Comprehensive Review of Huffman Encoding Technique for Image Compression

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Abstract*—The image processing is used in the every field of life. It is growing field and is used by large number of users. The image processing is used in order to remove the problems present within the image. There are number of techniques which are suggested in order to improve the image. For this purpose image enhancement is commonly used. The space requirements associated with the image is also very important factor. The main aim of the various techniques of image processing is to decrease the space requirements of the image. The space requirements will be minimized by the use of compression techniques. Compression techniques are lossy and lossless in nature. This paper will conduct a comprehensive survey of the lossless compression Huffman coding in detail.*

Keywords— Huffman coding, Image compression, Image processing.

I. INTRODUCTION

The Huffman Coding is a compression technique which is lossless in nature. In lossless compression the pixel information is not lost. The Huffman coding uses tree like structure. The tree like structure will help in generating unique code which can be easily decodable. The advantages of using this technique are that it will produce minimum bit rate for every codeword generated. The Huffman Coding will be best described by the help of following example.

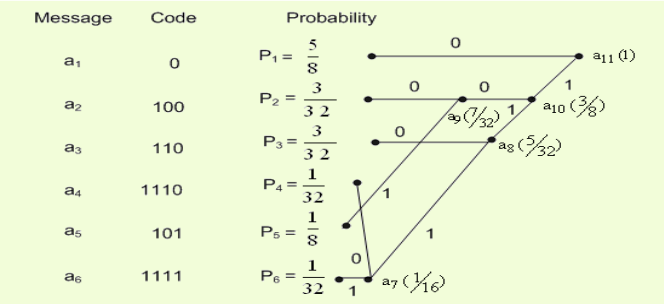

Fig. 1:Demonstration of Huffman coding

The Fig 1 shows the example in which every character of the string is divided into parts and then separately coded. The example takes the value of L=6 with the probability of each message possibility will be noted at each node.

Message	Codeword	Probability
a_1	0	$P_1 = 5/8$
a_2	100	$P_2 = 3/32$
a_3	110	$P_3 = 3/32$
a_4	1110	$P_4 = 1/32$
a_5	101	$P_5 = 1/8$
a_6	1111	$P_6 = 1/32$

Fig. 2: Demonstration of Huffman coding

In the first step the message with the lowest probabilities are selected. They are combined together to generate new node with combined probability. '0' will be assigned to one of the possibility and '1' will be assigned to other possibility. The process continues until we are left with the single node with probability '1'. In order to generate the codeword we begin from the last node having possibility '1' and move to the desired node collecting sequences of '0' and '1'. As shown in the Fig 2 the message a4 has Codeword '1110'. The Huffman coding generally produces the least average bit rate as compared to other methods. The existing approach follows iterative approach. Also existing scheme follows Binary search mechanism. The efficiency of the technique can be increased if Heaps along with recursive approach is followed. The analysis of the existing papers highlighted the advantages and disadvantages of the existing approach.

II. RELATED WORK

The study has been conducted in the area of efficient encoding schemes. The coding schemes which are used in the paper has lower average bit rate. The existing system uses iterative approach. Also bottom up approach is followed in the existing system. The various papers which we have considered are described in this section. [1] The paper indicates that compression techniques can be used in order to reduce the space requirements associated with the image. The correlation between the pixels is used in order to determine the amount of space which can be released. The calculations which are performed in the suggested technique is complex in nature. [2] The massive number of medical images produced by fluoroscopic and other conventional diagnostic imaging devices demand a considerable amount of space for data storage. [2]This paper proposes an effective method for lossless compression of fluoroscopic images. [2]The main contribution in this paper is the extraction of the regions of interest (ROI) in fluoroscopic images using appropriate shapes. [2]The extracted ROI is then effectively compressed using customized correlation and the combination of Run Length and Huffman coding, to increase compression ratio. [2]The experimental results achieved show that the proposed method is able to improve the compression ratio by 400 % as compared to that of traditional methods. [3] Lossy JPEG compression techniques are followed in this case. In this case pixel values are not preserved. The blocks of pixel are prepared and record of those pixels which are most commonly used are retained and values of less significant pixels are removed. The technique used in this case is Fourier Transformation which will require large number of calculations. [4] The JPEG compression is followed in this case. The technique suggested in this case is discrete cosine transformation. The technique is complicated and also produce high bit rate for the given section of the image. [5] the image processing technique is implemented for medical image processing. In medical generally image processing is used for MRI, X-Rays etc. The need for an efficient technique for compression of Images ever increasing because the raw images need large amounts of disk space seems to be a big disadvantage during transmission & storage. Even though there are so many compression technique already present a better technique which is faster, memory efficient and simple surely suits the requirements of the user. In this paper we proposed the Lossless method of image compression and decompression using a simple coding technique called Huffman coding. This technique is simple in implementation and utilizes less memory. A software algorithm has been developed and implemented to compress and decompress the given image using Huffman coding techniques in a MATLAB platform. [6]Principal Component Analysis will be used in this case. This technique is used in order to select those components which are required within the image. The primary objective of the above said technique is to remove the redundancy from the image. This technique is very efficient however complex to use. The higher bit rate is produced using this technique. [7] For courses in Image Processing and Computer Vision. Completely self-contained-and heavily illustrated-this introduction to basic concepts and methodologies for digital image processing is written at a level that truly is suitable for seniors and first-year graduate students in almost any technical discipline.[7] The leading textbook in its field for more than twenty years, it continues its cutting-edge focus on contemporary developments in all mainstream areas of image processing-e.g.,[7] image fundamentals, image enhancement in the spatial and frequency domains, restoration, color image processing, wavelets, image compression, morphology, segmentation, image description, and the fundamentals of object recognition. [7]It focuses on material that is fundamental and has a broad scope of application. [8] the paper suggested the technique of Huffman Encoding using the binary search technique. The Huffman Coding is a compression technique which is lossless in nature. In lossless compression the pixel information is not lost. The Huffman coding uses tree like structure. The tree like structure will help in generating unique code which can be easily decodable. The advantages of using this technique are that it will produce minimum bit rate for every codeword generated.

From the studied papers it is clear that in the existing system iterative approach is followed. Also in case of Huffman coding binary search techniques are used.

III. CONCLUSION

The review is conducted in order to determine which method is best to produce least average bit rate. The technique which comes out is Huffman coding. The technique which is used in this case is iterative. Also binary search is used rather than heap sort. In order to increase the performance we propose Recursive Huffman coding using Heap sort. The technique will produce least average bit rate and hence is less expensive.

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