Introduction:

1.1 Need of Image Coding: Since image has a very large information size, the image data size poses a problem when an image is stored or transmitted. Compression (encoding) of an image reduces the data size by removing the redundancy of the image or manipulating the values on levels that such manipulations are hard to visually recognize. Conventionally, as one of still image encoding methods, JPEG (Joint Picture Experts Groups) internationally recommended by the ISO and ITU-T is known. In JPEG, several kinds of encoding schemes are specified in correspondence with images to be encoded and applications. However, in its basic scheme except for a reversible process, an image is segmented into 8×8 blocks, the blocks undergo the discrete cosine transform (DCT), and transform coefficients are appropriately quantized and are then encoded. In this scheme, since the DCT is done in units of blocks, so-called block distortion is produced, i.e. block boundaries are visible when transform coefficients are coarsely quantized and encoded. On the other hand, recently, encoding schemes based on the wavelet transform have been extensively studied, and various encoding schemes using this transform have been proposed. Since the wavelet transform does not use block division, it does not suffer any block distortion and image quality a high compression ratio is superior to that of JPEG[1].

1.2 Image compression - An image is essentially a 2-D signal processed by the human visual system. Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages. When we speak about image compression, there are generally two different solutions, the lossless compression and the lossy compression. Lossy compression methods most often rely on transforming spatial image domain into a domain that reveals image components according to their relevance, making it possible to employ coding methods that take advantage of data redundancy in order to suppress it. A common characteristic of most images is that the neighboring pixels are correlated and therefore contain redundant information. The foremost task then is to find less correlated representation of the image. Two fundamental components of compression are
redundancy and irrelevancy reduction. **Redundancy reduction** aims at removing duplication from the signal source (image/video). **Irrelevancy reduction** omits parts of the signal that will not be noticed by the signal receiver, namely the Human Visual System (HVS). Image compression research aims at reducing the number of bits needed to represent an image by removing the spatial and spectral redundancies as much as possible. Since we will focus only on still image compression, we will not worry about temporal redundancy [2].

For still image compression, the `Joint Photographic Experts Group' or JPEG standard [4] has been established by ISO (International Standards Organization) and IEC (International Electro-Technical Commission). The performance of these coders generally degrades at low bit-rates mainly because of the underlying block-based Discrete Cosine Transform (DCT) scheme. More recently, the wavelet transform has emerged as a cutting edge technology, within the field of image compression. Wavelet-based coding provides substantial improvements in picture quality at higher compression ratios. The following fig. 1 shows the existing image compression model[2].

![Existing Compression Model](image)

**Fig 1 Existing Compression Model**

In the wavelet transform of an image, an original image is divided into four four frequency bands LL, HL, LH, and HH and processes for further dividing the lower frequency band (LL (1)) of these divided bands into four frequency bands, and further dividing the lowest frequency bands (LL (2)) of these divided bands are repeated for a predetermined number of times, thus generating $2n+1$ (the number of times of wavelet
transform) kinds of frequency bands. The number of times of repetitions of the wavelet transform will be referred to as a level count hereinafter, and the respective frequency bands will be referred to as LL (n), HL (n), LH (n) and HH (n) by appending the level count to LL, HL, LH and HH. For example, the LH component obtained by repeating the wavelet transform twice is expressed by LH (2).[14].

<table>
<thead>
<tr>
<th>LL2</th>
<th>HL2</th>
<th>HL1</th>
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<tbody>
<tr>
<td>LH2</td>
<td>HH2</td>
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| LH1 | HH1 |

Fig 2: Two level wavelet decomposition

Wavelet-based compression of images for storage and transmission involving hierarchical subband decomposition is an attractive way for achieving needed computational and coding efficiency. For compressing the wavelet coefficient array by exploring its statistical properties, is a process known as set partitioning in hierarchical trees (SPIHT). By structuring the data in hierarchical tree sets that are likely to be highly correlated, the Embedded zerotree the wavelet transform wavelet (EZW) process exploits the self-similarity of at different scales. The further partitioning of data is stored into lists, to gain additional compression [13].

Fig 3: Tree structure of SPIHT
1.3 Wavelet based image coding techniques

Wavelet based image coding techniques [6] provide substantial improvements in picture quality at higher compression ratios. Wavelet based image compression schemes include embedded zerotree wavelets (EZW) [8], Set partitioning in Hierarchical Trees (SPIHT) [7], Set partitioning embedded block (SPECK), and embedded block coding with optimized truncation (EBCOT).

There are some drawbacks of existing techniques. JPEG has a big compressing ratio, reducing the quality of the image, it is ideal for big images and photographs. The performance of these coders generally degrades at low bit-rates mainly because of the underlying block-based Discrete Cosine Transform (DCT) scheme [3]. This is improved by using wavelet decomposition, but it faces ringing artifacts. In wavelet decomposition; the approximate component of image is further decomposed. From the point of view of compression, where we want as many small values as possible, the standard wavelet transform may not produce the best result, since it is limited to wavelet bases (the plural of basis) that increase by a power of two with each step. These techniques suffer from blurring artifacts and ringing artifacts [10].

Blocking artifacts [3] are the result of the independent processing of each block in block-based signal processing. Staircase noise is one form of blocking artifact, which appears when a block includes image edges; the edge is degraded such that the block bands looks like the edge. Grid noise is other form of artifact where slight change of image intensity along the block boundary becomes noticeable in areas with slowly varying intensity with position.

Despite of its general success, the wavelet transform often fails to accurately capture high frequency information, especially at lower bit rates where such information is lost in quantization noise.

1.4 Drawbacks of existing system

Among wavelet based technologies, SPIHT [7] is mostly used because of excellent rate-distortion performance. However, it does not entirely provide desired features of progressive transmission spatial scalability and optimal visual quality and does not consider human visual system (HVS) properties. Also a larger amount of memory is required to maintain three lists, namely list of insignificant pixels, list of significant
pixels and list of insignificant sets that are used for storing the coordinates of wavelet coefficients and tree sets in the coding and decoding process. A great number of operations to manipulate the memory are also required in the codec scheme which greatly reduces the speed of coding procedure.

Although the SPIHT algorithm can produce embedded bit stream and provide good bit-distortion rate performance, but still it has some disadvantages. Because of Wavelet transform, it needs to do convolution operation with huge amount of data. Therefore, its computations become complex and encoding speed is badly reduced. In encoding, algorithm make use of correlativity of insignificant coefficients between subbands, But it fails to use in same subband. So the small parts of bits are used to encode the important information. Therefore, efficiency of algorithm is low and quality of reconstructed signal is not good [14].

1.5 Need of new encoding system

To sort all above issues the image coding technique using modified SPIHT and lifting wavelet can be implemented to have better image compression at low bit rates. The MSPIHT jointly considers the advantage of progressive transmission, spatial scalability Thus it outperforms the traditional SPIHT algorithm at low bit rate coding. Compared with SPIHT, compression efficiency of MSPIHT comes from two aspects. The lifting scheme lowers the number of arithmetic operations of wavelet transform. Moreover a significance reordering of modified SPIHT ensures that it codes more significant information belonging to the lower is implemented, it reduces the amount of memory and improves the speed of compression frequency bands earlier in the bit stream than that of SPIHT to better exploit the energy compaction of wavelet coefficient. HVS characteristics may be employed to improve the perceptual quality of compressed image by placing more coding artifacts in the less visually significant regions of the image. Finally, if listless implementation of SPIHT structure