Lossless Image Recovery Using Reversible Data Hiding

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Abstract: Recently, more and more importance is given to reversible data hiding (RDH) technique in images, since it has the capability of recovering the original image which is used for embedding data, without loss protecting the image content’s confidentiality. All previous methods embed data by reversibly vacating room from the images, which may be subject to some errors on data extraction and/or image restoration. This project propose a novel method by reserving room before embedding data in an image using a traditional RDH algorithm, and thus making it is easy for the reversibility of embed data in the image. The proposed method can achieve real reversibility, that is, data extraction and image recovery are free of any error. Experiments show that this novel method can embed more than 10 times as large payloads for the same image quality as the previous methods, such as for PSNR = 50dB.

Keywords: Reversible data hiding, histogram shifting.

I. INTRODUCTION

Data hiding technology has been diligently studied, for not only security-related problems, in particular, intellectual property rights protection of digital contents, but also non security-oriented issues such as broadcast monitoring. A data hiding technique embeds data into a target signal referred to as the original signal. In military and medical applications, restoration of the original signal as well as extraction hidden data are desired, so reversible data hiding (RDH) techniques that recover the original image have been proposed. Among many RDH methods, this paper focuses histogram shifting-based RDH (HS-RDH) methods. HS-RDH methods modify the histogram of an original image or a processed image to hide data into the image. Most multimedia data embedding techniques have the tendency to modify the host image in order to embed the data inside it. This modification in the host image leads to distortion or noise. Even though, this distortion is small, it is irreversible or image cannot be recovered completely, thus making the image lossy.

In many applications, it is important to get data and the image which is used for embedding data losslessly otherwise it may leads to serious problem. There are methods to extract the data inside the image without any loss to it, but most of the extraction leads to distortion of host image. This is not allowed in a number of domains – like military, legal documents and medical imaging, although some embedding distortion is allowed, permanent loss in recovered image is not allowed. This emphasizes the need for Reversible Data hiding techniques. This technique, like their lossy counterparts, insert information bits by modifying the host image, thus result in embedding distortion. But unlike other methods they also enable the removal of noise and the exact-lossless restoration of the original host image after extraction of embedded information.

The paper is organized as follows. Section 2 introduces the concept of reversible data hiding. Section 3 explains the proposed method for embedding data in image. Section 4 describes the experimental results for various test images. Finally the concluding remarks are given in section 5.

II. REVERSIBLE DATA HIDING

Reversible data hidings embed data bits by changing the host signal; however empowers the lossless reclamation of the first have motion in the wake of concentrating the implanted data. Frequently, declarations like contortion free, invertible, lossless or erasable watermarking are utilized as equivalent words for reversible watermarking. In most applications, the little twisting because of the data installing is generally average. Notwithstanding, the likelihood of recuperating the accurate unique picture is an attractive property in numerous fields, in the same way as lawful, medicinal and military imaging. Given us a chance to consider that deliberate reports (like bank checks) are checked, secured with a confirmation plan focused around a reversible data concealing, and sent through the Internet. Data hiding up are a gathering of systems used to put a safe data in a host media (like pictures) with little weakening in host and intend to concentrate the protected data afterwards. As a rule, the watermarked archives will be sufficient to recognize unambiguously the substance of the reports. Be that as it may, if any instability emerges, the likelihood of recouping the first unmarked report is exceptionally intriguing.

Reversible data embedding, which is likewise called lossless data embedding, installs imperceptible data (which is known as a payload) into an advanced picture in a reversible manner. As an issue prerequisite, the quality corruption on the picture after data embedding ought to be low. An interesting gimmick of reversible data embedding is the reversibility, that is, one can uproot the installed data to restore the first picture. The inspiration of reversible data embedding is contortion free data embedding. In spite of the fact that intangible, embedding some data will inescapably change the first substance. Indeed an exceptionally slight change in pixel qualities may not be attractive, particularly in touchy symbolism, for example, military data and medicinal data. In such a situation, all of data is paramount. Any
change will influence the knowledge of the picture, and
the right to gain entrance to the first, crude data is
constantly needed.

As a rule of data concealing, the spread media will
encounter some bending because of data concealing and
can't be rearranged over to the first media. That is, some
lasting bending has jumped out at the spread media
much after the concealed data have been concentrated
out. In a few applications, for example, therapeutic
judgment and law implementation, it is basic to turn
around the checked media once more to the first cover
media after the shrouded data are recovered for some
legitimate contemplation. In different applications, for
e.g., remote sensing and high-vitality molecule
physical trial examination, it is likewise sought that the
first cover media can be recouped in light of the obliged
high-accuracy nature. The checking strategies fulfilling
this necessity are alluded to as reversible, lossless,
twisting free or invertible data concealing systems.
Reversible data concealing encourages gigantic
probability of uses to connection two sets of data in such
a path, to the point that the spread media can be
losslessly recouped after the shrouded data have been
concentrated out, therefore giving an extra parkway of
taking care of two separate sets of data.

III. HISTOGRAM

An "image histogram" is a sort of histogram that goes
about as an issue representation of the tonal conveyance
in an advanced picture. It plots the quantity of pixels for
every tonal worth. By taking a gander at the histogram
for a particular picture a viewer will have the capacity to
drive the whole tonal appropriation at a glance. Image
histograms are available on numerous present day
advanced cam's. Photographic artists can utilize them as
a help to demonstrate the dispersion of tones caught, and
whether picture point of interest has been lost to
extinguished highlights or passed out shadows. The
level hub of the chart speaks to the tonal varieties, while
the vertical pivot speaks to the quantity of pixels in that
specific tone. The left half of the level pivot speaks to
the dark and dullzones, the centre speaks to medium
light black and the right hand side speaks to light and
immaculate white ranges. The vertical hub speaks to the
measure of the territory that is caught in every one of
these zones. Accordingly, the histogram for an
exceptionally dull picture will have the larger part of its
information focuses on the left side and focus of the
diagram. Altemately, the histogram for a splendid
picture with few dull ranges and/or shadows will have a
large portion of its information focuses on the right side
and focus of the diagram.

IV. HISTOGRAM SHIFTING

Ni et al. uses zero or least purpose of histogram. On the
off chance that the crest is lower than the zero or least
point in the histogram, it builds pixel values by one from
higher than the top to lower than the zero or least point
in the histogram. While implanting, the entire picture is
sought. When a crest pixel worth is experienced, if the
bit to be installed is "1" the pixel is included by 1, else it
is kept in place. Then again, if the crest is higher than
the zero or least point in the histogram, the calculation
diminishes pixel values by one from lower than the top
to higher than the zero or least point in the histogram,
and to insert bit "1" the experienced top pixel worth is
subtracted by 1. The unravelling methodology is tranquil
straightforward and inverse of the installing procedure.
The calculation basically does not take after the general
guideline of lossless watermarking.

V. PROJECT IMPLEMENTATION

This block diagram explains the data embedding system
employed in this project. The image used in this project
is standard 256x256 grey scale image like gold hill,
Lena image etc. The image is split in to 2 parts on the
basis of the rows, Part A and Part B. Part A is used of
data hiding purpose and part B is used for saving the lsb
of part A. 2 rows of Image is separated from rest of the
of the image tomake part A i.e. 2x256 will be called as
part A.

![Fig 3.1 Embedding block diagram](image)

Least significant bit like name only suggest have least
effect on the image quality. Human eye can’t perceive
the loss of this little data that is why this is used for
embedding data. All LSB of part A is collected so that in
that place data can be embedded.Data which is being
embedded is in text format. That data is converted in to
binary bits before it is embedded in to image. All the
slots from which the LSB are removed are used to put these bits. In this project, only 2 rows are used, depending on the application necessity these rows can be increased.

VI. EXPERIMENTAL RESULTS

There are many criteria for judging the image recovery. Few of them are PSNR, MSE reconstructed, MSE etc. We are considering the PSNR and MSE reconstructed as performance measure. The peak signal to noise ratio can be mathematically expressed as given in equation

$$PSNR=10 \log_{10} \left( \frac{255^2}{MSE} \right)$$  (1)

Where MSE is the mean square error between the original (i.e. $x$) and the de-noised image (i.e. $\tilde{x}$) with size $M \times N$

$$MSE = \frac{1}{M \times N} \sum_{i=1}^{M} \sum_{j=1}^{N} (x(i,j) - \tilde{x}(i,j))^2$$  (2)

Fig 3.2 Extracting data form image

The combined image contains embedded data inside part A, top part of the image contains the data which is required. So that part is separated from rest of the image. All the lsb from the part taken from combined image is collected and used to recreate the data that was embedded inside the image. Now the lsb of A which are put inside the part B, are extracted again, just by reversing process. Histogram is shifted back using same principle of RDH.
Fig 1: Barbara images (a) Original (b) histogram of b (c) original histogram (d) shifted histogram (e) lsb of a in b (f) Watermarked image
VII. CONCLUSION

In this paper, the image recovery using reversible data hiding method is implemented to the test images. Peak signal to noise ratio and Mean Square Error is taken as performance measure; different PSNR and MSE value are shown in tables above. It can be noted that MSE values are very low. These results imply that images that are used for embedding data are recovered without any loss in data.

REFERENCES


