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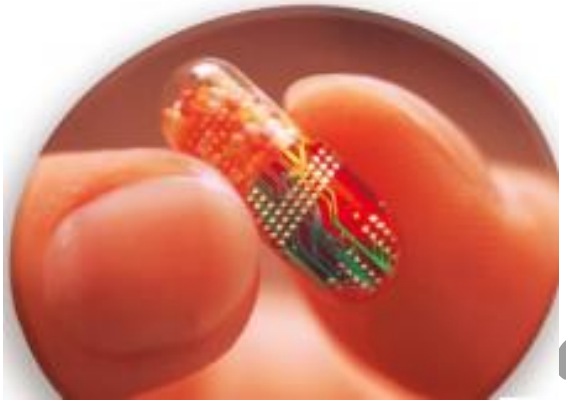
ELECTRONIC CAMERA ENDOSCOPY: MAGIC PILL FOR HEALTH CARE



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Abstract: **Earlier method that Doctors would have preferred was Endoscopy Procedure. By which Doctor able to see the inside lining of digestive track. This Examination is performed using an Endoscope-a flexible fiber optic tube with a tiny TV camera at the end [2, 5, 6]. The conventional method for this system is camera's endoscopy or electronic pill. Imagine a vitamin pill-sized camera that could travel through your body taking pictures, helping diagnose a problem which doctor previously would have found only through surgery [1, 2, 3, 4]. It is being beneficially used for disease detection & abnormalities in human body. Therefore it is also called as" MAGIC PILL FORHEALTH CARE"[4, 5].**

Keywords: Endoscopy, Microelectronic pill, E-capsule, ASIC, etc.

1. INTRODUCTION

Our Body is a sensitive system. Many times even doctors aren't able to interpret the disease. Thus it becomes too late to cure it [5]. To remove these problem scientists discovered electronic capsule. Use of discrete & relatively large components, poor reliability, short lifetimes & low sensitivity makes it out-dated [1, 5].

To overcome all these problems Professor Jon Cooper and Dr Erik Johan Essen from Glasgow University, U.K has led to the development of a modern microelectronic pill [2, 5, 6].

When Microelectronic pill is swallowed, then it will travel through the Gastro Intestinal Track & simultaneously perform multi-parameter in situ physiological analysis [1, 4]. After completing its mission it will come out of the body by normal bowel movement [4].

The pill is 16mm in diameter & 55mm long weighing around 5 gram. It records parameters like temperature, pH, Conductivity, & Dissolved Oxygen in real time. Imagine a vitamin pill-sized camera that could travel through your body and taking pictures, helping diagnose a problem which doctor previously would have found only through surgery [3].

2. TECHNOLOGY USED

Pill Camera developed on the basis of NANOTECHNOLOGY. Nanotechnology deals with objects measured in nanometers. Nanometer can be visualized as billionth of a meter or millionth of a millimeter or it is 1/80000 width of human hair [3, 6].

3. INTERNAL VIEW OF THE E-CAPSULE

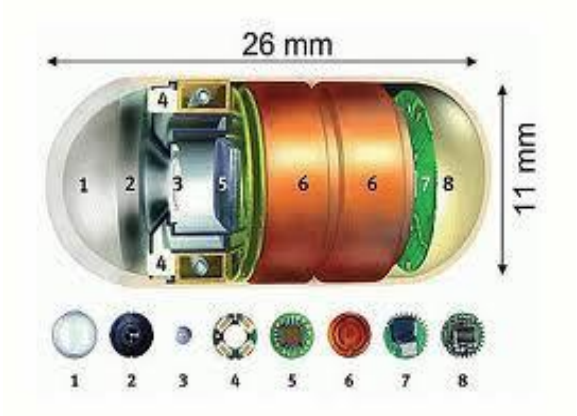

Fig.1: Internal view of the E-capsule

DESCRIPTION

The device, called the Diagnostic Imaging System, comes in capsule form and contains a figure shows the internal view of the pill camera [2, 4, 6]. It has 8 parts:

1. Optical Dome.
2. Lens Holder.
3. Lens.
4. Illuminating LEDs.
5. CMOS Image Sensor.
6. Battery.
7. ASIC Transmitter.
8. Antenna.

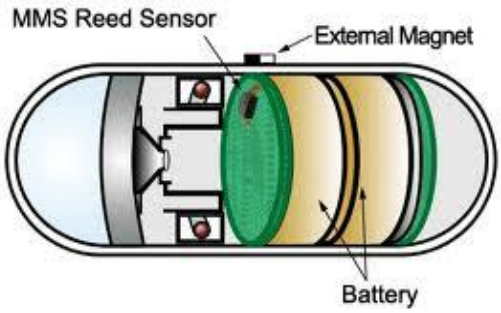

Fig.2: Parts of E-capsule

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 [3].

OPTICAL DOME

It is the front side of the capsule and it is bullet shaped. The main function of the optical dome is to receiving the light from the window of the capsule. Normally optical dome is made from non-conducting material It prevents the filtration of digestive fluids inside the capsule [3, 5, 6].

LENS HOLDER

After the optical dome there is a lens holder that accommodates the lens by using the lens holder. By using this lens holder lenses are tightly fixed in capsule. Hence it will avoid the problem of dislocation of lens [5, 6].

LENS

The lens is the internal pill camera which is placed behind the optical dome. The light which is received by optical dome is falls on the lens [5, 6].

ILLUMINATING LED'S

Illuminating LEDs illuminate an object. Non reflection coating is placed on the light receiving window to prevent the reflection. Light irradiated from the LED's pass through the light receiving window [5, 6].

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 [5, 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 [1, 4, 5, 6].

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.

ANTENNAE

As shown, the Antennae are arranged at the end of the capsule. It is enclosed in a dome shaped chamber [5].

4. MOVEMENT & WORKING OF CAPSULE THROUGH DIGESTIVE SYSTEM

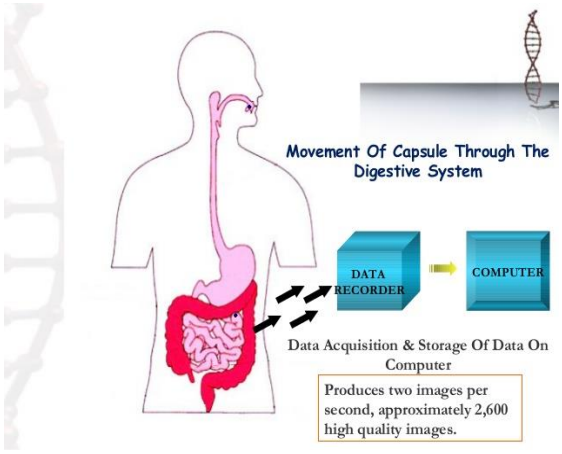

Fig.3:Movement of Capsule through Body

Pill camera is also called as Capsule Endoscopy the capsule contains a camera, an LED light, a battery and a built-in antenna [3]. The antenna transmits the images to as small recording unit that the patient wears on their waist during the study. The capsule is about the size of a large vitamin pill and it can easily swallow [3, 4, 5]. Once you swallowed it cannot be felt as it moves through the body. Then the pill has a clear view of the digestive track as it travels down. After completion of test it can be safely flushed down the toilet [4].

SHAPE OF PILL CAMERA

Height-25mm

Fig.4:Height of pill camera

Width-10mm

Fig.5:Width of pill camera

RANGE & ACCURACY

RANGE:

- Temperature from 0 to 70°C
- pH from 1 to 13
- Dissolved Oxygen up to 8.2 mg per liter
- Conductivity above 0.05 $mScm^{-1}$
- Full scale dynamic Range analogue signal = 2.8 V

ACCURACY :

- pH channel is around 0.2 units above the real value
- Oxygen Sensor is ±0.4 mgL.
- Temperature & Conductivity is within ±1%.

ADVANTAGES

- Painless, no side effects.
- High quality images.
- Simple procedure.
- High sensitivity and specificity.
- Avoids risk in sedation.
- Efficient than X-ray CT-scan, normal endoscopy.
- Power consumption is very less.
- Less transmission length & hence has zero noise interference.
- Small size, so can move easily through digestive system.
- Made of bio-compatible material, doesn't cause any harm to the body.

DISADVANTAGES

- Gastrointestinal obstructions prevent the free flow of capsule. is overcome using another product manufactured with the help of nanotechnology which is the rice-grain sized motor.
- It is very expensive and not reusable.
- Capsule endoscopy does not replace standard diagnostic endoscopy.
- It cannot be controlled once it has been ingested, cannot be stopped or steered to collect close-up details.
- Impossible to control Camera behaviour can be overcome using a bi-directional telemetry Camera..
- Patients with pacemakers, pregnant women ,small babies face difficulties.
- Micro Electronic Pills are expensive & are not available in many countries.

FUTURE SCOPE

- It seems likely that capsule endoscopy will become increasingly effective in diagnostic gastrointestinal endoscopy. This will be attractive to patients especially for cancer or varices detection because capsule endoscopy is painless and is likely to have a higher take up rate compared to conventional colonoscopy and gastroscopy. Double imager capsules with increased frame rates have been used to image the esophagus for Barrett's and esophageal varices. The image quality is not bad but needs to be improved if it is to become a realistic substitute for flexible upper and lower gastrointestinal endoscopy. An increase in the frame rate, angle of view, depth of field, image numbers, duration of the procedure and improvements in illumination seem likely.

- Colonic, esophageal and gastric capsules will improve in quality, eroding the supremacy of flexible endoscopy, and become embedded into screening programs. Therapeutic capsules will emerge with brushing, cytology, and fluid aspiration; biopsy and drug delivery capabilities. Electro cautery may also become possible. Diagnostic capsules will integrate physiological measurements with imaging and optical biopsy, and immunologic cancer recognition. Remote control movement will improve with the use of magnets and/or electro stimulation and perhaps electromechanical methods. External wireless commands will influence capsule diagnosis and therapy and will increasingly entail the use of real-time imaging. However, it should be noted that speculations about the future of technology in any detail are almost always wrong.

- The development of the capsule endoscopy was made possible by miniaturization of digital chip camera technology, especially CMOS chip technology. The continued reduction in size, increases in pixel numbers and improvements in imaging with the two rival technologies-CCD and CMOS is likely to change the nature of endoscopy. The current differences are becoming blurred and hybrids are emerging. The main pressure is to reduce the component size, which will release space that could be used for other capsule functions such as biopsy, coagulation or therapy. New engineering methods for constructing tiny moving parts, miniature actuators and even motors into capsule endoscopes are being developed.

CONCLUSION

The Capsule Endoscopy 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.

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