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Pill Camera

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The aim of technology is to make products in a large scale for cheaper prices and increased quality. The current technologies have attained a part of it, but the manufacturing technology is at macro level. The future lies in manufacturing product right from the molecular level. Research in this direction started way back in eighties. At that time manufacturing at molecular and atomic level was laughed about. But due to advent of nanotechnology we have realized it to a certain level. One such product manufactured is PILL CAMERA, which is used for the treatment of cancer, ulcer and anemia. It has made revolution in the field of medicine.

This tiny capsule can pass through our body, without causing any harm. We have made great progress in manufacturing products. Looking back from where we stand now, we started from flint knives and stone tools and reached the stage where we make such tools with more precision than ever. The leap in technology is great but it is not going to stop here. With our present technology we manufacture products by casting, milling, grinding, chipping and the likes.

With these technologies we have made more things at a lower cost and greater precision than ever before. In the manufacture of these products we have been arranging atoms in great thundering statistical herds. All of us know manufactured products are made from atoms. The properties of those products depend on how those atoms are arranged. If we rearrange atoms in dirt, water and air we get grass. The next step in manufacturing technology is to manufacture products at molecular level. The technology used to achieve It takes pictures of our intestine and transmits the same to the receiver of the Computer analysis of our digestive system. This process can help in tracking any kind of disease related to digestive system. Also we have discussed the drawbacks of PILL CAMERA and how these drawbacks can be overcome using Grain sized motor and bi - directional wireless telemetry capsule.

KEYWORDS

Nanotechnology, Pill, Capsule screening, imaging innovation, Performance, Technical aspects

INTRODUCTION:

We have made great progress in manufacturing products. Looking back from where we stand now, we started from flint knives and stone tools and reached the stage where we make such tools with more precision than ever. The leap in technology is great but it is not going to stop here. With our present technology we manufacture products by casting, milling, grinding, chipping and the likes.

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The next step in manufacturing technology is to manufacture products at molecular level. The technology used to achieve manufacturing at molecular level is “NANOTECHNOLOGY”. Nanotechnology is the creation of useful materials, devices and system through manipulation of such miniscule matter (nanometer).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.

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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. No longer is such technology the stuff of science fiction films.

Trillions of assemblers will be needed to develop products in a viable time frame. In order to create enough assemblers to build consumer goods, some Nano machines called explicators will be developed using self-replication process, will be programmed to build more assemblers. Self-replication is a process in which devices whose diameters are of atomic scales, on the order of nanometers, create copies of themselves. For of self-replication to take place in a constructive manner, three conditions must be met.

Once swallowed, an electric current flowing through the UW endoscope causes the fiber to bounce back and forth so that its lone electronic eye sees the whole scene.

History:

Manipulation of atoms is first talked about by noble laureate Dr.Richard Feyngman long ago in 1959 at the annual meeting of the American Physical Society at the California institute of technology -Caltech and at that time it was laughed about. Nothing was pursued init till 80's. The concept of nanotechnology is introduced by Drexel in the year 1981 through his article "The Engines of Creation". In 1990, IBM researchers showed that it is possible to manipulate single atoms. They positioned 35 Xenon atoms on the surface of nickel crystal, using an atomic force microscopy instrument. These positioned atoms spelled out the letters" IBM".

In 2000, a group of doctors from England reported the production and use of a new instrument for determining internal bleeding in the small intestine of the digestive system. They used a device called a capsule endoscope, which was 1-1/8 inches long and 3/8 inches wide. It was the size of a large pill and it had an 8-hr battery, light source, a camera, and a small transmitter. After ingestion, the capsule takes 2 pictures per second for a total of 55,000 images. After 8 hours, the capsule sends the images to an external computer monitor, where the pictures are stored and processed to be later analyzed, while the pill is then disposed

PillCam has had tremendous success after its release in 2001 because of its improved safety and accuracy. It is more healthy than X-rays and radioactive tracing of stomach tumors. Currently, the PillCam video capsule has been used approximately 1.5 million times by more than 5,000 medical facilities in more than 75 countries. The new wireless capsule endoscopy has been established as the global standard for digestive diagnosis. Given Imaging, the PillCam company, has sold 221,300 capsules and reached an annual revenue of $157.8 million.

BARRIERS OF DEVELOPMENT

Barriers in development included the difficulty in obtaining regulatory clearance or approval to market the products. Also, changes in regulatory environment were difficult to get the FDA approval. Furthermore, the emergence of other products may make the Given Imaging products obsolete. In the initial testing of the technology, lack of an appropriate bowel preparation materials to be used with PillCam proved to be complications in development. Given Imaging was hindered by protection and validity of patents and other intellectual property rights. After PillCam was made, the competition from other companies increased dramatically. In the beginning, Iddan's team had barriers in obtaining reimbursement and finance for their product from government and commercial investors. Currently, quarterly variations in operating results make the success of the pill difficult to measure. The PillCam profit is also highly dependent on the impact of global economic conditions, which is an obstacle in the development. Finding businesses to implement the pill for commercial profit was difficult, but the success of the PillCam allowed it to make massive profits. More barriers include changes and reforms in applicable healthcare laws and regulations. Quality issues of the products, such as capsule retention, aspiration and failure to attach or detach, bleeding or perforation that could require Given Imaging to recall the drug.

PillCam cannot be used for everyone and is prohibited for people with gastrointestinal disorder. Patients with swallowing disorders, gastrointestinal obstructions based on pre-procedure testing and medical history cannot

undergo the PillCam procedure. People with implanted electromedical devices should not undergo the capsule endoscopy. The primary developmental barrier is that as the procedure occurs, there is risk of obstructing the pill due to the very disorders the pill is trying to detect. There is significant, extensive pre-procedure preparation and testing to make sure the pill will not be obstructed in the intestinal tract or cause internal bleeding. PillCam has a number of risks, including capsule retention, aspiration, or skin irritation. After ingesting the PillCam capsule, patients cannot be near an electromagnetic field until the pill has been excreted. Even people with allergies cannot undergo the test because of complications in medicines as well as dangers of allergic reactions. Medical, endoscopic, or surgical intervention may be necessary. Capsule endoscopy can't differentiate between malignant and benign tumors, so when it detects tumors, further tests are necessary otherwise a seemingly benign tumor could quickly kill a patient. It is impossible to control the trajectory of the capsule or to localize identified lesions. Capsule endoscopy has a rate of incidental findings and false-diagnosis rate of 11 percent.

Basic Structure

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. The optical dome contains the Light Receiving Windows.

Lens Holder:

The Lens Holder that part of the capsule which accommodates the lens. The lens is tightly fixed so that it does not get dislocated anytime.

Lens:

The lens is an integral component of the capsule. It is arranged behind the light receiving windows.

Illuminating LED's:

Around the lens and CMOS Image Sensor ,four LED's are present.These plural lighting devices are arranged in donut shape.

CMOS Image Sensor:

It is the most important part of capsule. It is highly sensitive and produces very high quality images.

Battery:

Battery is used in the capsule is button shaped and are two in number .The batteries are arranged together just behind the CMOS Image sensor. Silver oxide primary batteries are used.

ASIC Transmitter:

The ASIC Transmitter is arranged behind the batteries. Two Transmitting Electrodes are connected to the outlines of the ASIC Transmitter.

Antennae:

The Antennae is arranged at the end of the capsule. It is enclosed in a dome shaped chamber

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 The tiniest endoscope yet takes 30 two-megapixel images per second and offloads them wirelessly. See how it works

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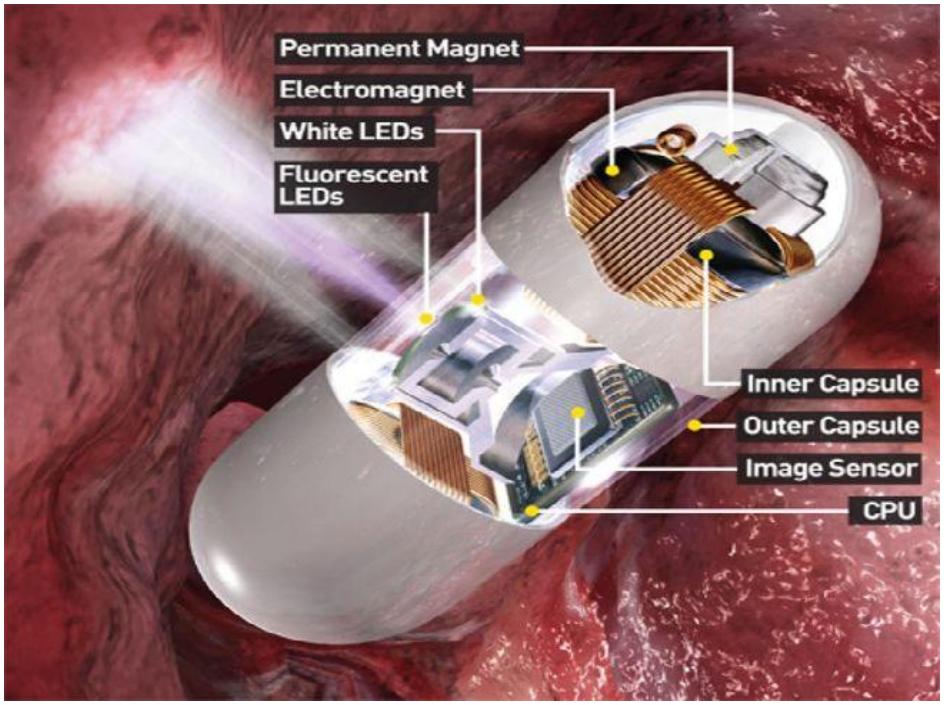
inside the body in an animation Pop this pill, and eight hours later, doctors can examine a high-resolution video of your intestines for tumors and other problems, thanks to a new spinning camera that captures images in 360 degrees. Developed by the Japanese RF System Lab, the Sayaka endoscope capsule enters clinical trials in the U.S. this month. The patient gulps down the capsule, and the digestive process begins. Over the next eight hours, the pill travels passively down the esophagus and through roughly 20 to 25 feet of intestines, where it will capture up to 870,000 images. The patient feels nothing.



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Down the Hatch

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Power Up

The pill camera doesn't need a motor to move through your gut, but it does require 50 mill watts to run its camera, lights and computer. Batteries would be too bulky, so the cam draws its power through induction charging. A vest worn by the patient contains a coil that continuously transmits power.

Start Snapping

When it reaches the intestines, the pill cam begins capturing 30 two-megapixel images per second (twice the resolution of other pill cams). Fluorescent and white LEDs in the pill illuminate the tissue walls.

Spin up for closeup

This contains a permanent magnet to turn the inner capsule and the image sensor 60 degrees every two seconds. It completes a full swing every 12 seconds—plenty of time for repeated close-ups, since the capsule takes about two minutes to travel one inch.

Offload Data

Instead of storing each two-megapixel image internally, Sayaka continually transmits shots wirelessly to an antenna in the vest, where they are saved to a standard SD memory card.

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Deliver Video

Doctors pop the SD card into a PC, and software compiles thousands of overlapping images into a flat map of the intestines that can be as large as 1,175 megapixels. Doctors can replay the ride as video and magnify a problem area up to 75-fold to study details.

Leave the Body

At around $100, the cam is disposable, so patients can simply flush it away.

AREAS OF APPLICATION

Because of their usage in capsule endoscopy, PILLCAMERAS have found many applications in a wide range of disciplines

1. Crohon's Disease

Crohn's disease is a chronic inflammatory disorder affecting any part of the gastrointestinal tract, but frequently involves the small and large bowel. Typical presenting symptoms include abdominal pain and diarrhea. Patients with this disorder may also have extraintestinal manifestations, including arthritis, uveitis, and skin lesions. The PillCam™SB capsule is an ingestible disposable video camera that transmits high quality images of the small intestinal mucosa. This enables the small intestine to be readily accessible to physicians investigating for the presence of small bowel disorders, such as Crohn's disease. Four meta-analyses have demonstrated that capsule endoscopy identifies Crohn's disease when other methods are not helpful. It should be noted that it is the best noninvasive procedure for assessing mucosal status, but is not superior to ileocolonoscopy, which remains the gold standard for assessment of ileocolonic disease. Mucosal healing along the small bowel can only be demonstrated by an endoscopic procedure such as capsule endoscopy. Achievement of long-term mucosal healing has been associated with a trend towards a decreased need for hospitalization and a decreased requirement for corticosteroid treatment in patients with Crohn's disease. Recently, we have developed and validated the Capsule Endoscopy Crohn's Disease Activity Index (also known as the Niv score) for Crohn's disease of the small bowel.

2.Mediaction related to small bowl injury

The development of capsule endoscopy (CE) in 2001 has given gastroenterologists the opportunity to investigate the small bowel in a non-invasive way. CE is most commonly performed for obscure gastrointestinal bleeding, but other indications include diagnosis or follow-up of Crohn's disease, suspicion of a small bowel tumor, diagnosis and surveillance of hereditary polyposis syndromes, Nonsteroidal anti-inflammatory drug-induced small bowel lesions and celiac disease. Almost fifteen years have passed since the release of the small bowel capsule. The purpose of this review is to offer the reader a brief but complete overview on small bowel CE anno 2014, including the technical and procedural aspects, the possible complications and the most important indications. We will end with some future perspectives of CE.

3. Ulcerative Colitis

Treatment of ulcerative colitis should be tailored to the severity of colonic inflammation, which in the past has been gauged mainly by clinical features and biochemical parameters. Recently, mucosal healing has been proposed as a standard to guide therapy. The aim of this multicenter study was to test whether mucosal appearance, as reported by colon capsule endoscopy (CCE), can be used to differentiate active from inactive ulcerative colitis.

Adult patients from Hong Kong, Singapore, and Taiwan who were suspected or known to have ulcerative colitis were included in this prospective study. CCE and conventional optical colonoscopy were offered to these patients on the same day after receiving standard bowel preparation. The primary endpoint was the accuracy of CCE in assessing colonic inflammation (defined as the presence of ulcers, erythema, erosions, edema, exudates in mucosa), using optical colonoscopy as the gold standard.

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4.CANCER DIAGNOSIS

Colonoscopies can be an uncomfortable procedure for patients who may already be worried about what the results may find. The process involves probing the large intestine with a tiny fibre optic camera, known as an endoscope, embedded in a 4ft long, flexible tube.

As well as colon cancer, colonoscopies can be used to detect and diagnose a whole host of diseases, including irritable bowel syndrome (IBS) and Crohn's disease.

The procedure itself is not only uncomfortable and expensive, it can also be ineffective at spotting smaller tumours – leading to misdiagnosis. Around 750,000 incomplete colonoscopies occur each year in the US alone, which means patients often have to undergo an additional procedure, such as an X-ray or CT scan, in order to complete the colorectal examination – incurring extra costs and risks in the process.

ADVANTAGES

The primary advantages of pill camera is that its a non-invasive and comprehensive diagnostic tool. The disposable capsule, no larger than a vitamin pill, has a tiny cameracomplete with its own lens and light source mounted inside. As the pill travels all the way through your digestive system, it takes pictures which are sent as images to a data recorder you wear on a waist belt. These images tell us more about your digestive system - from the inside - than any other technology available.

With capsule endoscopy, there is no pain or discomfort. There's no sedation, surgery or hospital stay required and the preparation is minimal. We obtain a comprehensive "picture" of your digestive system, focusing in on the small bowel area. After your test is complete, you will return and we will download the images from the data recorder to a computer and view a colour video of the pictures taken by the capsule.It is painless and have no side effects. It avoids the risk in sedation. It is very efficient than X-ray CT-scan, normal endoscopy.

Other advantages include:

1) No scar – as a natural body opening is used.
2)Quick recovery time.
3)Less time in hospital.
4)Often, no time in hospital is required as the procedure is performed in the doctor’s rooms.
Early detection of postoperative re-occurrence(finding early)
5)Prior to the endoscopy, your doctor will talk to you about your medical history including allergies and current medications. These factors can have an impact on the operation.

DISADVANTAGES

The PillCam COLON procedure has some risks. Please discuss these risks with your doctor, who can determine whether you are a suitable candidate for the PillCam COLON procedure.

PillCam COLON capsule cannot remove polyps if any are detected. Colonoscopy may later be recommended to remove and treat the findings from a PillCam COLON procedure. For the majority of patients, it is unlikely that there will be findings requiring a follow-up colonoscopy, but a second round of bowel preparation would be necessary if a follow-up colonoscopy is recommended by your physician

Both colonoscopy and PillCam COLON procedures require bowel preparation, but the PillCam COLON procedure requires up to 3 cups more of bowel preparation solution than colonoscopy requires

1."Unfortunately, patients with gastrointestinal structures or narrowing are not good candidates for this procedure due to the risk of obstruction". It might also happen that the pill camera might not be able to traverse freely inside digestive system, which may cause the tests to be inconclusive.

2. If there is a partial obstruction in the small intestine, there is a risk that the pill

will get stuck there and a patient who might have come in for diagnostically reasons may end up in the emergency room for intestinal obstruction.

3. The pill camera can transmit image from inside to outside the body. Consequently it becomes impossible to control the camera behaviour, including

the on/off power functions and effective illuminations inside the intestine. The first drawback is overcomes using another product manufactured with the help of nanotechnology which is the rice- grain sized motor. This miniature motor, when attached to the pill camera gives it a propelling action inside the body, which makes it easy for the pill to find its way through the digestive system. Also the grain-sized motor has an application of its own too. It can be employed to rupture and break painful kidney stones inside the body. The other two drawbacks can be overcome using a bidirectional wireless telemetry camera.

It cannot be used to take biopsies,apply therapy or mark abnormalities for surgery.

(i)Possible complications of pill endoscopy include:
(ii)Perforation of an organ
(iii)Excessive bleeding
(iv)Infection
(v)Allergic reaction to the anaesthesia.
(vi)Inflammation of the pancreas
(vii) Pill may retain in the small intestine and won't come out, therefore surgery is required.
(viii)While the capsule camera is inside the body, no MRI scans can perform their task due to the metallic components It costs more than normal endoscopy so government medical funds don't cover procedure.

CONCLUSION

Wireless capsule endoscopy represents a significant technical breakthrough for the investigation of small bowel, especially in light of the shortcomings of other available techniques to image this region. Though nanotechnology has not evolved to its full capacity yet the first rung of products has already made an impact on the market.Scientists predict that this is not all nanotechnology is capable of .They even see that in the decades to come,with the help of Nano technology one can make hearts,lungs,livers and kidneys,just by providing coal, water and some impurities and even prevent the aging effect.

Nanotechnology can be used to make miniature explosives, which would create havoc in human lives. Every new technology that comes opens new door and horizons but close some. The same true is with Nano technology too

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