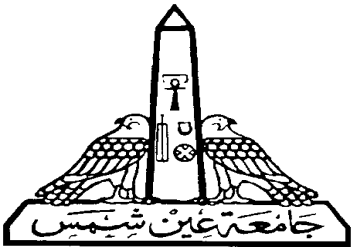

Ain Shams Universty
Faculty Of Engineering
Electronics and Communications Engineering Department

Enhancing Inter Frame Prediction in Advanced Video Codecs

A thesis submitted in partial fulfillment of the requirement of the Degree of Doctor of Philosophy In Electronics & Communication Engineering

Submitted by

Nahed Ali Saleh Bahran
M.Sc Degree in Electronic and Communication,
Faculty of Engineering, Assiut University, Egypt, 2011

Supervised by

Prof. Dr. Abd El Halim Zekry
Electronics and Communications Engineering Department,
Faculty of Engineering, Ain Shams University

Prof. Dr. Ismael Mohamed Hafez
Electronics and Communications Engineering Department,
Faculty of Engineering, Ain Shams University

Cairo-Egypt
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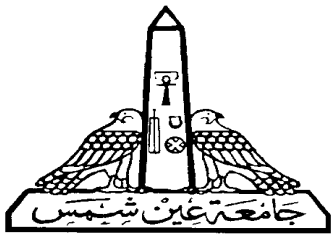

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FACULTY OF ENGINEERING
CAIRO-EGYPT
Electronics & Communication Engineering Department

EXAMINERS COMMITTEE

Student: Nahed Ali Saleh Bahran

Thesis: Enhancing Inter frame prediction in Advanced Video Codecs

Degree: Doctor of Philosophy in Electronics & Communication Engineering

Name, title and affiliation	Signature
1. Prof. El-sayed Mahmood El-rabaie Electronics and Communications Engineering Department, Faculty of Engineering, Menoufia University	…….
2. Prof. Wagdy Refa'at Anees Electronics and Communications Engineering Department, Faculty of Engineering, Ain Shams University	…….
3. Prof. Dr. Abd El Halim Abd Elnaby Zekry Electronics and Communications Engineering Department, Faculty of Engineering, Ain Shams University	…….
4. Prof. Dr. Ismael Mohamed Hafez Electronics and Communications Engineering Department, Faculty of Engineering, Ain Shams University	....…….

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Ph.D. of Science in Electrical Engineering (Electronics and Communication Engineering).

The work included in this thesis was carried out by the author at the Electronics and Communication Engineering Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis was submitted for a degree or a qualification at any other university or institution.

Signature:

Name: Nahed Ali Saleh Bahran

Date: 24/ 12 /2017.

Researcher Data

Name	:	Nahed Ali Saleh Bahran
Date of birth	:	1982
Place of birth	:	Ibb- Yemen
Academic Degree	:	M. Sc Degree
Field of specialization	:	Electronic and Communication Engineering
University issued the degree	:	Ain Shams University
Date of issued degree	:	2011
Current jop	:	Assisstant lecturer at Ibb University- Yemen

To the spirit of my father

To my beloved mother, brothers and sisters

To my wounded country "Yemen" which is suffered from a war

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ABSTRACT

In real time applications such as video streaming and video conferencing it is important that the video encoding/decoding is fast. H.264/MPEG-4 Part 10 or AVC (advanced video coding) is currently one of the most widely used industry standards for video compression. It has been developed to achieve significant improvements, in the compression performance, over the existing standards.

In fact, the high compression performance is accomplished by the implementation of intra and inter prediction techniques that remove spatial and temporal redundancies. Most video coding standards depend heavily on the use of inter frame prediction technique to obtain high compression efficiency. Inter prediction technique is developed by motion estimation (ME) and motion compensation (MC) techniques.

It is known, that most of the complexity of the H.264/AVC compression standard lies in the H.264 encoder. Motion estimation (ME) introduces high computational complexity. It consumes about 70% of the time required for H.264 encoder.

Several studies have been provided to reduce the complexity of the H.264 encoder and the compression time without affecting the quality of the video. In other words, many ME algorithms has been designed and implemented to overcome the problem of complexity and time consumption of the inter prediction technique.

In this thesis, a MATLAB design and implementation of Enhanced Predictive Zonal Search algorithm (EPZS) ME algorithm for H.264 AVC is presented.

This thesis also introduces a comparative study on the most popular ME algorithms using MATLAB. It presents that the EPZS algorithm is superior on the most common ME algorithms. From studying the ME algorithms utilized in the JM reference software “18.6”, EPZS ME provides the best results in terms of speed, video quality and data rate but there is no consideration about how it can be effectively implemented in hardware.

This thesis proposes, a novel hardware design and implementation of EPZS ME algorithm for H.264 AVC is presented. An efficient implementation of inter prediction process using EPZS algorithm as the motion estimation technique is realized. The resulting motion vectors are compared with that of the exhaustive search ME algorithm to verify its efficiency. The proposed design of EPZS is implemented in “VHDL”, simulated using “ModelSim SE 6.5”, synthesized using “Xilinx ISE Design Suite 13.3” and verified using “SIMULINK”. The proposed architecture provides a high speed and low hardware complexity implementation of H.264 encoder permitting its use in real-time applications of H.264 /AVC standard.

Also this thesis introduces two enhancement methods on the EPZS algorithm. These enhancements provide an improvement on the speed of the EPZS performance by about 18.05% without affecting the quality of the output frame.

Key words: Prediction, Motion Estimation, EPZS, VHDL, Codec.

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