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Review Article

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Pill Camera: A new avenue in the field of endoscopy

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Abstract Technology aims to make products in a larger scale for cheaper prices and increased quality. The current technologies have attained a part of this, but the manufacturing technology is still at its macro level. Manufacturing product right from the molecular level is the scope of future.

In earlier days, manufacturing at molecular and atomic level was laughed about. But we have realized it to a certain level only after the advent of nanotechnology. PILL CAMERA iso ne such product manufactured, which is used for the treatment of cancer, anemia, and ulcer. This product revolutionized the field of medicine.

This capsule is so tiny that it can pass through our body, without causing any harm. This captures the pictures of our intestine and transmits it to the receiver of the computer for the analysis of our digestive system. This process helps in tracking any disease related to our digestive system. Also I have discussed the drawbacks of PILL CAMERA and methods to overcome these drawbacks i.e. by using Grain sized motor and bi-directional wireless telemetry capsule.

Capsule endoscopy helps your doctor evaluate the small intestine. This part of the bowel cannot be reached by traditional upper endoscopy or by colonoscopy. The most common reason for doing capsule endoscopy is to search for a cause of bleeding from the small intestine. It may also be useful for detecting polyps, inflammatory bowel disease (Crohn's disease), ulcers, and tumors of the small intestine.

Keywords Pill Camera, Endoscopy

Introduction

Imagine a vitamin pill-sized camera which could travel through your body capturing pictures, helping doctor to diagnose a problem which previously would have found only through surgery. Such technology is no longer the stuff of science fiction films.

The miniature e camera, along with a light, transmitter, and batteries, called Capsule Cam, is housed in a capsule, the size of a large vitamin pill, and is used in a procedure known as capsule endoscopy, which is a noninvasive and painless way of looking into the esophagus and small intestine.

Once swallowed, the capsule is propelled through the small intestine by peristalsis, and acquires and transmits digital images at the rate of two per second to a sensor array attached to the patients abdomen, through a recording device worn on a belt stores the images, to be examined and reviewed.

Material and Methods

The device, called the Diagnostic Imaging System, comes in a capsule form and contains a camera, lights, transmitter and batteries. The capsule has a clear end that allows the camera to view the lining of the small intestine.

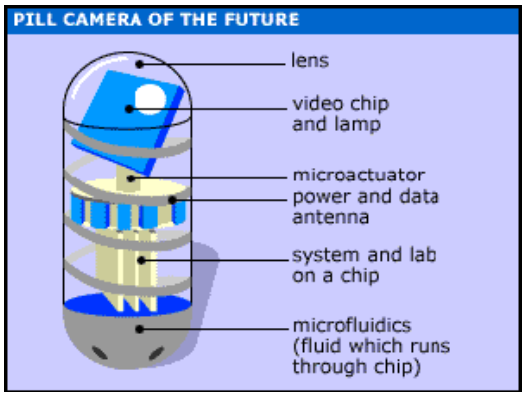
Capsule endoscopy consists of a disposable video camera encapsulated into a pill like form that is swallowed with water. The wireless camera takes thousands of high-quality digital images within the body as it passes through the entire length of the small intestine. The latest pill camera is sized at 26*11 mm and is capable of transmitting 50,000 color images during its traversal through the digestive system of patient.

Video chip consists of the IC CMOS image sensor which is used to take pictures of intestine. The lamp is used for proper illumination in the intestine for taking photos. Micro actuator acts as memory to store the software code that is the instructions. The antenna is used to transmit the images to the receiver. For the detection of

reliable and correct information, capsule should be able to design to transmit several biomedical signals, such as pH, temp and pressure. This is achieved with the help of Soc.

Working

- It is slightly larger than normal capsule. The patient swallows the capsule and the natural muscular waves of the digestive tract propel it forward through stomach, into small intestine, through the large intestine, and then out in the stool.
- It takes snaps as it glides through digestive tract twice a second. The capsule transmits the images to a data recorder, which is worn on a belt around the patient's waist while going about his or her day as usual.
- The physician then transfers the stored data to a computer for processing and analysis the complete traversal takes around eight hours and after it has completed taking pictures it comes out of body as excreta.
- Study results showed that the camera pill was safe, without any side effects, and was able to detect abnormalities in the small intestine, including parts that cannot be reached by the endoscope.



Pill Camera

Internal view of the capsule

1. Optical Dome:

- This shape results in easy orientation of the capsule axis along the central axis of small intestine and so helps propel the capsule forward easily. This consists of light receiving window.

2. Lens Holder:

- The Lens Holder is that part of the capsule which accommodates the lens. The lens is tightly fixed to the holder so that it doesn't get dislocated anytime

3. Lens:

- The Lens is an integral component of the capsule. It is arranged behind the Light Receiving Window

4. Illuminating LED's:

- Around the Lens & CMOS Image Sensor, four LED's (Light Emitting Diodes) are present. These plural lighting devices are arranged in donut shape.

5. CMOS Image Sensor:

- CMOS (Complementary Metal Oxide Semiconductor) Image Sensor is the most important part of the capsule. It is highly sensitive and produces very high quality images. It has 140º field of view and can detect objects as small as possible

6. Battery:

- Battery used in the capsule is buttons shaped and are two in number as shown. The batteries are arranged together just behind the CMOS Image Sensor.
- Silver Oxide primary batteries are used (Zinc/Alkaline Electrolyte/Silver Oxide). Such a battery has an even discharge voltage, disposable and doesn't cause harm to the body.

7. ASIC Transmitter:

- The ASIC (Application Specific Integrated Circuit) Transmitter is arranged behind the Batteries as shown. Two Transmitting Electrodes are connected to the outlines of the ASIC Transmitter. These electrodes are electrically isolated from each other.

8. Antennae:

- As shown, the Antennae is arranged at the end of the capsule. It is enclosed in a dome shaped chamber.

Pill Camera platform Components:

Sensory array belt

Like ECGleads, several wires are attached to the abdomen to obtain images by radio frequency. These wires are connected to data recorder on a belt. The position of the capsule is calculated by the sensor arrays. Receiver belt is worn by the patient around his or her waist over clothing. This belt holds recording device and battery pack. Sensors are incorporated within the belt. Sensor array includes sensor pads, data cable, battery charging and receiver bag.

Data recorder:

This is the small portable recording device attached to the sensor belt placed in recorder pouch. It weighs around 470gm. The signals transmitted by the camera is received and recorded by the data recorder which is placed on patient's body. This recorder receives and stores 5000 to 6000 JEPG images.



Data recorder Sensory array beltReal time viewer

Real Time Viewer:

This is a hand held device and enables real-time viewing. This contains rapid reader software and colour LCD monitor. This is used to test the proper functioning before procedures and confirms location of capsule.

Rapid work station:

Rapid workstation performs the function of reporting and processing of images and data. Image data from the data recorder is downloaded to a computer equipped with software called rapid application software. It helps to convert images in to a movie and allows the doctor to view the colour 3D images. Once the patient has completed the endoscopy examination, the antenna array and image recording device are returned to the health care provider. The recording device is then attached to a specially modified computer workstation and the entire examination is downloaded in to the computer, where it becomes available to the physician as a digital video.

The workstation software allows the viewer to watch the video at varying rates of speed, to view it in both forward and reverse directions, and to capture and label individual frames as well as brief video clips. Images showing normal anatomy of pathologic findings can be closely examined in full colour. A recent addition to the software package is a feature that allows some degree of localization of the capsule within the abdomen and correlation to the video images.

Procedures followed during capsule endoscopy

- The procedure begins with the patient fasting from the midnight on the day before the examination. Surfactant may be administered before the examination to enhance viewing.
- Patient is fitted with antenna array and image recorder
- The recording device and its battery pack are worn on a special belt which allows the patient to move freely
- A fully charged capsule is removed from its holder
- Capsule is swallowed only after the indicator light show that the data is being transmitted and received.

- Capsule is then swallowed with small amount of water.
- Once the capsule is ingested, the patient should avoid ingesting anything other than cellular liquids for approximately 2 hours.
- The examination can be considered complete after 7-8 hours of capsule consumption.
- Patient can now return the antenna and recording device to the physician.
- Downloading of data in the recording device takes to workstation takes approximately 2.5-3 hours.
- Interpretation of data takes approximately 1 hour.
- Individual frames and video clips of normal and pathologic findings can be saved and exported as files for incorporation into procedure reports or patient records

Discussions

Advantages

- High quality images with accurate and precise results
- Simple procedure with high sensitivity and specificity
- This method is more efficient than x-ray, CTscan, endoscopy

Disadvantages

Pill camera is a revolution, no doubt about it but there are few medical risks

1. Patients with gastrointestinal structures or narrowing's are not preferred for this conduct because they pose the risk of obstruction
2. Pill gets struck if there is a partial obstruction in the small intestine and a patient who is undergoing diagnostic process may end up in the emergency room for intestinal obstruction.
3. The pill camera transmits image from inside to outside the body. Sometimes it becomes impossible to control the camera behavior, including the on/off power functions and effective illuminations inside the intestine.

This drawback can be overcome by using a bidirectional wireless telemetry camera. The current paper presents the design of a bidirectional wireless telemetry camera, 11mm in diameter, which can transmit video images from inside the human body and receive the control signals from an external control unit

Conclusion

Though nanotechnology is still evolving to its full capacity yet the first rung of productshave already made an impact on the market. In the near future most of the conventional manufacturing processes will be replaced with a cheaper and better manufacturing process "nanotechnology'. Pill camera is a pioneering concept for Medical Technology of the 21st century.

The endoscopy system is the first of its kind to be able to provide non-invasive imaging of the entire small intestine. It has revolutionized the field of diagnostic imaging to a great extent and has proved to be of great help to physicians all over the world. In this study capsule endoscopy was superior to push enteroscopy in the diagnosis of recurrent bleeding in patients who had a negative gastroscopy and colonoscopy. It was safe and well tolerated.

Wireless capsule endoscopy represents a significant technical breakthrough for the investigation of the small bowel, especially in light of the shortcomings of other available techniques to image this region. The capsule endoscopy seems best suited to patients with gastrointestinal bleeding of unclear etiology who have had non diagnostic traditional testing and in whom the distal small bowel (beyond reach of a push enteroscope) needs to be visualized.

References

[1]. "Capsule endoscopy turning upundiagnosed cases of Crohn's disease".*Physorg.com*

[2]. *Pink Tentacle*. "Sayaka: Next-generationcapsule endoscope"

[3]. Rondonotti E, Villa F, Mulder CJ, JacobsMA, de Franchis R. Small bowel capsuleendoscopy in 2007: indications, risks andlimitations. World J Gastroenterol.2007;13:6140–6149.

[4]. MichałMackiewicz, Capsule Endoscopy - State of the Technology and Computer Vision Tools After the FirstDecade. *New Techniques in Gastrointestinal Endoscopy* 2011,104-118.

[5]. Wireless capsule endoscopy. Technology status evaluation report. *Gastrointestinal endoscopy* 2013,78(6),805-812.

[6]. Mehmet R. Yuce; TharakaDissanayake; Ho Chee Keong, *Wireless Telemetry for Electronic Pill Technology*.2010,1-7.