

DIAGNOSTIC TECHNIQUES & BIOTELEMETRY

Bio-Telemetry is used for measuring the Bio-potentials of different physiological events at some distance. The

Applications are 1. monitoring of Astronauts.

2. monitoring of patients in Ambulance.

3. Medical Information can be transmitted to the home (or) office.

4. Research on wild Animals

5. Isolation of electrically susceptible

Physiological parameters which are adaptable to Bio-Telemetry:-

~~which are~~
Different parameters are adaptable.

→ ECG By using Surface Electrodes

→ Measurement of Blood pressure using the micro phone and cuff.

→ The other parameters can be measured are

EMG, EEG, ECG & blood flow along with temperature

* Two methods are used for measuring the Bio-potentials

i. Direct method for obtaining Electrical sig directly.

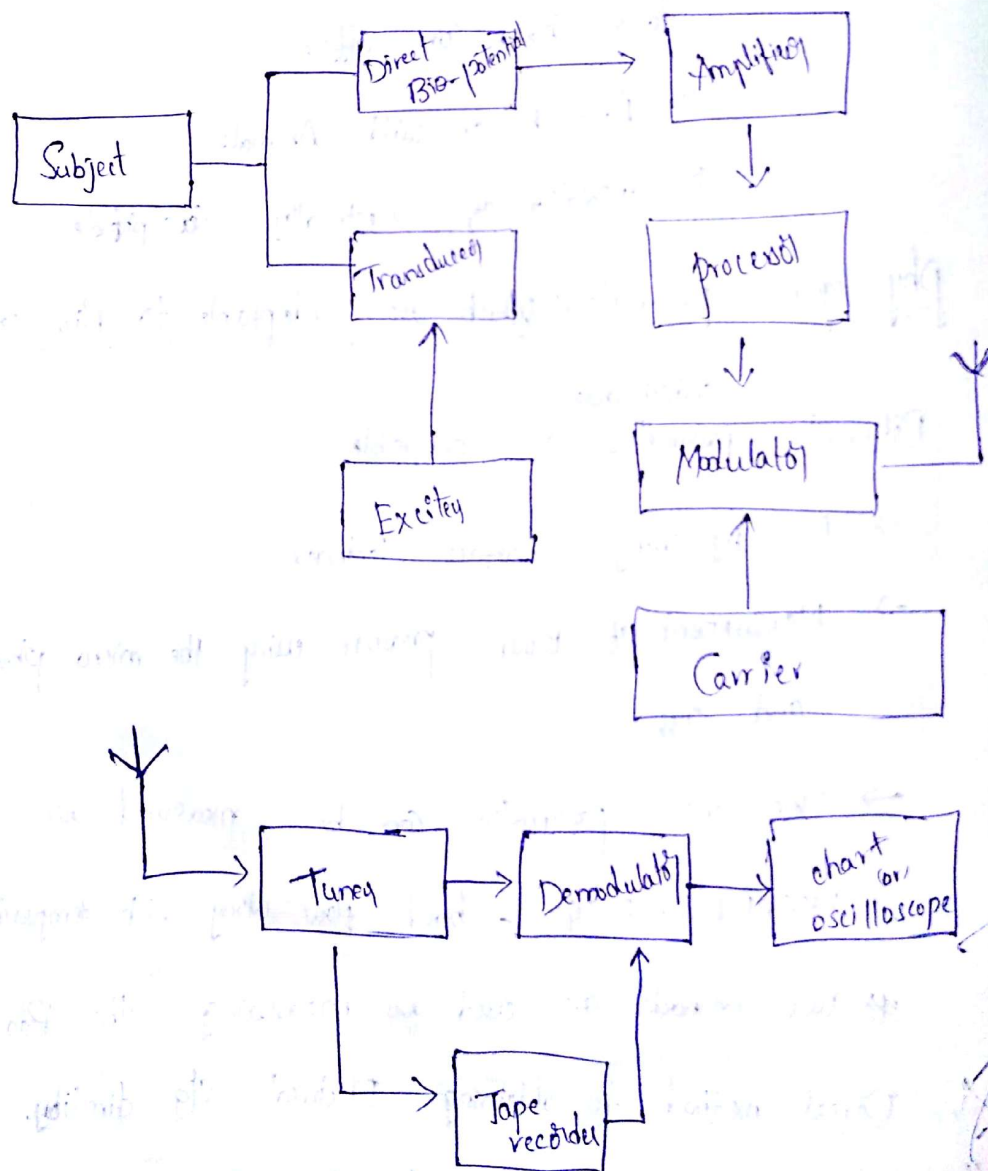
ii. Indirect method used for converting the available parameters into Electrical parameters.

Components of Bio-Telemetry :-

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The Components used in Bio-Telemetry System are transmitter (Tx) & Receiver (Rx) which are capable of transmitting & Receiving bio-potentials.

The Representation of These Components can be shown as



Important Terms & Their definitions :-

i) Range :- The distance that can be Transmitted by a Transmitter.

ii) Modulation :- Impressing the Information upon the Carrier Signal.

iii) Demodulation :-

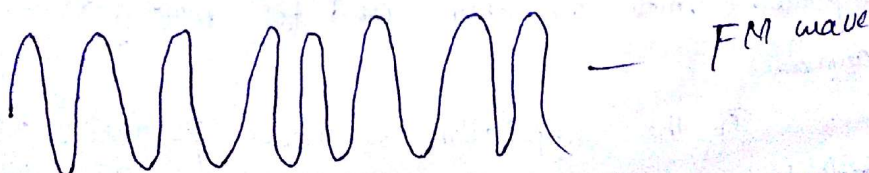
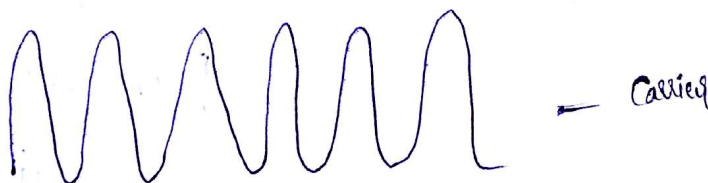
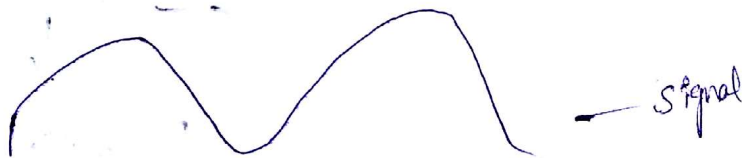
Recovering of original signal from Rf Carrier wave

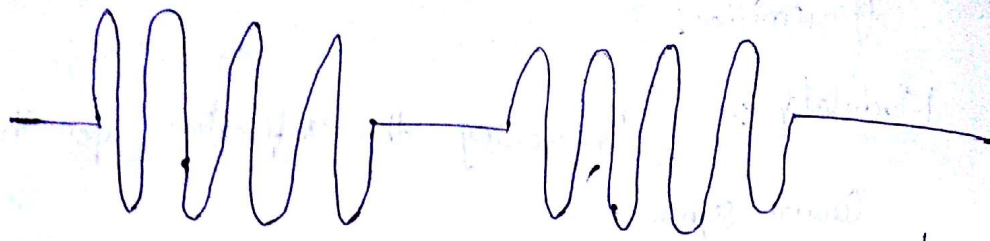
iv) Amplitude Modulation :-

The Amplitude of the Carrier is made to Vary ^{Amplitude} information signal.

v) Frequency Modulation :-

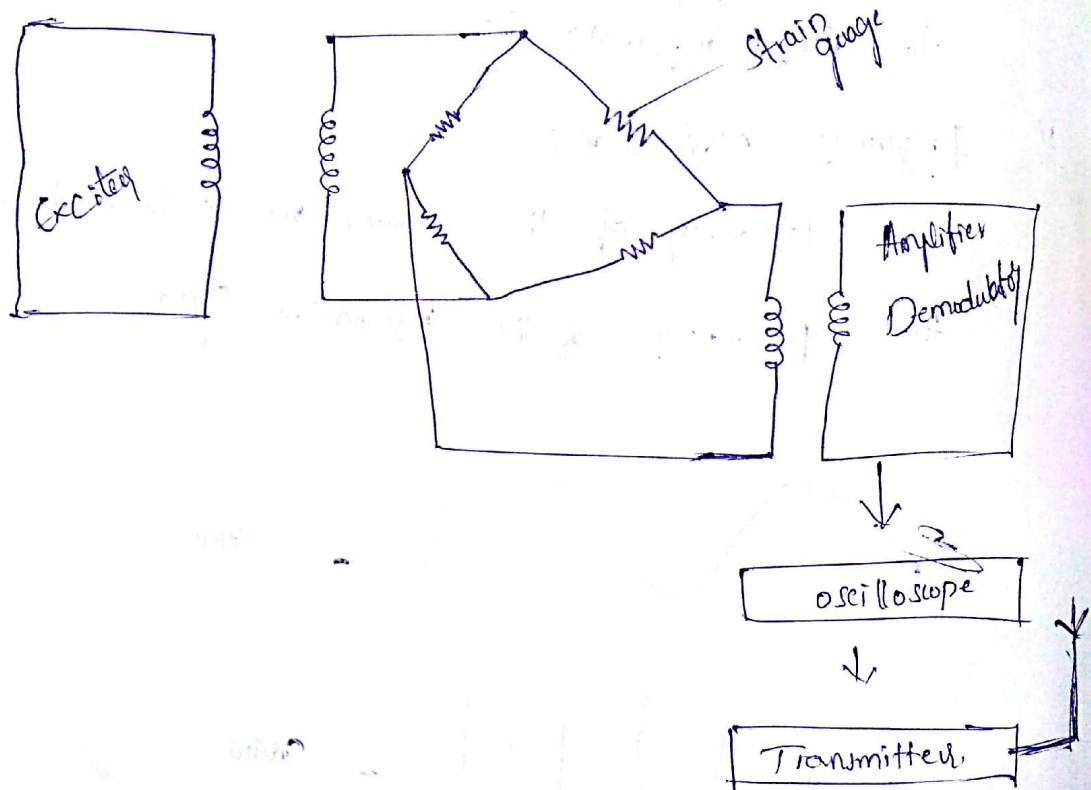
Frequency of the Carrier wave is made Vary the frequency of the information signal





pulse
modulated
wave

The Real time Example for this is Blood pressure Measurement ckt using Strain gauge ckt.



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Sometimes, it is necessary to place the components inside the Human body. while performing the surgeries these Implantable units are also used for making research on animals.

In the application of nerve potentials we use Implantable receiver for obtaining the potential of

Neuve. These Implantation must be done without taking any Risk for the patient. we had to follow certain (91)

Basic rules for Implanting these units

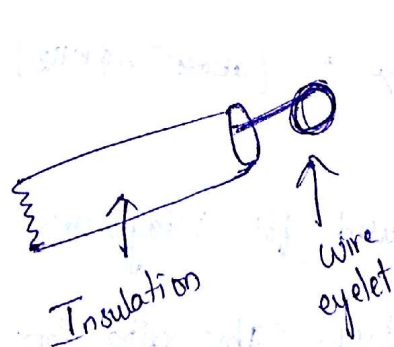
i. The unit must be small and signals received must be small

ii. The outer case of the unit and the wires must not interact with the body fluids and moisture.

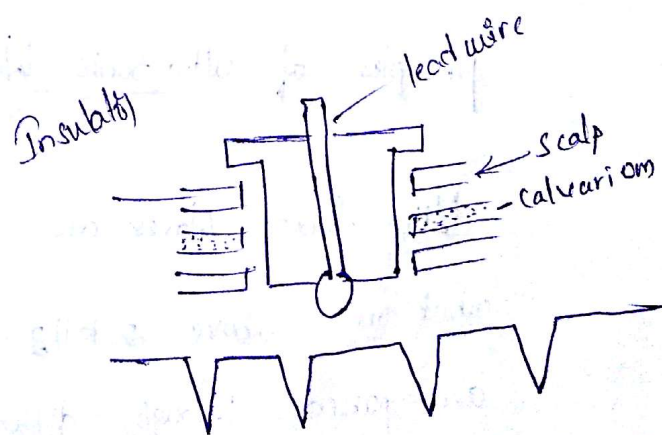
iii. Lithium Batteries are preferred as they have long life with small size. The weight of the batteries ranges from 0.3 grms with capacity of 20 mA per hour. to 12 gr with capacity of 1000 mA / hr. This Implantable set consist of Transducer, Transmitter & a power Source.

Generally for ECG The Transmitter is placed on a belt which is tied around the ~~waste~~ waist of the human body.

The eg units can be shown as



Wireloop electrode



Silver-Sphere Electrode.

Telemetry for ECG measurement during Exercise

I Schematic Coronary Artery - disease ⁽⁷²⁾ is generally occurred in the heart. for measuring the Bio-potentials for the patient we place a transmitter on the Belt of the patient using electrodes while exercising on the treadmill

Telemetry for emergency patient monitoring

Ambulances must be provided with the necessary Equipment for sending the ECG & other physiological parameters Information to the hospital.

So, that the patient can be monitored by the hospital doctors.

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Diagnostic technique of human body :-

Principles of ultra Sonic Waves :- [above 20 kHz]

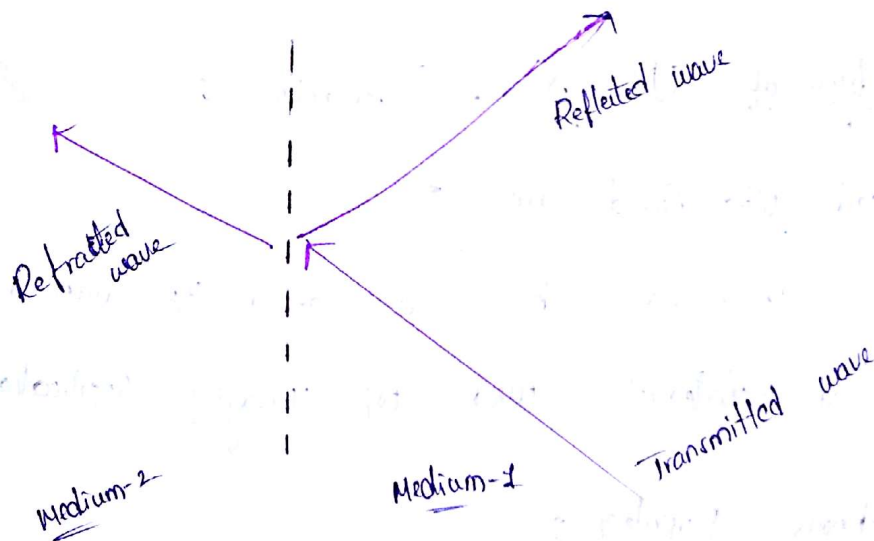
Ultra Sonic Waves are used for Diagnostic purposes which are above 20 kHz freq. This ultra Sonic waves are passed through different mediums and the principle depends on The reflection and refraction of the waves.

The Reflection and refraction laws of so. are obeyed

This reflection depends on the density of mediums. and the angle of Transmission. Bones, Gas, air, have high densities

The different types of Materials having diff properties.

<u>Material</u>	<u>Temp (°C)</u>	<u>Density (g/cm³)</u>	<u>Velocity (m/sec)</u>
Water	40	0.992	1529
Brain	37	1.030	1510
Muscle	37	1.070	1570
fat	37	0.97	1440
Bone	37	1.77	3360



* Similarly the propagation velocity of Sound waves can be listed as below 1550 m/sec in body fluids, 3360 m/sec in Bones & 1440 m/s through fat.

* The depth of penetration at which the ultra sound wave is attenuated to half the amount applied is known as "half layer of the material."

For Eg:-

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<u>Material</u>	<u>frequency (kHz)</u>	<u>Half cycle distance (cm)</u>
Blood	100	35
Muscle	80	2.1
fat	80	3.3
Bone	80	0.23

For moving objects we had to calculate the Doppler shift.

$$\Delta F = \frac{2V}{\lambda}$$

where V is the velocity

λ is the wavelength

Different types of Ultra Sound Transmission :-

i, pulsed ultra sound waves :-

These waves have a freq of 10 kHz with 1 μ sec

Time period intervals used for Imaging Applications.

ii, Continuous Doppler :-

The wave is Transmitted continuously but the Reflections are taken Separately. ^{used} $\uparrow$ Blood flow measurement

iii, pulsed Doppler :-

Short pulses are sent for Transmission and the echoes are received for the Velocity and distance Measurement.

iv Range-gated pulse Doppler:-

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Separate gate ckt is used for measurement of the distance and velocity of a target which is at a distance. Application is

used for Blood velocity measurement.

Ultra Sonic Imaging:-

The internal organs of the human body are taken as Images by using the ultra sound principles. The information gives size, velocity and the location of organs without using surgery.

This Imaging can be done using 3 types of Displays → A Scope Display :-

A wave form is transmitted and the reflected waves are also displayed.

→ M Scope Display :-

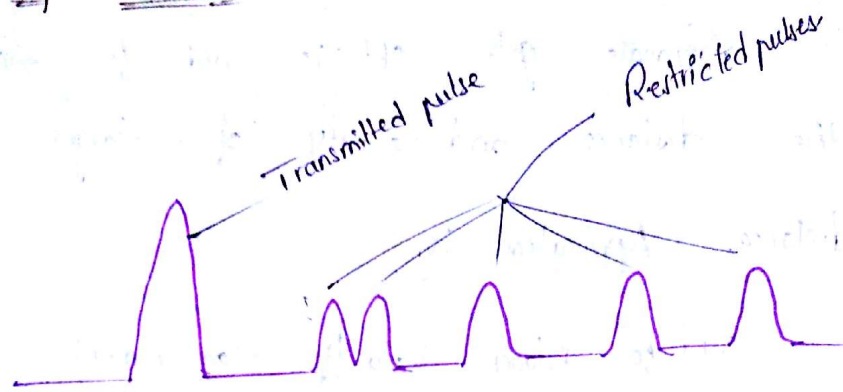
This M Scope display also gives the information about transmission & reflected pulses by showing the variation in brightness.

→ B Scope Display :-

This also displays the information of the transmission and reflected pulses for a stationary body.

A Scope Measurement Wave form :-

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A-Scope

M-Scope Measurement Wave form :-

(Brightness more) →



M-Scope

Ultra Sonic DIAGNOSIS :-

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Ultra Sonic diagnosis are used for diff medical applications like Cardiology, Brain Studies and the analysis of Eyes.

Each organ has diff method of analysis. For heart

ECG is used and for Brain EEG & for Eyes Ultra Sono-

gram. For Studying about diff chambers of the heart, Veins we use ultra Sono graph.

Transducer is the main part used for converting one form energy into another form. ECG is generally used for detecting the body fluids by ultra Sonic wave. EEG used for making the analysis of Brain by placing a Transmitter near the Brain and it sends two types of deflections making the mid

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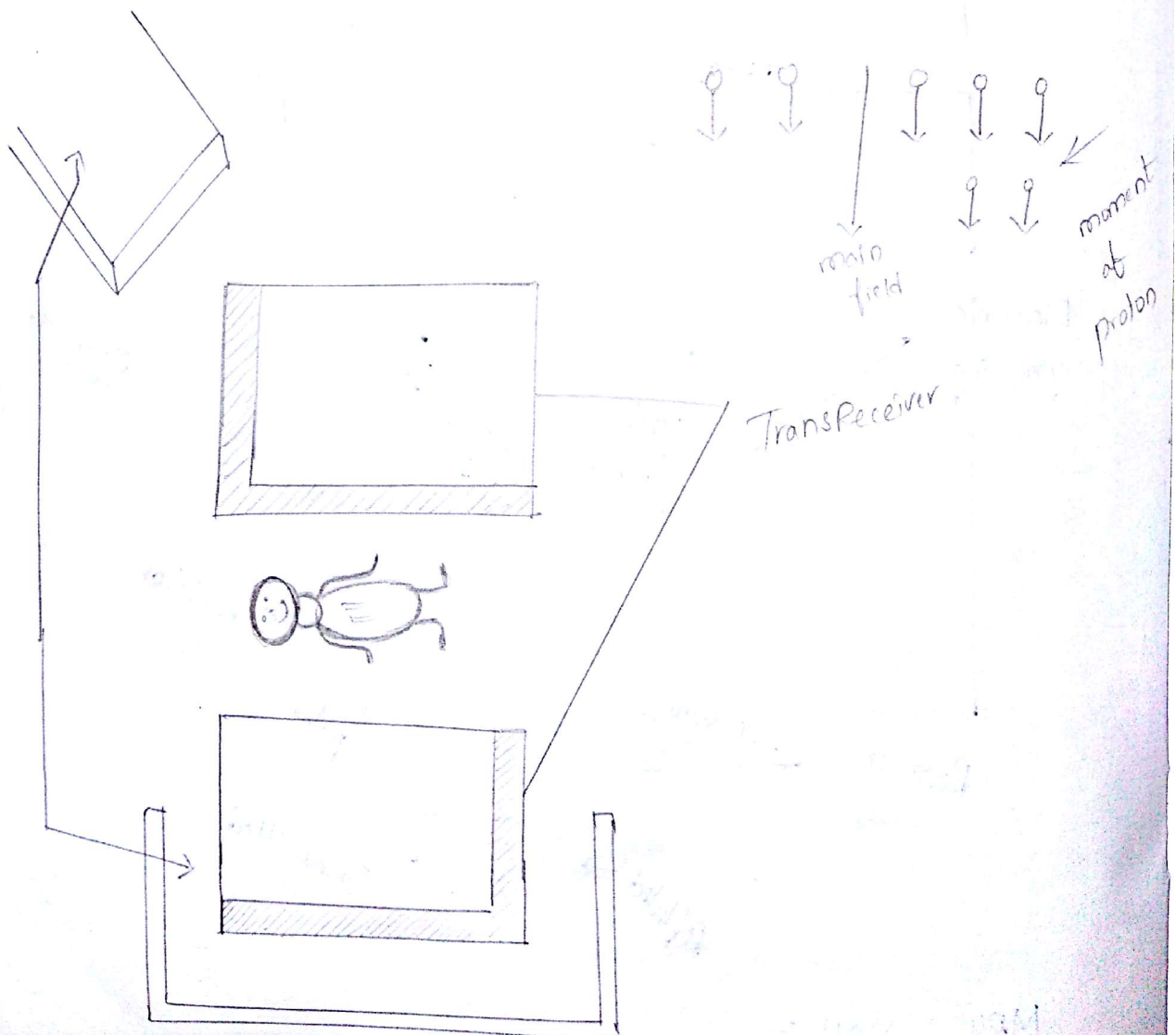


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With each other the remaining single proton will be (98)
ideal when some amount of 'Rf' energy is applied to
this kind of protons. Then the protons will jump into
the higher state and after reaching the higher state
the energy will be removed so that the protons
release the energy which is detected by the detectors
and then encoded with amplification. The 'Rf' energy
applied is done by using magnetic field.



Types of MRI's

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1. ECG gated Spin Echo MRI :- This is used for scanning the static images.
2. ECG referenced gradient Echo MRI :-
This is used for heart problems.
3. Cine gradient Echo MRI :-
Is also used for heart problems.
4. Cine MRI :- used for analysis of heart beat.

Disadvantages of MRI :-

- It cannot be used for scanning the images of bones, Blood vessels of Brain, heart, Eyes, Kidneys.
- It is expensive. Technique

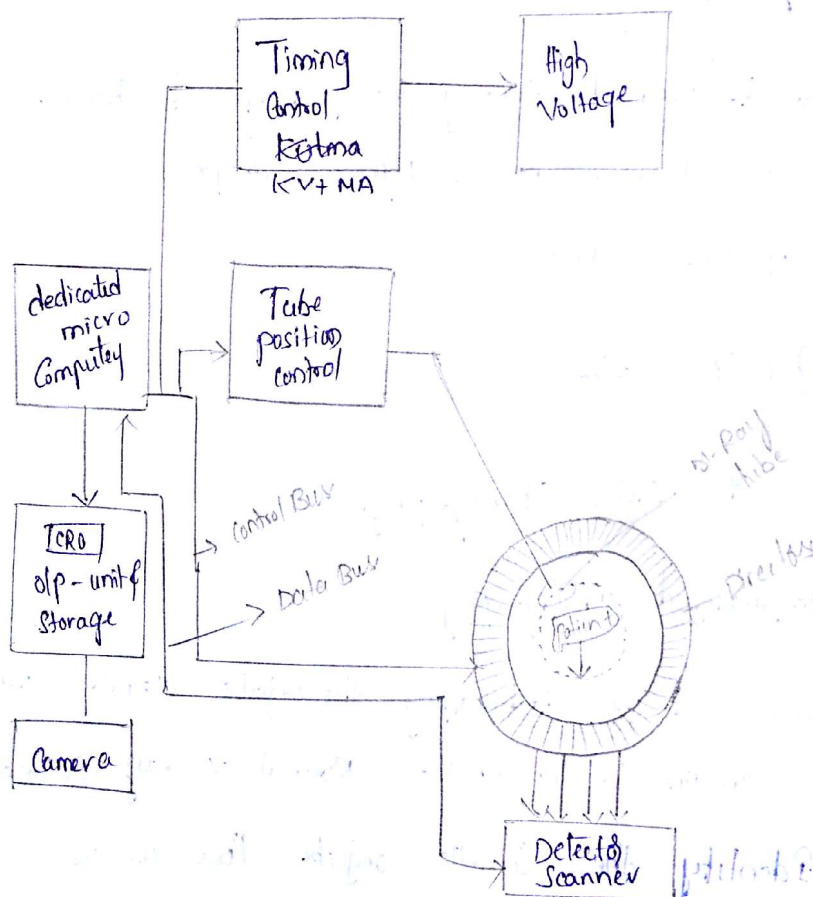
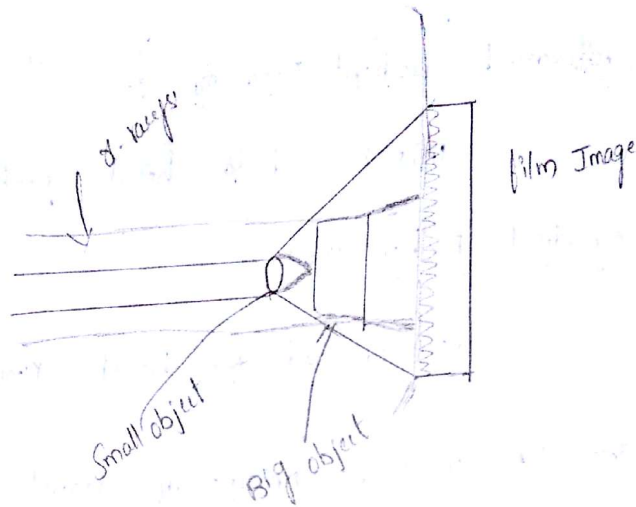
CAT (or) CT Scan :-

CAT - Computerized Axial Tomography.

CT - Computerized Tomography.

CT Scan is used for identifying the objects clearly when two objects are in line to each other. Normal X-ray Scanners will not identify the small objects. Hence we use X-rays along with Computer Technology which is known as CT Scan. The principle used here is the reflections of the smaller object is taken along with the bigger object.

In the modern days fan beams are used for Scanning (100) and it will take $2\frac{1}{2}$ sec. for Scanning the given objects. Discrete Images also can be reconstructed



X-ray & Radio Isotope Instrumentation

Definitions - X-rays are electro magnetic waves with a wave length of 10^{-6} to 10^{-10} cm. In terms of frequency

The Range will be 10^{10} mHz to 10^{14} mHz.

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Generation of Ionizing Radiation:-

When fast moving electrons are decelerated suddenly the x-rays will be formed. The same principle is used by taking a heated Cathode which is connected to the Vacuum diode. So that the electrons are accelerated and travel towards the anode. When these electrons hit the anode the x-rays are generated. For heating the cathode we use 30 kv voltage with few milliamp current.

