

---

---

## Hiding Techniques using MP3

Shamaa Shakeb

Dr.Ahmed S. Nori

*Ass. Lecturer*

*Ass. Prof.*

Dept. of Statistical and Info.

Dept. of Computer Science

College of Computer Sciences and Mathematics

University of Mosul

### Abstract

In last years, Steganography techniques involving audio file formats appear to be increasing in popularity. This may be attributed to the fact that current steganalysis tools available to the general public fall short when applied to audio files. Another factor that may be contributing to the increasing popularity is the widespread popularity of the MP3 file format and its ubiquitous presence on the Internet.

In this paper, an introductory look at steganography and the important methods for hiding data in audio is shown, as well as the strengths and weaknesses of each method. An overview about sound and their file formats especially MP3 file format and its attribute and features.

Here, some steganography techniques on sound (Low Bit Encoding, Phase Coding) has been used to apply them on MP3 file format which had been chosen as a cover for data transmission.

### MP3

MP3

MP3

MP3

**Steganography .1**

(Host)

Steganography

Graphy Steganos

[1][2] .Covered Writing

**Pure Steganography ❖**

**Secret\_key Steganography ❖**

.Stego\_key

**Public\_key Steganography ❖**

Public key

[3].Decoding Process Private key

**Hiding data in Audio .2**

(Human Audio System (HAS))

Noise

[4] .

**.3**

Bender (2000) •

[1] .

Cvejic (2004) •

[2]. Audio

[3] . Cummins •

(2008) Yan Audio

[4] . Audio

MP3 •

[5].(2009) MP3 Diquan

Wang Yan

[6] .MP3

Al-Rababah (2010) •

[7].MPEG MP3

MP3 .4

: .1.4

(1±)

[4].

.2.4

:MP3

**MP3 (Moving Picture Expert Group Layer III) .I**

.MP3

Frannhofer Institute

MPEG 1 layer 3

MP3

.MP3

[5][7] .

|       |                    | MP3                            | .II  |
|-------|--------------------|--------------------------------|------|
|       | (Frames)           | MP3                            |      |
| 32bit | Header             |                                |      |
|       |                    | MP3                            |      |
|       | .(1)               | .                              |      |
|       | : MP3              |                                |      |
|       | <b>Bit Rate</b>    |                                | .a   |
| Audio |                    |                                |      |
|       |                    | (Resolution)                   |      |
|       | :                  | MP3                            |      |
|       |                    | <b>Constant Bit Rate (CBR)</b> | •    |
|       |                    | <b>Variable Bit Rate (VBR)</b> | •    |
|       |                    | <b>Sampling Rate</b>           | .b   |
|       | Resolution         |                                |      |
|       | .(Hz)              |                                |      |
|       |                    | <b>ID3 Tags</b>                | .c   |
|       |                    | MP3                            |      |
|       | [6][8] .( ID3 tag) |                                |      |
|       | <b>MP3 Encoder</b> | <b>MP3</b>                     | .III |
|       | :                  |                                |      |
|       | .(20 kHz-20 Hz)    |                                | .a   |

.b

.(Simultaneous(Auditory)Masking)

.c

.(Temporal Masking)

: MP3

frames

.a

Bit Rate

.b

.c

(Human Psychoacustice)

(Huffman Coding)

.d

Header

.e

[6][7][8] .

MP3

(1)

| Sign | Length (bit) | Description  |
|------|--------------|--|
| A    | 11           | Frame sync (all bits set)  |
| B    | 2            | MPEG audio version (MPEG 1, 2, etc)  |
| C    | 2            | MPEG layer description (layer I, II, III)  |
| D    | 1            | Protection (if on, then check sum follows header)                                      |
| E    | 4            | Bit-rate index (lookup table used to specify bit-rate for this MPEG version and layer) |
| F    | 2            | Sampling rate frequency(lookup table)  |
| G    | 1            | Padding bit (on or off, compensates for unfilled frames)                               |
| H    | 1            | Privet bit (on or off, allows for application specific triggers)                       |

|   |   |  |
|---|---|--|
| I | 2 | Channel mode (stereo, joint stereo, dual channel, single channel)                |
| J | 2 | Mode extension (used only with joint stereo to conjoin channel data)             |
| K | 1 | Copyright (on or off)  |
| L | 1 | Original (off if copy of original, on if original)                               |
| M | 2 | Emphasis (respects emphasis bit in the original recording :now largely obsolete) |

**MP3** **.5**

Frames

MP3

32Bit

: MP3

4 bit

:(Bit Rate)

.I

.(2)

**Bit Rate**

(2)

| Bits Value | Bit Rate |
|------------|----------|
| 0001       | 32       |
| 0010       | 40       |
| 0011       | 48       |
| 0100       | 56       |
| 0101       | 64       |

| Bits Value | Bit rate |
|------------|----------|
| 0110       | 80       |
| 0111       | 96       |
| 1000       | 112      |
| 1001       | 128      |
| 1010       | 160      |

| Bits Value | Bit rate |
|------------|----------|
| 1011       | 192      |
| 1100       | 224      |
| 1101       | 256      |
| 1110       | 320      |
| 1111       | Bad      |

2 bit

:(Sampling Rate)

.II

.(3)

(3)

| Bits Value | Sample Rate |
|------------|-------------|
| 00         | 44100       |
| 01         | 48000       |
| 10         | 32000       |
| 11         | Reserved    |

.III Padding Bit :

0:Frame is not padded

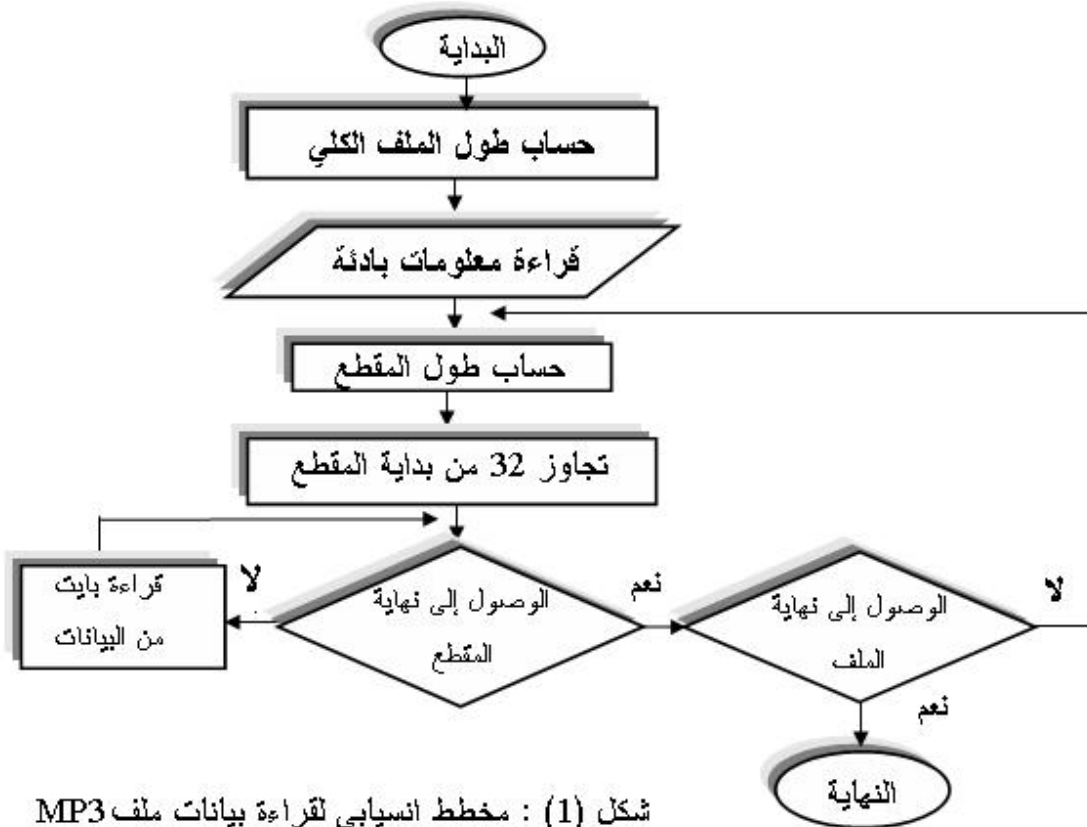
1: Frame is padded with extra slot

Frame Length in Byte =  $144 * \text{Bitrate} / \text{Sample Rate} + \text{Padding}$

[1][7] . MP3 byte slot

.MP3

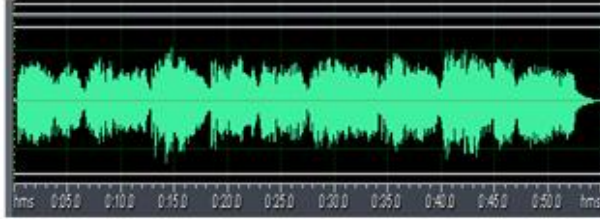
(1)



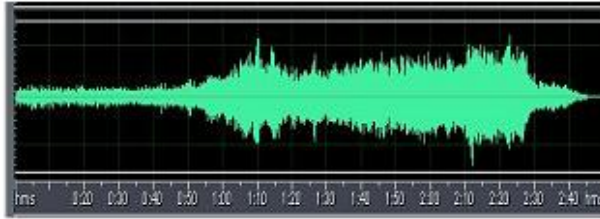
شكل (1) : مخطط انسيابي لقراءة بيانات ملف MP3

MP3

الشكل (2) الإشارة لملف MP3  
(تلاوة لصورة الفاتحة).  
بنسبة تعيان 44.1 kHz  
وسرعة البيانات 96 Kb.



الشكل (3) الإشارة لملف MP3  
(ملف موسيقي).  
بنسبة تعيان 48 kHz  
وسرعة البيانات 256 Kb.

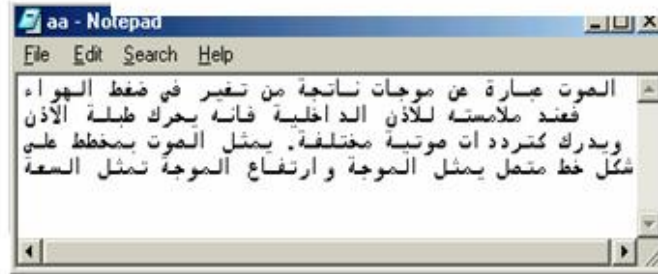


الشكل (4) الإشارة لملف MP3  
(فترات صوتية مستوية).  
بنسبة تعيان 44.1 kHz  
وسرعة البيانات 48 Kb.



شكل (5)

ملف نصي نوع TXT



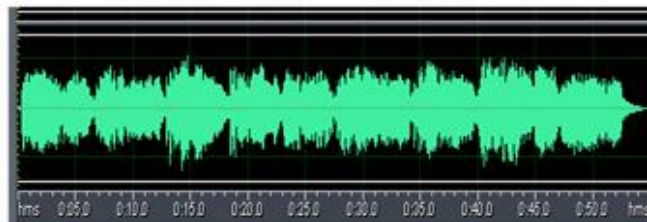
شكل (6)

ملف صورته نوع BMP



شكل (7)

ملف صوت نوع WAV

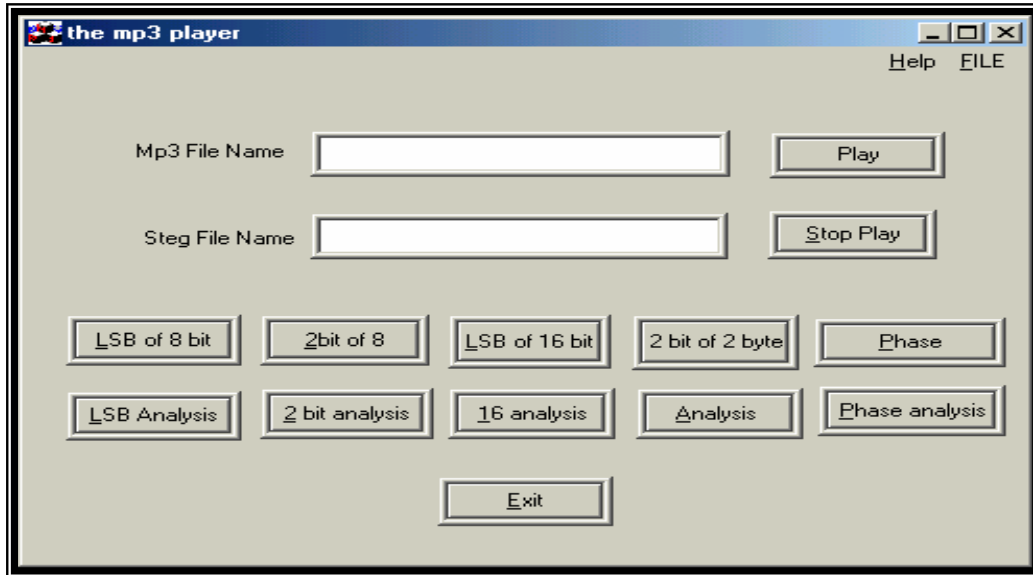




.( )

.7

:



(8)

:

**MP3** .I

file...open

.II

**MP3** .III

Visual

:

C++

PlayMP3 (char filename, int volume, int loop, priority).

:

: Filename •

.0-225 :Volume •

.False True :Loop •

True :Priority •

**.IV إيقاف التشغيل Stop Play :**

Close (); : MP3

**MP3 .8**

MP3

:

**Low Bit Encoding**



bit

**Phase Coding**



.Noise

**Low Bit Encoding**

**.9**

(LSB) Least Significant Bit

:

**Byte**

**.1.9**

**Byte**

**LSB**

**.a**

Byte

bit

:

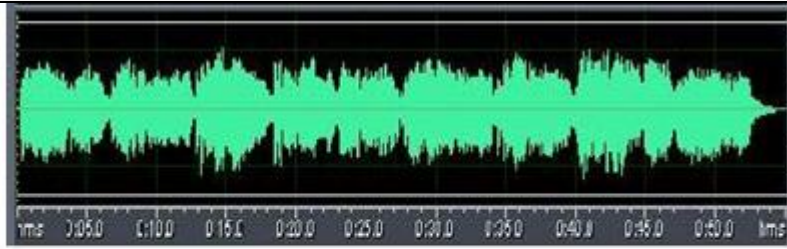
$$\geq [ 8 + ( \quad ) 8 + ( \quad ) 32 + \quad ]$$

$$[ 8 \div (( \quad ) 4 * \quad ) - \quad ]$$

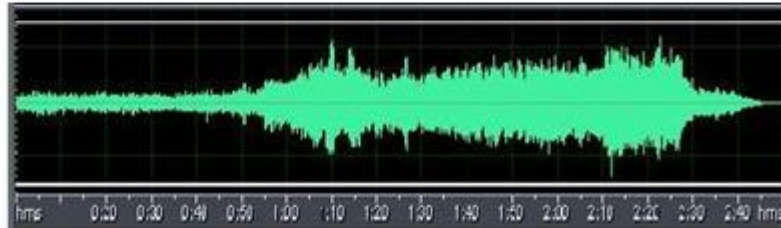
(9)

(10)

المنف الاول



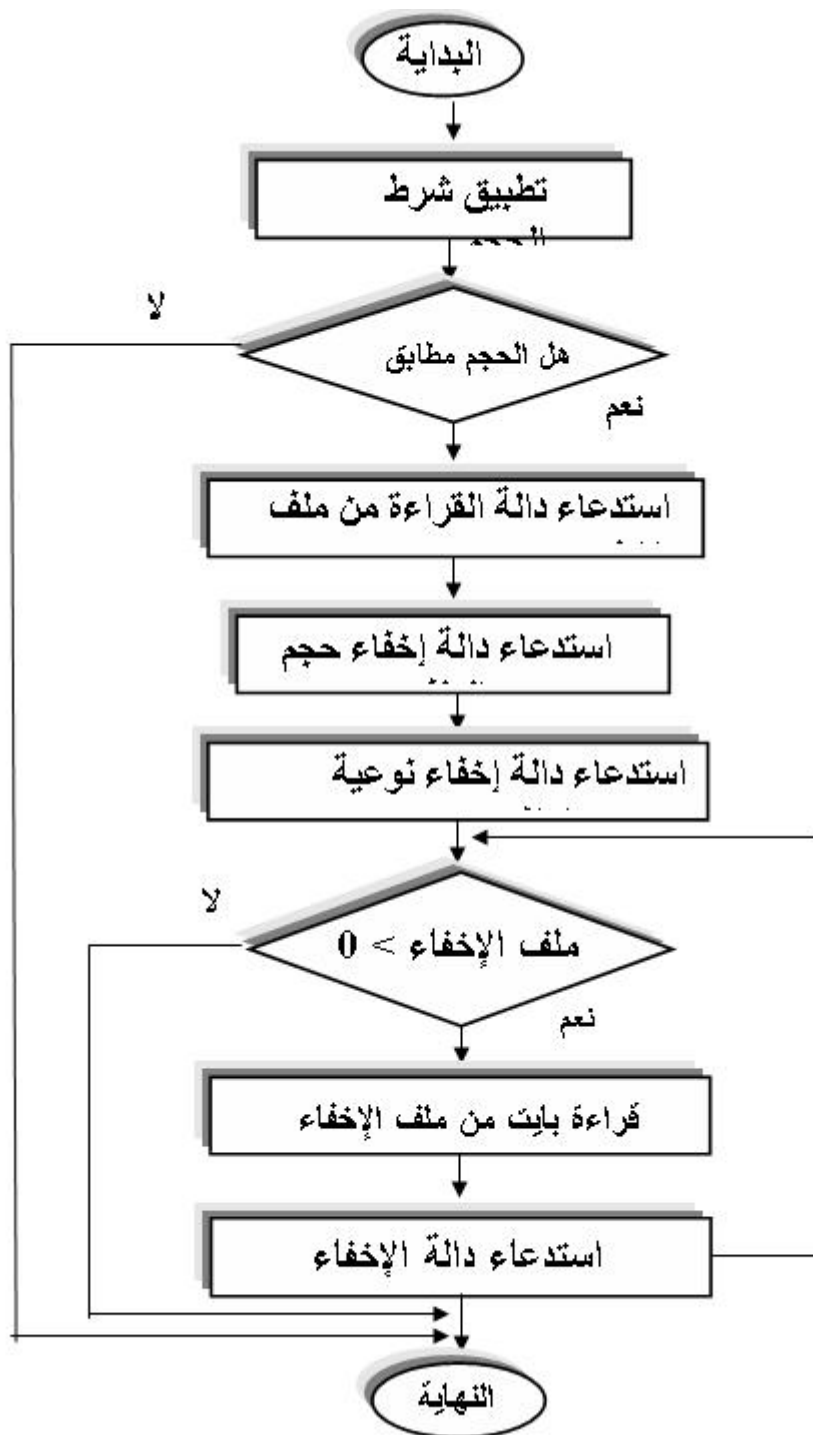
المنف الثاني



المنف الثالث



الشكل (9) النتائج بعد تغيير بت لكل بايت



(10)

.b 2LSB Bit

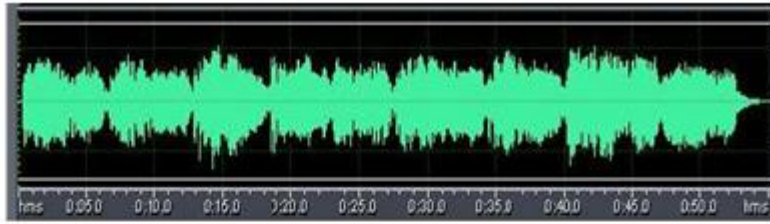
2bits

:

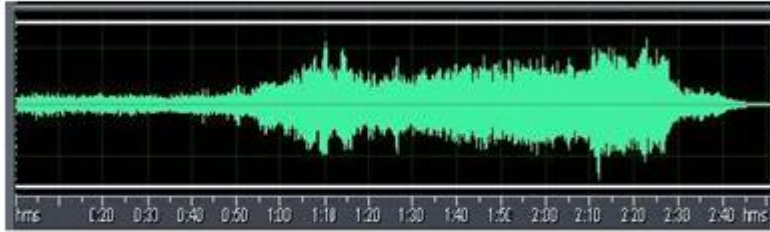
$$[ 4 \div (4)^* ) - \geq 4 + 4 + 16 + ]$$

(11).

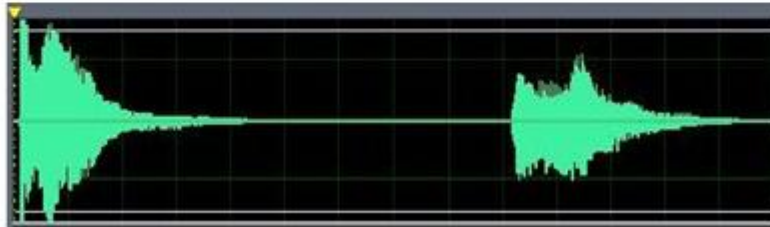
الملف الاول



الملف الثاني



الملف الثالث



الشكل (11) النتائج بعد تغيير 2LSB من كل بايت

2 byte .2.9

2 Bytes LSB .a

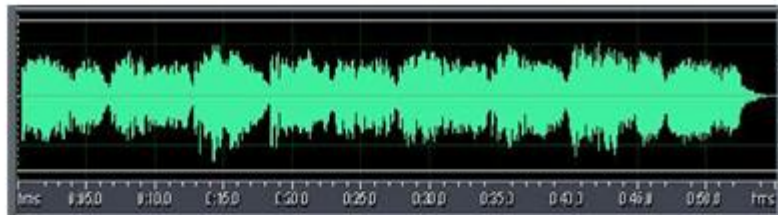
(2Bits)

:

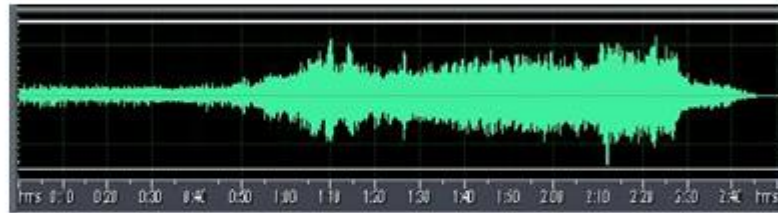
$$[16 \div (4^* \quad ) - \quad \geq 16 + 16 + 2 * 32 + \quad ]$$

(12)

الملف الاول



الملف الثاني



الملف الثالث



الشكل (12) النتائج بعد تغيير bit من كل 2byte

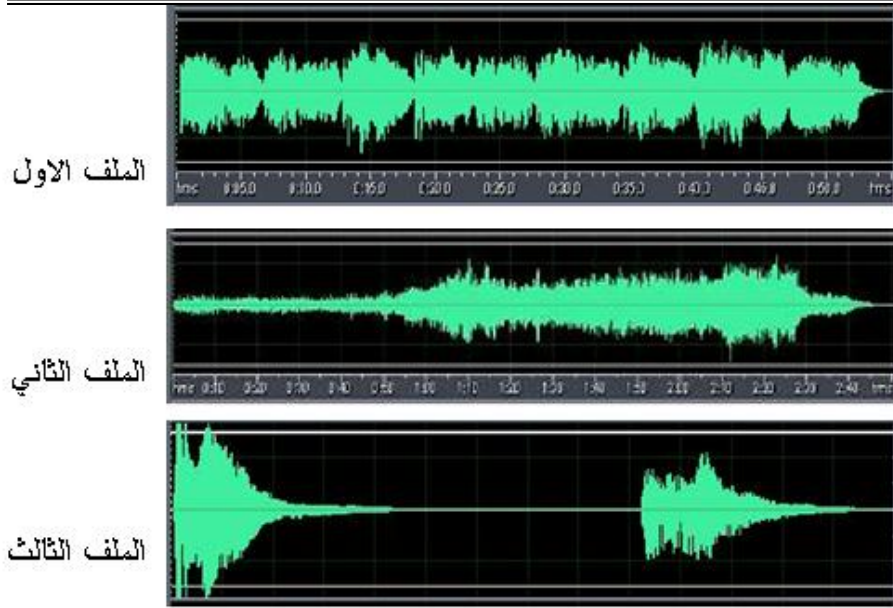
2Bytes 2LSB .b

(2bits)

:

$$[8 \div (4^* \quad ) - \quad \geq 8 + 8 + 32 + \quad ]$$

(13)

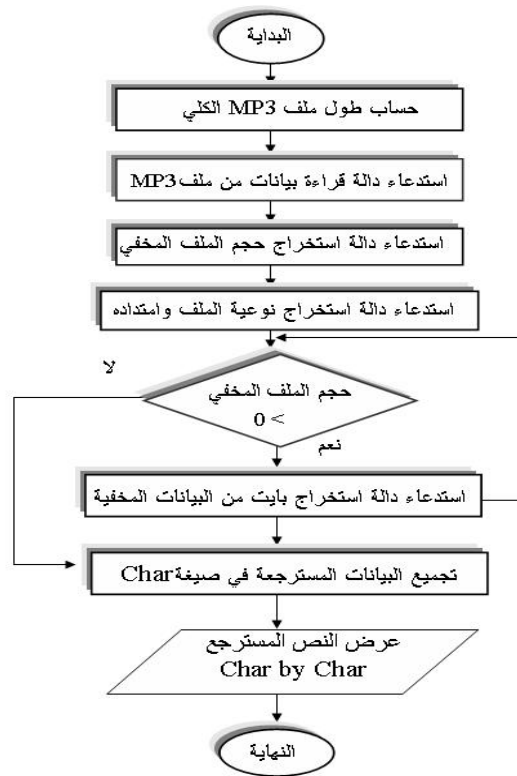


الشكل (13) النتائج بعد تغيير 2bits من كل 2byte

3.9

:

(14)



الشكل (14) عملية استعادة البيانات المخفية

—

---

**Phase Coding .10**

[1][8] :

.a  
 .b

Segmentation  
 Discrete Fourier Transform

$$F(u) = \frac{1}{N} \sum_{x=0}^{n-1} f(x) e^{-j 2 \pi u x / n} \dots\dots\dots (1)$$

: Magnitude Phase

$$\phi(u) = \tan^{-1} \frac{imag}{real} \dots\dots\dots (2)$$

$$|F(u)| = \sqrt{real^2 + imag^2} \dots\dots\dots (3)$$

.c

:

$$\Delta\phi(n+1) = \phi(n+1) - \phi(n) \dots\dots\dots (4)$$

.d

:

$$0 \longrightarrow \frac{\pi}{2}, \quad 1 \longrightarrow -\frac{\pi}{2}$$

.e

:

$$\varphi(n) = \varphi(data) \dots\dots\dots (5)$$

.f

$$\varphi(n) = \varphi(n-1) + \Delta\phi(n) \dots\dots\dots (6)$$

Original Magnitude                      New Phase

: Inverse Fourier Transform

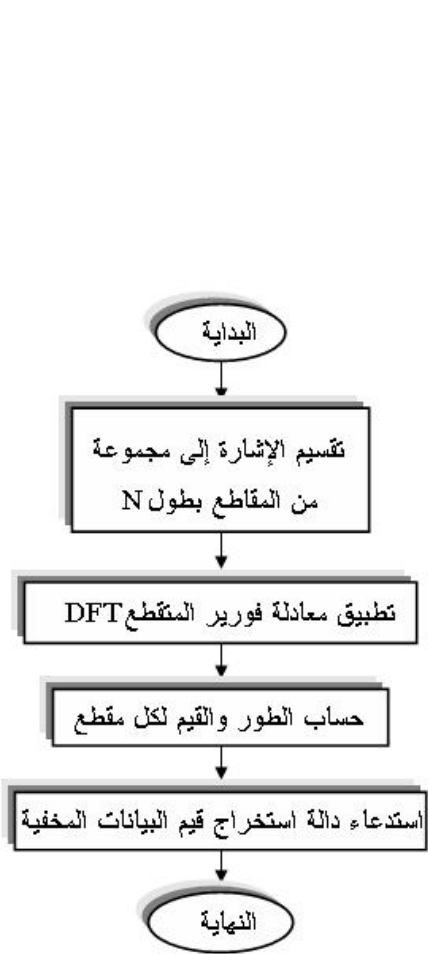
$$f(x) = \sum_{u=0}^{n-1} F(u) e^{j 2 \pi u x / n} \dots\dots\dots (7)$$

.g

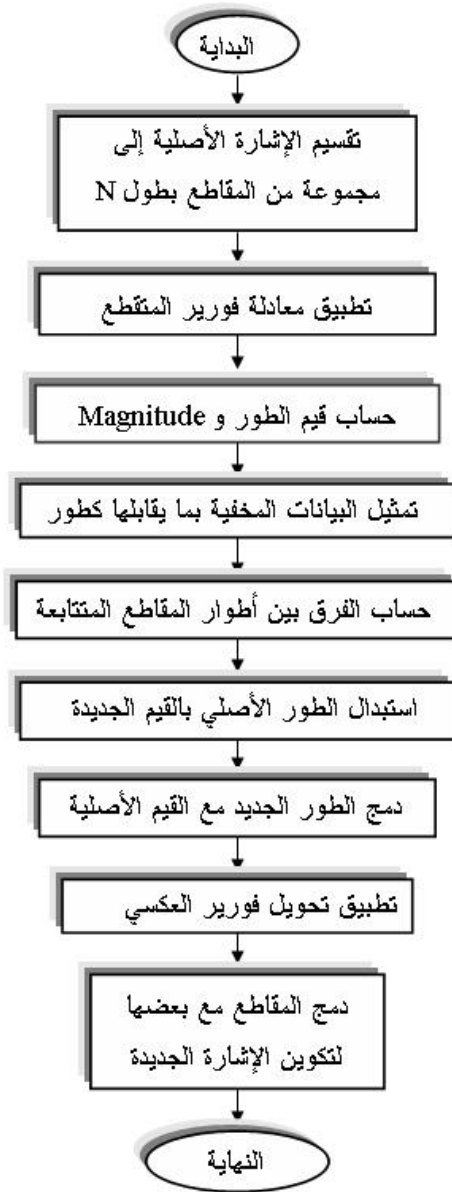
(16)(15)

.(17)

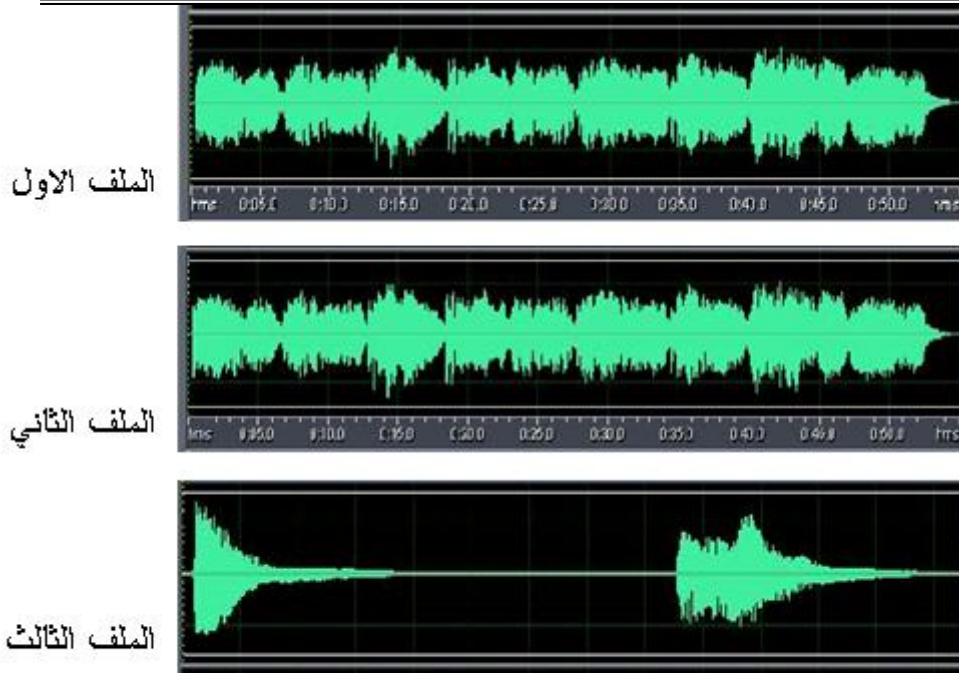




الشكل (16) مخطط انسيابي لعملية فك الإخفاء بطريقة استبدال الطور



الشكل (15) مخطط انسيابي لطريقة استبدال الطور



الشكل (17) النتائج بعد الإخفاء باستبدال الطور

.11

MP3

Bit Rate

Sample Rate

.( )

(4)

|      |       |                              |
|------|-------|------------------------------|
|      |       |                              |
| 99 % | (TXT) | <b>LSB<br/>(1Bit, 2Bits)</b> |
| 98 % | (BMP) |                              |
| 95 % | (WAV) |                              |
| 97 % | (TXT) |                              |
| 96 % | (BMP) |                              |
| 95 % | (WAV) |                              |

.12

1. Bender, W., et. al., (2000), "Applications for Data Hiding", IBM SYSTEMS JOURNAL, VOL 39, NOS 3&4.
2. Cvejic, N., (2004), "Algorithms For Audio Watermarking And Steganography", Department of Electrical and Information Engineering, Information Processing Laboratory, University of Oulu.
3. Cummins, J., et. al., (2004), "Steganography And Digital Watermarking", School of Computer Science, The University of Birmingham.
4. Yan, D. and Wang, R., (2008), "Reversible Data Hiding for Audio Based on Prediction Error Expansion", International Conference on Intelligent Information Hiding and Multimedia Signal Processing, IEEE, pp.249-252.
5. Diqun, Y., et. al., (2009), "Quantization Step Parity-based Steganography for MP3 Audio", Fundamenta Informaticae archive, Volume 97, Issue 1-2 (January), Pp:1-14 .
6. Yan, D. and Wang, R., (2009), "Huffman Table Swapping-Based Steganography For Mp3 Audio", Springer Sciences+Business Media.
7. Al-Rababah, O. A., (2010), "A Steganography Method Based on Hiding secrete data in MPEG/Audio Layer III", International Journal of Computer Science and Network Security, VOL.10 No.7, July.
8. <http://en.wikipedia.org/wiki/Mp3>