CLASS	**: T.E. E &TE**	**SUBJECT: DIP**
EXPT. NO.	**: 9**	**DATE:**

TITLE : IMAGE COMPRESSION USING HUFFMAN CODING

CO2:	Perform the image compression techniques on image.

AIM: Implement Huffman coding algorithm for an Image Compression.

SOFTWARE REQUIREMENT: Google Colaboratory /Jupyter Notebook

9.1 THEORY:

The term data compression refers to the process of reducing the amount of data required to represent a given quantity of information.

Compression Measures:

Compression Ratio: This is defined as

$$\frac{\text{File size before Compression}}{\text{File size after Compression}}$$

Redundancy: It represents repetition of data.

$$R = 1 - \frac{1}{C}$$

In an image there are three types of redundancies in order to compress file size. They are:

a) Coding redundancy: Coding redundancy is associated with the representation of information. The information is represented in the form of codes. If the gray levels of an image are coded in a way that uses more code symbols than absolutely necessary to represent each gray level then the resulting image is said to contain coding redundancy.

b) Interpixel redundancy: Interpixel redundancy is due to the correlation between the neighbouring pixels in an image. That means neighbouring pixels are not statistically independent. The grey levels are not equally probable. The value of any given pixel can be predicated from the value of its neighbours that is they are highly correlated. The information carried by individual pixel is relatively small. To reduce the interpixel redundancy the difference between adjacent pixels can be used to represent an image.

c) Psychovisual redundancy: The Psychovisual redundancies exist because human perception does not involve quantitative analysis of every pixel or luminance value in the image. Its elimination is real visual information is possible only because the information itself is not essential for normal visual processing.

9.1.1 HUFFMAN CODING

One of the most popular techniques for removing coding redundancy is due to Huffman (Huffman [1952]). When coding the symbols of an information source individually, Huffman coding yields the smallest possible number of code symbols per source symbol. In terms of Shannon's first theorem the resulting code is optimal for a fixed value of n, subject to the constraint that the source symbols be coded one at a time. In practice, the source symbols may be either the intensities of an image or the output of an intensity mapping operation (pixel differences, run lengths, and so on). The first step in Huffman's approach is to create a series of source reductions by ordering the probabilities of the symbols under consideration and combining the lowest probability symbols into a single symbol that replaces them in the next source reduction.

At the far left, a hypothetical set of source symbols and their probabilities are ordered from top to bottom in terms of decreasing probability values. To form the first source reduction, the bottom two probabilities are combined to form a "compound symbol". This compound symbol and its associated probability are placed in the first source reduction column so that the probabilities of the reduced source also are ordered from the most to the least probable. This process is then repeated until a reduced source with two symbols (at the far right) is reached. The second step in Huffman's procedure is to code each reduced source, starting with the smallest source and working back to the original source.

Huffman's procedure creates the optimal code for a set of symbols and probabilities subject to the constraint that the symbols be coded one at a time. After the code has been created, coding and/or error-free decoding is accomplished in a simple lookup table manner. The code itself is an instantaneous uniquely decodable block code.

9.2 Example on Huffman Coding:

9.3 Algorithm:

9.4 Conclusion:

9.5 References:

i. Gonzalez R, Woods R, "Digital image processing", Pearson Prentice Hall, 2008.

ii. Gonzalez R, Woods R, Steven E, "Digital Image Processing Using MATLAB®", McGraw Hill Education, 2010.

iii. Jayaraman S, Esakkirajan S and Veerakumar T, "Digital Image Processing" Tata McGraw Hill, 2010

iv. Joshi, Madhuri A. "Digital Image Processing: an algorithm approach", PHI Learning Pvt. Ltd., 2006.

v. Pictures taken from: http://www.imageprocessingplace.com/root_files_V3/image_databases.html

v. http://ijarse.com/images/fullpdf/1467705501_8_Research_Paper.pdf

(Course Teacher)