

## Design and Development of IP for Modified Haar Wavelet Transform (MHWT) Image Fusion Using FPGA



**Sumant S. Yaligar**  
sumantbgm@gmail.com  
Ph. No: 0 95385 23815

<b>Student's Name</b>	<b>Sumant S. Yaligar</b>	<b>RTES (FT-2014)</b>
<b>Academic Supervisors</b>	Sanket Dessai	
<b>Industrial Supervisor(s)</b>		

**Keywords:** FPGA, Image Fusion, Modified Haar Wavelet Transform, Hardware Design

**Abstract:**

The modern technological advancements and progressive needs of human beings have led image processing as one of the popular subjects, in a particular image fusion. This is mainly due to fast growth in the field of digital imaging which is most used in remote sensing, bio medical and other satellite applications.

The necessity of robustness in embedded systems has led to a situation where system needs to store huge amount of data and process it as fast as possible. The tasks involved are complex and hence need larger computational power. This leads us to thinking of developing a specialized hardware which will considerably reduce the time consumed by the processes. Hence this constraint can be resolved by implementing Image fusion as reconfigurable design. Field Programmable Gate Array (FPGA) as name suggests, it has reconfigurable architecture and is considered as usable platform for image processing applications.

The specific algorithm considered for the process of image fusion for implementation of FPGA is Modified Haar Wavelet Transform (MHWT) based image fusion where at the time four pixels are consider in calculation of different bands as compared to conventional Haar wavelet based image fusion. The process of modification uses the far less memory and computation power hence it is ideal for hardware implementation. The FPGA implantation of MHWT based image fusion is done on Digilent development board with Spartan 6 series FPGA. The architecture is developed in VHDL. The timing analysis is performed and report is obtained for I/O interactions, memory units etc. The Architecture is made to run in co-simulation with Simulink. The design is tested with different kinds of images and run successfully.



**Design flow for MHWT based fusion**



**Multitemporal image fusion**

**Conclusions:** The pre-processing on FPGA allow increase in speed and quality of MHWT image fusion. The system behaves well with images with low noise content, especially medical images As seen in result section for result 1 and 2 consists of multi temporal medical images the fused image is much better compared to multimodal and multifocal images, the quality is analysed based on how much details and clarity is present in the image based on visual analysis. The system also gives good quality fused for over or under exposed images. Overall the Design is sleek, however there always scope for much more compression and further try to improve the quality of fusion can be done.