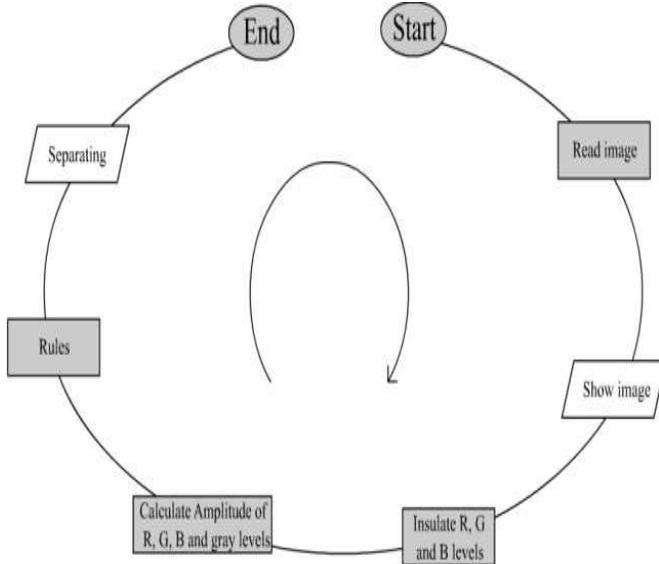


Fig. 1: A sample of Gastric Ulcer



Fig. 2: A sample of Gastric Cancer

In this study, first the general method is described via flowchart 1, and then property selection is explained as a rule. Next, assessment and then the suggested method will be presented and finally, both discussion and conclusion are presented.



Flowchart 1: the Algorithm phases for differentiating the images of Gastric Ulcer and Cancer

Property Selection Issue

Property selection issue is actually defined as selecting those kinds of properties that possess the maximum capability in predicting the outputs [5]. What the definition of the suggested subset can depend on the problems that we are going to solve [6]. In this research, color domain method was used to examine and classify the data. As it was said before, whiteness of the injuries caused by Gastric Ulcers and redness of Gastric Cancer ulcers are the main reasons of using the noticed method.

Gastric Ulcer and Gastric Cancer

Mucosal harm and fracture scaled more than 5mm², of which the depth reaches the mucosal sub-layer, is called *Gastric Ulcer* and even sometimes *Duodenal Ulcer* [7]. This kind of disease usually appears in old ages and its most prevalence will take place in the sixth decade of a human's life [8]. One-third of gastric ulcer cases are observed among men. Considering the malign potentiality of the disease, biopsy samples must be extracted from the injury [9]. The benign ulcers are usually found at the end of the stomach but rarely on its dome [10].

It is possible to say that the H-Pyloric infection is warm, negative micro aerial bar-shaped bacterium which can be found at the deep part of mucosal layer (a layer that covers the internal surface of the stomach) or between mucosal layer and sealing cells in the stomach [11]. During the beginning phases, the microbe remains at the end part of the stomach, but as far as times passes it can migrate to the front end of the stomach [12].

The rate of H-Pylori prevalence depends on a country's level of standards. In developing countries 80 percent of people may be afflicted by H-Pyloric infection, while in the developed countries this will change to 50 – 90 percent and in the U.S this rate will be around 30 percent [13]. The rate of H-Pyloric infection occurrence in the developed countries is reducing. This infection is usually transferred in these countries through mouth-to-mouth or mouth-anal ways [14].

The clinical symptoms and traces are as follows:

Pain in abdomen, which is very usual in digestive disorders like gastric and duodenal ulcers, but it doesn't deserve so much to be predicted for diagnosing gastric or duodenal ulcer. Not complaining about digestive disorders before, 10 percent of people with digestive problems caused by non-steroidal drugs are referring to the hospitals, having intensive side-effects such as digestive system's bleeding and penetrated ulcers [15].

Gastric ulcer can also cause some effects like gastric outlet obstruction, gastric puncture and digestive system's bleeding [16].

Gastric ulcer diagnosis will be done by Stomach Endoscopy or Radiography. For lots of patients with clinical symptoms of gastric ulcer it will be clarified that they are suffering from that disease. Through radiography with a doubled contrast up to 90 percent of ulcers can be found, but not the tiny ones, i.e. smaller than half-a-centimeter (0.5cm). The most critical, sensitive and exclusive method to diagnose the ulcers in the digestive system is endoscopy [17].

Gastric ulcer healing is by removing and supplanting S- Pylori [18]. The rate of dying by gastric cancer in developed countries has been clearly reducing during the recent 75 years due to unknown reasons; however, it is increasing in Iran, unfortunately [19].

There is a dramatically high risk of gastric cancer among the economically-poor families [20]. Around 85 percent of gastric cancer cases have been of the Adenocarcinomas type (a type of cancer cell) and the remained 15 percent include Lymphomas, Leomyosarcomas and Gastrointestinal cells [21].

The Adenocarcinomas is two types: Intestinal and Diffused [22]. The reason of cancer is long-term use of foods rich in nitrates, smoking and salt [23]. One of the noticeable symptoms of cancer is that when the disease is still superficial and can be cured by a surgery operation, actually it does not show any symptoms [24]. As the tumor swells, it gets larger and progresses with symptoms like pain in the upper part of the stomach (Epigastrium), amnesia, fullness and heaviness feeling after eating food, anorexia (inappetence) constant and severe pain and a smooth sense of nausea [25]. Gradual weight loss, nausea, and vomiting are mostly observed in cancers appear in the form of polyp or swelled masses. Disorders in swallowing (dysphagia) and early satiety might be of the significant symptoms of the diffused tumor at the gastric cardiac (at the stomach inlet). Anemia and lack of ferrous are very common symptoms found in gastric cancer [26].

Some researchers believe that the best and the most precise way to diagnose gastric ulcer is possible by means of endoscopy, since 8 percent of those seemed-to be- benign ulcers can be malign ones [27]. Endoscopy makes it possible take samples and benign ulcers can be differentiated from the malign ones [28]. Gastric cancer's healing might involve total tumor and lymph glands removal; of course, less than one-third of people who are suffering from cancer are in the phase in which the total tumor removal is possible [29]. Moreover, Gastric Adenocarcinomas are relatively responding to radiotherapy [30]. The combination of radiotherapy and chemotherapy in progressed non-operatable cancers will provide the patients with 30 to 50 percent healing response [31]. Radiography along with double-contrast technique can be the easiest way to diagnose the gastric cancer in patients suffering from stomachache [32].

Data Bank

The first step in performing the tasks of the diagnosis-related projects mainly involves calculating the required images in order to be processed. First of all, after studying the articles titled with topics related to various diseases diagnosis via image processing method, and consulting with experts of the field, it was decided to use CT-Scan

images. Considering the problems occurred with using these images, the colored images were selected to be used. There were 100 images of various sizes which were used in algorithm test, i.e. the program.

Proposed Method

As it was mentioned in the introduction, the purpose of this study is to present a method to make a differentiation between Gastric Ulcer and Cancer. Thus, our proposed method contains several phases that are going to be discussed in continue. We shall firstly discuss about the pre-processing phase and then continue with achieving colors domains, thresholds and making distinction between the ulcers. In the end, the results concluded through the algorithm will be reviewed.

Pre-processing

One of the first steps to solve a problem is to simplify it. Therefore, the initial images in RGB format will be divided into R, G, and B levels; this is shown in figure 3.

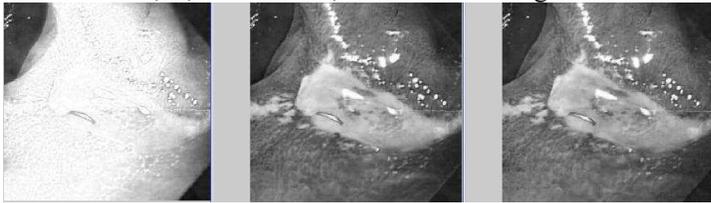


Fig. 3: Divided levels: R, G and B

Achieving Colors Domains

In this phase, red, green, blue and white colors domains are achieved in different intensities so that, after reviewing these abundances, some rules can be gained in next steps in order to make a distinction among the images. In figure 4, domains of red, green, blue and white color in different intensities are illustrated for an image of Gastric Ulcer.

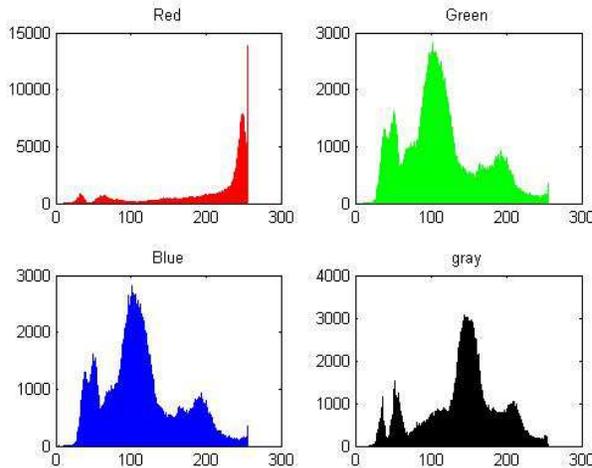


Fig. 4: Diagrams of Red, Green, Blue and White colors in different intensities for the image of Gastric Ulcer

Figure 5 illustrates the diagrams of Red, Green, Blue and White colors in different intensities for the image of Gastric Cancer.

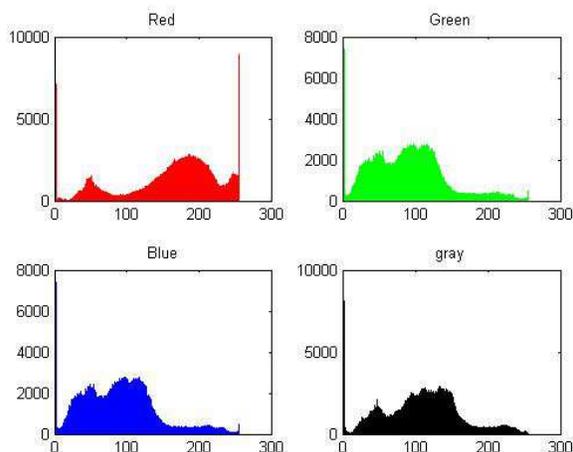


Fig. 5: Diagrams of Red, Green, Blue and White colors in different intensities for the image of Gastric Cancer Reviewing figures 4 and 5 and taking into account the previously explained points, the high intensity-pixel domains of Red, Green, Blue and White colors must be considered.

Achieving the Threshold

In table 1 patterns of some high intensity-pixel domains values of Red and White, Blue and Green, for the Gastric Ulcer – related images are given.

Table 1: Values of Red, Green, Blue and White colors domains for the Gastric Ulcer-related images

Row	Red	Green	Blue	White
1	41251	9042	9042	17081
2	48821	14388	14388	32409
3	80721	4134	4134	14644
4	39397	9998	9998	19550
5	47596	2043	2043	2438
6	109698	59461	59461	82498
7	860	64	64	71
8	176604	49716	49716	89015
9	112106	9755	9755	21330
10	23417	11046	11046	17903
11	40524	16150	16150	24669
12	49656	1534	1534	1621
13	104385	3300	3300	25645
14	154822	81826	81826	79510
15	58640	21176	21176	32165
16	172237	42219	42219	71114
17	55821	2700	2700	3560
18	75814	14186	14186	28015
19	52185	20544	20544	31497

In table 2, patterns of some high intensity-pixel domains values of Red and White, Blue and Green, for the Gastric Cancer – related images are given.

Table 2: Values of Red, Green, Blue and White colors domains for the Gastric Cancer-related images

Row	Red	Green	Blue	White
1	177570	12908	12908	4269
2	197711	27876	27876	4347
3	144929	43590	43590	9323
4	111404	4521	4521	7211
5	145253	4151	4151	5254
6	104333	4683	4683	6147
7	20155	8775	8775	11242
8	297373	57097	57097	12567

9	41880	6312	6312	7820
10	142770	1019	1019	49461
11	171037	5576	5576	10751
12	103793	30224	30224	49041
13	200549	4206	4206	61149
14	116986	25227	25227	30105

By reviewing tables 1 and 2, previously explained points about the images related to both Gastric Ulcer and Cancer are confirmed.

After reviewing table 1 the following rules for the gastric ulcer – related images will be achieved:

- Red domain is more than 10000 units;
- White domain is less than 10000 units;
- Green or Blue domain is more 10000 units.
- Doubled Green or Blue domain is less than the Red domain.

After reviewing table 2 the following rules for the gastric cancer – related images will be achieved:

- Red domain is less than 10000 units;
- White domain is more than 10000 units;
- Green or Blue domain is less 10000 units.
- Doubled Green or Blue domain is more than the Red domain.

The rules mentioned above may not be completely respected in some cases, but with a combination of the above conditions it is possible to come up with the required purpose.

Making Distinction between the Ulcers

After applying the rules gained through an algorithm framework and running the algorithm on images, the written program will make distinction between the input images and clears which image belongs to gastric ulcer and which one relates to gastric cancer.

An example of an output program is given in figures 6 and 7.



Fig. 6: An output gained via diagnosing gastric cancer

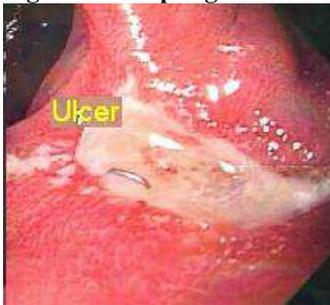


Fig. 7: An output gained via diagnosing gastric ulcer

Conclusion

In this paper, the Color Domain calculation method and classification was used to diagnose gastric ulcer and cancer diseases by means of a type of computer software dubbed MATLAB 7.14. In this method through a computer, with features as 2.0 Intel and 1 GB memory, the process for each image will last around 4 seconds. Of the advantages of this method we may refer to the followings:

- 1- In diagnosing operation, rapidity plays a key role on which the presented algorithm has well focused.
- 2- The success rate of this algorithm diagnosis will be 90 to 95 percent.

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