Sudan University of Science and Technology

College of Engineering

School of Electronics Engineering

Simulation of Real- time Pitch Shifting Algorithm

A Research submitted in partial fulfillment for the requirements of the Degree of B.Sc. (Honors) in Electronics Engineering

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قال

{آتـونـي زبـر الحديـد حتى إذا سـاوى بـين الـصدفـين
قـال انـفـخوا حتى إذا جعله نـارا قـال آتـونـي
أفـرغ عـلـيه قـطرا (96)فـمـا اسطاعـوا أن
يـظهروه ومـا استطاعوا لـه نـقـبـا (97)قـال هذا
رحمة من ربـي فـإذا جـاء وعد ربي جعلـه دكـاء
وكـان وعد ربـي حقـا (98)}

صدق الله الـعظيم

سورة الـكهف الآيـة
{96-98}

DEDICATION

This dissertation work dedicated to our family and many friends,a special feeling of gratitude to our loving parents.

Acknowledgements

Wish to thank our god and our parents.

Also wish to thank various people for their contribution to this project.

*Special thank should be given to Dr. Rashed our research project supervisor for his professional guidance and valuable support***.**

Abstract

Pitch, known as the fundamental frequency, is one of the main characteristics of sound.

The purpose of this study is to change the pitch of a signal without changing its length.

The solution of this problem is PSOLA algorithm, which is the best method to shift pitch in musical industry application .

pitch-shifting algorithms can be divided into two categories; firstly time-domain which algorithm divided into three sections: a pitch detector(determine a fundamental frequency),a time compressor/expander(used to change the duration of the signal) ,and a pitch shifter(achieve a high quality output), secondly frequency-domain techniques like the time-domain technique is based on shifting small overlapping window blocks of data in time and resampling.

There are various methods of detecting and shifting pitch, but in the interests of simplicity, accuracy, and speed, a three step process is used.

المستخلص

الهدف من هذا البحث تغيير درجه الصوت دون تغيير في الطول وفي خصائص الصوت الأخري,ودرجه الصوت هي عباره عن التردد الأساسي وهو الخاصيه الرئيسيه في خصائص الصوت .

هذا التغيير الزي يحدث عباره عن ازاحه وهي نوعان اعتمادا علي السرعه والدقه والبساطه :

ازاحه في مجال الزمن.

ازاحه في مجال التردد.

في هذا البحث سوف نتطرق الي الازاحه في مجال التردد, وسنتناول الازاحه في مجال الزمن نظرا لبساطته وكفاءه خوارزمياته وسنتحدث عن احدي خوارزمياته بشكل اوسع .

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APPREVIATIONS

PSOLA	Pitch Synchronous Overlap Add
SSB	single-sideband modulation
STFT	ShortTime Fourier Transform
WSOLA	waveform similarity overlap and add
DFT	DiscreteFourier Transform
AMDF	Average Magnitude Difference Function
NFC-TSM	normlized filter correlation- time-scale modification
OLA	Overlap and Add
AC	Auto Correlation Function
GLS-TSM	Global and local search time scale modification

LIST OF SYMBOLS

g^(t)	anysignal
Xp[n]	the analytic signal
ω*c*	the amountof frequency shift in radians per second
X[n]	the input signal
TS	the sampling period
N	the total number of samples in a window.
K	k is the lag index
F	f is the detected fundamental frequency.
fs	the sampling rate
d	the distance (in sample points) between candidates j1 and j2
B	fine tuning parameter .
j	ranges from 1 to n (the number of pitch mark candidates).
h(j)	the height of candidate j in region i.
hmax and hmin	max and min of the signal.

Chapter One

Introduction

1.1 Introduction:

Pitch shifting is away to change the pitch of a signal without changing its length**.** In practical application, this is usually achieved by changing the length of the sound, using one of the methods and then performing a sample rate conversion to change the pitch. in general, pitch-shifting algorithms can be divided into two categories; firstly time-domain which algorithm divided into three sections: a pitch detector(determine a fundamental frequency) ,a time compressor/expander(used to change the duration of the signal) ,and a pitch shifter(achieve a high quality output), secondly frequency-domain techniques like the time-domain technique is based on shifting small overlapping window blocks of data in time and resampling[1].

High-quality techniques for pitch-shifting of audio and musical signals have received a lot of attention recently In multi-track audio recording and mixing, pitch-shifting is used to match the pitches of two recorded digital audio clips . Real-time pitch shifting algorithms can be used for performing deejays In music industry, pitch-shifting is used in sampling synthesizers, sound effects for Karaoke systems [2].

1.2 Problem Statement:

In many applications there is a need to create a change in the voice pitch without creating a change in the characteristics of the voice. Stretching the voice signal can result in distortion of the voice.

1.3 Proposed Solution:

Use computationally many efficient algorithms for altering the pitch and the length of digitally sampled sounds while maintaining the important characteristics of the original.

1.4 Research Aims and Objectives:

The aim of this design project is to simulate the best real-time speech pitch shifting algorithms in matlab and compare between ability to change the pitch without change the basic and important voice characteristic.

The project has several objectives:

• To explore and simulate several pitch shifting techniques.

•To implement and test of a suitable pitch shifting algorithm for high fidelity performance.

1.5Methodology:

Phase one:

Research for information knowledge.

Phase two:

Conduct a literature review to understand the work achieved in the area of pitch shifting.

Phase three:

Select algorithms to suit the intended application\ real time applications.

Phase four:

Understand information of algorithm parameter and calculation.

Phase five:

Recording the voice to used in test.

Calculation voice parameter such as pitch.

Determining the intended pitch shift.

Phase six:

Apply the algorithm with stated parameter.

Play the sound track to test pitch shift.

Analayize parameter.

1.6 Thesis Outlines:

In chapter one the statement of the problem, the proposal solution and methodology were discussed.

In chapter two discussion about audio and musical processing including the pitch shifting in frequency, time domain is presented; and other many algorithms in both time and frequency domain were discussed and a comparison table between many real time pitch shifting algorithms is also drawn.

In chapter three the best of this algorithm (psola)were discuss.

In chapter four we explain and simulate this algorithm.

In Chapter five include the conclusion of this project.