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 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. 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 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 by 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.

CONTENTS:

INTRODUCTION:

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

HISTORICAL OVERVIEW:

Manipulation of atoms is first talked about by noble laureate Dr.Richard Feyngman long ago in 1959 at the annual meeting of theAmerican Physical Society at the California institute of technology -
Caltech. and at that time it was laughed about. Nothing was pursued init till 80's. The concept of nanotechnology is introduced by Drexler 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 nickelcrystal, using an atomic force microscopy instrument. These positioned atoms spelled out the letters"IBM".

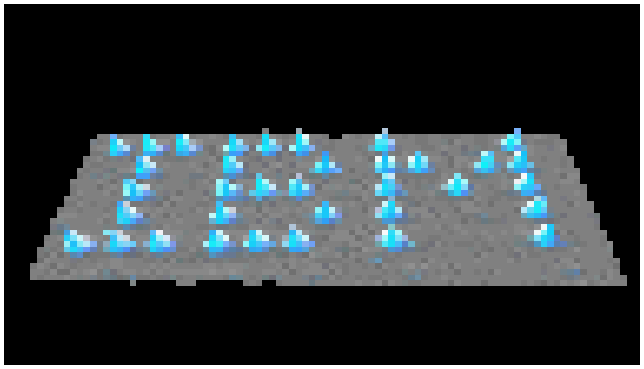


Image of the IBM spelled with 35 xenon atoms

MANUFACTURING PRODUCTS USING NANOTECHNOLOGY:

There are three 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. 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 be programmed 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

• 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.

• 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 be finite , then when desired number of nanorobots has been constructed , there should be no unused quantities of any ingredient remaining.

• 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.

POTENTIAL EFFECTS OF NANOTECHNOLOGY:

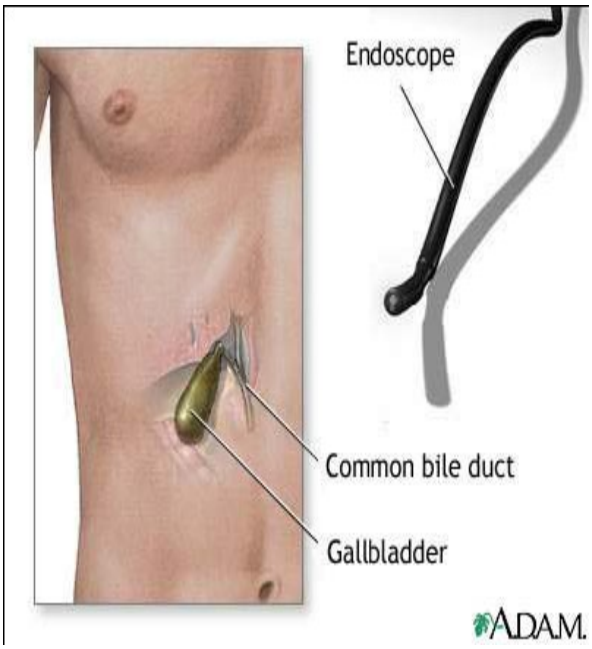
As televisions, airplanes ,computers revolutionized the world in the last century, scientists claim that nanotechnology will have an even more profound effect on the next century. Nanotechnology is likely to change the way almost everything, including medicine, computers and cars, are designed and constructed.

One of the fascinating application of nanotechnology in the field of medicine is in the form of Pill camera. Pill camera has shown to world what wonders miniaturization can workout.

PILL CAMERA

Introduction:
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.

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 candiagnoses be made for certain conditions routinely missed by other tests, but disorders can be detected at an earlier stage, enabling treatment before complications develop

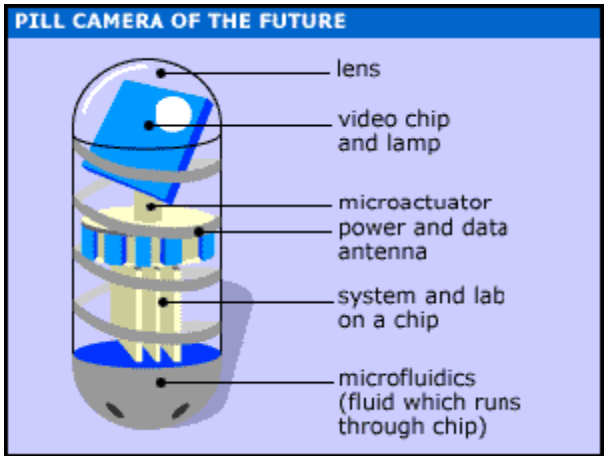


DESCRIPTION:

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 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. This is achieved with the help of Soc.

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.



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 the stomach, into the 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 day as usual. The physician then transfers the stored data to a computer for processing and analysis. The complete traversal takes around eight hours 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.

DRAWBACKS:

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

1)"Unfortunately, patients with gastrointestinal structures or narrowing's 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 overcome by using another product manufactured with the help of nanotechnology which is the rice- grain sized motor. This miniature motor, when attached to the pill camera gives it a propelling action inside the body, which makes it easy for the pill to find its way through the digestive system. Also the grain-sized motor has an application of its own too. It can be employed to rupture and break painful kidney stones inside the body. The other two drawbacks can be overcome using a bidirectional wireless

telemetry camera. 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 images.

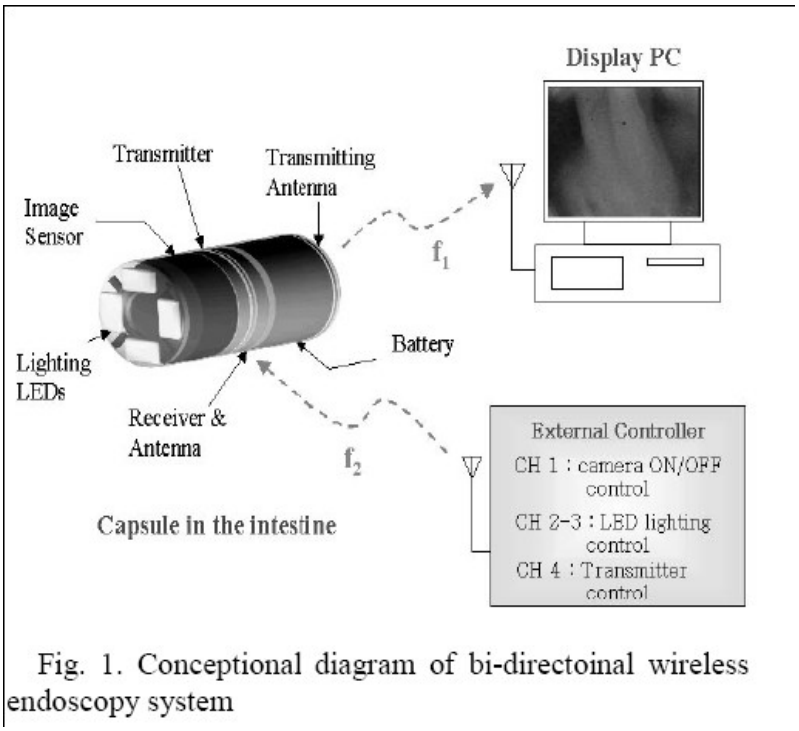


Fig. 1. Conceptional diagram of bi-directoinal wireless endoscopy system

The CMOS image sensor is a single chip 1/3 inch format video camera, OV7910, which 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.

Circuit Block diagram of Transmitter and Receiver

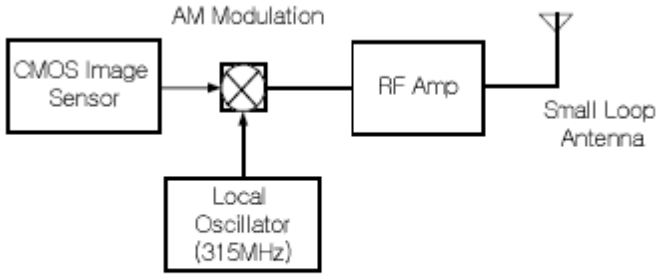


Fig. 2. The video signal transmitter of capsule inside.

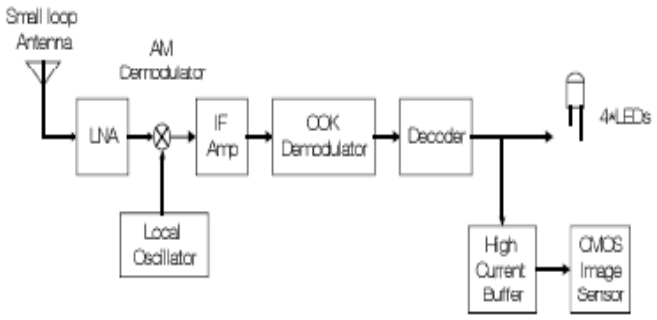


Fig. 3. Receiver circuit inside capsule.

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

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.

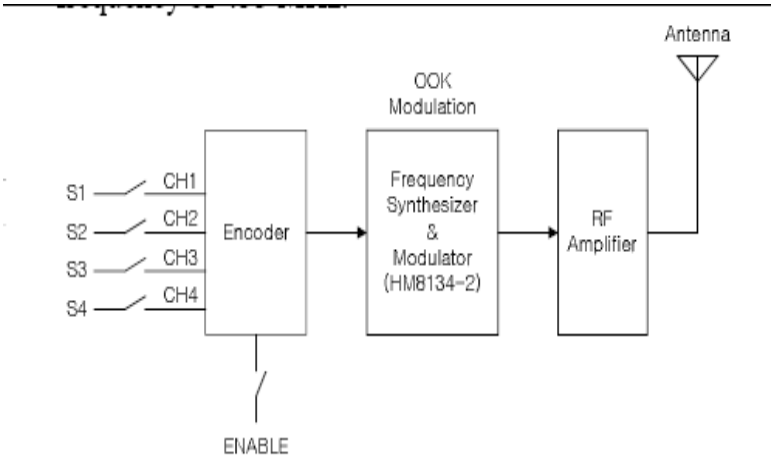


Fig. 4. External control circuit

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 16 different 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 on a computer.

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 in many

APPLICATIONS OF NANOTECHNOLOGY IN OTHER FIELDS:

• Nanotechnology may have its biggest impact on the medical industry. Patients will drink fluids containing nanorobots programmed to attack and reconstruct the molecular structure of cancer cells and viruses to make them harmless.
• Nanorobots could also be programmed to perform delicate surgeries --such nanosurgeons could work at a level a thousand times more precise than the sharpest scalpel. By working on such a small scale, a nanorobot could operate without leaving scars that conventional surgery does.
• 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.

Conclusion:

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 ‘nanotechnology’. 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.
Nanotechnology 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.

REFERENCES:

Electronics for you, journal
Web Sites:
www.sciencedaily.com
www.zyvex.com.
www.nanotech.gov