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Pill Camera

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Abstract: The aim of technology is to make products in a large scale for cheaper price and increased quality. As the current manufacturing technology is at macro level but the future lies in manufacturing product at molecular level. On the basis & advent of nanotechnology one such product manufactured is pill camera. "Camera Pill" or Capsule endoscopy is a new diagnostic tool that permits a direct visual examination of the small intestine, an area of the body not previously accessible using upper endoscopy from above or colonoscopy from below. The pill, known as the Capsule Endoscopy, is about the size of a multivitamin and is swallowed with a sip of water. The pill is made of specially sealed biocompatible material that is resistant to stomach acid and powerful digestive enzymes and thus every care is taken such that the caps will not rupture or burst. Its non-invasive diagnostic alternative that is relatively quick, easy, office based test that will encourage people to see their doctors to get checked for diseases, Capsule endoscopy helps your doctor evaluate the small intestine. This part of the bowel cannot be reached by traditional upper endoscopy or by colonoscopy. The most common reason for doing capsule endoscopy is to search for a cause of bleeding from the small intestine. It may also be useful for detecting polyps, inflammatory bowel disease (Crohn's disease), ulcers, cancers, andanemia and tumors of the small intestine. It takes picture of our intestine and transmits the same to the receiver of the computer for analysis of our digestive system. This process can help in tracking any kind of disease related to digestive system.

Keywords: colonoscopy, endoscopy, polyps, crohn's disease.

I. INTRODUCTION

1.1 PREAMBLE

Technology is like an expanding universe. As there is a great progress in manufacturing products, humans are still thinking more complex about innovative ideas. With our present technology we manufacture products by casting, milling, grinding, chipping and integrated fabrication. 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 manufactured products are made from atoms.

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 (nanometre). Nanotechnology deals with objects measured in Nanometers. Nanometre can be visualized as billionth of a meter or millionth of a millimetre 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 [3] [5].

Millions of assembler needed to build products. In order to create enough assemblers to build consumer goods, some Nano machines called explicators will be developed using self-replication process. Self-replication is a process in which devices whose diameters are of atomic scales, on the order of nanometres, create copies of themselves.

1.2. OBJECTIVE

1) Pill camera endoscopy is used to detect intestinal cancer, oesophageal diseases like crohn's disease.
2) Its major use is to capture live colour footage of small intestinal track and detect any digestive system disease at very early stage.

1.3ORGANIZATION

This topic is mainly focus on cancer treatment at early stage. It includes information as follows.
Chapter 2: This chapter includes about capsule endoscopy literature survey and history.
Chapter 3: This chapter contains detail information about Pill camera.
Chapter 4: This chapter contains information about total pil camera endoscopy from mouth to anus [6] [7] (M2A).

II. LITERATURE SURVEY

2.1 INTRODUCTION

All manufactured products are made from atoms and properties of those products depend on how those atoms are arranged in great thundering statistical herds. 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. And pill camera is one of its example which takes pictures of our intestine and transmits the same to the receiver of the Computer for analysis of our digestive system. This process can help in tracking any

kind of disease related to digestive system. Also some drawbacks of PILL CAMERA are mentioned and how these drawbacks can be overcome using Grain sized motor and bi -directional wireless telemetry capsule [3] [1] [5].

2.2 HISTORICAL OVERVIEW

Manipulation of atoms is first talked about by noble laureate Dr.Richard Feyngmanlong ago in 1959 at the annual meeting of the American Physical Society at

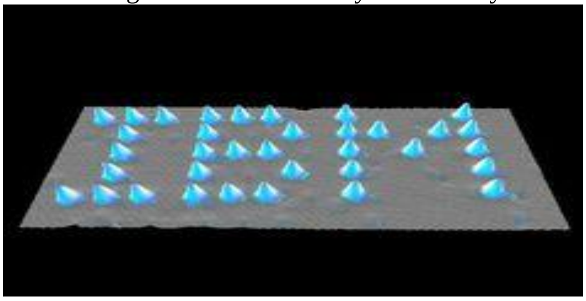

Fig2.1 Nickel Crystal Board

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.In 1990, IBM researchers showed that it is possible to manipulate single atoms. They positioned 35 Xenon atoms on the surface of nickel crystal fig 2.1, using an atomic force microscopy instrument. These positioned atoms spelled out the letters" IBM".

2.3 MANUFACTURING PRODUCTS USING NANOTECHNOLOGY

There are two steps to achieving nanotechnology-produced goods:

- Atoms are the building blocks for all matter in our Universe. All the products that are manufactured are made from atoms and 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.
- 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.In order to create enough assemblers to build consumer goods, some Nano machines called explicators will be developed using self-re-plication 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 nanometres, create copies of themselves. For of self-replication to take place in a constructive manner, three conditions must be met [3-2].

2.3.1 Nano Robot

- The 1st requirement is that each unit be a specialised machine called Nano robot, one of whose functions is to construct at least one copy of itself during its operational life apart from performing its intended task. An e.g. of self-replicating Nano robot is artificial 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 tobuild complete copies of Nano robot in question. Ideally the quantities of eachIngredient should be such that they are consumed in the correct proportion theprocess is intended to be finite, then when desired number of Nano robot has been constructed, there should be non-use quantities of any ingredient.

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 Nano robot and cause the process to fail or falter. Once Nano robots are made in sufficient numbers, the process of most of the Nano robots is changed from self-replication to mass manufacturing of products. The Nano robots are connected and controlled by super computer which has the design details of the product to be manufactured. These Nano robots now work in tandem and start placing each molecules of product to be manufactured in the required position. The process of most of the Nano robots is changed from self-replication to mass manufacturing of products.

2.4 POTENTIAL EFFECTS OF NANOTECHNOLOGY

Nanotechnology [4] [5] 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 anaesthesia 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. 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.

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2.4.1 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. Attempt shave madeto develop longer endoscopic instruments. This Technique called push enteroscopy has had only limited success. [1] [2] 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. 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.

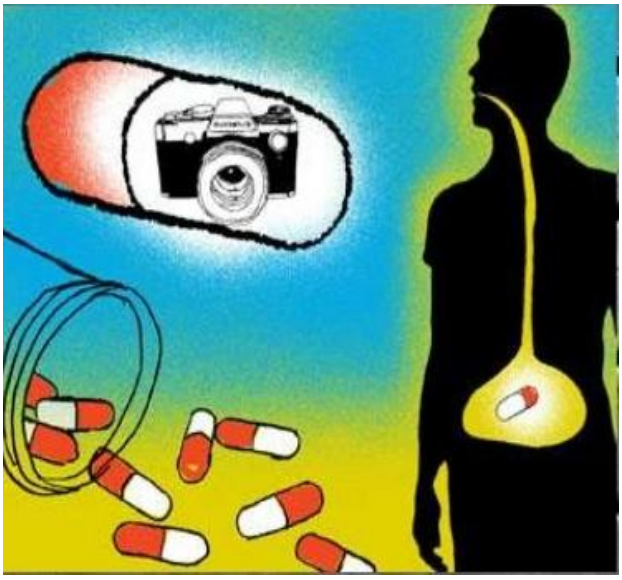

Fig 2.2 View of Capsule

2.4.2 Peristalic Activity

Patients report that the video capsule is easier to swallow than an aspirin as shown in fig 2.2. 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 [7] [6] 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. 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[4].If you've ever been plagued by temporary amnesia and forgottenwhetherornotyoutook your medication, Take heart U.S. researchers have engineered a pill that will jog your memory.

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.

2.4.3 Gastrointestinal Tract

Research shows that the pill leaves behind a trace of silver when it passes through the body. [7] [6] 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.

2.5 SUMMARY

This survey comes to the point that capsule endoscopy is superior to push enteroscopy in the diagnosis of recurrent bleeding in patients who had a negative gastroscopy and colonoscopy. It is safe and well tolerated. Wireless capsule endoscopy represents a significant technical breakthrough for the investigation of the small bowel, especially in light of the shortcomings of other available techniques.

The capsule endoscopy seems can suit to patients with gastrointestinal bleeding of unclear etiology who have had non diagnostic traditional testing and in whom the distal small bowel (beyond reach of a push enteroscopy) needs to be visualised.

III. PILL CAMERA

3.1 INTRODUCTION

The pill camera is a new diagnostic tool that permits a direct visual examination of the small intestine. It is that area of the body which is not previously accessible using upper endoscopy or colonoscopy. The pill is known as M2A capsule endoscopy.

3.1.1 PILL –SIZED CAMERA

Imagine a vitamin pill-sized camera as shown in fig 3.1 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.

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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 capsule which contains conventional camera as shown in fig 3.2 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.

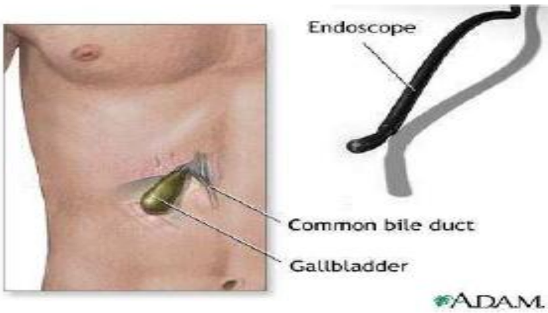

Fig 3.2 Conventional Camera

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. As shown in fig 3.3 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 colour images during its traversal through the digestive system of patient [2] [3] [6].

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.

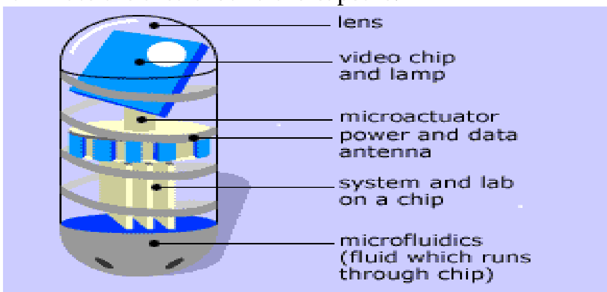

Fig3.3 Disposable Video Camera

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

3.3 COMPONENTS OF CAPSULE CAMERA

As shown in fig 3.4 capsules consist of eight components with their respective function as below:-

Fig 3.4 Components of Capsule Camera

3.3.1 Optical Dome

- This shape results in easy orientation of the capsule axis along the central axis ofsmall intestine and so helps propel the capsule forward easily.
- The Optical Dome contains the Light Receiving Window.

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 damage.

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3.3.3 Lens

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

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 doughnut shape.

3.3.5 CMOS Image Sensor

- CMOS 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

3.3.6 Battery

Battery used in the capsule is button shaped and two in number as shown in fig 3.4. Batteries are arranged together just behind the CMOS Image Sensor. Silver Oxide primary batteries are used (Zinc/Alkaline Electrolyte/Silver Oxide).Such a battery has an even discharge voltage, disposable and doesn't cause harm to the body.

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.

3.3.8 Antenna

The Antenna is arranged at the end of the capsule. It is enclosed in a dome shaped chamber. 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 [6], it is not a medication, but rather a single-use video colour-imaging capsule.

Besides the miniature colour 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 photo detector (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.

3.4 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 Data Recorder 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 Data Recorder 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 Centre. [7] [3]Endoscopy and radiological imaging are the traditional methods for small bowel diagnostics. In ESO endoscopy, as shown in fig 3.5 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.

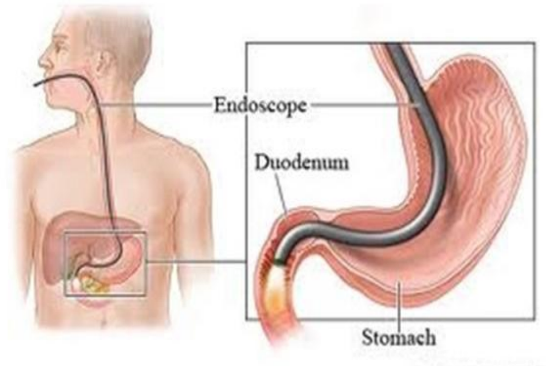

Fig 3.5 Endoscopy Using ESO Method

3.5. 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.

3.6 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

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primary use of capsule endoscopy is to examine areas of the small intestine that cannot be seen by other types of endoscopy such as colonoscopy or esophagogastroduodenoscopy (EGD). This type of examination is often done to find sources of bleeding or abdominal pain.

3.7 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. [1] [3]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 tumours and other problems, thanks to a new spinning camera that captures images in 360 degrees developed by the Japanese RF System Lab.

3.7.1 Power Up

The Sayaka doesn’t need a motor to move through your gut, but it does require 50 milli 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.

3.7.2 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.

3.7.3 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.

3.7.4 Leave the Body

At around $100, the cam is disposable, so patients can simply flush it away. Pill passes down in the oesophagus 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. [5]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. 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.

IV. PILL CAMERA ENDOSCOPY

4.1 INTRODUCTION TO ENDOSCOPY

Endoscopy means looking inside the body for medical reasons using an endoscope. Unlike most other medical imaging devices, endoscopes are inserted directly into the organ. Endoscopy can also refer as using borescope. An endoscope is a flexible camera that travels into the body’s cavities to directly investigate digestive tract, colon or throat. 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. The tiny camera is like swallowing a pill to diagnose internal body is better option than long flexible cords.

4.1.1 SWALLOWEDCAPSULE

Capsule is swallowed by the patient like a conventional pill.It takes images as it is propelled forward by peristals is.A wireless recorder, worn on a belt, receives the image transmitted by the pill. [4]A computer workstation processes the data and produces a continuous and still images. Movement of capsule as shown in fig 4.1 through the digestive System produces two images per second, approximately 2,600 high quality images.

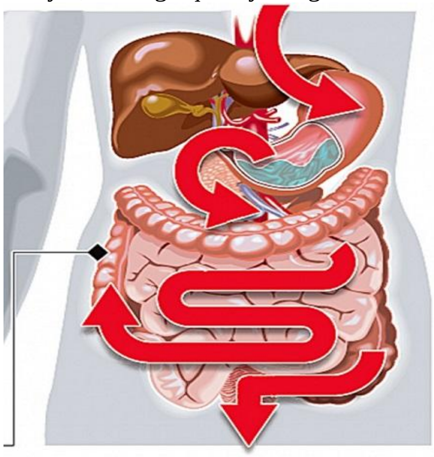

Fig 4.1 Movement of Capsule

4.2 BLOCK DIAGRAM OF TRANSMITTER AND RECEIVER

In the first block diagram, one SMD type transistor amplifies the video signal for efficient modulation using a

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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 (ON/OFF Key) 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.

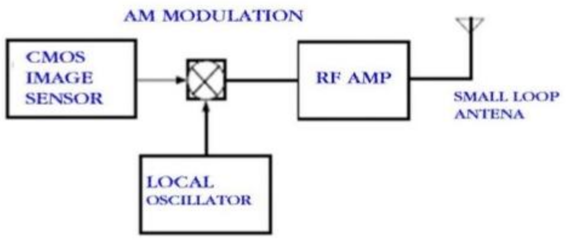

Fig 4.2 Transmitter circuit inside capsule

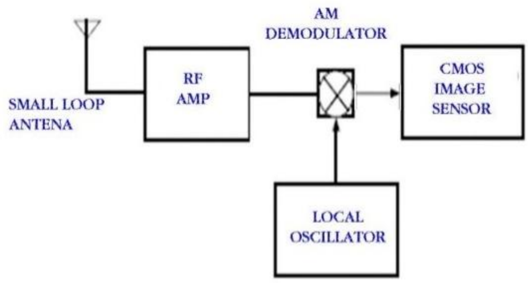

Fig 4.3 Receiver circuit inside capsule

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 [4] 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. The proposed telemetry capsule can simultaneously transmit a video signal and receive a control determining the behaviour 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 [4] LEDs for proper illumination in the intestine. Accordingly, proposed telemetry module for bidirectional and multi-channel communication has the potential applications.

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 behaviour 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 [3] NTSC-type analog colour 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.

4.3 ENDOSCOPY PROCEDURE

Pill endoscopy [5] is a new spin off of regular endoscopy, where and endoscope it inserted into the body to observe the walls of various organs and reacts. 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 into your 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

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11x26mm 4 gram capsule, which contained a colour video camera, a radio transmitter, 4 LEDs and a battery. 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[2]. 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 thingwith 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. 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 centre, 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. [1] 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 moulded parts, plastic aspheric lenses and high-precision opt-mechanical assemblies. Today, we are active in miniature camera-lenses for mobile and automotive applications, printer sensor optics, optical storage and high power LED lens solutions.

4.3.1 Smallest Tethered Endoscope

The PicoEndo [2] 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. Pico Endo delivers more images at an improved quality, including images processed into 3D. The Pico Endo 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.

4.3.2Entrance 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.

4.4 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 [5].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 [5] 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. "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 oesophageal cancer have more than tripled [3]. The oesophagus is the section of digestive tract that moves food from the throat down to the stomach. Oesophageal cancer often follows a condition called Barrett's oesophagus, a noticeable change in the oesophageal lining. Patients with Barrett's oesophagus can be healed, avoiding the deadly oesophageal 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. Any screen that detected whether you had a treatable condition before it had turned into cancer would save lives."

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4.4.1 Missile Optical Camera

Only a small percentage of people who get Barrett's oesophagus, 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 Defence. [3] 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.

4.5 DIGESTIVE TRACK

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 is aid with peristaltic activity. The patient comfortably continues with regular activities throughout the examination without feeling sensations resulting from the capsule's passage.

4.5.1 Uses

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

4.5.2 Advantages

- Biggest impact on the medical industry [5].
- Nano robots can perform delicate surgeries
- They can also change the physical appearance.
- They can slow or reverse the aging process.
- Used to shrink the size of components.
- Nano technology has the potential to have a positive effect on the Environment

4.5.3 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 [5].
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 [5]. The first drawback has overcome 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.

4.5.4 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 oesophagus. 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 oesophagus. 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 diarrhoea, 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 anaemia may occur.

4.5.5 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.

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4.6 ESOPHAGEAL VARICES

Gastroesophagealvarices [6] are present in 40-60% of patients with cirrhosis Haemorrhage from oesophagealvarices 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. Pictures by pill camera of gastroesophageal endoscopy [7] and path moving of capsule are as shown in fig 4.4 and fig 4.5 respectively.

Fig.4.4 Images of Gastroesophageal Tract

Fig.4.5 Path of Moving Pill from Digestive System

V. CONCLUSION

5.1 INTRODUCTION

The given endoscopy capsule is a pioneering concept for medical technology of the 21st century. The endoscopy system is the first of its kind to be able to provide non-invasive imaging of the entire small intestine. It has revolutionized the field of diagnostic imaging to a great extent and has proved to be of great help to physicians all over the world. In the near future most of the conventional manufacturing processes will be replaced with a cheaper and better manufacturing process “nanotechnology”.

5.2 CONCLUSION

Scientists predict that this is not all nanotechnology is capable to produce such products. They even foresee that in the coming decades, 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. Nanotechnology has the power to revolutionize the world of production, but it is sure to increase unemployment in next generation. This pill camera technology has glorified biomedical science and helped doctors to diagnose such a complicated intestinal bowel in easy way. Use of Pill camera on large scale will reduce unwanted death rate in upcoming decades. But in rare case the capsule which is swallowed if does not pass through body further then, it may need to be removed endoscopic ally or surgically. So this proposed capsule endoscopic model has to be further modified after knowing its disadvantage which occurs while the transmission of video image.

5.3 FUTURE SCOPE

This pill camera technology in future can be design to sense temperature, pressure, and various diseases with its virus present in body. Also it can be made in the form of programmable chip so that it can work blood cell (WBC’s and RBC’s) reconstruction. This can prevent patients from surgical operation.

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