An Efficient Implementation of Video Steganography on FPGA using DWT and LSB Algorithm

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Abstract: In this research I have proposed the method of video steganography for security purpose. Here the real time video is taken as the input for the cover file. By using the video as cover media we can hide our secrete information. For the embedding the cover file and the secrete image we have used the LSB substitution method, so the unauthorized people cannot extract the secrete image. After applying the LSB we get the stego image, which is then compressed by using the Lifting DWT method. Lifting DWT method is useful for compressing the image at different levels. The main purpose of the video steganography is to improve the security so we can transmit our important data securely. To increase the capacity we have used the Field Programmable Array Logic (FPGA) board. Here we have selected the Spartan3EDK tool for the implementation purpose.

Keywords: FPGA, Lifting DWT, LSB, Steganography.

1.Introduction:

In the cryptography method we encrypt the message for hiding the information, but the existence of encrypted message is known, so unauthorized user can get that information. So there are limitations and also many disadvantages of the cryptography. So, to avoid these problems and prevent our data from the unauthorized people we use another approach which is a digital Steganography. We can define the steganography as the art and science of hiding the secret information for the security purpose. Here we can use the different digital data such as text, audio and video as a cover media to hind secrete information. So, the third parties cannot detect the presence of the secrete data. Therefore, the steganography method is used for the embedding the secrete message into another digital data.

The main purpose of this work is to develop a Steganography by using video as a cover file, which is called as the video steganography. This video steganography provides the security as well as it will increase the computing speed. Here real time video is taken as the carrier file then that video file is converted into the number of frames. These number of frames are then saved as the images. From these images we will select the cover file. Then, the secrete image will embedded with the cover file by using the Least Significant Bit (LSB) substitution, which forms the stego image. The changes which are formed in the stego image are not visible to the normal human eyes. The main advantage of the using video as the cover media is the video has the large size than that of the image, so the capacity of the embedding the data will be increased. Redundancy is another advantage of using the video steganography. Frequency and Spatial domain methods are used in the video steganography. Discrete Wavelet Transform (DWT) is included in frequency domain technique and the LSB in a spatial domain technique, which are used in this project. For getting the secret image from the cover image we use the Inverse Discrete Wavelet Transform (IDWT) method, which is used for the decompression process at the receiver side. By dembedding the decompressed image we get the secrete image from the cover image at receiver side. Security key is provided at both embedding and dembedding process, which improves the security.

The main project is classified into two parts as. The steps are as follows:

1. At first real time video is converted into images from the frames and then the header file is created. Then the embedding process of cover file and secrete file is done by using LSB substitution with the help of the MATLAB software.
2. After that, by using Xilinx platform studio (Spartan3EDK tool) we have to implement the project.

The remaining paper is organized as follows. Block diagram is given in section 2. Section 3 explains the LSB substitution method which is used for the embedding process. Section 4 explains the Lifting DWT method for the compression purpose. In the section 5 there are implementation and the results are given. Conclusion, acknowledgment and the references are given the section 6, 7 and 8.

2.Block Diagram:

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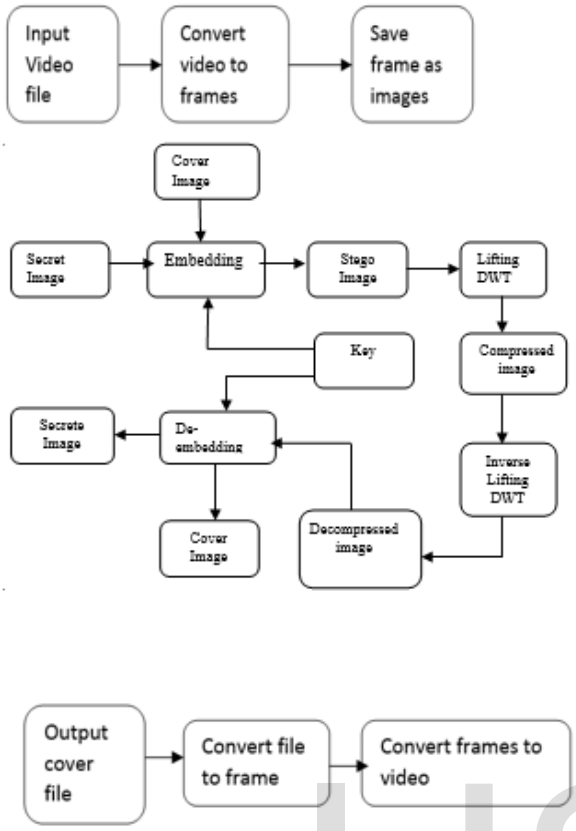


Fig 1: Overall Architecture Block Diagram

3.LSB Substitution:

For embedding the secrete image into the cover file we use the least Significant Bit (LSB) method is used which is quite simple and common. First we will convert video file into number of frames and after that we will convert each frame into image. After that, we will change the 8th bit i.e. Least Significant Bit of all the bytes to a bit of the secret data. Byte in the 24-bit image is represented by using the bit of the three color components i.e. red, green and blue. Hence, the 3 bits are stored in each pixel. Therefore the resulting changes to the least significant bits of the images are indistinguishable from the original by a human eyes.

Let, we will take an example of three pixels with the RGB encoding.

10010100 10001101 01010101
10100110 01101110 10001010
10011100 10010101 10011001

Here, with the RGB pixels of the cover image we will embed the number 150 which has the binary representation as 11001000. After that we will get the result as follows:

1001010**1** 1000110**1** 0101010**0**
1010011**0** 0110111**1** 1000101**0**
1001110**0** 1001010**0** 1001100**0**

In this embedding process only 4 bits are changed in the grid for embedding the message. Here, only half of bits from the cover image are need to be changed for hiding the secrete message.

4.Discrete Wavelet Transform:

Discrete Wavelet Transform is widely used in the applications of image processing. There are the different features of the DWT such as the compression of the image as well as the transmission of the image. Hence, here we have used DWT for image compression. By using the convolution or FIR filter structure DWT has been implemented.

In this project we have used the lifting based scheme of the DWT. Lifting DWT method splits the high as well as low pass wavelet filter into a sequence of the upper and lower triangular matrices, this is the main feature of the lifting based DWT. After that, it will convert the filter implementation into banded matrix multiplications. There are 3 steps are present in the lifting DWT. These are: Split, Predict and Update.

1. Split: In this step signal splits into even and odd coefficients.
2. Predict: In this step even samples and predict factors multiplied with each other, and obtained results are then added to the odd samples from which we get the detailed coefficient in high pass filter.
3. Update: Coarser coefficient can be obtained in low pass filter by multiplying the detailed coefficient from step 2 and the update factor and adding these results into the even samples.

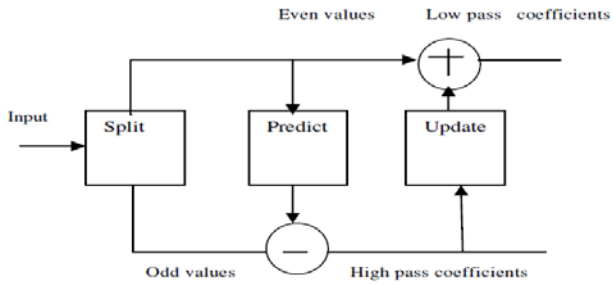


Figure 2: Lifting based DWT method

By using the lifting based DWT, we can compress the image at different levels. At the first level of compression there are four bands of image are formed as LL1, LH1, HL1 and HH1. Then at the next level LL1 band is again subdivided into the sub bands as LL2, LH2, HL2, and HH2. The image formed is more compressed than the first level. LL2 band is again subdivided into the four sub bands. The image formed at this level is also more compressed than the other two levels.

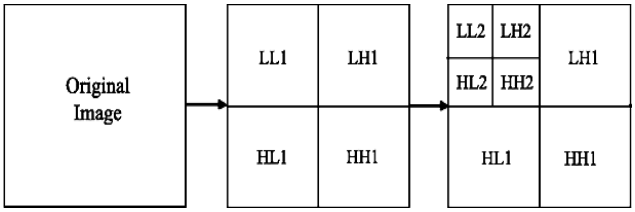


Figure 3: Block Diagram of Level 2-D DWT

5.Implementation and results:

The images shown in figure 4 are the input image and the secrete image which are embedded by using LSB substitution.

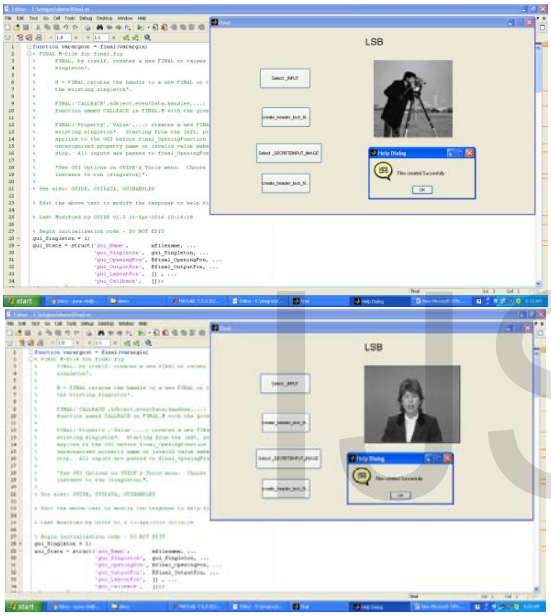


Figure 4: Input and Secrete image

After using the DWT and IDWT techniques following results are obtaind which are as shown in the figure 5.

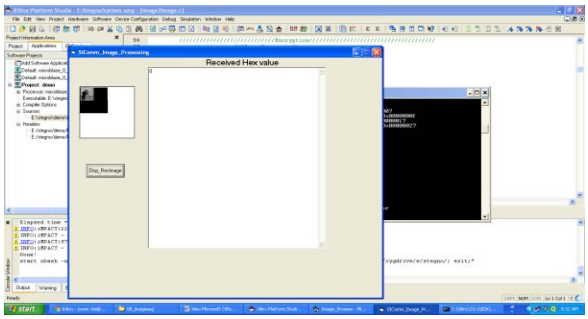


Figure 7: Stego Image

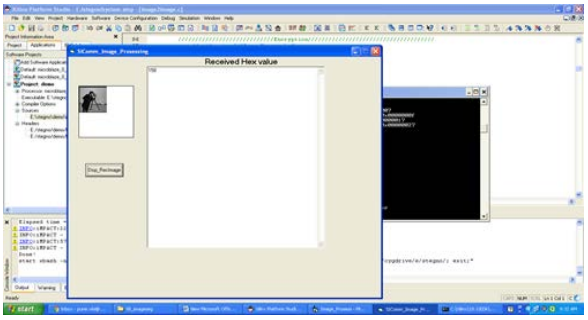


Figure 5: DWT and IDWT image

After implementing on the FPGA board the input image obtained is as shown in the figure 6 and the stego image with the secrete image is as given in the figure 7.

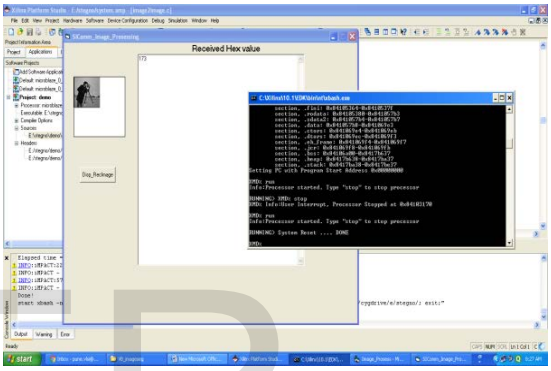
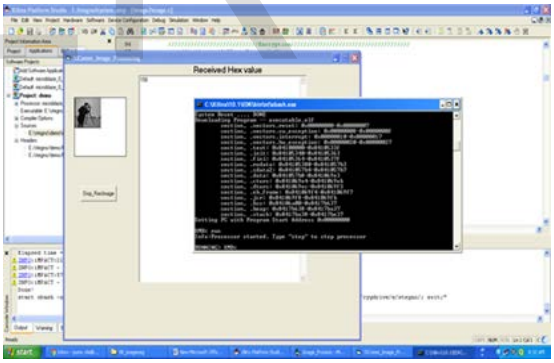


Figure 6: Input image with FPGA



6. Conclusion:

Here we have proposed a robust stegnographic method for hiding a secure information using a video as a cover media. Here, we have used LSB substitution scheme for embedding cover file and secret data with each other, because of which embedding capacity increases. After that, for the compression process we have used lifting DWT method. This lifting DWT provides us a secure way for hiding data. Then whole process is implemented on the FPGA board, which is used for the improving capacity. In this way, we can send our secrete information securely by using the video steganography process.

7. Acknowledgement:

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8. References:

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