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Digital Video Watermarking

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Abstract: There has been a tremendous hike in the amount of information being used from the Internet. This has led to an increase in the amount of information being available on the Internet. Due to this ever growing usage of multimedia content on the Internet, serious issues have been marked. Counterfeiting, forgery, fraud, and pirating of this content are most common amongst these issues. Consequently, copyright abuse is taking a toll among multimedia users who are rarely caught. This copyright abuse is the motivating factor in developing new technologies like digital image and video watermarking. Video watermarking deals with the watermarking process for videos. A need for video watermarking arose due to the fact that most of the information online these days is in the form of videos as well. Most of the watermarking techniques presented so far were utilizing monochrome or gray images as watermark. Now a day, it is necessary to have a technique which will embed image watermark because various organizations are using images as their logos. The proposed method serves the purpose of providing authenticity and copyright protection of videos using image watermark. The novelty of the proposed algorithm is image watermark being embedded into a video in an invisible manner. The method uses a combination of Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (DCT).

Key words: Video watermarking, hiding, embedding, DWT, DCT, PSNR, MSE

I. Introduction

A watermark is an identifying image or pattern in paper that appears as various shades of lightness/darkness when viewed by transmitted light (or when viewed by reflected light, atop a dark background), caused by thickness or density variations in the paper.[1] Watermarks have been used on postage stamps, currency, and other government documents to discourage counterfeiting. There are two main ways of producing watermarks in paper; the dandy roll process, and the more complex cylinder mould process. Watermarks vary greatly in their visibility; while some are obvious on casual inspection, others require some study to pick out. Various aids have been developed, such as watermark fluid that wets the paper without damaging it. A watermark is very useful in the examination of paper because it can be used for dating, identifying sizes, mill trademarks and locations, and determining the quality of a sheet of paper. A watermark is an identifying image or pattern in paper that appears as various shades of lightness/darkness when viewed by transmitted light (or when viewed by reflected light, atop a dark background), caused by thickness or density variations in the paper.[1] Watermarks have been used on postage stamps, currency, and other government documents to discourage counterfeiting. There are two main ways of producing watermarks in paper; the dandy roll process, and the more complex cylinder mould process. Watermarks vary greatly in their visibility; while some are obvious on casual inspection, others require some study to pick out. Various aids have been developed, such as watermark fluid that wets the paper without damaging it. A watermark is very useful in the examination of paper because it can be used for dating, identifying sizes, mill trademarks and locations, and determining the quality of a sheet of paper.

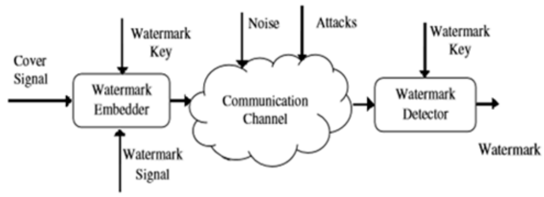

Figure 1.1: General process of digital watermarking

Video watermarking technology, nearly related to information security, information hiding and data authentication science, and it is a new edge research area of the current era in application of video and copyrights. In nowadays, the rapid construction of network of massages, Youtube video and e-business make this technology very crucial and necessary for all forms of digital products protection, its applicability continuously boosted widespread. All these increasing demands for people enforces the author to design a better watermarking algorithm that must be combined with these controlled fashion and technologies so as to strive against all kinds of attacks and form integrated solutions for digital contents' copyright protection. **Methodology**

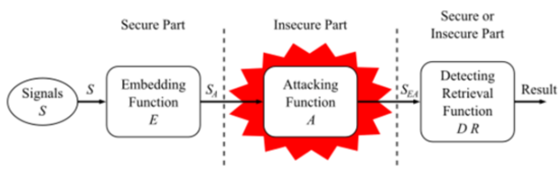

Figure 2.1: General digital watermark life-cycle phases

The actual strength of the frequency domain schemes is overcoming the shortcomings of spatial domain schemes.

Moreover it imparts some special attributes to potray a different representaion of a originally transmitted signal.

- **Discrete Cosine Transform (DCT):**

Discrete Cosine Transform (DCT) based watermarking techniques are divided into Global- based DCT watermarking schemes and Block-based DCT watermarking schemes. The major benefit of this DCT algorithm is its powerfulness against simple alterations in image-processing such as Brightness adjustment, Low-pass filtering, Blurring of images and Contrast adjustment.

- **Discrete Fourier Transform (DFT):**

Fourier analysis is the most widely used methods for evaluating and analysis of the signal in frequency-domain. A signal is divided into its constituent sinusoids of various frequencies by this technique. It has a useful data content but also has some other serious limitations. During the transformation of signal information from time-domain to a frequency-domain, the time-domain information is completely lost and cannot be recovered back. In the chosen frequency-bands of the calculated magnitude of the DFT, the watermark is embedded, thereby generating a watermarked magnitude domain.

- **Discrete Wavelet Transform (DWT):**

Discrete Wavelet Transform is a time-domain analysis algorithm with the window size being fixed and is convertible. Those signals which are DWT transformed in its high-frequency districts have a good time-differentiated rate and also somewhat better frequency-differentiated rate in its low-frequency districts. The information content from the signal can be very effectively filtered by this technique.

2.1 Design of system interface:

- **MATLAB:**

MATLAB (an abbreviation of "matrix laboratory") is a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

- **Graphical user interface (GUI):**

The graphical user interface is a form of user interface that allows users to interact with electronic devices through graphical icons and audio indicator such as primary notation, instead of text-based user interfaces, typed command labels or text navigation. GUIs were introduced in reaction to the perceived steep learning curve of command-line interfaces (CLIs), which require commands to be typed on a computer keyboard.

- **MP4 video format:**

MPEG-4 Part 14 or MP4 is a digital multimedia container format most commonly used to store video and audio, but it can also be used to store other data such as subtitles and still images. Like most modern container formats, it allows streaming over the Internet. The only official filename extension for MPEG-4 Part 14 files is .mp4. MPEG-4 Part 14 (formally ISO/IEC 14496-14:2003) is a standard specified as a part of MPEG-4. Portable media players are sometimes advertised as "MP4 Players", although some are simply MP3 Players that also play AMV video or some other video format, and do not necessarily play the MPEG-4 Part 14 format.

- **JPEG image format:**

JPEG is a commonly used method of lossy compression for digital images, particularly for those images produced by digital photography. The degree of compression can be adjusted, allowing a selectable tradeoff between storage size and image quality. JPEG typically achieves 10:1 compression with little perceptible loss in image quality. Since its introduction in 1992, JPEG has been the most widely used image compression standard in the world, and the most widely used digital image format, with several billion JPEG images produced every day as of 2015.

- **Mean square error (MSE):**

The MSE is a measure of the quality of an estimator—it is always non-negative, and values closer to zero are better. The MSE is the second moment (about the origin) of the error, and thus incorporates both the variance of the estimator (how widely spread the estimates are from one data sample to another) and its bias (how far off the average estimated value is from the truth.

- **Peak-signal-to-noise ratio (PSNR) :**

The term peak signal-to-noise ratio (PSNR) **is** an expression for the ratio between the maximum possible value (power) of a signal and the power of distorting noise that affects the quality of its representation. The term peak signal-to-noise ratio (PSNR) is an expression for the ratio between the maximum possible value (power) of a signal and the power of distorting noise that affects the quality of its representation. Because many signals have a very wide dynamic range, (ratio between the largest and smallest possible values of a changeable quantity) the PSNR is usually expressed in terms of the logarithmic decibel scale.

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III Result and discussion

In our approach we have embedded two images in a video. One video in the first half and the second video in the second half. This will provide better authentication and better security against the intruders.

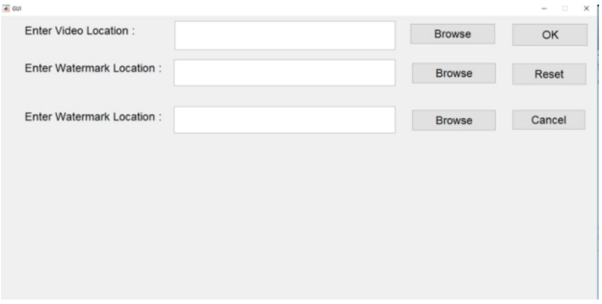

Figure 3.1: Graphical user interface

The above figure 3.1 shows the graphical user interface (GUI) for enabling the user to select the video and browse the content of the image that will be watermarked. The GUI is made in the MATLAB software. First browse location is for video selection, second and third browse location is for selecting the images to be watermarked in the video.

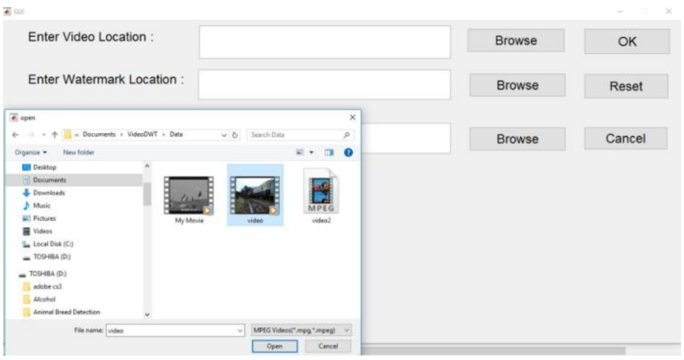

Figure 3.2: Video selection

Figure 3.2 shows the pop up window for video selection when browse button for video location is clicked.

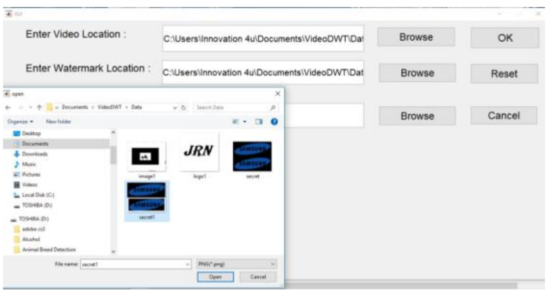

Figure 3.3: Image for watermark selection

Figure 3.3 shows the pop up window for image to be water marked in the video selection when browse button for image location is clicked.

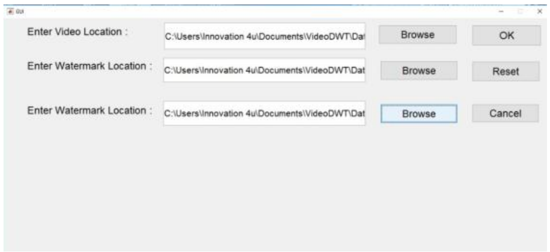

Figure 3.4: GUI after selection

The above figure 3.4 shows the graphical user interface after the video and the images to be embedded is selected.

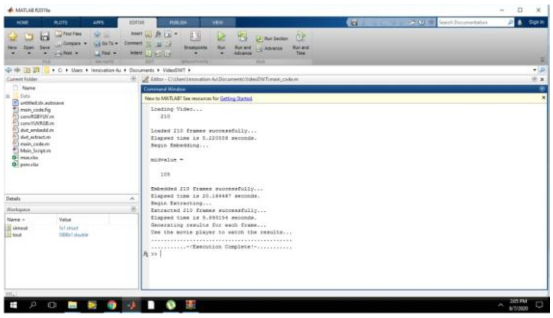

Figure 3.5: Command window for video divided in 210 frames

A small video is selected and divided into 210 frames as shown in figure 3.5. The time taken to divide in the frames is 5.22 seconds. The mid value of the frame is taken to divide the total into two parts. And the two images are embedded in both the halves. The total time taken is 20.144 seconds. After embedding the watermark is extracted. The whole 210 frames are extracted successfully in 9.89 seconds.

Figure 3.6: One frame out of 210 frames of video

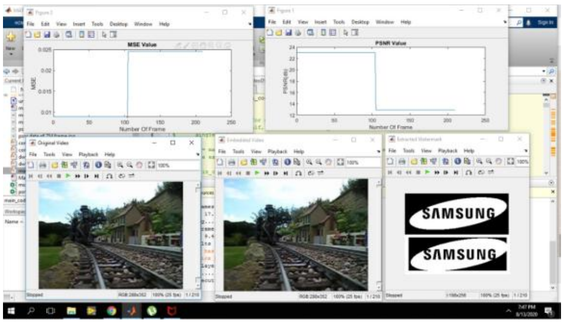

Figure 3.7: Result of embedding and extracting video of 210 frames

Figure 3.7 shows the result window after extracting the watermarked image.

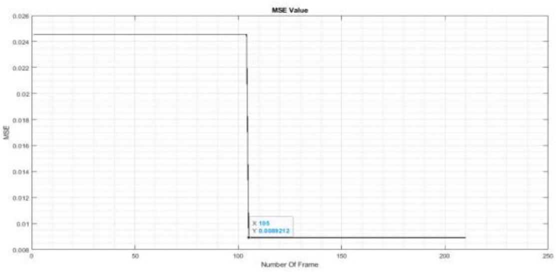

Figure 3.8: MSE value plot for 210 frames

Mean squared error (MSE) for the embedded and extracted video of 210 frames is shown above in figure 3.8. MSE is found to be 0.0245.

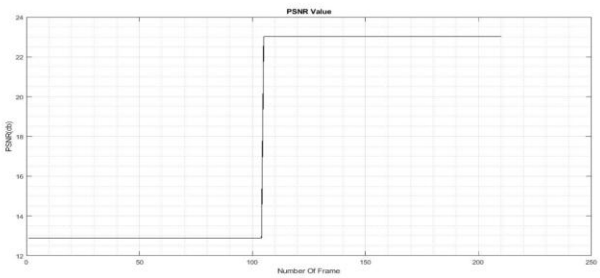

Figure 3.9: PSNR value plot for 210 frames

The figure 3.9 shows the PSNR for the embedded and extracted video of 210 frames. Here the PSNR is found to be 13db.

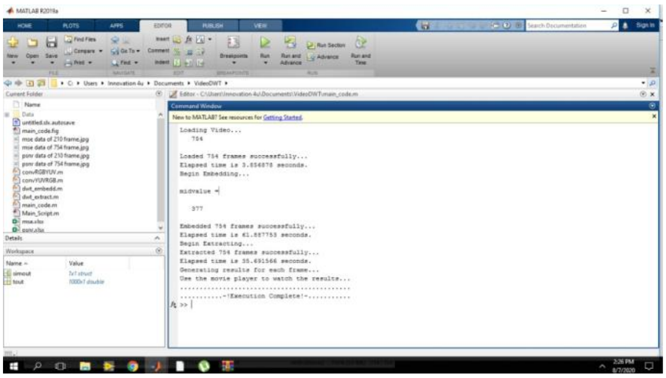

Figure 3.10: Command window for video divided in 210 frames

A small video is selected and divided into 754 frames as shown in figure 3.10. The time taken to divide in the frames is 3.85 seconds. The mid value of 377 of the frame is taken to divide the total into two parts. And the two images are embedded in both the halves. The total time taken is 61.88 seconds. After embedding the watermark is extracted. The whole 754 frames are extracted successfully in 35.69 seconds.

Figure 3.11: One out of 754 frames of video

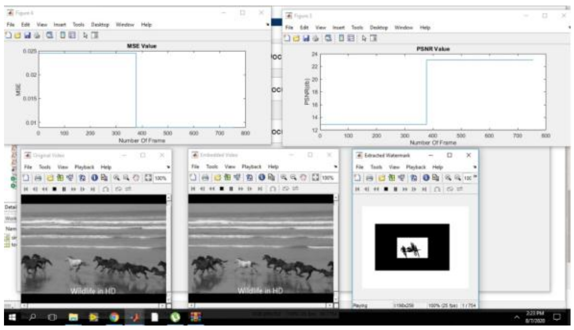

Figure 3.12: Result of embedding and extracting video of 754 frames

Figure 3.12 shows the result window after extracting the watermarked image.

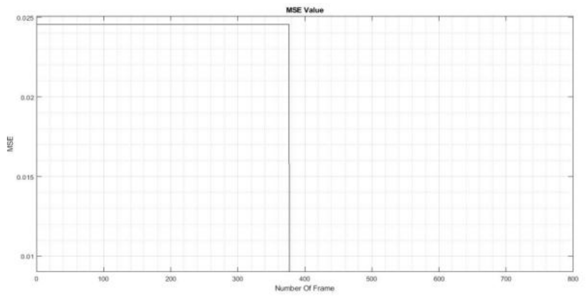

Figure 3.13: MSE value plot for 754 frames

Mean squared error (MSE) for the embedded and extracted video of 754 frames is shown above in figure 3.13. MSE is found to be 0.024.

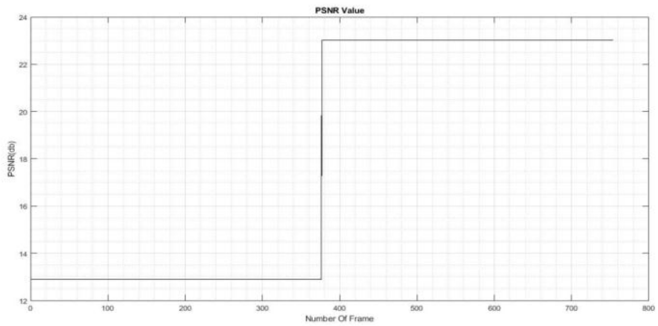

Figure 3.14: PSNR value plot for 754 frames

The figure 3.14 shows the PSNR for the embedded and extracted video of 754 frames. Here the PSNR is found to be 23db.

IV. Conclusion

Firstly, an overview of digital video watermarking applications and their challenges, such as the imperceptibility and security of a watermark, blind detection and robustness to attacks was provided. In the literature, a great deal of work has been undertaken by researchers to develop a digital image or video watermarking algorithm that deals with these issues. The watermark embedding techniques were classified based on the domain in which they embedded the watermark, including compressed, spatial and transform. Each technique was discussed in detail and some existing works related to them were then reviewed. Transform domain watermarking techniques were considered to be robust, stable and provide more imperceptibility than spatial and compressed domain-based approaches. We also discussed geometric-invariant watermarking techniques and surveyed relevant studies. After undergoing the several studies it can be concluded that video watermarking using wavelet transform is very secure watermarking technique .for image compression single value decomposition method used in the existing search papers.

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