Digital Radiography

In Dentistry

Dr. Sana'a Al-Qasab

Digital radiography in dentistry

General idea: digital radiography (D.R) is unlike conventional dental radiography, in D.R. no films or processing chemicals is used, instead D.R. uses an electronic sensor and computerized imaging system.

Definitions

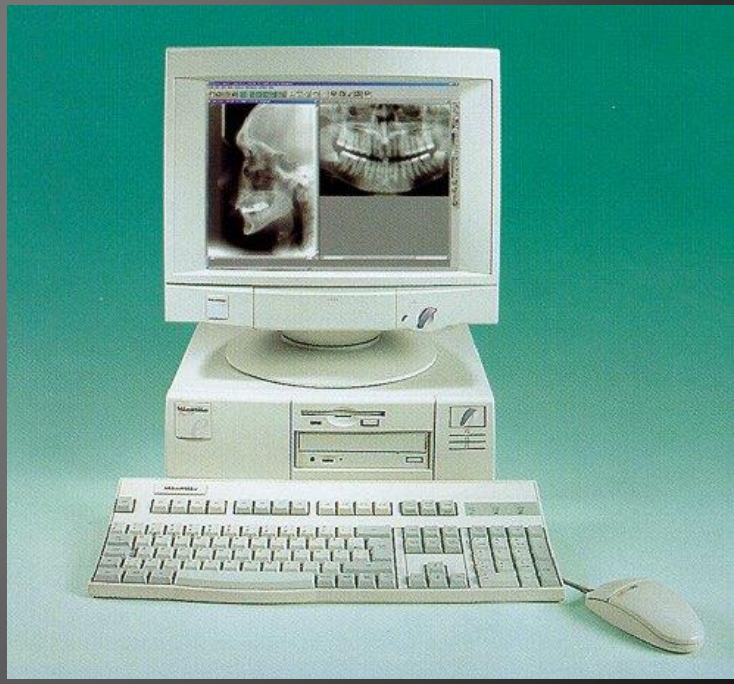
Charge coupled device (CCD)

D.R.

Digital substraction

Pixel

Sensor



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Purpose & Use

1. To detect lesions, disease, and condition of teeth and surrounding structures.
2. To confirm or classify suspected disease.
3. To provide information during dental procedures (e.g. root canal therapy and surgical placement of implants).
4. To evaluate growth and development.

Fundamentals

1. D.R. refers to a method of capturing a radiographic image using a sensor, breaking it into electronic pieces and presenting and storing the image using a computer.
2. In D.R. the patient is exposed to x – radiation similar to that used in conventional radiography.
3. The resulting image is displayed an a computer screen rather than a film that must be processed in a darkroom.

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Types of digital imaging

1. Direct digital imaging

2. Indirect digital imaging

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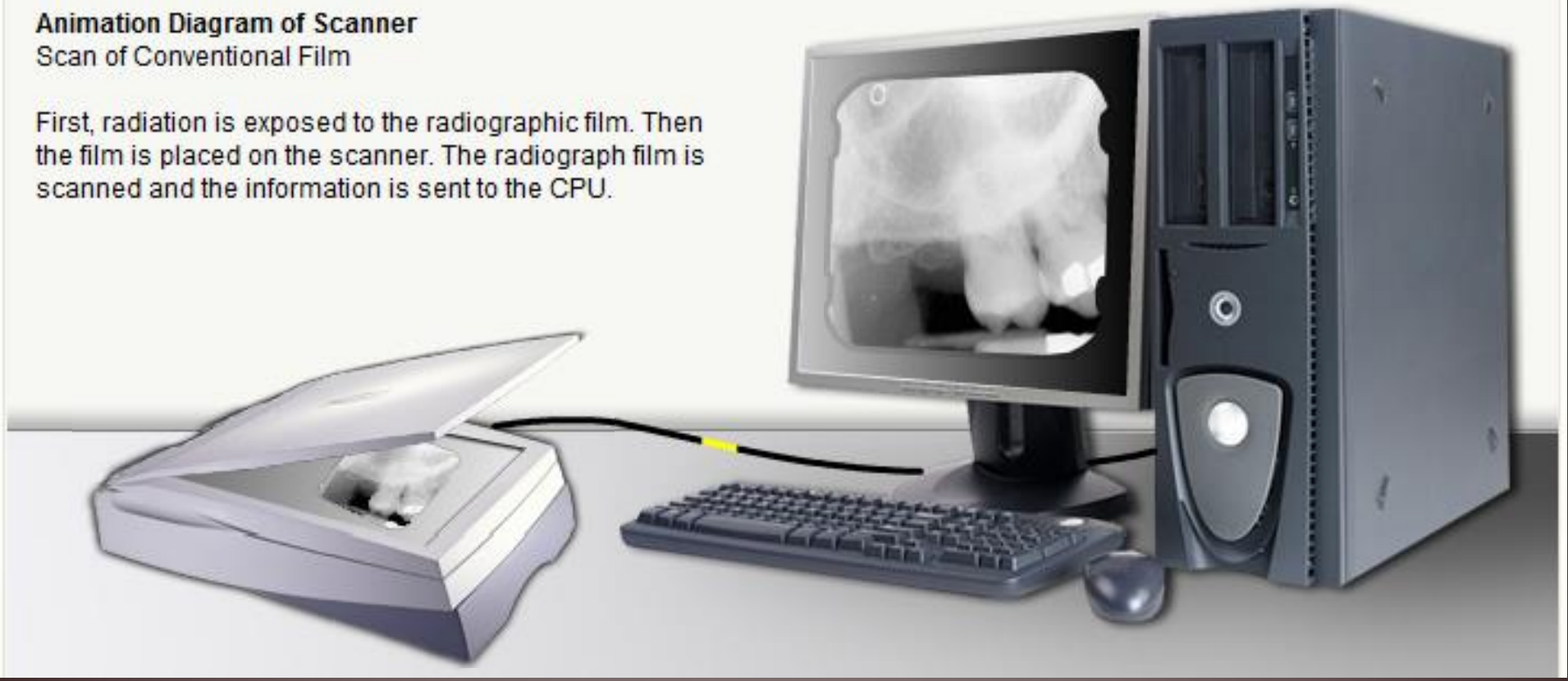
Animation Diagram of Scanner
Scan of Conventional Film

First, radiation is exposed to the radiographic film. Then the film is placed on the scanner. The radiograph film is scanned and the information is sent to the CPU.



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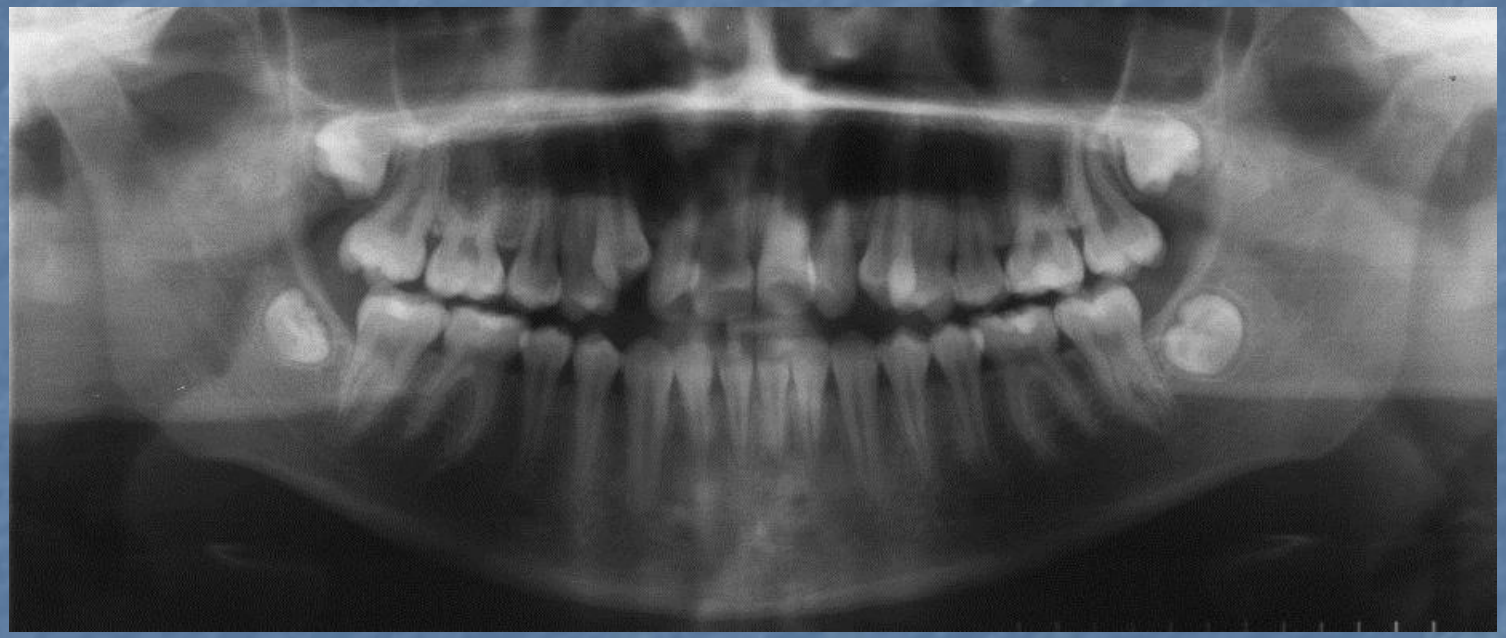
Panoramic radiography

ProMax

Dimax2

Panoramic Radiograph



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Cephalometry

ProMax

Dimax2

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Cephalometric Radiograph

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Equipments

1. X – radiation source

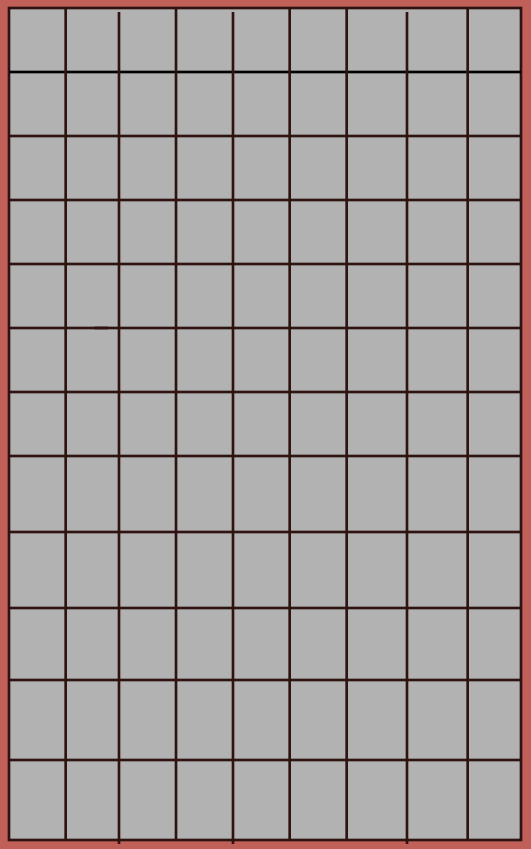
Always the conventional x – ray source can be used for digital imaging system however, the x –ray unit timer must be adapted to allow exposures in a time frame of 1/100 of a second. A standard x – ray unit that is adapted for digital radiographly can be functional for conventional radiography.

2. Intraoral sensor

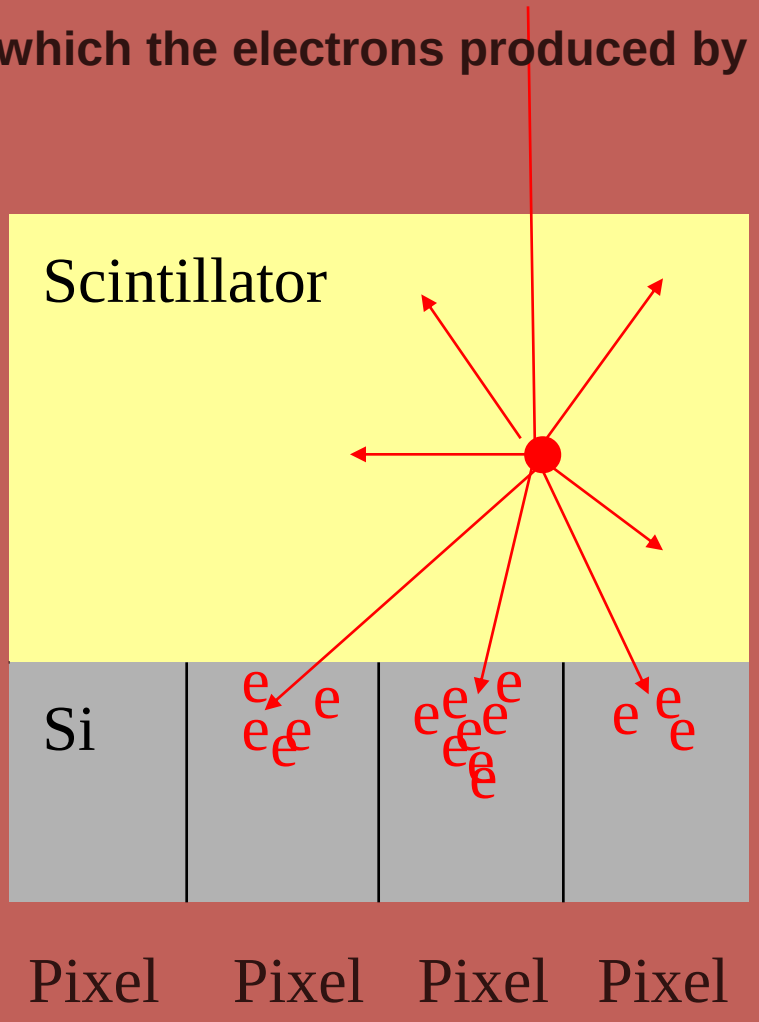
The sensor is a small detector, placed in the mouth of the patient and used to capture the radiographic image.

Intraoral sensors may be wired or wireless. Wired refers that the sensor is linked by a fiber optic cable to a computer that records the generated signal. Wireless refers to sensor that is phosphor coated, is not linked by a capable.

Charge – coupled device: it is the most common image receptor used in dental digital radiography. The CCD is a solid state detector that contains a silicon chip with an electronic circuit embedded in it. This silicon chip is sensitive to x –ray or light. A pixel is a small box into which the electrons produced by the x –ray exposure are deposited.



Pixels



PIXEL

The smallest resolvable rectangular area of an image, either on a screen or stored in memory. Each pixel in a monochrome image has its own brightness, from 0 for black to the maximum value (e.g. 255 for an eight-bit pixel) for white. In a color image, each pixel has its own brightness and color, usually represented as a triple of red, green and blue intensities

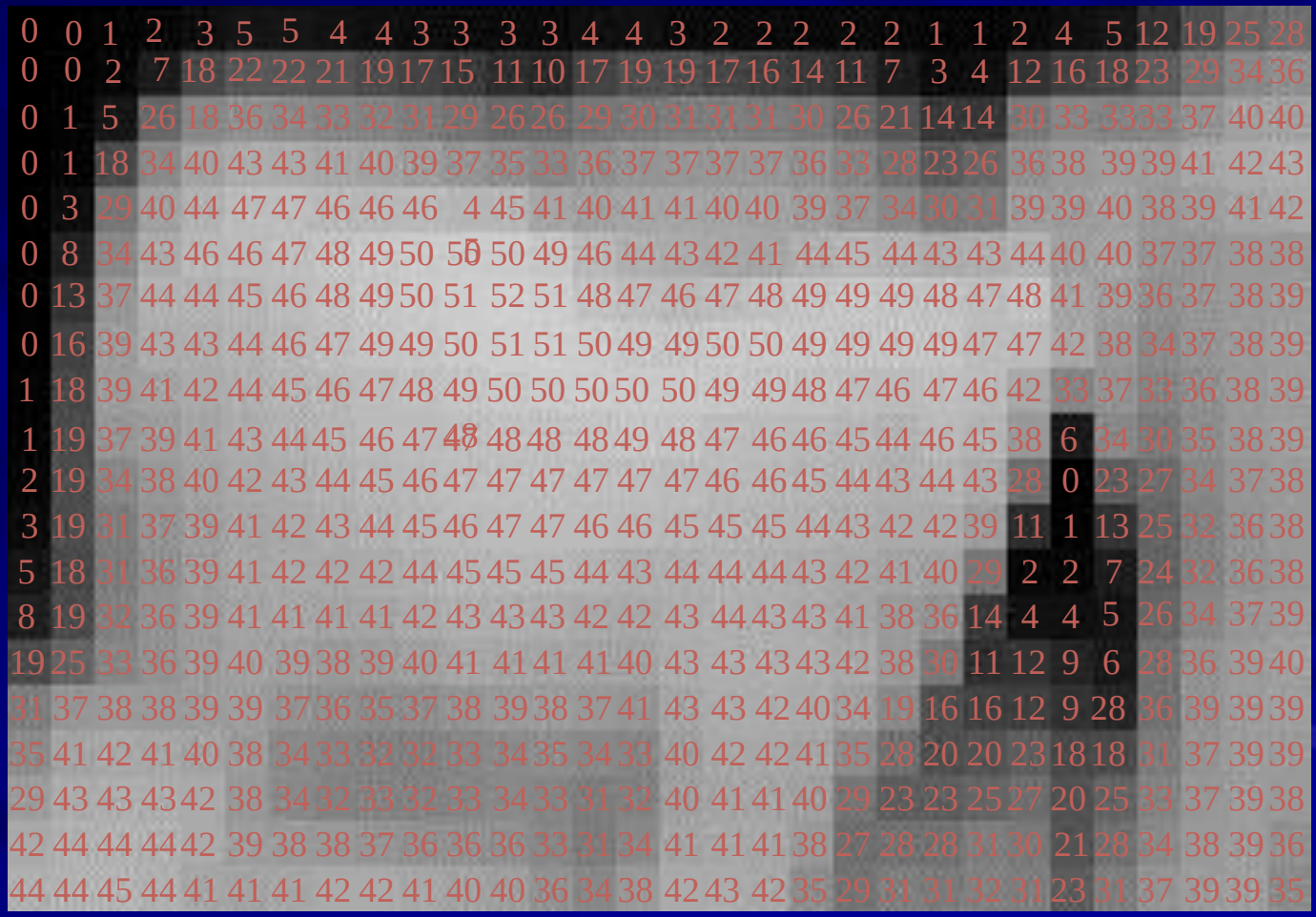
** Click and Drag Yellow Square

3. Computers

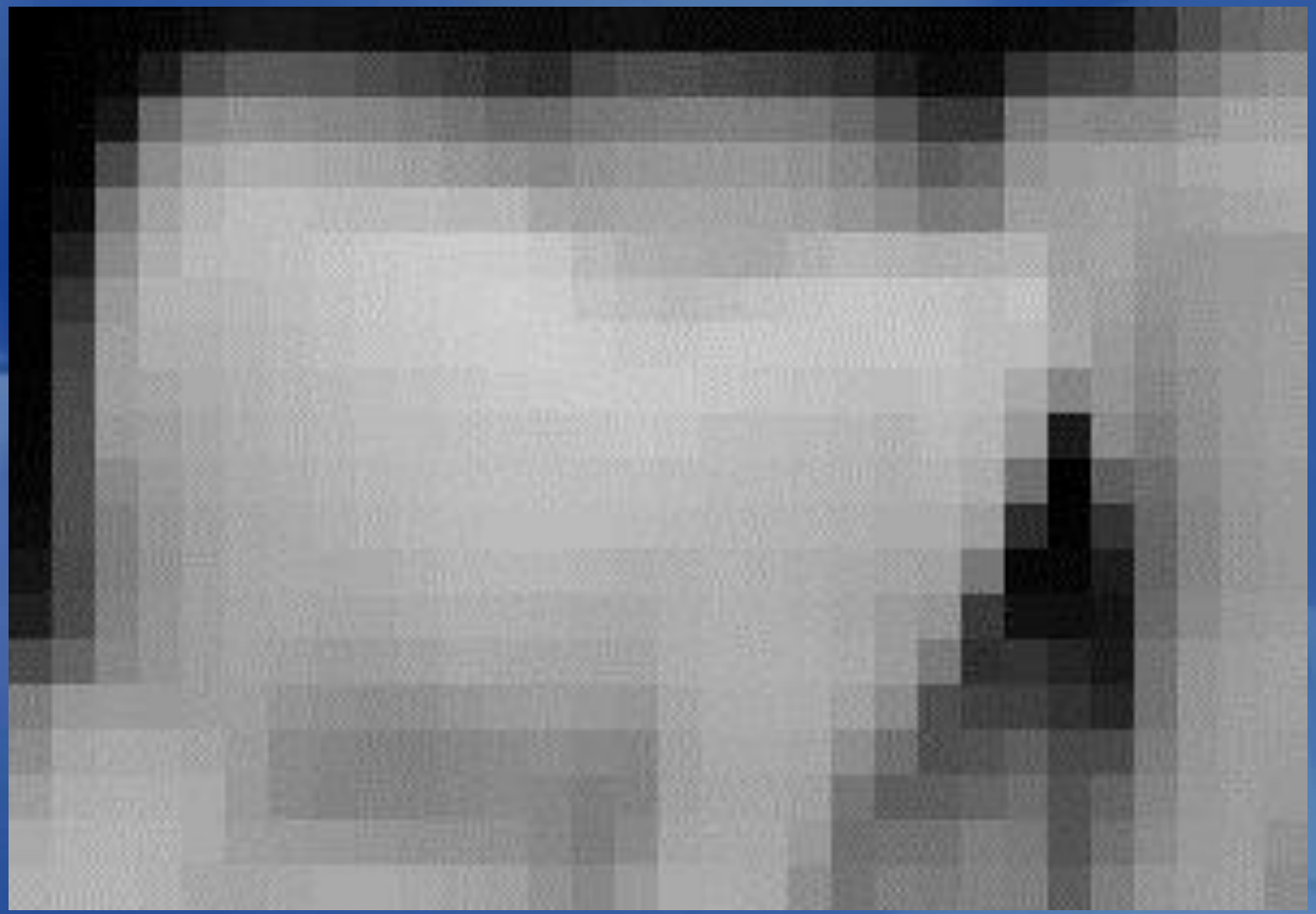
A computer is used to store the incoming electronic signal. The computer is responsible for converting the electronic signal from the sensor into a shade of gray that is viewed on the computer monitor.

There are many viewing features such as split screen technology that allows the operator to view and compare multiple image on the same screen for comparison and evaluation of disease progression. Another viewing feature allows specific images to magnified up to 4 times their original size for evaluation of apical area of a tooth. Linear and angular measurements can be also be obtained a features that is helpful in measuring the length of the root.

Digital values = gray levels



Gray levels



Step by Step Procedure

sensor preparation: The placement of the intraoral sensor in the mouth of patient is similar to the technique used in conventional film placement, but the number and size of the sensor vary with different manufactures, each sensor is sealed and water proofed and for infection control, the sensor must be covered with a disposable barrier because it cannot be sterilized.

Sensor placement: The sensor is held by bite block attachment or devices. The paralleling technique is the preferred exposure method because of dimensional accuracy of images and the ease of standardizing such images. Paralleling technique film holders must be used to stabilize to sensor in the mouth. As with conventional intraoral film, the sensor is centered over the area of interest. As in conventional radiography, the x –ray is aimed to strike the sensor. An electronic charge is produced on the surface of the sensor, this electronic signal is converted into digital form. The digital sensor in turn transmits this information to a computer then the image is processed by a computer and stored by the software.

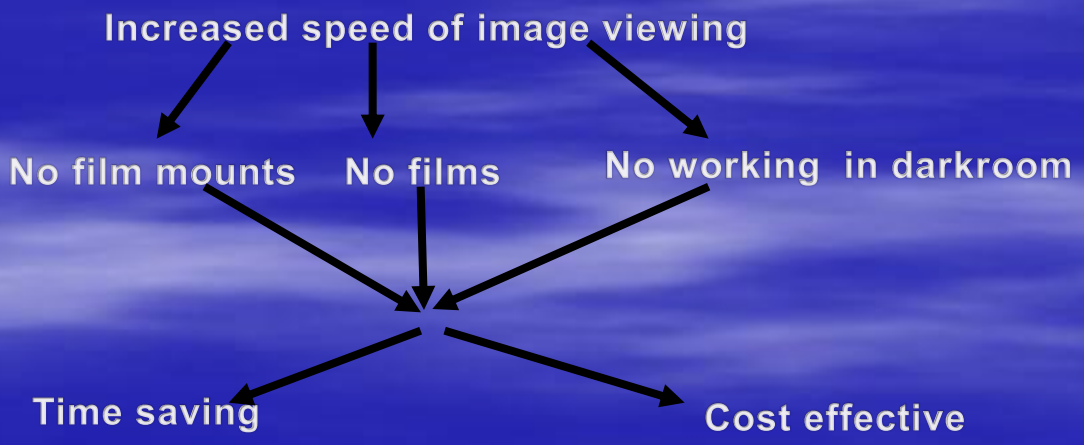
Analogue image

The complete image

Advantages

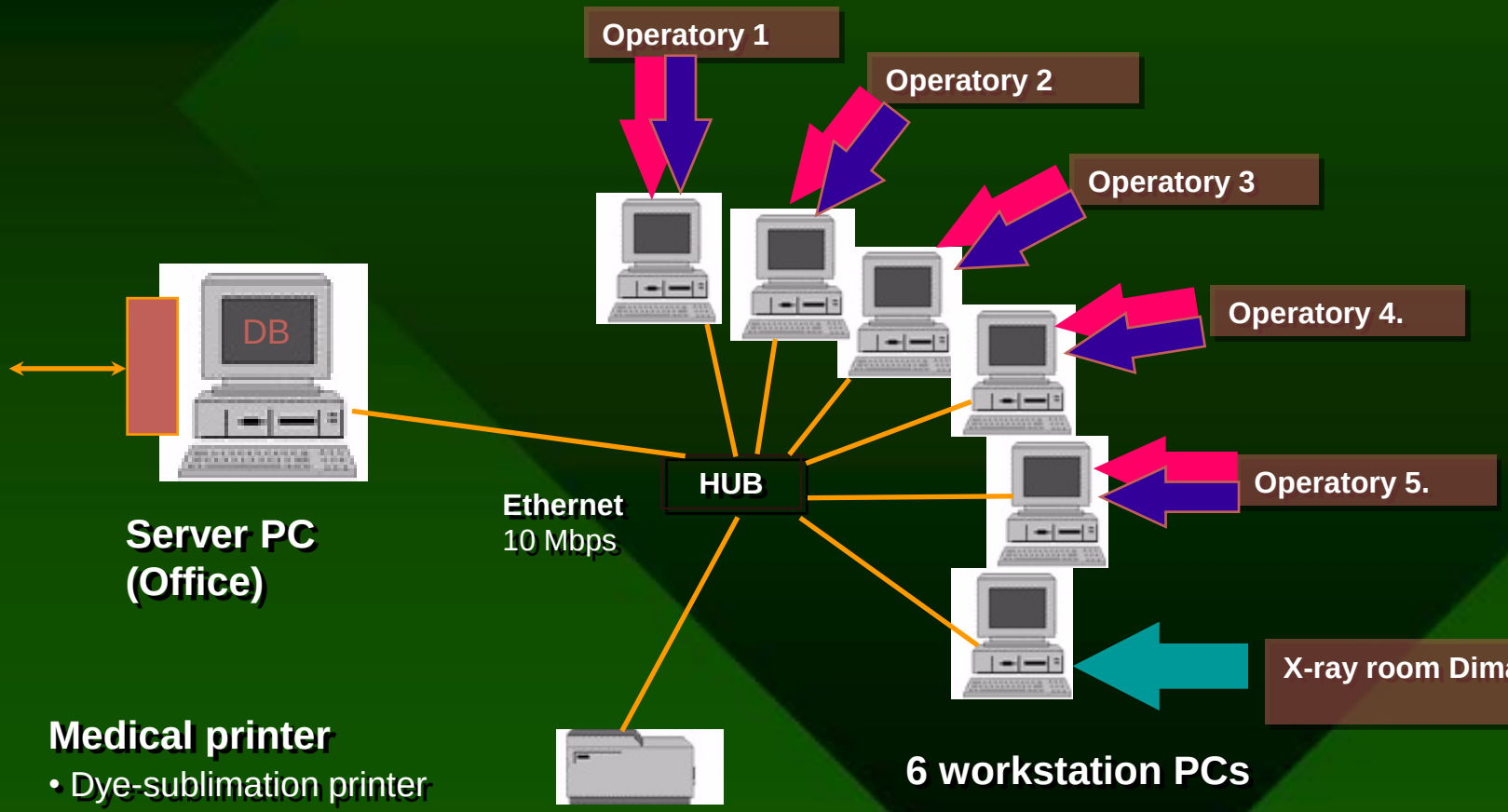
Superior gray – scale resolution: DR uses up to (256) colors of gray compared to the (16) or (25) shades of gray differentiated on a conventional film.

Reduced exposure to radiation: Decreased exposure results from the sensitivity of CCD so the radiation exposure is (50 to 80)% less than what is required for E – speed films.



Easy and fast communication: Digital images can be electronically transmitted to refereeing dentists or consultants

Enhancement of diagnostic images: Digital subtraction (D.S.) in which the gray scale is reversed as mentioned previously D.S. also eliminates distracting black ground information.



Disadvantages

Image quality: Conventional dental x –ray film has a resolution of (12 to 20) lP/mm while in CCD has a resolution closer to (10) lP/mm, (line pairs/mm) a CCD system appears to be adequate for diagnosis of dental disease.

Sensor size: The bulky nature of the sensor cause gag reflex for the patient.

Infection control: sensor cannot be sterilized by heat so it must be covered completely by a disposable plastic sleeve to prevent cross – contamination between patients

Initial set up costs: the range of cost depends on the manufacturer, the level of computer equipment and auxillary features e.g. an intraoral camera, service for any repairs must also be considered. The initial cost may reach to 10, 000$