Implementing Wireless Capsule Endoscopy WCE in Digestive System Diagnostics

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Abstract
The purpose of this research is to discuss the revolutionary endoscopy method WCE that would enhance the diagnostic accuracy and reliability level. Additionally, a comparison has been made with other currently in practice endoscopy methods to single out the strengths and advantages of such endoscopy method. The limitation of this research caused by limited up to data due to the strict privacy policy normally adopted by hospitals regarding releasing patients information. This limitation will impose a partially outdated comparison results and conclusions. However, the past trends showed a steady increase in the number of medical facilities that decided to approve the usage of the WCE. These trends are derived from direct interactions with various medical communities. This paper originality and value come from the fact that increasing number of patients showed a serious reluctant toward continuing all their prescribed medical testing or procedures. Consequently, serious implication can be expected affecting those patients’ health. WCE if understood correctly by both patients and doctors will have a positive impact on the success of diagnostic and treatment statistics.

Introduction
The human digestive system has many organs, such as: the esophagus, stomach, small intestine, and large intestine, etc. Therefore, many different types of diseases have been discovered and diagnosed through the years. Endoscopes have been the most important diagnostic tool used to examine the upper and the lower parts of the digestive system. Nevertheless, these traditional endoscopes suffer from severe limitation due to their inability to visualize the entire digestive system.

Other surgical approaches are in use today and can provide a high level of diagnostic data. However, high costs and after surgery complications are serious disadvantages.

WCE as a promising alternative was approved by FDA in 2001 in United States. Many patients have benefited from this revolutionary technology worldwide. However, because it is a recent advancement, there is a scarcity of professionals experienced to use this technology.

WCE Design Basics:
Dimensions: 11 X 24 mm (fig 2). Thus, it is easy to be swallowed
The front end of the WCE has micro camera “Optical Dome”
Light unit built from powerful LEDs (Light Emitting Diodes)
Wireless transmitter that has short range because of the size of the WCE
Battery enough to operate the device for about eight to ten hours.

WCE Disadvantages:
camera can be configured by several parameters. However, the most interesting factor is number of captured images or frames per second (FPS) which will count to the total time needed to view these images. Usually, this time is about 6 – 8 hours of continuous video stream. As a result, some medical professionals find it impractical to analyze the information derived from WCE devices. When WCE finishes its work, doctors will be able to download all captured images (typically from 50,000 to 160,000) and analyze them.

Substantial research activities on how to summarize or compress captured images.
Benefiting from artificial intelligence in designing an automated computer system.
There are already available many algorithms for objects detection and tracking.

The Paper Model

Dependent Variable 1: WCE is a Painless Procedure
“The development of wireless capsule endoscopy alleviates painless imaging of the small intestine (Moloudi, Fritsch-Roemer, & Suevos, 2003) p2.” In many times this is the reason why patients refuse to accept such procedures, putting their health at risks. “Colonooscopy is sometimes painful for the patient and often difficult for the endoscopists, but it is hard to predict how difficult or painful the examination will be (Hall & Church, 1994) p12.”

In a recent study for, a questionnaire was distributed to 180 patients, the results were:

- 14% out of the total participating patients have expressed their experience with endoscopy as a painful process
- 59% find it as an oppressive
- 47% reported a good experience
- Other group of patients has expressed an increased level of anxiety, depression before administering endoscopy

Dependent Variable 2: WCE is an Advancement in Endoscopy
WCE innovation opened the door wide to many advanced algorithms techniques. “The wireless capsule endoscopy (WCE) invented by Given Imaging has been gradually used in hospitals due to its great breakthrough that it can view the entire small bowel for gastrointestinal diseases (Li & Meng, 2009a) p12.”

Video Summarization algorithm is applied to filter out all faulty, out of scope to increase the reliability

Dependent Variable 3: WCE has a 3D Capability
Due to many difficulties facing WCE, such as limited Illumination and irregular motion of the capsule endoscope 3D become a potential solution.
A recent paper for has demonstrated the possibility for utilizing image segmentation to obtain a 3D reconstruction of the mucosal tissues.
However, this reconstruction requires sophisticated mathematical models that normally consumes large amount of computing processing power

Dependent Variable 4: WCE Images are Numerical Representation
Computer aided images are just numerical representations
This fact makes it possible to automatically analyze images and detect interesting textures, that is, any abnormal structure that can be defined as a medial concern Doctors usually spend long time doing such analysis manually and generally report that this process became tedious and unreliable after a short while. Stefanini and others pointed that computer aided detection system is feasible, though it has limitations as well
Consequently, it is very important to design algorithms that can automatically recognize abnormal structures. These known as objects detection algorithms

Dependent Variable 5: Most of WCE Images are Wasteful
A study by Nawaratna, Oh, Yuan, Lee, & Tang (2010) has found that only less than 5% of the total captured images typically have useful information regarding abnormalities
Some reasons are:
- While WCE moving inside patient’s digestive system; it faces gains movements that makes it turn and flip. As a result, many captured images become wasteful
- Limited illumination yet is another problem. Although a powerful illumination source is built in WCE, it still not enough to illuminate all antra

Importance of the Model
This work is important because it provides an explanation of relatively new technology that many people still not aware of. This one of the reason why WCE still did not receive attention that it deserves from both research and medical practice communities
Doctors generally tend to use it when they already know and skilled in using. Therefore, they are reluctant to delve into new technologies that they do not yet have a complete control on its effects or interactions with other environmental factors
From this point of view, we believe in the importance of spreading positive understanding among all interested communities including the general public.

Conclusion
WCE is to dominant the field of endoscopy in near future. Eilersten has claimed that while many other endoscopy technologies are still in practice widely, continuous evaluation reports and surveys are published constantly to address their side effects on patients’ health
On the other hand, WCE as is still relatively recent technology, it is therefore the most expensive compared to other endoscopy technologies. Such burden has a significant impact on adopting WCE especially in countries with low economy level. However, as new advancements and developments are published in this interesting and exciting field on daily basis, we strongly believe that the costs of implementing WCE should decrease dramatically in the coming few years. Nevertheless, other researches such as charity organizations and other health helping centers can be investigated to support the application of such new technology to needed individuals around the world.