ABSTRACT

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 nanotecnlogy 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. At that time manufacturing at molecular and atomic level was laughed .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.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 .Besides this we have reviewed the process of manufacturing products using nanotechnology.

Some other important applications are also discussed along with their potential impacts on various fields. 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.

If you have ever had to endure medical testing like a lower GI to give the doctor an idea of what is going on in your intestines, you know that it is a truly terrible experience. Now, let’s all cheer as such uncomfortable testing may never be needed again.

CHAPTER-1

INTRODUCTION

1.1 GENERAL

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 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.These technologies we have made more things at a lower cost and greater precision than before.

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 nanomachines 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 repliction 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.

1.2 IMAGE PROCESSING

The image processing then combines all this information to create a two-dimensional color picture.

In the tested model the fiber swings 5,000 times per second, creating 15 color pictures per second."The procedure is so easy I could imagine it being done in a shopping mall," Seibel said.A wireless scope manufactured by a different group, originally designed to pass through the body and detect intestinal cancer, is now being marketed for esophageal cancer screening. The competing technology comes in a pill about the width of an adult fingernail and twice as long

It consists of just a single optical fiber for illumination and six fibers for collecting light, all encased in a pill. Seibel acted as the human volunteer in the first test of the UW device. He reports that it felt like swallowing a regular pill, and the tether, which is 1.4 mm wide, did not bother him. It is disposable and expelled normally and effortlessly with the next bowel movement. The scanning endoscope developed at the UW is fundamentally different.

After the exam, the patient returns to the doctor's office and the recording device is removed. The stored images are transferred to a computer PC workstation where they are transformed into a digital movie which the doctor can later examine on the computer monitor. Patients are not required to retrieve and return the video capsule to the physician. At the same time the fiber spins and its tip projects red, green and blue laser light. The image processing then combines all this information to create a two-dimensional color picturae.

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CHAPTER-2

LITERATURE REVIEW

2.1 NEED FOR STUDY

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.

2.2 HISTORICAL OVERVIEW:

Manipulation of atoms is first talked about by noble laureate Dr.Richard

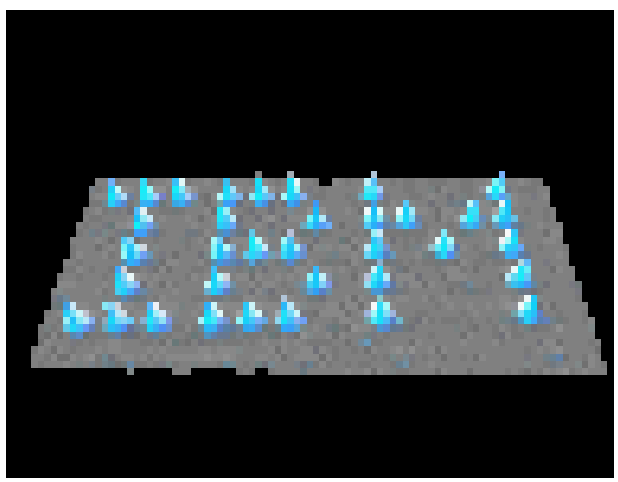


Fig2.2 nickel crystal board

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 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.

2.2.1 ENGINES OF CREATION:

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”.

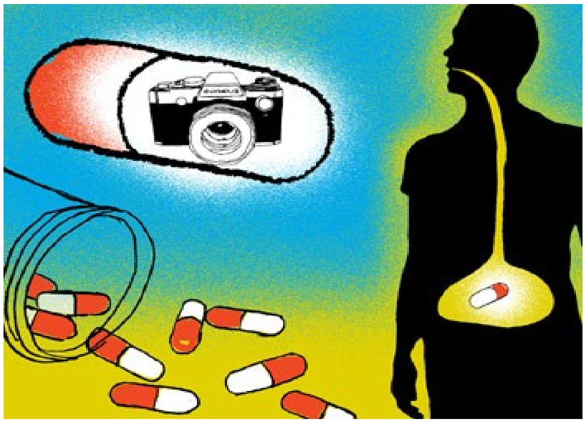


Fig 2.2.1 view of capsule

2.3 MANUFACTURING PRODUCTS USING NANOTECHNOLOGY:

There are three steps to achieving nanotechnology-produced goods: Atoms are he building blocks for all matter in our Universe. All the products that are manufactured are made from atoms.

The properties of those products depend of how those atoms are arranged .for e.g. If we rearrange the atoms in coal we get diamonds, if we rearrange the atoms in sand and add a pinch of impurities we get computer chips.Scientists must be able to manipulate individual atoms. This means that they will have to develop a technique to grab single atoms and move them to desired positions. In 1990,IBM researchers showed this by positioning 35 xenon atoms on the surface of a nickel
crystal, using an atomic force microscopy instrument. These positioned atoms spelled
out the letters "IBM."

- The next step will be to develop nanoscopic machines, called assemblers, that can beprogrammed to manipulate atoms and molecules at will. It would take thousands of years for a single assembler to produce any kind of material one atom at a time. 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 nanomachines 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 repliction to take place in a constructive manner, three conditions must be met .

2.3.1 NANOROBOT

- The 1st requirement is that each unit be a specialised machine called nanorobot, one of whose functions is to construct atleast one copy of itself during its operational life apart from performing its intended task. An e.g. of self replicating nanorobot is artifical antibody. In addition to reproducing itself, it seeks and destroys disease causing organism.

2.3.2 INGREDIENTS

- The 2nd requirement is existence of all energy and ingredients necessary to build complete copies of nanorobot in question. Ideally the quantities of each ingredient should be such that they are consumed in the correct proportion., if the process is intended to befinite , then when desired number of nanorobots has been constructed , there should be nounused quantities of any ingredient remaining.

2.3.3 REPLICATION PROCESS

- The 3rd requirement is that the environment be controlled so that the Replication process can proceed efficiently and without malfunctions. Excessive turbulence, temperature extremes, intense radiation, or other adverse circumstances might prevent the proper functioning of the nanorobot and cause the process to fail or falter. Once nanorobots are made in sufficient numbers, the process of most of the nanorobots is changed from self replication to mass manufacturing of products. The nanorobots are connected and controlled by super computer which has the design details of the product to be manufactured. These nanorobots now work in tandem and start placing each molecules of product to b manufactured in the required position. the process of most of the nanorobots is changed from self replication to mass manufacturing of products.

2.4 POTENTIAL EFFECTS OF NANOTECHNOLOGY:

As televisions, airplanes, computers revolutionized the world in the last century; scientists claim that nanotechnology will have an even more profound effect on the next century. Nanotechnology is likely to change the way almost everything, including medicine, computers and cars, are designed and constructed. The resolution is better than 100 microns, or more than 500 lines per inch. Although conventional endoscopes produce images at higher resolution, the tethered-capsule endoscope is designed specifically for low-cost screening.Using the scanning device is cheap because it's so small it doesn't require anesthesia and sedation, which increase the cost of the traditional procedure.

The capsule must be expelled before you can have an MRI (Magnetic Resonance Imaging) study. This can easily be checked by an x-ray if you're not sure.

In August, a year after Given Imaging received U.S. Food and Drug Administration approval to begin clinical trials in the United States, the FDA granted Given Imaging permission to begin marketing the capsule. In FDA testing, the Given Imaging Diagnostic System detected physical abnormalities more successfully than push enteroscopy and surgical techniques.

"In my study, the M2A capsule was able to identify pathologies in the small intestine that were not identified by standard methods," said Blair S. Lewis, associate clinical professor of medicine at Mount Sinai School of Medicine in New York and a member of Given Imaging's Medical Advisory Board, who headed the clinical tests..

As a result of the FDA approval, the company, which has already released its product in Europe, Australia and Israel, now has access to the U.S. market. The swallowable pills, which will cost about $300 each, can be used for diagnostic tests and treatments for gastrointestinal diseases such as cancer, Crohn's disease and irritable bowel syndrome..

Given Imaging raised $60 million when it issued its initial public offering on the NASDAQ market at the beginning of October. It floated 5,000,000 ordinary shares at an opening price of $12 in the exchange's first public offering in seven weeks. Lehman Brothers served as global book-running manager for the offering and Credit Suisse First Boston was joint lead manager with Robertson Stephens acting as co-manager..

The company so far has no revenue or profits, and as of June 30 had accumulated losses of $19.5 million. When its innovative product started receiving recognition, people wondered if, like so many hot technologies coming out of Israel, it would end up on the block for some high-priced acquisition..

The trend in Israel is to develop something and wait for someone to buy it," said Arkady Glukhovsky, Given's vice president of research and development. "Not in our case. We want to develop, manufacture and sell the M2A. We are not a one-shot company but a multiple shot.

2.4.1 Scope test:

In this situation, one of the first diagnostic studies ordered are special "scope" tests of the digestive tract. Gastroscopy is used to check the first 4 feet of the upper digestive tract (colored pink above) and colonoscopy to evaluate the colon and rectum (colored brown above). As you can see, most of the 20 feet of small intestine (colored green above) lies beyond the reach of these two studies. Fortunately, most bleeding problems seem to occur in the area than can be "scoped" and the source of bleeding is usually found and treated. Common problems would include hiatal hernia, gastritis, ulcers, polyps, and, sometimes, stomach or colon cancer.

A patient had severe iron deficiency anemia and scope tests of the stomach and colon are normal? It is not uncommon for doctors to evaluate a patient with unexplained anemia and neither gastroscopy nor colonoscopy scope examinations reveal the diagnosis. By a process of elimination, it then becomes likely that the source of bleeding lies somewhere in-between - below the reach of the gastroscope and above the reach of the colonoscope - in the 20 feet of small intestine. How then is this area examined?

Well, not very well. Gastroscopy and colonoscopy cannot reach this far. Contrary to popular belief, special imaging studies like CT scan or MRI are not useful in this circumstance. X-rays of the small intestine can be performed after drinking a chalky solution of barium. Called a *small bowel series*, this test has been available for many years, but has a limited accuracy. X-rays are still only shadow pictures and do not view the object itself like a camera.

2.4.2 Why not use large endoscope?

Since scope tests were first invented, doctors have wanted to be able to visualize the entire gut - all 30 feet. But, a direct view of the small intestine has remained elusive.

Attempts have been made to develop longer endoscopic instruments. This technique called push enteroscopy has had only limited success. The longer instruments are difficult to control and manipulate and are hard to maintain. The accuracy of push enteroscopy is still limited since even in the best of hands the entire small intestine is not visualized.

In 1981, an Israeli physician, Dr. Gavriel Iddan, began development of a video camera that would fit inside a pill. Technology was not ready and the idea was put on hold. It took 20 years for technology to catch up with Dr. Iddan. In 2001, the FDA approved the Given Diagnostic Imaging System. This may sound like science fiction, but this 11 x 26 mm capsule weighs only 4 gms (about 1/7th of an ounce) and contains a color video camera and wireless radiofrequency transmitter, 4 LED lights, and enough battery power to take 50,000 color images during an 8-hour journey through the digestive tract. About the size of a large vitamin, the capsule is made of specially sealed biocompatible material that is resistant to stomach acid and powerful digestive enzymes. Another name for this new technique is Wireless Capsule Endoscopy.

2.4.3 peristaltic activity

Patients report that the video capsule is easier to swallow than an aspirin. It seems that the most important factor in ease of swallowing is the lack of friction. The capsule is very smooth, enabling it to slip down the throat with just a sip of water. After the Given M2A capsule is swallowed, it moves through the digestive track naturally with the aid of the peristaltic activity of the intestinal muscles. The patient comfortably continues with regular activities throughout the examination without feeling sensations resulting from the capsule's passage. During the 8 hour exam, the images are continuously transmitted to special antenna pads placed on the body and captured on a recording device about the size of a portable Walkman which is worn about the patient's waist. After the exam, the patient returns to the doctor's office and the recording device is removed. The stored images are transferred to a computer PC workstation where they are transformed into a digital movie which the doctor can later examine on the computer monitor. Patients are not required to retrieve and return the video capsule to the physician. It is disposable and expelled normally and effortlessly with the next bowel movement.

If you've ever been plagued by temporary amnesia and forgotten whether or not you took your medication, take heart: U.S. researchers have engineered a pill that will jog your memory.

The pill, designed by engineers at the University of Florida, is embedded with a tiny, non-toxic microchip and antenna that can be digested. When it's ingested, it emits a signal that is picked up by a small electronic device carried or worn by the patient. That device, in turn, signals a cell phone or laptop, letting a patient or medical professional know the pill has been taken.

"It is a way to monitor whether your patient is taking their medication in a timely manner," said Rizwan Bashirullah, an assistant professor in electrical and computer engineering at the University of Florida.

The pill is intended to improve patient compliance with prescriptions. Many people forget to take their medications regularly, which can exacerbate their medical problems, result in unexpected hospitalizations and undermine clinical trial results.

The pill has yet to be tested on humans. To date, it has been tried out on cadavers and models of humans. Scientists have also conducted experiments on the pill to see how effectively it dissolves in stomach acid.

2.4.4 gastrointestinal tract

Research shows that the pill leaves behind a trace of silver when it passes through the body. Silver coats the pill and also makes up the antenna; however, the amount left behind in the body is less than is absorbed by the average person drinking tap water, according to researchers.Scientific advances in areas such as nanotechnology and gene therapy promise to revolutionize the way we discover and develop drugs, as well as how we diagnose and treat disease. The 'camera in a pill' is one recent development that is generating considerable interest. Until recently, only the proximal (oesophagus, stomach and duodenum) and the distal (colon) portions of the gastrointestinal tract were easily visible using available technology. The twenty feet or so of small intestine in between these two portions was essentially unreachable. This hurdle might soon be overcome.

2.4.5 ENTEROSCOPY

On the left hand side, there is a column for Antenna type. Results can vary, but from my experience I was able to pull in stations coded in yellow and red with a very inexpensive $16 antenna from Radio Shack. If you are more than 30 miles from most stations, you will probably want to get a larger grid type antenna and place it in your roof or attic. A computer workstation using Given's Imaging propriety software processes the data and produces a video of the images together with additional relevant information from the digestive tract. Doctors can then view, edit, and save both individual images and the streaming video. The images produced are of an especially high quality. It looks like the Given ingestible video capsule is a win-win situation. With clinical trial results showing the M2A capsule more effective than enteroscopy and this procedure being, understandably, more popular, patients with suspected small intestine disorders will be popping the M2A pill with a smile.The patient comfortably continues with regular activities throughout the examination without feeling sensations resulting from the capsule’s passage. During the 8 hour exam, the images are continuously transmitted to special antenna pads placed on the body and captured on a recording device about the size of a portable Walkman which is worn about the patients waist. Image sensor elements with in-pixel amplifiers were described by Noble in 1968, by Chamberlain in 1969, and by Weimer . At a time when passive-pixel sensors – that is, pixel sensors without their own amplifiers – were being investigated as a solid-state alternative to vacuum-tube imaging devices. The MOS passive-pixel sensor used just a simple switch in the pixel to read out the photodiode integrated charge. Pixels were arrayed in a two-dimensional structure, with access enable wire shared by pixels in the same row, and output wire shared by column. At the end of each column was an amplifier. Passive-pixel sensors suffered from many limitations, such as high noise, slow readout, and lack of scalability. The addition of an amplifier to each pixel addressed these problems, and resulted in the creation of the active-pixel sensor. Noble in 1968 and Chamberlain in 1969 created sensor arrays with active MOS readout amplifiers per pixel, in essentially the modern three-transistor configuration. The CCD was invented in 1970 at Bell Labs.

CHAPTER-3

PILL CAMERA APPLICATION

3.1 PILL –SIZED CAMERA:

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.

FIG 3.1 PILL SIZED CAMERA

3.2 CONVENTIONAL METHOD:

Currently, standard method of detecting abnormalities in the intestines is through endoscopic examination in which doctors advance a scope down into the small intestine via the mouth. However, these scopes are unable to reach through all of the 20-foot-long small intestine, and thus provide only a partial view of that part of the bowel. With the help of pill camera not only can diagnoses be made for certain conditions routinely missed by other tests, but disorders can be detected at an earlier stage, enabling treatment before complications develop. however, the amount left behind in the body is less than is absorbed by the average person drinking tap water, according to researchers.Scientific advances in areas such as nanotechnology and gene therapy promise to revolutionize the way we discover and develop drugs, as well as how we diagnose and treat disease. The 'camera in a pill' is one recent development that is generating considerable interest.

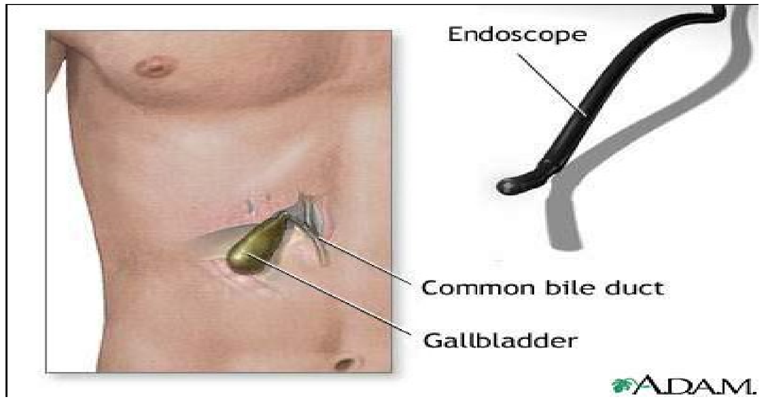


Fig 3.2 conventional camera

3.2.1 Diagnostic imaging system

The device, called the given Diagnostic Imaging System, comes in 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 pH, temp and pressure instructions. The antenna is used to transmit the images to the receiver. For the detection of reliable and correct.

The tiny cameras are swallowed by patients who want less invasive examinations of their digestive track. Until now U.S. DRAM maker Micron Technology Inc. had been the biggest promoter of the camera-in-a-pill concept, with companies such as Israel's Given Imaging charging as much as $450 for its PillCam. MagnaChip is highlighting the low-light sensitivity of the camera, but provided no specification detail. Usually, an LED flash is used to illuminate the area around the capsule.

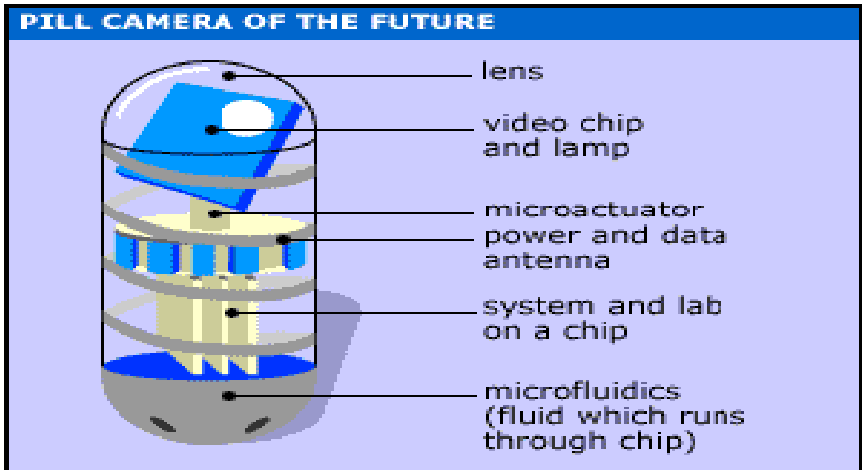


Fig3.2.1 future pill camera

3.2.2 video chip:

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 designed to transmit several biomedical signals, such as pH, temp and pressure.

3.3 COMPONENTS OF CAPSULE CAMERA

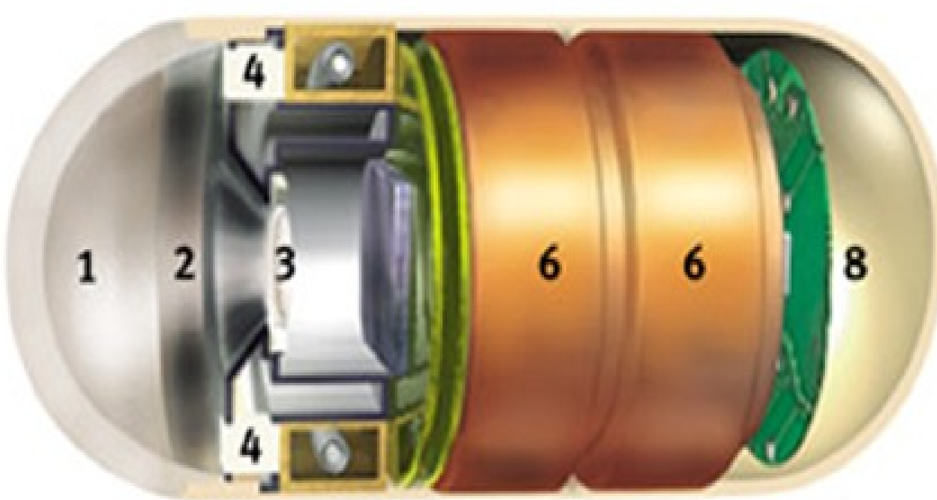


Fig 3.3 components of capsule camera

3.3.1.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.
- The Optical Dome contains the Light Receiving Window.

Fig 3.3.1 optical dome

3.3.2 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 anytime

Fig3.3.2 lens holder

3.3.3. Lens:

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

Fig3.3.3 lens

3.3.4 .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**.**

Fig 3.3.4 illuminating led's

3.3.5.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

5

Fig 3.3.5 CMOS image sensor

3.3.6 battery:

Battery used in the capsule is button shaped and are two in number as shown. 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 a even discharge voltage, disposable and doesn't cause harm to the body

6

Fig 3.3.6 battery

3.3.7 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.

Fig 3.3.7 ASIC transmitter

3.3.8 antennae:

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

Fig 3.3.8 antennae

Once swallowed, the missile pill travels through the small intestine propelled by the contractions of the gastrointestinal tract. The squeezing motion acts as a squeegee, wiping the lens clean for clear pictures.Along the way it films digital images and transmits them to a receiver worn by the patient. The recorder also tracks the capsule's location within the body.

The capsule itself is larger than an aspirin, about 11 mm x 26 mm in size and about 4 grams in weight. Called the M2A, it is not a medication, but rather a single-use video color-imaging capsule. Besides the miniature color video camera, the capsule contains a light source, batteries, a transmitter, and an antenna. Once swallowed this capsule/camera travels easily through the digestive tract and is naturally excreted. It is never absorbed in the body. The patient wears a wireless Given Data Recorder on a belt around his or her.

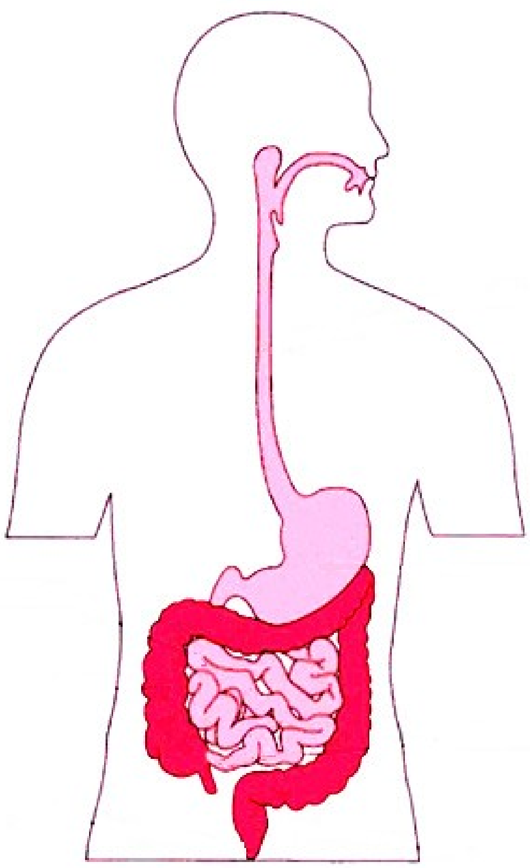
Standard CMOS APS pixel today consists of a photodetector (a pinned photodiode), a floating diffusion, a transfer gate, reset gate, selection gate and source-follower readout transistor the so-called 4T cell. The pinned photodiode was originally used in interline.

CHAPTER-4

ENDOSCOPY PROCEDURE

4.1 SWALLOWED CAPSULE:

Capsule is swallowed by the patient like a conventional pill.It takes images as it is propelled forward by peristalsis.A wireless recorder, worn on a belt, receives the image transmitted by the pill.A computer workstation processes the data and produces a continuous still images.



Movement Of capsule Through The Digestive System

Produces two images per second, approximately 2,600 high quality images

Fig 4.1 movement of capsule

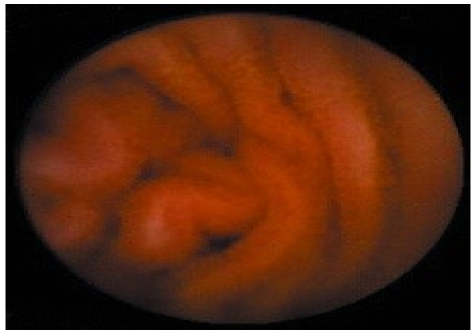


Image obtained by capture camera

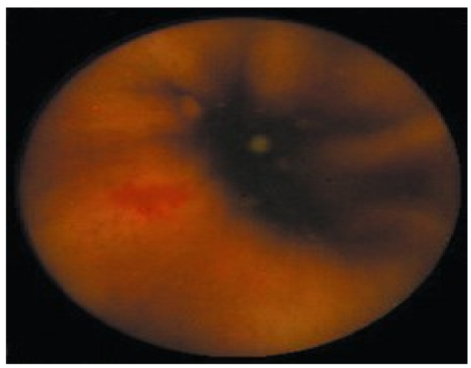


fig 4.1 image obtained by camera

4.2 CIRCUIT BLOCK DIAGRAM OF TRANSMITTER AND RECEIVER:

In the first block diagram, one SMD type transistor amplifies the video signal

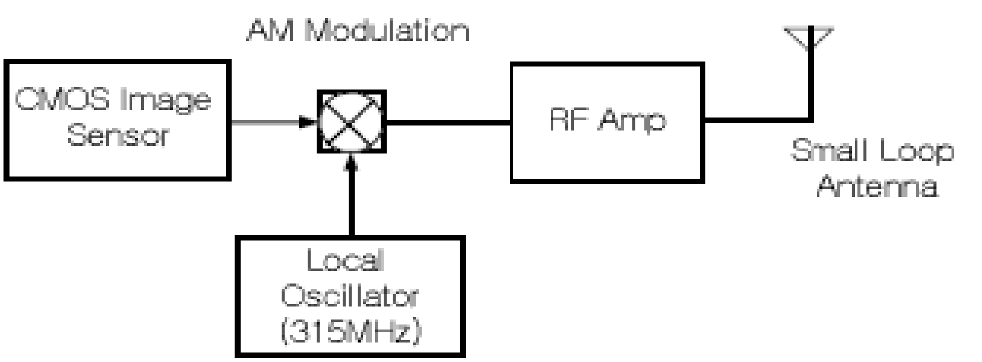


Fig. 2. The video signal transmitter of capsule inside.

Fig. 3. Receiver circuit inside capsule.

Fig 4.2 received circuit inside capsule

For efficient modulation using a 3 biasing resistor and 1 inductor. In the bottom block,a tiny SAW resonator oscillates at 315 MHZ for modulation of the video signal. This modulated signal is then radiated from inside the body to outside the body. For Receiver block diagram a commercialized ASK/OOK (ON/OFF Keyed) super heterodyne receiver with an 8-pin SMD was used. This single chip receiver for remote wireless communications, which includes an internal local oscillator fixed at a single frequency, is based on an external reference crystal or clock. The decoder IC receives the serial stream and interprets the serial information as 4 bits of binary data. Each bit is used for channel recognition of the control signal from outside the body. Since the CMOS image sensor module consumes most of the power compared to the other components in the telemetry module, controlling the ON/OFF of the CMOS image sensor is very important.

Moreover, since lightning LED's also use significant amount of power, the individual ON/OFF control of each LED is equally necessary. As such the control system is divided into 4 channels in the current study. A high output current amplifier with a single supply is utilized to drive loads in capsule.

4.3 EXTERNAL CONTROL UNIT:

A schematic of the external control circuit unit is illustrated below, where the ON/OFF operation of the switch in the front of the unit is encoded into 4 channels Control signals. These digital signals are then transferred to a synthesizer and modulated into an RF signal using a OOK transmitter with a carrier frequency of 433 MHz.

To verify the operation of the external control unit and telemetry capsule, CH1 was used to control ON/OFF of CMOS image sensor and CHs 2-4 to control led lighting. The four signals in front of the control panel were able to make 16different control signals (4 bit, 2^4 = 16).The bi-directional operation of telemetry module is verified by transmitting video signal from CMOS image sensor image data was then displayed .

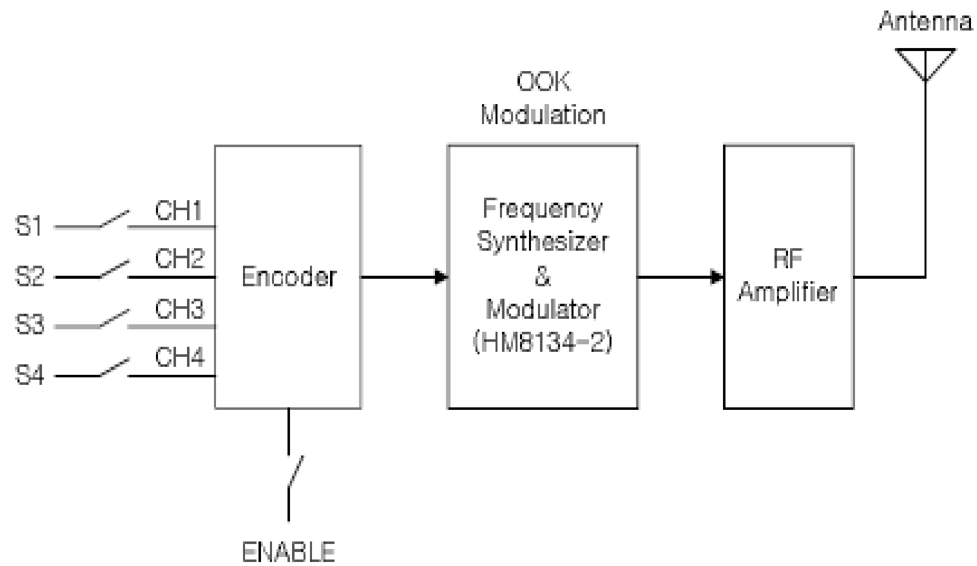


Fig. 4. External control circuit

Fig 4.3 external control unit

The proposed telemetry capsule can simultaneously transmit a video signal and receive a control determining the behavior of the capsule. As a result, the total power consumption of the telemetry capsule can be reduced by turning off the camera power during dead time and separately controlling the LEDs for proper illumination in the intestine. Accordingly, proposed telemetry module for bidirectional and multi-channel communication has the potential applications .

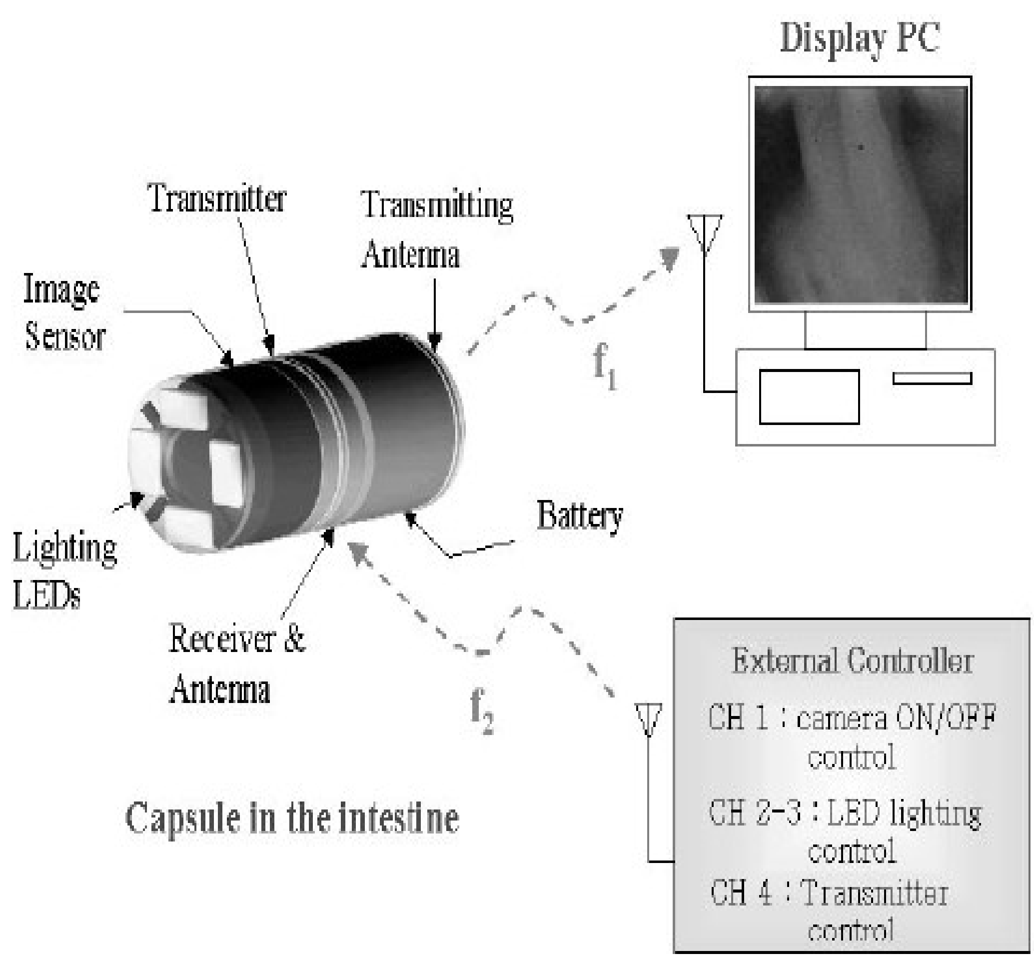


Fig. 1. Conceptional diagram of bi-directoinal wireless endoscopy system

Fig 4.4 conceptional diagram of bidirectional wireless endoscopy system

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.

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. It includes transmitting antenna and receiving antenna, a demodulator, a decoder, four LED's, a CMOS image sensor, along with their driving circuits. The receiver demodulates the received signal that is radiated from the external control unit. Next, the decoder receives this serial stream and interprets the five of the binary digits as address code. The remaining signal is interpreted as binary data. As a result proposed telemetry model can demodulate the external signals to control the behavior of the camera and 4 LED's during the transmission of video image. The CMOS image sensor is a single chip 1/3 inch format video camera, OV7910, this can provide high level functionality with in small print footage. The image sensor supports an NTSC-type analog color video and can directly interface with VCR TV monitor. Also image sensor has very low power consumption as it requires only 5 volt dc supply.

The capsule is capable of transmitting up to eight hours of video before being naturally expelled. No hospitalization is required. The film is downloaded to a computer workstation and processed using a software program called RAPID (reporting and processing of images and data), also developed by Given Imaging. It condenses the film into a 30-minute video. The software also provides an image of the pill as it passes through the small intestine so the physician can match the image to the location of the capsule. Future capsules to be developed using its basic platform. It is not inconceivable that this same technology can be used to pump medication locally and directly.

The power system need only make up for losses caused by inefficiencies in this process. These losses could presumably be made small, thus allowing our artificial red blood cells to operate with little energy consumption conditions of temperature and pressure. Thus, our spheres are over 2,000 times more efficient per unit volume than blood. Occupancy statistics would allow determination of concentration. Today's monoclonal antibodies are able to bind to only a single type of protein or other antigen, and have not proven effective against most cancers.

CHAPTER-5

RESOLUTION OF LENS

5.1 LENS/ILLUMINATION/LAYER:

Starting at the top level that closest to the transparent portion of the capsule?is the lens/illumination layer. An annular PCB surrounds the single plastic molded lens, supporting the LEDs and their associated current-limit resistors. Below this lens level is the imager layer, home to a 256-by-256pixel CMOS color image sensor. Marking on the chip indicates it is a custom device from Photobit, a company acquired by Micron Imaging in 2001. Combined with the plastic lens, the camera offers a claimed 140? viewing angle and 0.1mm feature resolution within the GI tract being imaged.

Behind the imager layer is a pair of Eveready No. 399 silver oxide watch batteries, wired in series to create the sole 3V supply for the PillCam. The two button cells provide 3V at 55mA-hr, or 165mW-hr of total available energy. Since the device runs for up to eight hours, a time-averaged power draw of approximately 20mW is implied.

5.1.1 Switch layer

The switch layer located behind the batteries provides the means to preserve precious battery energy before the PillCam is ingested by the patient. A reed switch mounted on the switch layer circuit board is held open by a magnet in the PillCam's shipping holster, interrupting the battery connection. When the package is opened and the capsule is removed from its holster for swallowing, the reed switch closes and power to the PillCam begins to flow.

5.1.2 Transmitter layer

The final strata of the PillCam is the transmitter layer is home to the only other IC, a custom ASIC developed by Given and of unmarked foundry origin. The chip must provide system control along with radio transmission. A 27MHz crystal located on the reverse side of the transmitter layer is consistent with both functions. The 3.2-by-3.5mm flip-chip ASIC contains a small block of logic, a very small memory array and a variety of mixed-signal circuits. Since the output from the image sensor is presumed to be preconverted to digital form, the radio and LED drive circuits are the likely functions included in the analog portion of the ASIC.

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5.2 RF EMISSION GUIDELINES

Per FCC filings, the transmitter operates at either 432.13MHz or 433.94MHz, with minimum-shift-keying modulation. MSK has the general benefits of providing constant-envelope modulation, transmitter simplicity and good spectral efficiency. A simple air coil is the radiating antenna element, tucked into the rounded capsule end opposite the camera. Transmit power is held low to manage power consumption, as the receiver antennas are in close proximity with the waist-worn monitor.

Nevertheless, FCC filings indicate the PillCam stays within emitted RF guidelines only when the pill is inside the body. The minute or so that it takes the pill to go from activated/depackaged form to ingestion is apparently given a waiver as part of the PillCam's regulatory approval.

Image capture, switch and transmitter layers are all fabricated on a single rigid-flex PCB. Delayering the board among the three islands of functionality creates flex circuits to interconnect those regions. The assembly is folded up around the batteries, and a pair of gold-plated coil springs distributes power from the imager layer to the lens/illumination layer through holes in the lens barrel.

The 8hr PillCam lifetime provides up to 57,000 images at a 2fps rate, with the LEDs flashing only during image capture. The combination of low-power CMOS imagers,

5.2.1 Pill camera not so hard for patient to swallow:

As the miniaturisation of cameras continues apace, more and more innovative products are thrown up, such as this pill camera. Basically a lens on a piece of string (isn't that something that Hell's Angels like to do involving string, bacon and laydeez, and goes by the name of Wolfbagging , the technology costs just $300—far less than a $5,000 endoscope. Developed at the University of Washington, the only person who has tried it out so far is research associate professor Eric Siebel.

"Never in your life have you ever swallowed anything and it's still sticking out of your mouth, but once you do it, it's easy," he said of the device. It consists of seven fiber optic cables in a capsule about the size of a painkiller, with a 1.4-mm tether that allows the doctor to move the camera around and pull it back up once the exploration is finished.

Testing starts at the Seattle Veterans' Administration hospital next year. Once given the thumbs-up, the reusable gadget (disinfect, rinse, repeat, I guess) is expected to be used in the fight against oesophagal cancer. Normal endoscopes are considerably bigger and can only be swallowed after the patient has been sedated (and liberally greased up, probably).

5.2.2 Gastroesophageal reflux disease:

(GERD), is a backflow of acid-containing fluid from the stomach into the esophagus. If it persists, it can develop into a more serious condition known as Barrett’s esophagus. Barrett’s esophagus is a condition in which cells of the lining of the esophagus become pre-malignant and can lead to a potentially fatal form of cancer known as esophageal adenocarcinoma.

5.2.3 Picoendo:

PicoEndo is about to produce a functional prototype. An even smaller camera sensor than the current 2.55 mm is under development. The processing software exists. The developers believe that by using a combination of white, UV, and NIR LEDs in the lens holder, that it may be possible to conduct an optical biopsy in situ instead of (or in addition to) a physical biopsy. A search for suitably sized UV and NIR LEDs is underway.

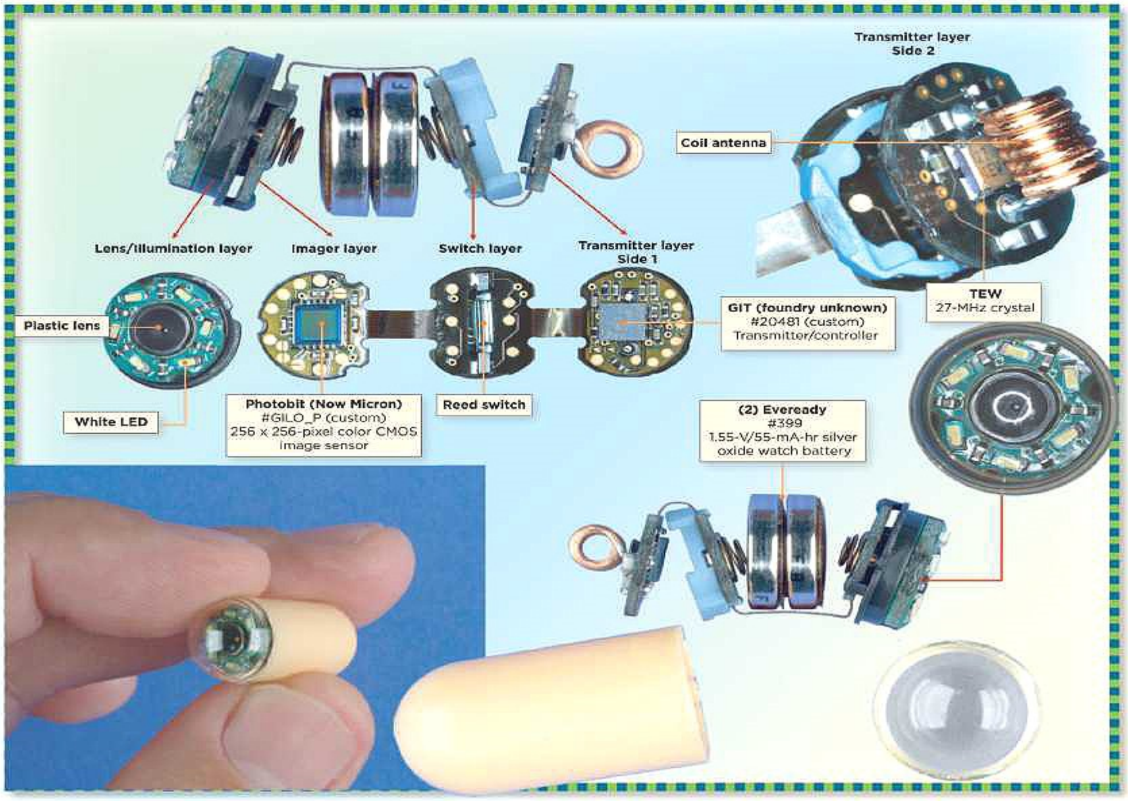

Fig 5.2.3 parts of capsule

Besides the miniature color video camera, the capsule contains a light source, batteries, a transmitter, and an antenna. Once swallowed this capsule/camera travels easily through the digestive tract and is naturally excreted. It is never absorbed in the body. The patient wears a wireless Given Data Recorder on a belt around his or her waist, much like a portable "Walkman. These signals can also track the physical course of the capsule's progress. During this procedure, users feel no pain or discomfort and are able to continue their regular activities as the camera works inside the body and the sensors and belt work outside. The entire process takes about eight hours.

People who are exposed to radiation or hazardous chemicals in their work environment are at a higher risk of illness. Occasional testing is typically done but may not detect a disease in its early stage. Early detection could initiate timely treatment with a higher chance of success, and have a worker removed from the hazardous environment to prevent further damage.

CHAPTER-6

PILL ENDOSCOPY

6.1 ENDOSCOPY PROCEDURE

Pill endoscopy is a new spin off of regular endoscopy, where and endoscope it inserted into the body to observe the walls of various organs and racts. Now there are pill cameras you can swallow that will take pictures of your organs and tracts,without the discomfort of having a tube inserted intoyour body.A major issue with current endoscopies is there is about 20 feet of the digestive track that is out reach of current methods. In order to overcome this an Israeli physician, Dr. Iddan, in 1981 began the development of a camera that would fit into a pill. Unfortunately, technology wasn't ready for this. It took until 2001 for it to be possible. In 2001 the FDA approved the Given Diagnostic Imaging System. The system was an 11x26mm 4 gram capsule, which contained a color video camera, a radio transmitter, 4 LEDs and a battery. The camera could take up to 50,000 pictures in the 8-hour trip through the digestive track. The pill is moved around the body with peristaltic contractions. Throughout the procedure the patient can perform daily tasks without discomfort.Throughout the 8-hours, the images are transmitted to a device about the size of a walkman. The images are received through special antenna pads placed on the body. From this the images can be downloaded to the computer for examination.One company has put a new twist on the pill camera. Other pill cameras have their lenses and sensor in the moving direction, requiring a wide angle lens. The problem with this is the peripheral regions of the picture become distorted. So RF Systems developed Sayaka. It is designed to take picture of the whole surface of the digestive tract.This is possible by its spinning camera, which takes pictures in a full 360 degrees. Another advancement with Sayaka is it is not battery powered. Instead it gets its power through induction charging. A vest worn by the patient transmits power, due to a coil in the vest. Once the pill reaches the intestines it begins to take 30 pictures per second. The walls of the intestine are lit by florescent and white LEDs. In order to spin the camera 360 degrees, an electromagnet reverses its polarity causing a permanent magnet to rotate the inner capsule and the mage sensor 60 degrees every two seconds. A full rotation takes 12 seconds, which it perfect to get a continuous picture of the internal wall of the intestine. For it takes the capsule about 2 minutes to travel an inch within the intestine.

A German company is developing a pill that can be moved up and down the esophagus using an external magnet. This would allow doctors to view a specific spot in the esophagus. Overall pill endoscopy is becoming an efficient low cost way to view the internal walls of Organs and the digestive tract. Preparation for a pill camera study requires fasting for 10-12 hours beforehand to ensure an empty stomach. Following capsule ingestion, after a brief period of observation, patients are permitted to leave the endoscopy center, with instructions to return within seven hours, at which time the data recorder will be removed. During the study, normal activity may be resumed. Light food is generally permitted beginning four hours after the capsule is ingested. The capsule is disposable and will usually pass naturally during a bowel movement within 8-24 hours.

Patients with a history of abdominal surgery, cardiac pacemaker or difficulty in swallowing should notify the doctor in advance. Complications are rare with pill camera studies,and generally occur when there is an obstruction in the intestinal tract. Notify the doctor if in the event of abdominal pain, chest pain, fever or vomiting. Do not undergo an MRI study until the capsule has passed. Results of the examination will be available after the captured images have been transferred to a computer and studied by your doctor.

We have a solid track record and a strong reputation in precision molded parts, plastic aspheric lenses and high-precision opto-mechanical assemblies. In series ranging from 10.000 per year to 20 million per year. Today, we are active in miniature camera-lenses for mobile and automotive applications, printer sensor optics, optical storage and high power LED lens solutions.We are developing our business growth through the creation and mass manufacturing of low cost, high volume optical solutions. The Key strategy is to make the most of our optics skill set, by combining it with world class toolbuilding and our over 75 years experience in plastics processing. All of these skills are applied in a one multi company team approach to ensure higher assembly performance and, consequently, improved customer system performance.

6.1.1 Collimating lenses

Among the products manufactured in Triumph HT Optics are miniature camera lenses for CIF, VGA and several Megapixel formats. The international SMIA standard is supported with several designs, including the EMC shielding of the lens amount. The lenses are characterized by an optimal design for manufacturing, resulting in high yield processes and therefore a reliable delivery to our customers. A 100% MTF test on state of the art test equipment is part of our outgoing inspection.

Other product lines are collimating lenses for laser applications and fresnellenses for solar concentrators and illumination, mouse optics and rearview cameralenses for the automotive industry. A true specialty are the objective lenses which are manufactured for pill camera's.

6.1.2 Smallest tethered endoscope

The PicoEndo endoscope is the smallest tethered endoscope in the world (4.5mm x 12.0mm). It is also inexpensive enough to use and discard. It provides a dramatic cost reduction in equipment requirements from conventional endoscope or pill camera systems, which can cost upwards of $30,000 USD. PicoEndo delivers more images at an improved quality, including images processed into 3D. The PicoEndo system is applicable to medical tasks such as photographing the surface of the esophagus and to applications in any other industry that needs to place a tiny electronic camera eye in a location that is difficult to view, such as inspecting the interiors of assembled engines.

6.1.3 Teering cable:

Because of its string (or tether), which also acts as an electronic connection and teering cable, the body of the endoscope does not have to contain batteries, memory, or processing electronics as do the much larger camera pills. The size of the camera and lens system determines the size of the unit. PicoEndo currently uses a camera and lens system 2.55mm across, but a system about half that size is under development. The unit is small enough for even children to swallow easily without sedation. The attached electronic tether string allows the camera capsule to be withdrawn or steered after it has entered as far as the operator needs. The tether connects PicoEndo to a special signal processing unit that in turn connects to a standard office PC. The disposable endoscopy head, image processing unit, and software are estimated to cost $1,000 USD, a substantial cost reduction from the less capable larger systems. The system offers 160,000 pixel resolution at 30 fps (about that of a conventional endoscope) in a camera head that is far smaller and that requires no sedation; it offers a 140-degree field of view that allows it to "see around corners,' which a conventional endoscope cannot do.

Fig 6.1 conventional lens

In collaboration with engineers from Given Imaging, the Israelite Hospital in Hamburg and the Royal Imperial College in London, researchers from the Fraunhofer Institute for Biomedical Engineering have developed the first-ever control system for the camera pill. The camera pill can be swallowed by a patient. A doctor can move the camera pill by a magnetic remote control. The steerable camera pill consists of a camera, a transmitter that sends the images to the receiver, a battery and several cold-light diodes which briefly flare up like a flashlight every time a picture is taken.

6.2 FROM ENTRANCE TO EXIT

The camera-in-a-pill capsule, or ***pill-cam***, measures 2.5cm by 1.1cm and contains a minuscule digital camera, a light source, and of course a battery to power it up. However, the real genius of the pill-cam lies in its tiny radio transmitter and antenna (also contained in the capsule!) which enables it to transmit data (pictures!) to a data recorder that the patient wears strapped around the waist. From the moment it is swallowed it takes pictures at a rate of two shots every second, right up until the moment it is excreted.

6.2.1 Solving a mystery illness

Tony Hulatt (name changed to respect privacy), a 19-year-old university student was one of the first people in Australia to benefit from using pill-cam technology. Tony had been suffering abdominal pain, anaemia, and bleeding from the bowel for over eighteen months, and had undergone numerous intrusive tests in hospital. Yet none of these tests had been able to identify his mystery illness.

6.2.2 Intrusive tests

Like other patients with these symptoms, Tony had undergone an endoscopy – an intrusive procedure in which doctors pass a tube down the throat and into the gut to try and see what might be wrong. Tony was also subjected to a colonoscopy, which does the same thing but tries to take a look from the other direction! Neither of these tests could identify his problem.

6.3 SWALLOWING A PILL – LESS PAINFUL THAN SURGERY

In the past, doctors have been diagnosing problems associated with the small intestine – such as cancer, ulcers and polyps – by using X-rays or exploratory surgery. These techniques are both unpleasant and painful, as is surgery. The beauty of pill-cam technology is that patients don't need to go through any special bowel preparation or go under anaesthetic. Patients can simply swallow the pill-cam in the morning and then go about their normal daily life (even go shopping!) and then return the data recorder to the doctor at the end of the day.

6.4. SOME AMAZING FACTS ABOUT THE CAM PILL-

The pill-cam 'capsule' is about the same size as a large multi-vitamin tablet, i.e. 2.5cm x 1cm.Two digital images of the intestine lining are taken every second time taken for the pill cam's entire journey through the body is approximately 7 hours.Hospitals make use of a computer software programme to speed up viewing the video .Half of the pill-cam ‘capsule’ consists of batteries .The miniature lens takes pictures from 2-3cm away.The tiny Perspex dome over the lens ensures that all images taken are in focus – even when it is touching the wall of the intestine.The procedure costs about £1000, with the pill-cam itself costing about half that amount.The official name of the so-called ‘pill-cam’ is the M2A™ Capsule Endoscopy, and it was developed by the Israeli company Given Imaging Ltd.The tiniest endoscope yet takes 30 two-megapixel images per second and offloads them wirelessly. See how it works 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.

A fundamentally new design has created a smaller endoscope that is more comfortable for the patient and cheaper to use than current technology. Its first use on a human, scanning for early signs of esophageal cancer, will be reported in IEEE Transactions on Biomedical Engineering."Our technology is completely different from what's available now. This could be the foundation for the future of endoscopy," said lead author Eric Seibel, a University on research associate professor of mechanical engineering.

In the past 30 years diagnoses of esophageal cancer have more than tripled. The esophagus is the section of digestive tract that moves food from the throat down to the stomach. Esophageal cancer often follows a condition called Barrett's esophagus, a noticeable change in the esophageal lining. Patients with Barrett's esophagus can be healed, avoiding the deadly esophageal cancer. But because internal scans are expensive most people don't find out they have the condition until it's progressed to cancer, and by that stage the survival rate is less than 15 percent.

"These are needless deaths," Seibel said. "Any screen that detected whether you had a treatable condition before it had turned into cancer would save lives."

An endoscope is a flexible camera that travels into the body's cavities to directly investigate the digestive tract, colon or throat. Most of today's endoscopes capture the image using a traditional approach where each part of the camera captures a different section of the image. These tools are long, flexible cords about 9 mm wide, about the width of a human fingernail. Because the cord is so wide patients must be sedated during the scan.

6.4.1 Scanning endoscope

The scanning endoscope developed at the UW is fundamentally different. It consists of just a single optical fiber for illumination and six fibers for collecting light, all encased in a pill. Seibel acted as the human volunteer in the first test of the UW device. He reports that it felt like swallowing a regular pill, and the tether, which is 1.4 mm wide, did not bother him.

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, one pixel at a time. At the same time the fiber spins and its tip projects red, green and blue laser light. The image processing then combines all this information to create a two-dimensional color picture.

In the tested model the fiber swings 5,000 times per second, creating 15 color pictures per second.

"The procedure is so easy I could imagine it being done in a shopping mall," Seibel said.

A wireless scope manufactured by a different group, originally designed to pass through the body and detect intestinal cancer, is now being marketed for esophageal cancer screening. The competing technology comes in a pill about the width of an adult fingernail and twice as long. By contrast, the UW's scanning fiber endoscope's dimensions are about half as big and the device fits inside a standard pill capsule. The pill could be even smaller, Seibel said, but the researchers chose a size that would be easy to handle and swallow.

Another disadvantage of wireless capsules is they only allow a single fly-by view.

"we have no control over the other pill once it's swallowed. It just flutters down," Seibel said. But since the UW scope is tethered, the doctor can move it up and down along the region of interest.

6.4.2 Missile optical camera

Only a small percentage of people who get Barrett's esophagus, about 5 percent to 10 percent, develop

Israeli military scientist Gabriel Iddan spent years working on missile technology as the head of the electro-optical design section of the Rafael Armament Development Authority at the Ministry of Defense. Iddan had worked on the seeker, or the "eye" of the missile, which captures the targets and guides it, and believed the same technology . While on sabbatical eight years ago in Boston, Iddan decided to design a tiny capsule containing a guided missile optical camera that could be swallowed, and would send images in real time as it traversed a patient's intestines. But money for the project was scarce. "I tried in vain to raise money," he said. "People thought the idea was farfetched. They thought it was good for a movie but not for a business. Rafael told me to raise money by myself.Iddan pressed on, creating the M2A Swallowable Imaging Capsule, or the missile pill.

6.4.3 Three-dimensional camera

During the next four years, Iddan developed a three-dimensional camera capable of a Iddan and his team worked on the capsule, numerous technological breakthroughs occurred that made his concept more realistic. First, a new silicon, called CMOS, made it possible for all of the components of the camera to be placed on a single chip - reducing both its size and power consumption. Advances in ASIC design allowed the integration of a tiny video transmitter with sufficient output, efficiency and bandwidth to fit inside the capsule. White light emitting diode illumination made it possible for the reflections..

They went to work. Dov Avni, whom Iddan calls "the guru of video cameras" at Rafael, invented a camera the third of the size of a dime. The color video camera sits on a chip that is 4 mm square and 1 mm wide. On another 3 mm chip sits a transmitter and an optical sensor. Altogether, the camera, transmitter, battery, a tiny floodlight and an antenna fit into a disposable pill that is 2.5 cm long and 1.5 cm wide.. "It's like swallowing a missile that doesn't explode," says Gavriel Meron, chief executive officer of Given Imaging, the company established three years ago to produce the pill. Meron, who volunteered to swallow the pill, said: "It was easier than swallowing an aspirincancer. So any screening method must have a low price to be cost-effective.

"The next big challenge is to make this cheaply," Seibel said. The researchers are negotiating a contract to commercialize the technology. In the future they hope to not only take pictures, but also deliver treatments through the device, and to apply it to other diseases.

The research was funded by the National Cancer Institute and Pentax Corp. Early funding was provided by the Whitaker Foundation and the Washington Technology Center. Co-authors at the UW are Drs. Michael Kimmey and Jason Dominitz in gastroenterology at the UW Medical Center; Richard Johnston, C. David Melville and Cameron Lee in mechanical engineering; Steve Seitz in computer science and engineering; and Robert Carroll, now in electrical engineering and computer science at the University of California, Berkeley.

6.4.4 Smooth plastic capsule

The smooth plastic capsule contains a miniature video camera and is equipped with a light source on one end, batteries, a radio transmitter and antenna. After it is swallowed, the PillCam SB capsule transmits approximately 50,000 images over the course of an 8-hour period (about 2 images per second) to a data recording device attached to a belt worn around the patient’s waist.

The small bowel images are then downloaded into a Given Workstation computer where a physician can review the images in order to make a diagnosis. The patient gulps down the capsule, and the digestive process begins.

6.5 ESO CAPSULE ENDOSCOPY WORK

During the 20-minutes procedure, the PillCam ESO video capsule transmits about 2,600 color images (14 images per second) to a data recording device attached to a belt worn around the patient’s waist. The images are then downloaded into a Given® Workstation computer where a physician can review the images in order to make a diagnosis.

A patient fasts for 10 hours prior to the procedure, then swallows the PillCam SB video capsule with a glass of water. Images and data are acquired as the PillCam SB capsule passes through the digestive system over an 8-hour period. This information is transmitted via a SensorArray to the portable DataRecorder attached to a belt worn around the patient's waist.

6.5.1 Data recorder

Once the patient swallows the capsule they can continue with their daily activities. After eight hours they return to the physician's office with the DataRecorder so the images can be downloaded, and a diagnosis can be made.

A patient will fast for at least two hours before swallowing the PillCam ESO video capsule. The capsule is easily swallowed with water while the patient lies on his or her back. The patient is then raised by 30 degree angles every two minutes until the patient is sitting upright. Similar to the PillCam SB procedure, the patient is wearing the DataRecorder on a belt around the waist.A PillCam capsule endoscopy requires no preparation or sedation, and recovery is immediate. Both the PillCam SB and PillCam ESO disposable capsules make their way through the rest of the gastrointestinal tract and then are passed naturally and painlessly from the body, usually within 24 hours.

Both PillCam SB and ESO video capsules are 11 mm x 26 mm and weigh less than 4 grams. Capsule endoscopy with PillCam SB video capsule is widely covered in the U.S. A list of payers can be obtained from our Reimbursement Center. A permanent CPT Code for capsule endoscopy with PillCam ESO was assigned by the American Medical Association and the Center for Medicare and Medicaid Services effective January 1, 2007.Endoscopy and radiological imaging are the traditional methods for small bowel diagnostics. In endoscopy, the physician inserts an endoscope, a flexible tube and optical system approximately 3.5 feet long, through the patient's mouth or anus. Typically, this procedure will include sedation and recovery time. During a radiological imaging examination, the patient swallows a contrast medium (such as barium) or a dense liquid that coats the internal organs to make them appear on x-ray film. The procedure produces a series of black and white x-ray images of the lumen, or cavity, of the small intestine.

6.5.2 Lighted flexible tube

A doctor uses an endoscope, a long, thin, lighted flexible tube with a small camera on the end. The endoscope is inserted through the patient's mouth and into the esophagus. Although the patient is awake during the procedure, doctors administer sedatives intravenously, and spray numbing agents into the patient's throat to prevent gagging. Recovery time is one to two hours until the effects of the sedatives wear off and the patient's throat may be sore for up to two days.

Both the PillCam SB and ESO procedures do not require sedation and can be administered in a doctor's office. Studies have shown patients undergoing either PillCam procedure have a much higher level of satisfaction due to procedural convenience and comfort and immediate recovery. The PillCam SB is considered the gold standard for detecting diseases of the small bowel such as Crohn's disease and obscure bleeding.

In a study of 106 patients, the sensitivity level of the PillCam ESO was rated similar to the sensitivity level of a traditional endoscopy in detecting abnormalities in a patient's esophagus. PillCam ESO accuracy is comparable to traditional endoscopy.

Inflammatory Bowel Disease (IBD) is a family of chronic diseases affecting the intestines. Crohn's disease and ulcerative colitis both fall under the same umbrella and were once believed to be the same disease. Patients with IBD experience such symptoms as persistent diarrhea, abdominal pain or cramps, fever and weight loss, and joint, skin, or eye irritations in varying degrees. Some may not experience all of these symptoms.

Patients may also experience cycles of remission and relapse as the disease progresses. While Crohn's disease is rarely fatal, there is no cure. Instead, doctors focus on treating the symptoms. If left untreated, symptoms may worsen, and health problems such as abscesses, obstruction, malnutrition and anemia may occur.

6.5.3 Gastrointestinal association data

According to American Gastrointestinal Association data, approximately 19 million of Americans suffer from various disorders of the small intestine including bleeding, Crohn's disease, celiac disease, irritable bowel syndrome and small bowel cancers. Of these 19 million people, approximately 500,000 people suffer from Crohn's disease.

6.6 ESOPHAGEAL VARICES:

Gastroesophageal varices are present in 40-60% of patients with cirrhosis Hemorrhage from esophageal varices is a leading cause of death in cirrhotic patients, with mortality rates as high as 50% .Varices are veins that have become enlarged due to increased pressure. The increased blood flow causes these fragile blood vessels to become so stretched that they are susceptible to breaking and bleeding.

CHAPTER-7

ENDOSCOPIC EXAMINATION

7.1 NANOTECHNOLOGY

Additionally, nanorobots could change your physical appearance. They could be programmed to perform cosmetic surgery, rearranging your atoms to change your ears, nose, eye color or any other physical feature you wish to alter.There's even speculation that nanorobots could slow or reverse the aging process, and life expectancy could increase significantly. In the computer industry, the ability to shrink the size of transistors on silicon microprocessors will soon reach its limits. Nanotechnology will be needed to create a new generation of computer components. Molecular computers could contain storage devices capable of storing trillions of bytes of information in a structure the size of a sugar cube.

Nanotechnology has the potential to have a positive effect on the environment. For instance, airborne nanorobots could be programmed to rebuild the thinning ozone layer. Contaminants could be automatically removed from water sources, and oil spills could be cleaned up instantly. And if nanotechnology is, in fact, realized, it might be the human race's greatest scientific achievement yet, completely changing every aspect of the way we live.

7.2 EXISTING SYSTEM:

Currently, standard method of detecting abnormalities in the intestines is through endoscopic examination in which doctors advance a scope down into the small intestine via the mouth. However,these scopes are unable to reach through all of the 20-foot-long small intestine, and thus provide only a partial view of that part of the bowel. With the help of pill camera not only can diagnoses be made for certain conditions routinely missed by other tests, but disorders can be detected at an earlier stage, enabling treatment before complications develop.

7.3 PROPOSED SYSTEM:

The capsule is the size and shape of a pill and contains a tiny camera. After a patient swallows the capsule, it takes pictures of the inside of the gastrointestinal tract. The primary use of capsule endoscopy is to examine areas of the small intestine that cannot be seen by other types of endoscopy such as olonoscopy or esophagogastroduodenoscopy (EGD).This type of examination is often done to find sources of bleeding or abdominal pain .

7.4 CAPSULE 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 inside the body in 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.

7.4.1 Power up:

The Sayaka doesnt need a motor to move through your gut, but it does require 50 milliwatts 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.

7.4.2 Start snapping :

When it reaches the intestines, the Sayaka 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 wall.

7.4.3 Spins for closeups:

Previous pill cameras place the camera at one end, facing forward, so the tissue walls are visible only in the periphery of their photos. Sayaka is the first that gets a clearer picture by mounting the camera facing the side and spinning 360 degrees so that it shoots directly at the tissue walls.As the outer capsule travels through the gut, an electromagnet inside the pill reverses its polarity. This causes 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.

7.4.4 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.

7.4.5 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.

7.4.6 Leave the body:

At around $100, the cam is disposable, so patients can simply flush it away. The below is the block diagram of receiver that receives the pictures snapped by the camera inside the stomache.

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.Patients report that the video capsule is easier to swallow than an aspirin. It seems that the most important factor in ease of swallowing is the lack of friction. The capsule is very smooth, enabling it to slip down the throat with just a sip of water. After the Given M2A capsule is swallowed, it moves through the digestive track naturally with the aid of the peristaltic activity of the intestinal muscles. The patient comfortably continues with regular activities throughout the examination without feeling sensations resulting from the capsule's passage. During the 8 hour exam, the images are continuously transmitted to special antenna pads placed on the body and captured on a recording device about the size of a portable Walkman which is worn about the patient's waist. After the exam, the patient returns to the doctor's office and the recording device is removed. The stored images are transferred to a computer PC workstation where they are transformed into a digital movie which the doctor can later examine on the computer monitor. Patients are not required to retrieve and return the video capsule to the physician. It is disposable and expelled normally and effortlessly with the next bowel movement.

It passively down the esophagus and through roughly 20 to 25 feet of intestines, where it will capture up to 870,000 images.

This is an exam of the small intestine of your digestive system. You will need to swallow a small capsule that contains a camera with flash. The capsule is about the size of a multivitamin pill. This capsule takes 75,000 to 80,000 pictures as it passes through the digestive tract. These pictures will transmit to sensor pads that are placed belly. The images are stored in a small device that is held on a belt you will wear around the waist.

Research shows that the pill leaves behind a trace of silver when it passes through the body. Silver coats the pill and also makes up the antenna; however, the amount left behind in the body is less than is absorbed by the average person drinking tap water, according to researchers. 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 stored images are transferred to a computer PC workstation where they are transformed into a digital movie which the doctor can later examine on the computer monitor. Patients are not required to retrieve and return the video capsule to the physician. It is disposable and expelled normally and effortlessly with the next bowel movement.

CHAPTER-8

DIGESTIVE TRACK

8.1 SMALL INTESTINE

The best of hands the entire small intestine is not visualized. The visit to attach the sensor pads and swallow the capsule will take 30 minutes to an hour. You are able to leave the hospital at this time. the digestive track naturally with the aid of the peristaltic activity of the intestinal muscles. The patient comfortably continues with regular activities throughout the examination without feeling sensations resulting from the capsule's passage.

8.2 USES:

- Crohn's Disease.
- malabsorption Disorders.
- Tumors of the small intestine & Vascular Disorders.
- Ulcerative Colitis
- Medication Related To Small Bowel Injury

8.3 ADVANTAGES:

- Biggest impact on the medical industry
- Nanorobots can perform delicate surgeries.
- They can also change the physical appearance.
- They can slow or reverse the aging proces.
- Used to shrink the size of components.
- Nano technology has the potential to have a positive effect on the Environment.

8.4 DRAWBACKS:

It is a revolution, no question about it but the capsule poses medical risks

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 diagnostical 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 behavior, including the on/off power functions and effective illuminations inside the intestine. The first drawback is overcomed using another product manufactured with the help of nanotechnology which is the rice- grain sized motor.

The bidirectional wireless telemetry camera, 11mm in diameter, can transmit video images from inside the human body and receive the control signals from an external control unit. It include stream transmitting antenna and receiving antenna, a demodulator, a decoder, four LED’s, a CMOS image sensor, along with their driving circuits.The receiver demodulates the received signal that is radiated from the external control unit. Next, the decoder receives this serial stream and interprets the five of the binary digits as address code. The remaining signal is interpreted as binary data. As a result proposed telemetry model can demodulate the external signals to control the behavior of the camera and 4 LEDs during the transmission of video image. The CMOS image sensor is a single chip 1/3 inch format video camera, OV7910, this can provide high level functionality with in small print footage. The image sensor supports an NTSC-type analog color video and can directly interface with VCR TV monitor. Also image sensor has very low power consumption as it requires only 5 volt dc supply. Since scope tests were first invented, doctors have wanted to be able to visualize the entire gut - all 30 feet. But, a direct view of the small intestine has remained elusive.

Attempts have been made to develop longer endoscopic instruments. This technique called push enteroscopy has had only limited success. The longer instruments are difficult to control and manipulate and are hard to maintain.

The accuracy of push enteroscopy is still limited since even in the best of hands the entire small intestine is not visualized. The visit to attach the sensor pads and swallow the capsule will take 30 minutes to an hour. You are able to leave the hospital at this time.

CHAPTER-9

CONCLUSION

The given endoscopy capsule is a pioneering concept for medical technology of the 21^{st} 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.

Though nanotechnology has not evolved to its full capacity yet the first rung of products have 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 **<u>"nanotechnology".</u>** Scientists predict that this is not all nanotechnology is capable of. They even foresee that in the decades to come, with the help of nanotechnology one can make hearts, lungs, livers and kidneys, just by providing coal, water and some impurities and even prevent the aging effect. **<u>Nanotechnology</u>** has the power to revolutionize the world of production, but it is sure to increase unemployment.

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

You will need to return at the time your nurse gives you. The study takes 8 hours. The capsule most often will pass in your bowel movement. You will not need to retrieve the capsule. In the rare case that the capsule does not pass it may need to be removed endoscopically or surgically. The remaining signal is interpreted as binary data. As a result proposed telemetry model can demodulate the external signals to control the behavior of the camera and 4 LEDs during the transmission of video image