MEDICAL IMAGE COMPRESSION AND WATERMARKING

Muhammad Zubair Hasan

Shahir Abdullah

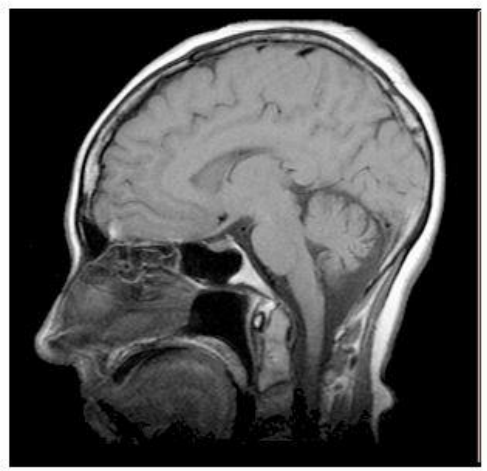
Objective :

- To implement lossless image compression and decompression using data compression algorithm
- Watermark the image for security and ownership purposes
- Implement these feautures using java language

What are medical images ?

Some examples

- MRI / FMRI (Function Magnetic Resonance)



Why compress medical images?

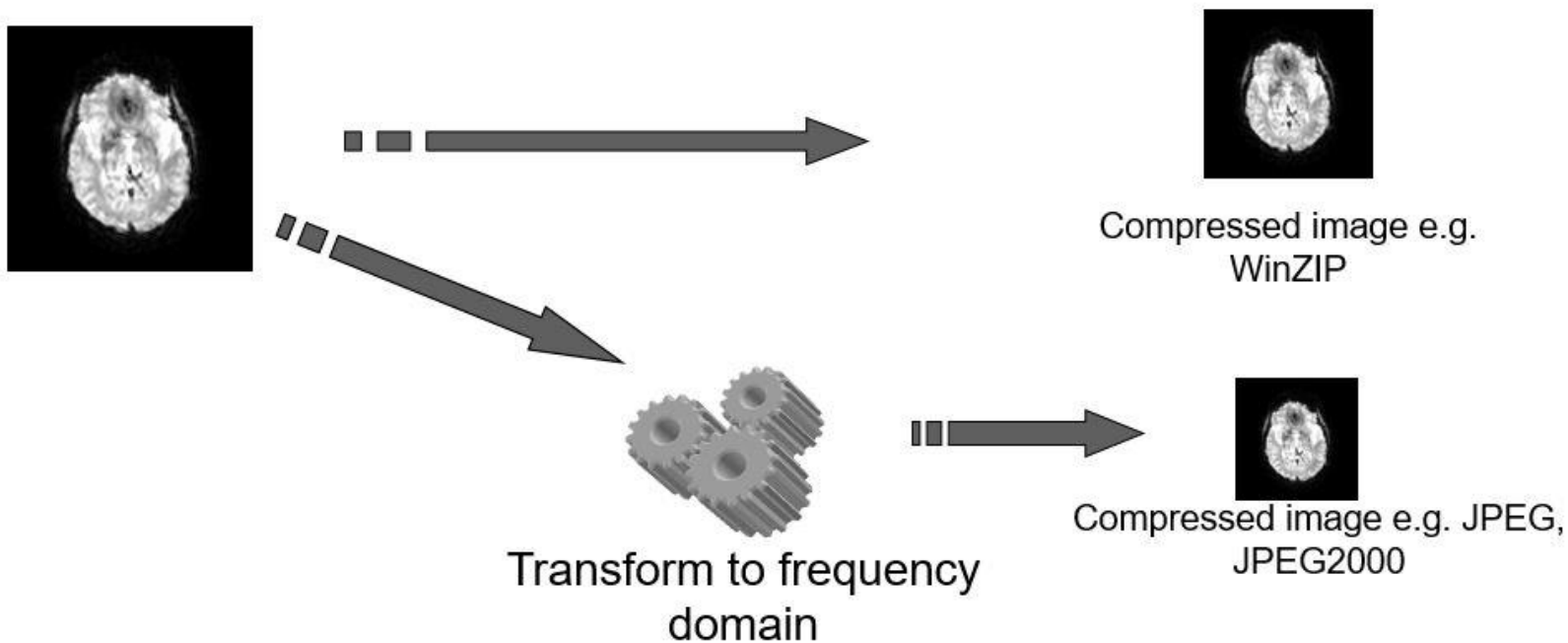
- Growing need for storage
- Efficient data transmission
- Telemedicine
- Tele-radiology applications
- Real time Tele-consultation.
- PACS (Picture archiving and communication systems)

Techniques used

Compression techniques may be classified into:

- Lossy
- Lossless

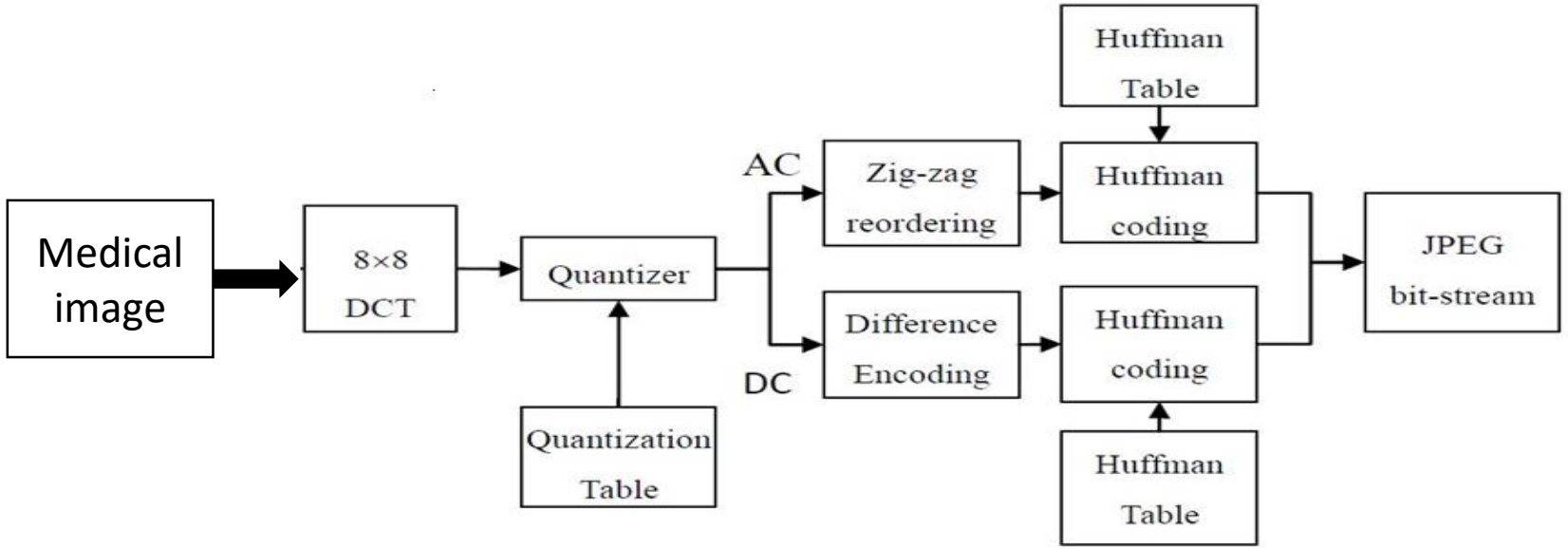
Moreover, compression algorithms may be applied in the spatial domain or frequency domain



JPEG 2000 and JPEG-LS

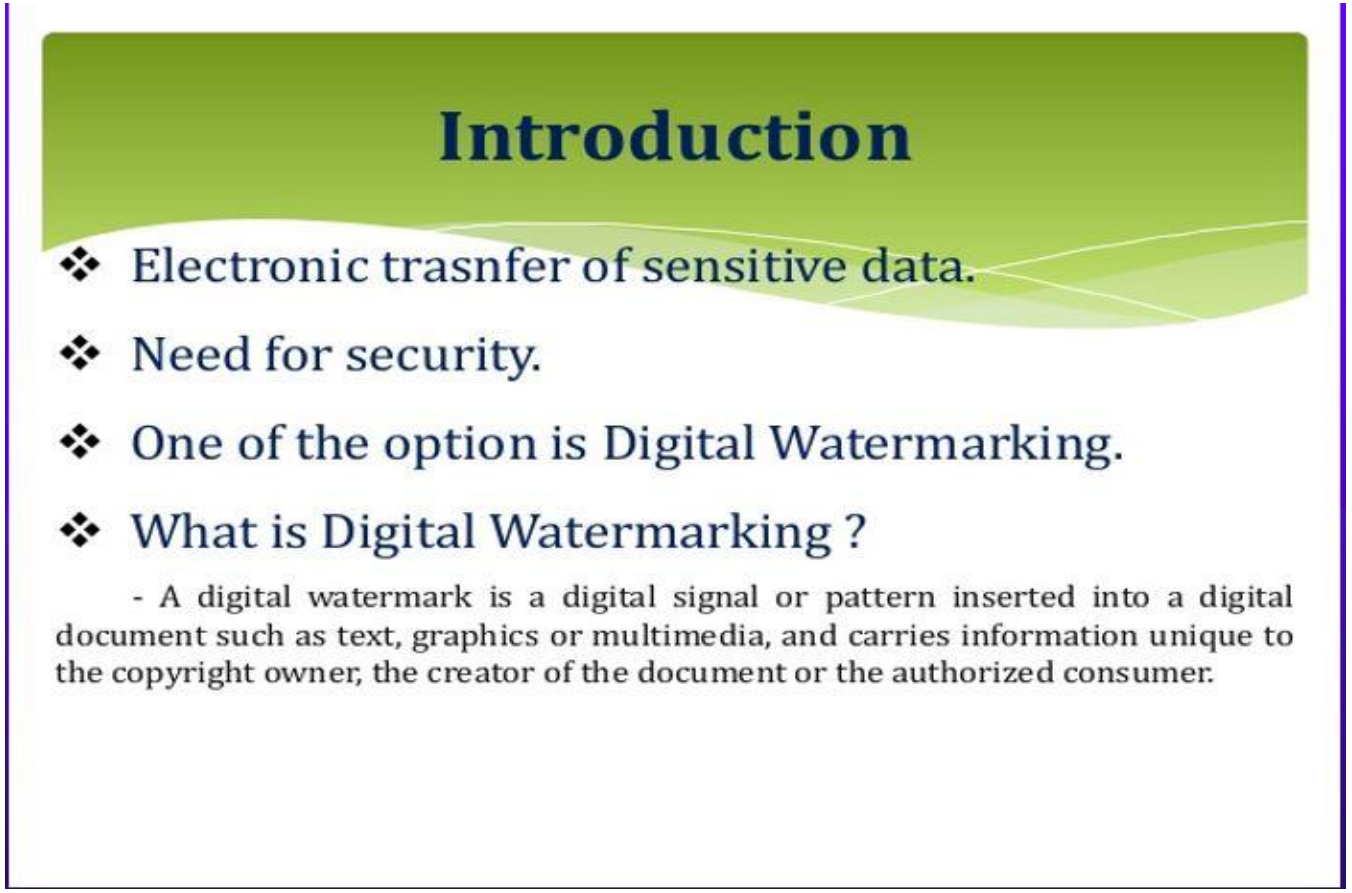
- High compression efficiency
- Lossless color transformations
- Progressive by resolution and quality
- Multiple component images
- ROI coding (static and dynamic)
- Error resilience capabilities
- Object oriented functionalities (coding, information, embedding)

Implementation :



Baseline JPEG encoder

Watermarking :



Digital Watermark Classification

* Based on visibility of watermarks
* Based on the content to be watermarked
* Based on different image domains

Example: 1. Visible Watermark

2. Invisible Watermark

Figure 3.1: Original image

Figure 3.2: Watermarked image

Figure 3.3: Watermark

ISSUES

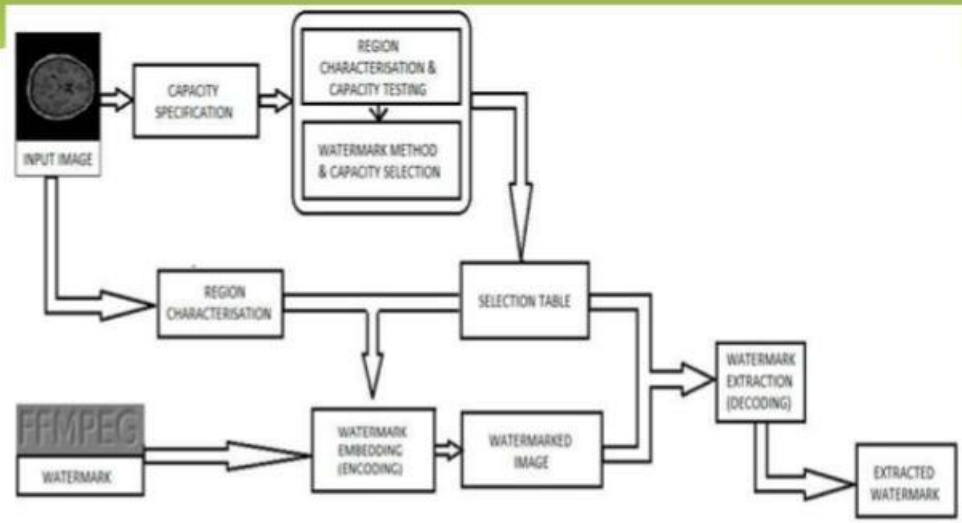
(i) Confidentiality *- Access only to the authorised user.*

(ii) Reliability which focuses on two main aspects:

a) *Integrity* **-** *untampered and true data.*

b) *Authentication* – *Recieved from an authenticated sender i.e. Unmodified image.*

Basic Architecture :



System Design:

1. Region Characterisation.

2. Watermarking method selection.

3. Watermark Embedding.

4. Watermark Extraction.

1. Region Charaterisation

- We divide the host image into blocks of size 8X8.

- SD is calculated for each block and are categorised into specific four region according to the following table:

Region	1	2	3	4
σ_{min}	0	2^2	2^3	2^4
σ_{max}	2^2	2^3	2^4	2^5

2. Watermarking method selection

❖ According to the region categorisation done above, watermarking along with the payload capacity is selected from the following table:

Parameter	Current Implementation
region - shape - size	square blocks 8x8 pixels
region characterisation	σ_R - standard deviation
watermark methods and payload capacities	DCT2 - DCT with 2 bits per block DCT1 - DCT with 1 bit per block LSB2 - LSB with 2 bits per block LSB1 - LSB with 1 bit per block

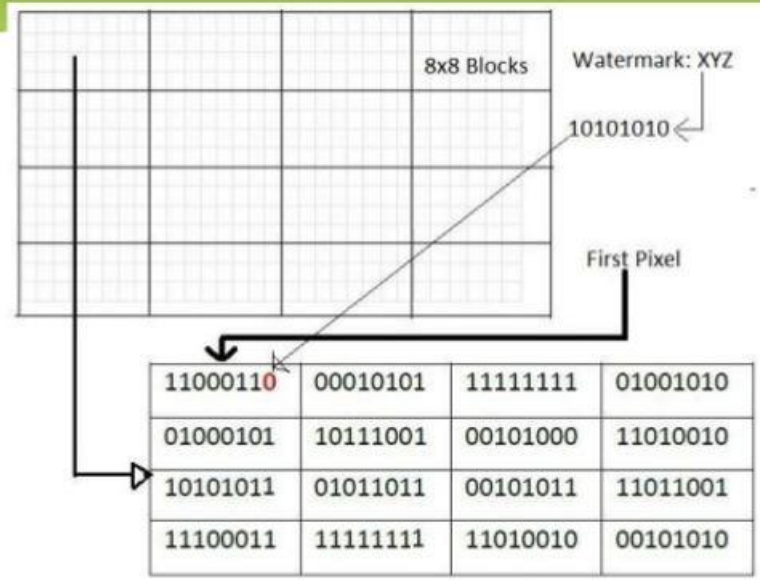
3. Watermark Embedding

❖ Each block is watermarked with the selected watermarking method.

❖ The four watermarking methods are:

1. DCT-1 bit.
2. DCT-2 bit.
3. LSB-1 bit.
4. LSB-2 bit.

LSB


8x8 Blocks
Watermark: XYZ
10101010
First Pixel
11000110 00010101 11111111 01001010
01000101 10111001 00101000 11010010
10101011 01011011 00101011 11011001
11100011 11111111 11010010 00101010

DCT

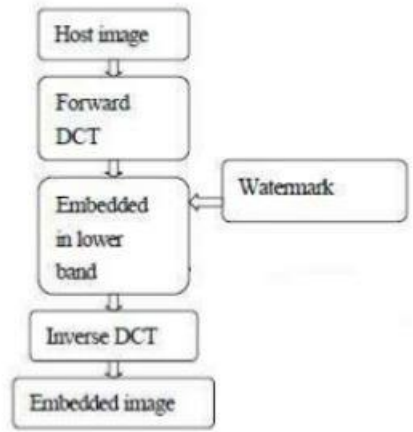
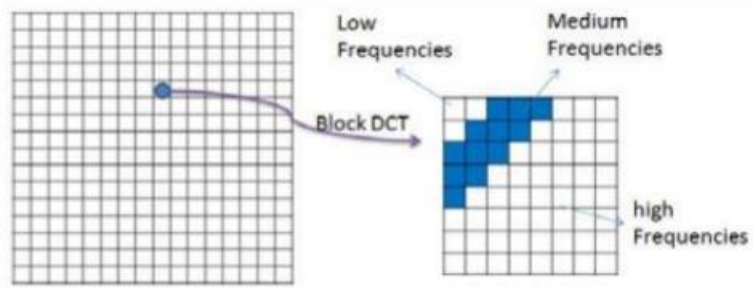


Figure 3. The embedded flow chart

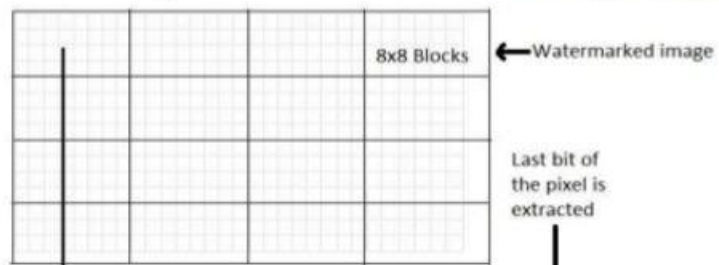
DCT

- Bringing an image into DCT domain



4. Watermark Extraction

- Same as above we use the selection table to categorise the blocks of watermarked image into the regions and the extraction is performed using the extraction algorithms for the above embedding methods.



Output: