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CAPSULE ENDOSCOPY (PILL CAMERA)

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Abstract— Recent technology aims to manufacture products in a large scale for cheaper prices and increased quality. The existing technologies have attained a part of it, but the manufacturing technology is working at macro level. The future lies in manufacturing the products right from the molecular level. Research in this direction have been started way back in eighties. At that time manufacturing at molecular and atomic level was considered impossible. But due to the advancement in nanotechnology we have realized it to a certain level. One such product manufactured is the PILL CAMERA, which is used for the treatment of cancer, ulcer and gallstones. It has also made revolution in the field of medicine. This tiny capsule passes through our body, without causing any harm. It takes pictures of our internal organs such as intestine and transmits the same to the receiver of the Computer for the analysis of our digestive system. This process helps in tracking any kind of disease related to digestive system. Also we have discussed the drawbacks of using PILL CAMERA and how these drawbacks can be overcome using Grain sized motor and bi-directional wireless telemetry capsule.

Keywords— Nano technology, Pill camera, Endoscope

I. INTRODUCTION

Endoscopy is a procedure in which doctor uses specialized instruments to view and operate on the internal organs of body. It allows surgeons to see problems within our body. It involves the insertion of an endoscope which is a long flexible tube with a camera attached at the end into the gastrointestinal tract through the mouth. It allows doctor to visually examine an organ without having to make a large incision. A screen in the operating room lets the doctor see exactly what the endoscope sees. By using the traditional endoscopy there is a huge risk of bleeding, infection, tearing of the gastrointestinal tract. In recent years there is a huge revolutions in the field of nanotechnology which has played a major role in overcoming these drawbacks [1]. Basically nanotechnology is the domain which is related with the application of sub micron technology. It is a part of science and technology which is related with the control of matter on the atomic and molecular scale i.e., things which are smaller about 100 nanometres. With the help of Nanotechnology, we can manufacture products such as Electronic devices, catalysts, sensors, etc with very minute dimensions. Nanotechnology has lead to the invention of various application based products at very low cost and great precision than ever before. One such application of nanotechnology is pill camera. The pill camera is a new diagnostic tool which permits a direct visual examination of the small intestine. It is that area of the body which was not been previously accessible using upper endoscopy or colonoscopy. The pill is known as M2A capsule endoscopy[1]. The microelectronic pill is a small electronic pill that can be completely swallowed by a normal patient.

Figure 1. Pill camera [1]

II. LITRETURE REVIEW

Researchers from the University of Glasgow, found a way of making swallowable cameras which are more effective to detect cancers of the throat and gut. In recent years, tiny sensing systems that are small enough for patients to swallow have proven to be a very valuable clinical alternative to more intrusive imaging methods such as endoscopes. Until now, the systems are often known as video-pill which have relied on illuminating patients' innards using a small light source, restricting clinicians to conclude based on what they can see in the spectrum of visible light. Dr. Richard Feynman first introduced the technology in order to take pictures of human intestine and transmits the same to the receiver of the Computer analysis of our digestive system [1]. Then it was observed that it is possible to manipulate single atoms. The diagnostic pill was invented in the early 1990s by Israeli inventor Gavriel Iddan [2].The year 1981 began with the development of the camera that would fit into the pill. In 2001 the FDA approved the given diagnostic imagining system first capsule which was named M2A Capsule for small intestine visualization which was a very huge revolution in the field of medicine.

Dr. Mohammed Al-Rawhani highlighted on how the traditional endoscopy methods could be harmful to the human body [3]. Since the methods leads to the image fluorescence 'phantoms'--mixtures of flavins and haemoglobins which closely shows how cancers is affected by the fluorescence in different parts of the body such as intestines, the bowel and the esophagus .The system can also be used to track antibodies creating a new way in detection of cancer.

III. BASIC CONCEPT

Evolution of wireless capsule endoscopy has lead to the new technology that has an effective use and application in the field of medical. So, the people with symptoms which indicate a possible problem in the gastrointestinal track can now swallow the tiny camera that takes snapshots inside the body for the physician to evaluate properly. The miniature camera along with light, transmitter and batteries which is completely known as a capsule cam, which is housed in the capsule and is in the size of a large vitamin pill. This is used for capsule endoscopy.

Once swallowed, the capsule moves through the small intestine and acquires the images to transmit it digitally at the rate of two per second to the sensor array attached to the patient abdomen, to a recording device worn on a belt which stores the images that needs to be examined. So, the people with symptoms which indicate a possible problem in gastrointestinal track can now swallow a tiny camera which takes the snapshots inside the body for the physician to evaluate properly. The most common reason for which capsule endoscopy is preferred is to search for the cause of bleeding in the small intestine. It may also be useful for detecting inflammatory diseases, ulcer and tumors of small intestine [1]. This is the painless way of looking inside the esophagus and small intestine.

The latest pill camera is sized at 26*11mm and is capable of transmitting 50,000 colour images during its travel through the digestive system. The capsule is in the form of a large vitamin pill and it can be easily swallowed. Once you swallow the pill, the person cannot feel the movement of the pill through the digestive track. The pill has a very clear view of the digestive track as it travels down. After the completion of the test it can be safely flushed down the toilet.

3.1 Components inside the pill camera

Figure 2. Architecture of caosule endoscopy[4]

3.1.1 Optical dome
It is the front part of the capsule and is in bullet shape. Optical dome is the light receiving window of the capsule. It prevents the digestive fluids inside the capsule from filtration.

3.1.2 Lens holder
It accommodates the lens properly which avoids the dislocation of lens.

3.1.3 Lens
It is the main integral part of the pill camera. It is placed exactly behind the optical dome so that the light through the window falls perfectly on the lens.

3.1.4 Illuminating LED's
Illuminating LED's are primarily used to illuminate an object. To prevent the reflection non reflection coating is placed on the light receiving window. lens and CMOS image sensor are surrounded by four LED's.

3.1.5 CMOS image sensor
It detect objects as small as 0.1mm as it have dual camera of 140 degree view each and a very high precision. It's a highly sensitive and produces the best quality images.

3.1.6 Battery
Two bullet shaped silver oxide primary batteries are used. These are made up of disposable and harmless material. Both the batteries are arranged together behind the CMOS image sensor.

3.1.7 ASIC transmitter
The application specific integrated circuit is arranged exactly behind the batteries. Two transmitting electrodes which are electrically isolated are connected to this transmitter.

3.1.8 Antenna
The other end of the capsule is arranged with antenna which enclosed in the dome shaped chamber.

The Antenna is arranged at the end of the capsule and is enclosed in the dome shaped chamber. Once swallowed, the pill travels through the small intestine propelled by the contractions of the gastrointestinal tract [4]. Along the way it takes digital images and transmit them to the receiver worn by the patient. The recorder can also track the capsule's location inside the body. The capsule is larger than an aspirin, which is about 11 mm x 26 mm in size and about 4 grams in weight. The capsule is known as M2A and is not a medicine, whereas it is a single-use video colour-imaging capsule. Besides the miniature colour video camera, the capsule contains many other components such as a light source, batteries, transmitter and an antenna. Once swallowed this capsule/camera travels very easily through the digestive tract and after some time it is naturally excreted. It can be never absorbed by the body. The patient wears the wireless Data Recorder on a belt around his or her stomach.

3.2 Components outside the pill camera

3.2.1 Sensor belt

Through sensor belt several wires are attached to the abdomen like ECG leads to obtain the images which are captured by radio frequency. These wires are directly connected to the light weight data recorder worn on the belt. Sensor array is used to calculate and indicate the position of the capsule inside the body.

3.2.2 Data recorder

Data recorder is the small portable recording device placed in the recording pouch which is attached to the sensor belt. Data recorder receives and records all the signals transmitted by the camera to the array of sensors which are placed on the patient's body.

3.2.3 Real time viewer

This is a handheld device and it enables real time viewing. It consists of rapid reader software and a colour LCD monitor. It tests the proper functioning before the procedure and hence confirms the location of capsule.

3.2.4 Work station and rapid software

Rapid workstation performs all the function such as reporting and processing of images and data which are obtained. All the image data from the data recorder is downloaded to the computer equipped with software called as rapid application software. It helps to convert all the images as a movie and allows the doctor to view the colour 3D images for proper analysis.

3.3 lets discuss how to overcome the disadvantages of pill camera

3.3.1 What if the pill get struck if there is a partial obstraction in the small intestine?

The devise outside the human body which is observing the path of the capsule by recording the images as a video.
hence, if the images received are same for a certain period of time, then the doctor suggest them to have a glass of water, slowly so that the capsule moment again starts.

3.3.2 It is impossible to control camera's behaviour, so how it work?

Yes, it is impossible to control camera's behaviour. but as such there is no need to control the behaviour of the camera as it moves through the gastrointestinal track slowly and provides enough information to the doctor.

3.3.3 Some part/angle is not covered, how it works?

When the capsule endoscopy was introduced the camera which was used had 270 degree angle of view, because of which some part was not covered by the camera and because of which if there was some problem behind the camera then doctor's were not able to detect the problem.but now as the

technology is incresing day by day, the capsule either has two camera's so that no part is left uncovered or one camera which has a 360 degree angle view is used.
hence the problem is sloved and doctor's are able to detect the problem easily.

3.3.4 Costly as compared to normal endoscopy, then why is it used over endoscopy?

Yes, it is definitely costing a lot more than the normal endoscopy, but by using the normal endoscopy we cannot reach the small intestine and detect the bleeding in small intestine.
Hence, using capsule endoscopy we can easily reach to small intestine and find the cause of internal bleeding

IV. CONCLUSION

Though nanotechnology have not evolved to its full capacity yet the wide range of products have already made a great impact in the market. In the future most of the conventional manufacturing processes will be replaced with the cost effective and better manufacturing process known as "nanotechnology". The proposed technique in the process of endoscopy using the pill camera will be highly beneficial in the domain of biomedical and hence it will help the doctors to diagnose complicated intestinal bowel in an effective and an easy way. Moreover this technique will reduce the unwanted death rate over the decades.

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