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Survey of Security Issues in Various Database Using Digital Watermarking Techniques

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***Abstract* – Database security is a challenging concept in database management systems. The use of various database technologies has increased incredibly over the last few years on the different database applications emerged as an important solution to provide copyright protection, tamper detection, traitor tracing, and maintaining integrity of database. In this paper, analysis of various research papers is done based on the issues of different databases, different database watermarking schemes and watermarking attack. The issues in various papers are discussed for the different database management systems. Finally, the comparisons graph is constructed for various databases in the areas concerned with the watermark schemes, security issues and watermark attacks. This analysis helps the technical people and research scholars to face challenges in the field of digital database watermarking.**

***Keywords* – Database Security, Security Issues, Digital Watermarking, Databases, Watermarking Attack.**

I. INTRODUCTION

The rapid growth of internet and distributed technologies are ability to access and distributed the digital contents [2]. The web based services such as database services, digital repositories and libraries, e-commerce, online decisions support system, etc. These internet based applications make the digital database such as digital images, video, audio, database content, multimedia database, software, XML documents, geographic information system data and relational database that are used in different application domain.

As a result, the digital database is challenges in piracy, ownership proof, owner identification, forgery, copyright protection, tamper detection, traitor tracing, and maintain- - ing integrity of database. Digital watermarking is defined as the imperceptibly altering a work in order to embed information about the work. In the recent years copyright protection of digital content became a serious problem due to rapid development in technology. Watermarking is one of the important techniques is used to solve the copyright protection problem.

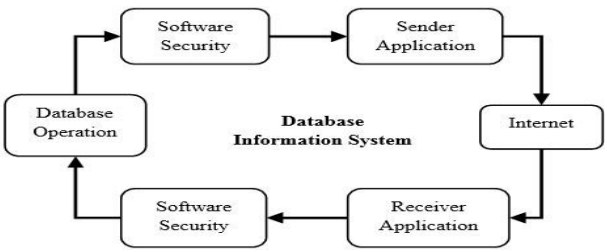

Fig.1. Generalized Architecture of Database Information System.

Initial stage, most of the digital watermarking was concentrated on watermarking of still images, audio, video, multimedia database, relational database, VLSI design etc. However, in the recent years watermarking of database systems started to receive attention because of the increasing use of it in many real-life applications. The comprehensive structure of database information system has been shown in Figure 1 which illustrates the flow of database objects.

II. RELATED WORK

Yuer Wang et al., [1], proposed an adaptive mechanism for watermarking relational database. This mechanism is adopted to choose an optimal embedding scheme for each datasheet according to its data characteristics based on predefined several fundamental schemes aiming at making distortion of the watermarked data to be smallest. The error-correcting coding technology and the majority voting principle are employed to improve the robustness of watermarking.

Mohamed Shehab et at., [2], proposed an optimization-based technique for watermarking of relational database. The watermarking of relational database as a constrained optimization problem and discuss efficient techniques to solve the optimization problem and to handle the constraints. This technique is resilient to watermark synchronization errors because it uses a partitioning approach that does not require marker tuples. Watermark decoding is based on threshold-based techniques characterized by an optimal threshold that minimizes the probability of decoding errors.

Min Huang et al., [3], proposed a New Watermark Mechanism (NWM) for watermarking of relational database using classifying and twice majority voting method, which pays much attention to data usability through relational structure and semantic constraints, marks each attribute separately.

Cong Jin et al., [4], proposed a conceptual framework for relational database based on secret sharing technology. Watermark technique to break the main secret into multiple parts and hide them individually in a relational database. The Lagrange Interpolating Polynomial method is used to recover the shared secret. The threshold scheme is used to decide the minimum number parts required to recover the secret data completely.

Jasmine Selvakumari Jeya I and Suganthi J [5], Medical images need to be transmitted with the patient's information without altering the image data. The present paper discusses secured indexing of lung CT image (SILI) which is a secured way of indexing the lung CT images with the

patient information. Authentication is provided using the sender's logo information and the secret key is used for embedding the watermark into the host image. Watermark is embedded into the region of Noninterest (RONI) of the lung CT image. RONI is identified by segmenting the lung tissue from the CT scan image.

Jiang-Bin Zheng et al., [6], proposed a Multi-Channel DWT domain for watermarking of image. Firstly, this DWT domain watermarking generates a watermarking template referring to one channel's DWT coefficients of the image. Secondly, this watermarking template is embedded into other DWT channel of this image. In both watermarking template and watermarking image undergo same geometric attack, self-synchronization between the embedded watermarking and watermarking image can obtained automatically during detecting watermarking.

Radu Sion et al., [7], proposed a watermarking technique that embeds watermark bits in the data statistics. The data partitioning technique used is based on the use of special marker tuples, which makes it vulnerable to watermark synchronization errors resulting from tuple deletion and tuple insertion. Chuanxian Jiang et al., [8], proposed a Discrete Wavelet Transform (DWT) for watermarking of relational database. This paper focus on the analysis of the wavelet high frequency coefficients of corresponding data and give the definition of the intensive factor. By employing the linear correlation detection method, this paper proposes the watermarking algorithm, which can embed the watermark into relational database successfully in DWT domain.

Mustapha Machkour et al., [9], proposed a mechanism using the content-based watermarking technique. The databases are encrypted and inserted in an image associated to it. Julien Lafaye et al., [10], proposed an optimized Fingerprinting System for relational Database using weight-independent constraints. An exhaustive one based on integer linear programming constraints solving and a scalable pairing heuristic used for reduce the computation time. The practical collusion-secure finger- -printing is based on binary alterations located at exactly the same positions. Watermark detection using false-hit and false-miss occurrence probabilities.

Chaokun Wang et al., [11], proposed an Arnold transform based method on watermarking relational data. ATBaM substantially improves watermark security by using image scrambling technology which could confuse the well-regulated watermarking information and diffuse errors. Jasmine Selvakumari Jeya I and Suganthi J[12], Watermarking of medical images greatly helps to provide authentication for safe storage and transmission of image databases. This paper presents a review on image watermarking algorithms for indexing medical images. We have attempted at embedding and extraction of both visible and invisible watermarking algorithms over a set of 23 patient's lung images. Jianhua Sun et. al., [13], proposed a novel multiple watermarking scheme, which embeds two image watermarks into relational database. Hsien-Chu Wu et. al., [14], proposed a SVR predictive function to obtain characteristic of the database and uses Huffman coding to encode the characteristic for compressing important payload information. In detection phase, minor and necessary additional payload information of the database is used to accomplish tampering detection.

Lintao Lv et. al., [15], proposed a semi-fragile watermarking algorithm resisting to RST. The algorithm can be used to verify the authenticity and integrity of image content. First the algorithm generates watermarking information by using the edge of the scaled image, and embeds watermarking information based on human visual system. Before detecting watermarking, the parameters of geometric distortions are estimated and restored by using the original moment information.

Radu Sion[16], proposed a novel method of rights protection for categorical data through watermarking. This method discovers new watermark embedding channels for relational data with categorical types and design novel watermark encoding algorithm.

Rakesh Agrawal et. al., [17] proved that watermarking technique is robust against various types of attacks. The watermarking technique ensures the bit positions of some of the attributes of some of the tuples contain specific values. The tuples, attributes within a tuple, bit positions in an attribute, and specific bit values are algorithmically determined under the control of the private key known only the owner of the data.

Xiangrong Xiao et. al., [18], proposed a novel robust watermarking algorithm based on the Second-LSB (Least Significant Bit). The algorithm first groups the data by the hash value of the primary key and positions with the second-LSB of the data in every group. The watermark is not directly embedded in one single item, but one bit is embedded into one group by setting a pseudo-random number to the LSB of the data. A threshold, which is used for detection to be compared with the occurrence frequencies of LSB positioned in embedding, and set according to the distribution probabilities of the data.

Fan Hong et. al., [19], proposed a novel neural network based image watermarking algorithm in wavelet domain is described. Firstly select some wavelet coefficient in zero trees from sub images of different resolutions according to different 2x2 pixel block, and then establish the relational model among these coefficients by using the neural network. Finally a bit of the watermark is embedded by adjusting the polarity between a high frequency coefficient and the output value of the model. In this method, the filter banks are regarded as the key to take overall control of the embedding process.

Kamran M et. al., [20], proposed information preserving watermarking scheme for the Electronic Medical Records (RMR) system. In this scheme the classification accuracy is never degraded by more than 1 percent. Jasmine Selvakumari Jeya I and Suganthi J[21], Ownership rights on outsourced relational database are extremely vital subject in today's internet surroundings and in much content sharing request, because the rapid growth of the internet and related technologies offered an unprecedented ability to access and redistribute digital content. Ying Wang et. al., [22], proposed a watermarking algorithm based on numerical attribute in relational databases. The watermarking is embedded by the Arnold transforming

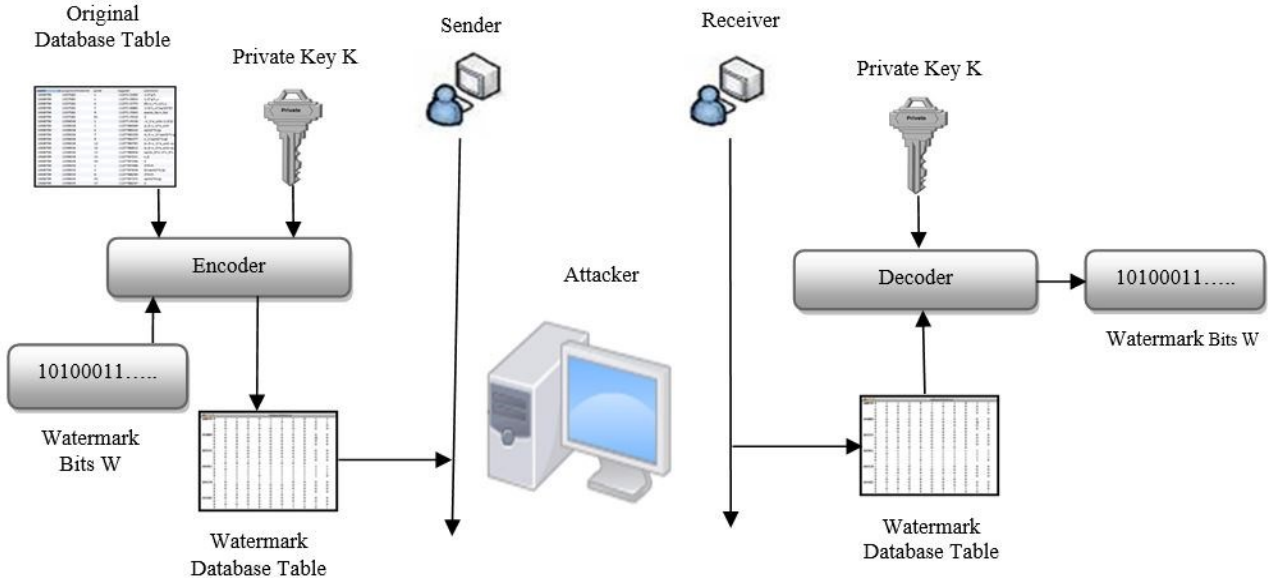

Fig. 2. Basics of Digital Watermarking.

and scrambling technology and modifying the parity of the low decimal number of numeric attribute in the physical storage space in the relational database.

III. Database Watermarking

In general, the database watermarking techniques consist of two phases:

1. Watermark Embedding
2. Watermark Verification

The Figure 2 shows the basic of watermarking techniques.

A. *Watermark Embedding*

In the watermark embedding a private key K is used to embed the watermark W into the original database. The watermarked database is made publicly available. The private key K is only known the owner of the database.

B. *Watermark Verification*

To verify the ownership of a database, the verification phase is performed where the database is taken as input and by using the private key K that is the same which is used during the embedding pages. Finally the embedded watermark is extracted and compared with the original database information.

IV. Application of Digital Watermarking

There are a number of possible applications for digital watermarking technologies and this number is increasing rapidly. For example, in the field of data security, watermark may be used for certification, authentication and conditional access. Certification is an important issue for official documents, such as identity cards or passports.

When database content is used for very critical application such as commercial transactions or medical applications, it is important to ensure that the content was originated from a specific source and that it had not been changed, manipulated or falsified. This can be achieved by embedding a watermark in the underlying data of the database. Digital watermarks for relational databases are useful in many applications shown in the Figure 3.

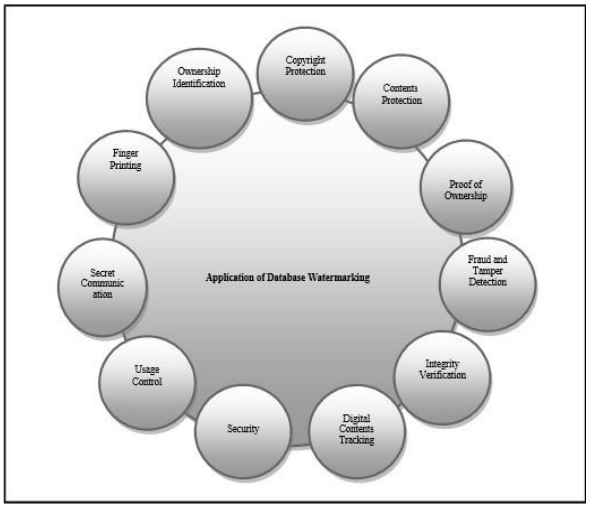

Fig. 3. Application of Database Watermarking.

V. Database Watermarking Issues

The important issues that arise in the study of digital watermarking techniques for relational databases are:

Robustness

Watermarks embedding in database should be robust against malicious or accidental attempts at removal without destroying the usability of the database.

Security

An unauthorized person cannot detect, retrieve, or modify the embedded watermark database used by the public key cryptography methods. Owner of the database should be the only one who has knowledge about them.

Imperceptibility

The watermark database should look like same as the original database to the normal eye. The viewer cannot detect that watermark is embedded in it.

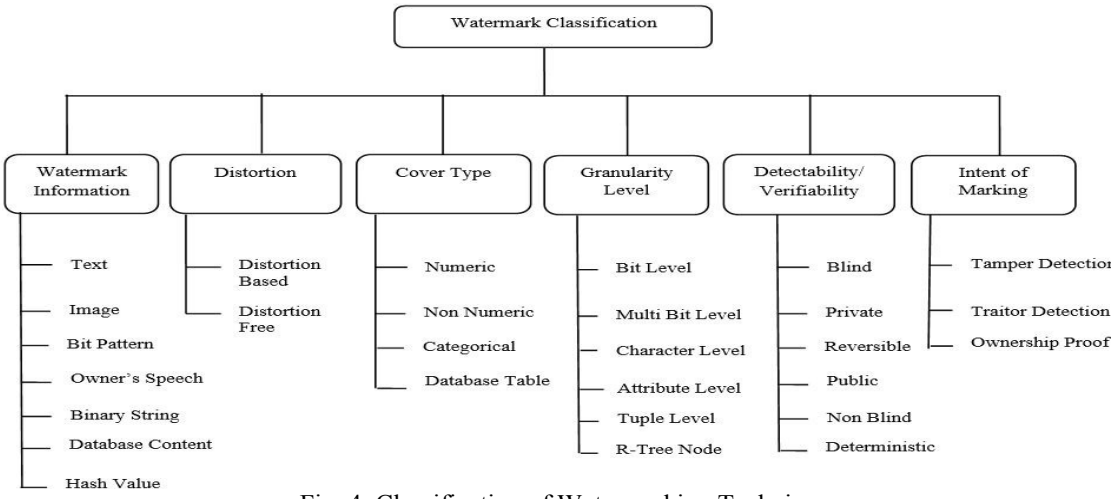

Fig. 4. Classification of Watermarking Techniques.

Data Capacity

It determines the optimal amount of data that can be embedded in a cover and the optimum way to embed and extract this information.

Usability

The changes in the data of the database during watermarking process should not degrade the usability of the data. The amount of allowable change differs from one database to another, depending on the nature of stored records.

Incremental Watermarking

After a database has been watermarked, the watermarking algorithm should compute the watermark values only for the added or modified tuples, keeping the unaltered watermarked tuples untouched.

False Positives and False Negatives

The false hit is the probability of a valid watermark being detected from unwater marked data, whereas false miss is the probability of not detecting a valid watermark from watermarked data that has been modified in typical attacks. The false hit and false miss should be negligible.

Public System

The watermarking system should assume that the method used for inserting a watermark is public. Defense must lie only in the choice of the private parameter.

Non Interference

If multiple marks are inserted into a single relational database, then they should not interfere with each other.

VI. Classification of Watermarking Techniques

The Watermarking techniques can be classified into different dimensions as shown in Figure 4.

Watermark Information

The different watermarking techniques embed the different types of watermark information.

Distortion

The watermarking techniques based on distortion based and distortion free based depending on the marking introduces any distortion to the underlying data.

Cover Type

The watermarking techniques can be classified based on the type of cover into which marks are embedded.

Granularity Level

The watermarks techniques performed by modifying or inserting information at different levels.

Verifiability

Verifiability will deterministic or probabilistic, it can be performed by various methods.

Indent of Marking

The watermarking techniques are designed to serve a purpose that is integrity, tamper detection, ownership proof and traitor detection.

VII. Empirical Analysis

In this section we discuss the different types of database, security scheme, security issues and security attacks and also analysis the comparison graph for the various schemes. Table 1 illustrates the types of database, watermarking scheme and security issues. In this table, analysis the following databases:

a. Relational database
b. Object-oriented database
c. Object-relational database
d. Image database
e. Numeric database
f. Categorical database
g. Medical database
h. Text database
i. Non-numeric database
j. Large database
k. Video database
l. Audio database
m. Multimedia database

Security issues are important concept in the database systems. So that discussed and listed the related security issues for each database security schemes. In Table 2 analysis the various types of attack for the relational database and watermarking schemes. There are three types of attacks was discussed in Table 2. They are

a. Insertion Attack

b. Deletion Attack
c. Alteration Attack

In each attack how many percentages of tuples are inserted, deleted and alerted and what is the percentage of watermark accuracy in each attack. Table 3 shows the accuracy and inserted tuples for relational databases. From this table illustrate the comparisons graph for the various types of attack in different watermark schemes. Figure 5 shows the watermark detection in insertion attack for the various watermarking schemes are compared and measured in percentage.

In Figure 6 shows the watermark detection in deletion attack and for various watermark schemes in accuracy and deleted tuples are measured in percentage. In Figure 7 compared and measured for watermark detection in alteration attack for various watermark schemes and alter tuples. Many research papers are discussed in digital image watermarks techniques for various databases attacks. Table 4 discussed the image watermark schemes with various types of attacks measured in watermark similarities and processing time.

Table 1. Assessment of Various Database, Security Scheme an Security Issues.

SNO	AUTHORS NAME	TYPES OF DATABASE	SECURITY SCHEME	SECURITY ISSUES
1.	Yuer Wang et at., [1]	Relational Database	Adaptive Mechanism for optimal embedding scheme	Piracy, Good Robustness, Good Invisibility
2.	Mohamed Shehab et at., [2]	Relational Database	Watermark optimization-based techniques using genetic algorithm and pattern search	Secure, Robustness, Accuracy
3.	Min Huang et al.,[3]	Relational Database	New watermark mechanism using classifying and twice majority voting method	Unobtrusive, Robust
4.	Cong Jin et al., [4]	Relational Database	Lagrange interpolating polynomial method and threshold scheme.	Secure, Robustness
5.	Jasmine et al., [5]	Medical Database	Indexing algorithm	Authenticated, Indexing
6.	Jiang-Bin Zheng et al.,[6]	Color Image	Multi-Channel DWT domain	High Robust
7.	Radu Sion et al.,[7]	Numeric Relational Data	A new mark encoding method using secure mapping	Secure
8.	Chuanxian Jiang et al.,[8]	Relational Database	Discrete wavelet transform	Robustness, Invisibility
9.	Mustapha Machkour et al.,[9]	Object –relational and object-oriented database	Content-based watermarking techniques and encryption techniques	Integrity, Confidentiality
10.	Julien Lafaye et al., [10]	Relational Database	Optimized fingerprinting system using weight-independent constraints	Robustness, Secure
11.	Chaokun Wang et al.,[11]	Relational database	An arnold transform based method	Security, Correction
12.	Jasmine et al.,[12]	Medical Database	Visible and Invisible Watermarking Algorithms	Indexing
13.	Jianhua Sun et al.,[13]	Relational Database	Multiple watermarking relational databases using image	Robust, Feasible
14.	Hsien-Chu Wu et. al.,[14]	Relational Database	SVR predictive difference method	Authentication
15.	Lintao Lv et. al.,[15]	Image Data	Resisting rst watermarking algorithm	Security
16.	Radu Sion et al.,[16]	Categorical Database	Novel watermark encoding algorithm.	Data Quality, Security
17.	Rakesh Agrawal et al.,[17]	Relational Database	Data partition and hashing techniques	Copyright protection
18.	Xiangrong Xiao et al.,[18]	Relational Database	A novel robust watermarking algorithm based on the second lsb.	Robustness, Blind Detection, Tuple order Independent, Invisibility
19.	Fan Hong et al.,[19]	Image Data	A semi-fragile watermarking scheme based on neural network	Security, Robust
20.	Kamran M et al.,[20]	Electronic Medical Records	Information preserving watermarking scheme	Accuracy, Robust
21.	Jung-Nan Chang et al.,[23]	Database	Difference expansion based on svr prediction	Tamper detection, Time efficient, Authenticate, Security
22.	Kaiyin Huang et al.,[24]	Relational Database	Cluster-based watermarking technique	Security, Quality, Invisibility
23.	Song Yige et al.,[25]	Relational Database	Robust watermarking algorithm based on dct transform	Robust, Invisibility
24.	Sardroudi, H.M. et al.[26]	Numeric Relational Database	A new watermark approach using image	Ownership Rights, Imperceptibility
25.	Xiaomei Dong et al.,[27]	Relational Database	An algorithm resistive to inevitability attack	Copyright Protection
26.	Xiaoxiao Fan et al.,[28]	Relational Database	A pre-process model of database watermarking based on metadata	Robustness, Effectiveness
27.	Farfoura et al.,[29]	Relational Database	A novel blind reversible method	Blindness, Robustness
28.	Ashraf Odeh. et al.,[30]	Relational Database	Binary image watermarking	Copyright Protection, Robustness
29.	Meng-Hsiun Tsai et al.,[31]	Database	Support vector regression	Tamper Detection

30.	Lizhong Zhang et al.,[32]	Textual and Numerical Database	Carriage returns character and linefeed character approach.	Proving Ownership
31.	Hanyurwimfura, D. et al.,[33]	Non-numeric Data	Text format based relational database watermarking	Blind Proving ownership
32.	Wang Yanmin et al.,[34]	Relational Database	Effective bits of numerical field	Robustness
33.	Yang Jian et al.,[35]	Relational database	A zero watermarking algorithm	Copyright Protection, Blind, Safety Robustness
34.	Sonnleitner, E. et al.,[36]	Large Database	A robust watermarking approach	Protect ownership, Non-Copyright, Non-intrusive, Blind, Reversible
35.	Roy,S. et al.,[37]	Image Database	Spread-spectrum method	Better performance, Robustness, False Alarm, Reduction of Distortion
36.	Yu Fu et al.,[38]	Relational Database	Novel watermarking algorithm	Security, Robustness, Protect data loss
37.	Lafaye,J. et al.,[39]	Relational Database	Watermarking security using ahk algorithm	Security, Robustness
38.	Ying wang et al.,[40]	Numeric Attribute	Arnold transforming and scrambling technology watermarking algorithm	Copyright protection, Strong Robustness
39.	Franco Contreras et al.,[41]	Medical Database	Robust lossless watermarking based on circular interpretation bijective transformations	Lossless Watermarking, Copyright protection, Integrity control Traitor tracing, Robustness
40.	Haiqing Wang et al.,[42]	Relational Database	Speech based algorithm for watermarking	Copyright Protection, Feasible, Effective, Robust
41.	Min Li et al.,[43]	Relational Database	An asymmetric watermarking scheme	Security, Integrity Verification, Distortion Free
42.	Zhongyan Hu et al.,[44]	Relational Database	An image based algorithm for watermarking	Copyright Protection, Effectiveness, Robust
43.	Xun,Zhao Huai et al.,[45]	Relational Database	Digital watermarking algorithm based on lifting wavelet transformation	Blind watermarking, Robust, Good Invisibility
44.	Zhang Gul-fang et al.,[46]	Database	A watermarking algorithm based on improved sharing secret scheme	Security, Increased data capacity, Resisting subset attack, Improved performance, Copyright protection
45.	Xiangrong Xiao et al.,[47]	Relational Database	Second lsb-dependent watermarking	Robust
46.	Changsheng Xu et al.,[48]	Multimedia Database	Content based audio watermarking	Improve inaudibility, Robustness
47.	Deshpande, A. et al.,[49]	Relational Database	Cryptographic hashing function(md5)	Piracy, Ownership rights, Robust
48.	Zhi-Hao Zhang et al.,[50]	Relational Database	Watermarking relational database	Robustness
49.	Chang-Hsing Lee et al.,[51]	Image Data	An adaptive watermarking technique	Robustness
50.	Chuan-Fu Wu et al.,[52]	Image Data	Image refining technique	Robustness, Imperceptibility
51.	Xia-Mu Niu et al.,[53]	Image Data	Gray level digital watermarking	Secrete, Robustness
52.	Chih-Wei Tang et al.,[54]	Image Data	A feature-based robust watermarking	Robustness, Reliable, Secure
53.	Chen Tao et al.,[55]	Image Data	Integer-to-integer wavelet transforms	Copyright protection, Invisible, Robust
54.	Jen-Sheng Tsai et al.,[56]	Image Data	Selection of optimal feature region set	Robustness
55.	Sha Wang et al.,[57]	Image Data	An image quality evaluation method	Copyright protection, Robust
56.	Chih-Chin Lai et al.,[58]	Image Data	Discrete wavelet transform and singular value decomposition	Imperceptibility, Robustness
57.	Xiangyang Wang et al.,[59]	Audio Database	Support vector regression	Robust, High practicability
58.	Natgunanathan, I. et al.,[60]	Audio Database	Robust patchwork-based embedding and decoding scheme	Robust
59.	Byeong-Seob Ko et al.,[61]	Audio Database	Time-spread echo method	Robustness, Good Performance, Good Imperceptibility
60.	Xiang-yang Wang et al.,[62]	Audio Database	DWT and DCT approach	Inaudible, Robust
61.	Wen-Nung Lie et al.,[63]	Audio Database	Low-frequency amplitude modification	High Quality, High Robustness
62.	XiaMu Niu et al.,[64]	Video Database	Multi resolution watermarking	Robustness
63.	Alattar,A.M.; et al.,[65]	Video Database	Digital watermarking of low-bit-rate	Robustness
64.	Doerr,G et al.,[66]	Video Database	Frame –by-frame approach	Security

Table 2. Assessment of Various Types of Watermarking Attacks for Relational Database.

AUTHORS NAME	DATABASE	SECURITY SCHEME	PERCENTAGE		
			INSERT ATTACK	DELETE ATTACK	ALTER ATTACK
Mohamed Shehab et at., [2]	Relational Database	Watermark Optimization-Based Techniques(WOBT) using Genetic Algorithm and Pattern Search	100% accuracy even when more than 100% of the tuples are inserted	100% Accuracy out of 80% of the tuples are deleted	100% Accuracy out of 100% of the tuples are altered
Radu Sion et al.,[7]	Numeric Relational Data	A New Watermark Encoding Method using Secure Mapping	50% accuracy even when 10% of the tuples are inserted	50% accuracy even when 10% of the tuples are deleted.	No systematic alteration scheme is defined
Yuer Wang et at., [1]	Relational Database	Adaptive Mechanism for Optimal Embedding Scheme(AMOES)	99.01 % Watermark Accuracy even when 90% of the tuples are inserted	69.89 % Watermark Accuracy even when 90% of the tuples are deleted	41.76 % Watermark Accuracy even when 90% of the tuples are altered
Min Huang et al.,[3]	Relational Database	New Watermark Mechanism (NWM) using Classifying and Twice Majority Voting Method	75 % Watermark Accuracy even when 50% of the tuples are inserted	70 % Watermark Accuracy even when 60% of the tuples are deleted(λ=10)	55 % Watermark Accuracy even when 50% of the tuples are altered
Cong Jin et al., [4]	Relational Database	Lagrange Interpolating Polynomial Method and Threshold Scheme	-	1% data lost when 100% tuples are deleted	-
Chuanxian Jiang et al., [8]	Relational Database	Discrete Wavelet Transform (DWT)	60 % Watermark Accuracy even when 40% of the tuples are inserted	60 % Watermark Accuracy even when 38% of the tuples are deleted	60 % Watermark Accuracy even when 37% of the tuples are altered
Radu Sion[16]	Categorical Type	Novel Watermark Encoding Algorithm	15 % Watermark Accuracy even when 65% of the tuples are inserted	-	-
Xiangrong Xiao et. al., [18]	Relational Database	A Novel Robust Watermarking Algorithm(NRWA) Based on the Second LSB	50 % Watermark Accuracy even when 90% of the tuples are inserted	90 % Watermark Accuracy even when 80% of the tuples are deleted	90 % Watermark Accuracy even when 100% of the tuples are altered
Deshpande, A. et al.,[49]	Relational Database	New Watermarking Technique using Cryptographic Hashing Function (NWTCH)	100 % Watermark Accuracy even when 80% of the tuples are inserted(for 16 bit)	100% Watermark Accuracy even when 75% of the tuples are deleted(for 16 bit)	100 % Watermark Accuracy even when 90% of the tuples are altered(for 16 bit)
Zhi-Hao Zhang et al.,[50]	Relational Database	Watermarking Relational Database using Image	-	-	15.2 % Watermark Accuracy even when 30% of the tuples are altered
Zhongyan Hu et al.[44]	Relational Database	An Image Based Algorithm for Watermarking (IBAW)	99.5 % Watermark Accuracy even when 100% of the tuples are inserted	100 % Watermark Accuracy even when 100% of the tuples are deleted	68 % Watermark Accuracy even when 80% of the tuples are altered
Xiaomei Dong et .al.,[27]	Relational database	An Algorithm Resistive to Inevitability Attack (ARIA)	85 % Watermark Accuracy even when 55% of the tuples are inserted	85 % Watermark Accuracy even when 50% of the tuples are deleted	85 % Watermark Accuracy even when 50% of the tuples are altered
Odeh, A et al.,[30]	Relational Database	Binary Image Watermarking (BIW)	60 % Watermark Accuracy even when 100% of the tuples are inserted	10 % Watermark Accuracy even when 90% of the tuples are deleted	30 % Watermark Accuracy even when 80% of the tuples are altered

Watermark Similarity is an output of the digital watermark bit compare with the original watermark bit in percentage. Processing Time is a time has taken for watermark embedding and watermark verification in second. Figure 8 compared and measured the image watermark similarity for the various image watermarking attacks from the original watermark information and extracted watermark information. Figure 9 shows the processing time of various watermarking schemes for various database attacks using watermarking processing time in seconds. In Table 5 compared and measured the PSNR value for the various types of attacks in different image watermarks schemes.

Table 3. Accuracy and Database Attack for Relational Database Watermarking.

SNO	WATERMARK SCHEME	INSERT ATTACK (%)		DELETE ATTACK (%)		ALTER ATTACK (%)	
		ACCURACY (%)	INSERTED TUPLES (%)	ACCURACY (%)	DELETED TUPLES (%)	ACCURACY (%)	ALTERED TUPLES (%)
1.	WOBT	100	100	100	80	100	100
2.	RDMT	100	100	100	95	100	100

SNO	WATERMARK SCHEME	INSERT ATTACK (%)		DELETE ATTACK (%)		ALTER ATTACK (%)	
		ACCURACY (%)	INSERTED TUPLES (%)	ACCURACY (%)	DELETED TUPLES (%)	ACCURACY (%)	ALTERED TUPLES (%)
3.	AMOES	99.01	90	69.81	90	41.76	90
4.	NWM	75	50	70	60	55	50
5.	DWT	60	40	60	38	60	37
6.	NRWA	50	90	90	80	90	100
7.	NWTCH	100	80	100	75	100	90
8.	IBAW	99.5	100	100	100	68	80
9.	ARIA	85	55	85	50	85	50
10.	BIW	60	100	10	90	30	80

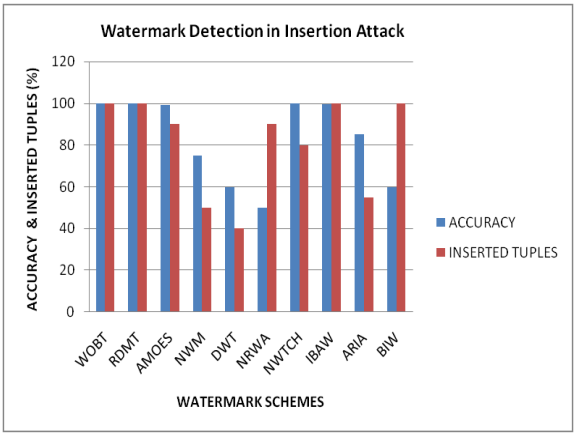

Fig. 5. Watermark Insertion Attack for Relational Database.

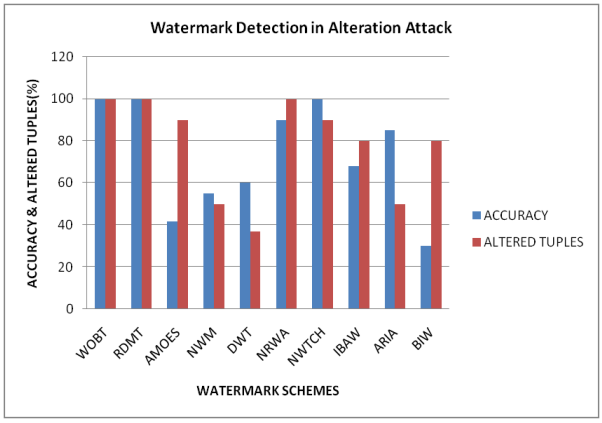

Fig. 7. Watermark Alteration Attack for Relational Database.

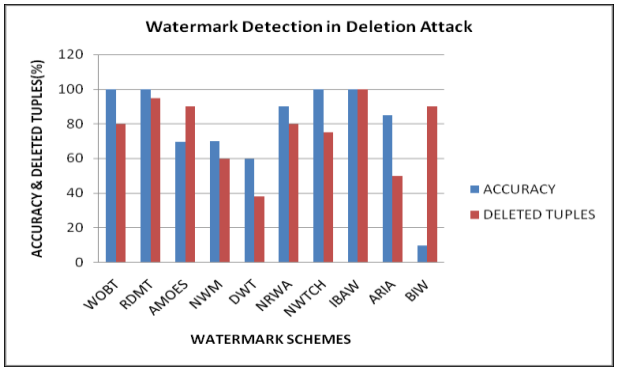

Fig. 6. Watermark Deletion Attack for Relational Database

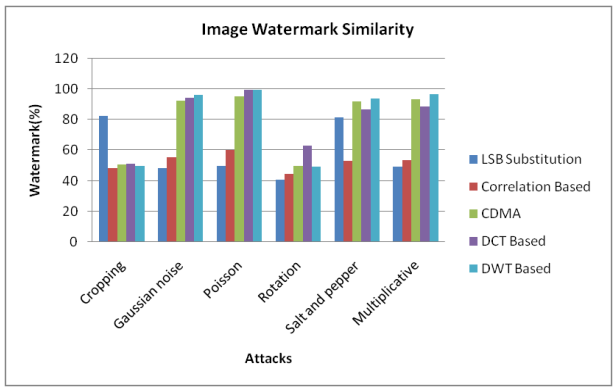

Fig. 8. Image Watermark Similarities for Image Watermarking.

Table 4. Assessment of Watermark Similarity and Processing Time for Various Image Watermarking Schemes.

AUTHOR'S NAME	WATERMARKING TECHNIQUES	TYPES OF ATTACKS	WATERMARKS (%)	PROCESSING TIME(S)
Nagaraj V. et al.,[74],2009 Anand Bora et al.,[67],2012	Least Significant Bit (LSB) Substitution	Cropping	82.60	00.29
		Gaussian noise	48.30	00.67
		Poisson	49.60	00.79
		Rotation	40.90	01.45
		Salt and pepper	81.60	00.67
		Multiplicative	49.40	00.65
Miyazaki A et al.,[75] ,2005	Correlation Based	Cropping	48.50	00.82
		Gaussian noise	55.60	00.90
		Poisson	60.30	01.06
		Rotation	44.60	03.62
		Salt and pepper	53.30	00.90

		Multiplicative	53.70	00.90
Deyun Peng et al.,[68], 2006	Code Division Multiple Access(CDMA)	Cropping	50.90	00.67
		Gaussian noise	92.70	05.34
		Poisson	95.50	05.50
		Rotation	49.80	10.51
		Salt and pepper	92.10	05.42
		Multiplicative	93.60	05.34
Chu, W.C. et al.,[70], 2006	Discrete Cosine Transform(DCT) Based	Cropping	51.10	03.23
		Gaussian noise	94.50	11.34
		Poisson	99.80	25.85
		Rotation	63.10	09.56
		Salt and pepper	86.60	18.13
		Multiplicative	88.70	19.26
Anand Bora et al.[67],2012	Discrete Wavelet Transform(DWT) Based	Cropping	50.00	12.27
		Gaussian noise	96.50	19.12
		Poisson	99.60	26.73
		Rotation	49.50	09.57
		Salt and pepper	94.10	17.68
		Multiplicative	96.70	19.41

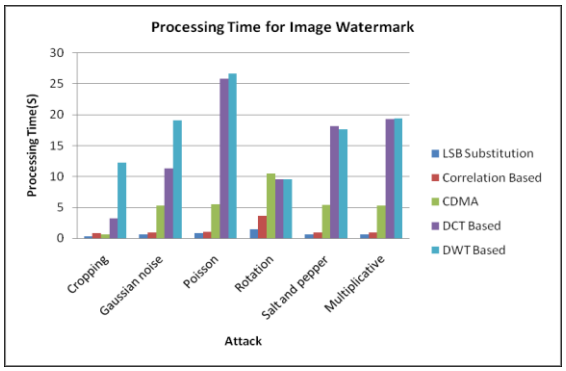

Fig. 9. Processing Time for Image Watermarking

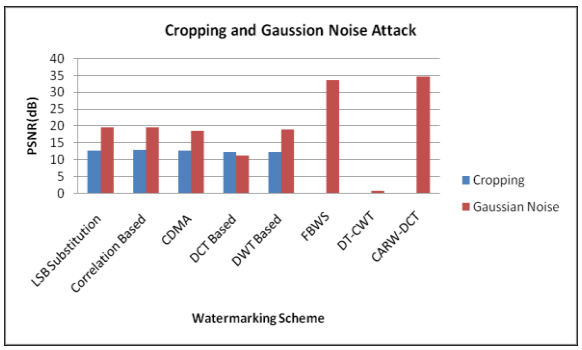

Fig. 10. Cropping and Gaussion Noise Attack for Image Watermarking

Table 5. Assessment of PSNR (dB) for Various Image Watermarking Schemes.

AUTHOR'S NAME	WATERMARKING TECHNIQUES	TYPES OF ATTACKS	PSNR (DB)
Nagaraj V. et al.,[74],2009 Anand Bora et al.,[67],2012	Least Significant Bit (LSB) Substitution	Cropping	12.85
		Gaussian noise	19.77
		Poisson	26.85
		Rotation	09.57
		Salt and pepper	18.12
		Multiplicative	19.41
Anand Bora et al.,[67],2012	Correlation Based	Cropping	12.93
		Gaussian noise	19.74
		Poisson	26.79
Miyazaki, A. et al., [75], 2005		Rotation	9.575
		Salt and pepper	18.27
		Multiplicative	19.45
Anand Bora et al.,[67],2012 Deyun Peng et al.,[68], 2006	Code Division Multiple Access(CDMA)	Cropping	12.78
		Gaussian noise	18.59
		Poisson	25.47
		Rotation	07.61
		Salt and pepper	17.31
		Multiplicative	19.16
Anand Bora et al.,[67],2012 Chu, W.C. et al.,[70], 2006	Discrete Cosine Transform(DCT) Based	Cropping	12.35
		Gaussian noise	11.34
		Poisson	25.85
		Rotation	09.56
		Salt and pepper	18.13
		Multiplicative	19.26
Anand Bora et al.,[67],2012	Discrete Wavelet Transform(DWT) Based	Cropping	12.27
		Gaussian noise	19.12
		Poisson	26.73
		Rotation	09.57
		Salt and pepper	17.68
		Multiplicative	19.41
Chih-Wei Tang et al.[69],2003	Feature-Based Watermarking Scheme (FBWS)	Medium Filtering	28.58
		Gaussian noise	33.73
		Requantization	07.78
		JPEG Compression	33.91
		Additive Uniform Noise	32.04
		Sharpening	22.24
Samira Mabtoul et al.,[72],2009	Dual Tree Complex Wavelet Transform (DT-CWT)	Gaussian noise	0.871
		JPEG Compression	0.935
		Medium Filtering	0.928
		Salt and pepper	0.932
Harsh K Verma et al.,[73],2009	CDMA Spread Spectrum in Spatial Domain	Brightness Attack (50%)	16.92
		Rotation attack(270degree)	11.82
	Comparison of Mid Band DCT	Brightness Attack (50%)	18.44
		Rotation attack (270 degree)	13.53
		Brightness Attack (50%)	22.61

	CDMA Spread Spectrum in Wavelet Domain	Rotation attack (270 degree)	16.25
Vikas Saxena et al.,[71], 2007	Collusion Attack Resistant Watermarking (CARW) DCT	JPEG Compression	39.99
		Histogram Equalization	34.67
		Zoom	34.67
		Brightness-Contrast Adjustment	34.67
		Hue-Saturation	34.67
		Gaussian Noise	34.67

PSNR is imperceptibility means that the perceived quality of the host image should not be distorted by the presence of the quality of a watermarked image, peak signal to noise ratio (PSNR) is typically used and it is based on mean square error. PSNR is measured decibels (dB). Figure 11 compared the PSNR value for the different image watermarking schemes in poission and rotation attacks in decibels (dB) and also Figure 12 compared the PSNR value for the different image watermarking schemes in salt and pepper noise and multiplicative attacks.

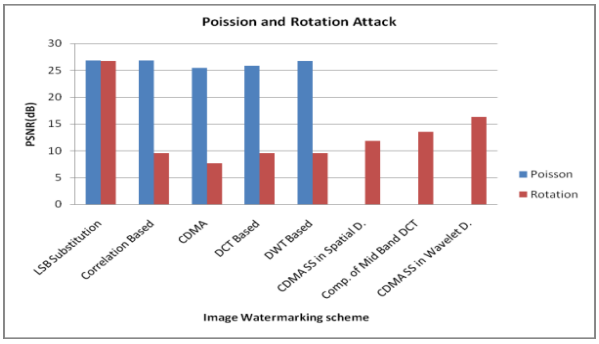

Fig. 11. Poission and Rotation Attack for Image Watermarking.

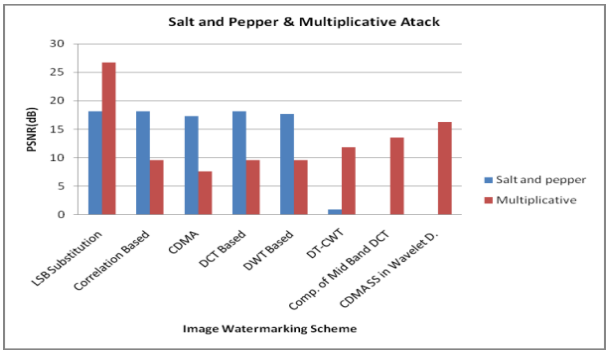

Fig. 12. Salt & Pepper and Multiplicative Attack for Image Watermarking.

VIII. Conclusion

In this survey the current state-of-the different watermarking schemes for the various databases like relational databases, image databases, audio databases and video databases are analyzed for security issues and an experimental analysis has been done and compared for various digital watermark relational database attacks. This paper will serve as a guideline for the researchers who want to do work in the field of security issues in digital watermark database so that they can have the knowledge of majority papers merged in this one.

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