

A Survey of Issues in Multimedia Databases

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ABSTRACT

Multimedia Database Security is a challenging concept in Database Management Systems. The use of Multimedia DBMS technology has increased terrifically over the last few years on the web as well as in several software applications. A multimedia communication system facilitates basic functions of Multimedia Database i.e. generation of multimedia data, its storage, and management, distribution, receiving, consuming, editing, and sharing, and so on. In this paper the different issues related to Multimedia Database Management System (MMDBMS) have been discussed. The challenges discussed by each paper reviewed in the field of Multimedia Database Management Systems have been analyzed. An empirical analysis has been done in the end to compare the issues stated by each author in literature. Due to this analysis it will help the technical people and research workers to avoid the indicated challenges while working in the field of Multimedia Database Management System (MMDBMS).

Keywords

Multimedia Database Management System, Database Management System.

1. INTRODUCTION

In the recent world everyone is dealing with multimedia everywhere. We have multimedia around us everywhere. Due to the evolution of information technology the importance of multimedia has enhanced. So, this is the reason that we have to structure the multimedia information in a structured order so that we may have information access whenever we require.

The multimedia data is not protected from unauthorized access. So, to cater for these security issues possible measures should be taken e.g. Data Analysis, Storage Management and Data Integrity should be checked to see how much the data in multimedia database is secure. While doing Data Analysis, Meta data management has to be done in order to do pattern matching. For Storage Management, the issues to be handled are access criteria for multimedia data types, and special index development. Data integrity checking includes maintenance of data by sustaining data quality, controlling concurrency, and multimedia updates recovery.

To keep multimedia databases secure and safe; is a difficult process e.g. command and control applications. In order to have a system secure completely and end to end security is needed i.e. there should be 100% secure multimedia database management system, secure networks, secure middle wares, and secure applications.

A comprehensive structure of Multimedia database information system has been shown in Figure 1 which depicts the flow of Multimedia data objects while processing.

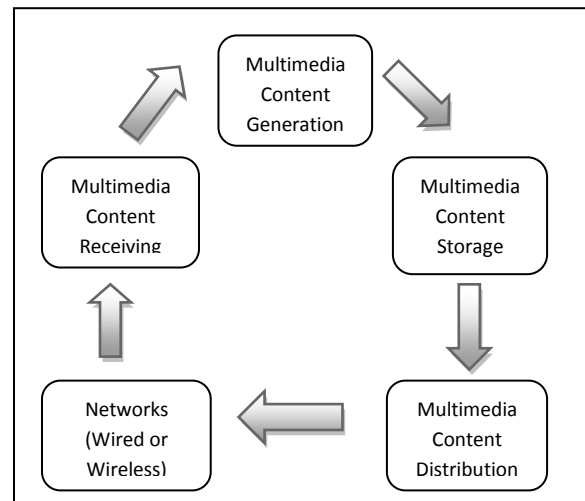


Fig 1: A Generalized Architecture of Multimedia Database Information System

1.1. Multimedia Data:

The objects of Multimedia data include texts, images, graphics, animations, video, sound recordings, music, signals etc. which are converted from different formats into digital media.

1.2. Database and Multimedia Database:

A database constitutes a controlled collection of data related to a given entity, and a Multimedia database is a controlled collection of multimedia data. They deal with such a huge amount of data which a simple DBMS is unable to deal.

1.2.1. DBMS and Multimedia Database Management System:

Database Management Systems constitute an organized set of data with the programs which are helpful for the definition, creation, storage, access, and querying of database. Multimedia Database Management System lies under multimedia information systems. A multimedia DBMS maintains multimedia data types, and provides services for the multimedia database creation, storage, access, query, and management. These are used when we have to deal with a huge amount of multimedia data objects of different types of data media.

A multimedia DBMS must provide basic functions of DBMS:

- Data independence
- Data modeling

- Data Creation
- Data organization
- Data retrieval
- Data Access [1]

1.3. Security of multimedia databases:

For editing and browsing the multimedia databases has a great security issue. While a person is editing or browsing a link; he should be properly checked that if he is authorized to do it or not e.g. films are edited and some portions of films are deleted, so, it should be taken into consideration properly to cater for security issues in this sense.

Similarly, multimedia transaction is another issue; in which the data from various locations is carried and is combined or simultaneously updated or edited.

Inference problem is also one of the major issues in MMDBMS indicated in this paper in which the user can see even those objects to which he is not authorized.

2. PROBLEM DEFINITION AND SCOPE OF SURVEY

A lot of problems are faced today due to multimedia security issues. In human being's life multimedia information applications have gained so much importance due to the large scale usage of mobile TV, digital libraries, video conferences and on-line chatting [7][8]. In general, the characteristics provided by a multimedia communication system are creation, organization, communication and consumption of multimedia data which includes images, texts, videos, audios, and animations, etc.

In this paper all the issues and problems which have been presented in different research papers in literature will be discussed and analyzed. A survey will be conducted to do a comparative analysis of the issues discussed by different authors focusing on the security and other emerging issues in Multimedia Database Technology.

3. RELATED WORK

There are various issues discussed related to Multimedia Databases in the research papers to be surveyed here [2, 3, 4].

Thuraisingham during a study [2] discussed Security and Privacy issues related to MMDBMS. The access control, security policies, security architecture and privacy problems which are being emerged from Multimedia Data Mining have also been explained in the paper. Also the security challenges being faced by the text, images, audio and videos have been discussed.

Security Policy:

The two kinds of security policies have been discussed by the author i.e. the security rules which are specific to some applications and secondly the security rules which are independent of any kind of applications. For these two kinds the security policy is such that, any user which is operating on a certain level is never authorized to access the multimedia data i.e. images, audio, and videos contained by any second user if the second user is at more sensitive level. The policy described is for multilevel purposes.

Architectures for secure MMDBMS:

The author has described certain architectures of secure multimedia database management system which is shown in Figure 2.

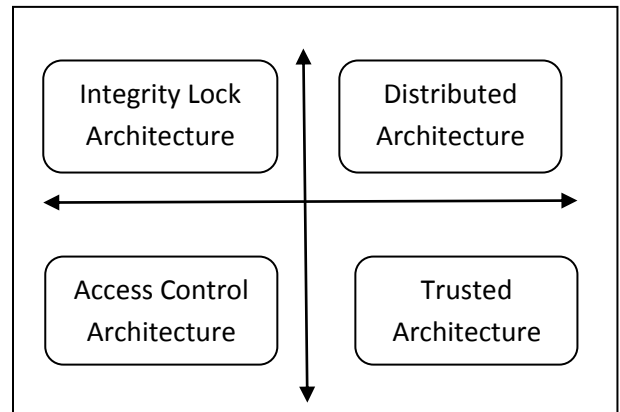


Fig 2: Architectures for secure Multimedia Database Management System

The architectures shown in Figure 2 are described as follows:

- **Integrity Lock Architecture:**

In this technique; in order to have a communication between multimedia data collector and multimedia data manager, a trusted agent at first calculates a cryptographic checksum for each multimedia data object which can be any kind of image, video or an audio. These data objects and checksums are stored in the database. Now, if the retrieved data is same as the data stored in the multimedia database then it means that it is the data without any kind of modification. It shows that the multimedia data manager is trust worthy.

- **Distributed Architecture:**

In this architecture; the data received by multimedia trusted agent can be either classified or unclassified data. If it is classified data then it is sent to classified data manager and if it unclassified data then it is sent to unclassified data manager.

- **Access control Architecture:**

The multimedia data is partitioned in this technique and operating system controls the access to this multimedia data i.e. unclassified and secret data are stored in their respective files. While querying this data is then recombined by the data manager. The data manager is not trusted in this technique.

- **Trusted Architecture:**

In this architecture the multimedia data manager is trusted in order to check the performance of above described architectures. The security issues related to Multimedia databases have been discussed by the author as stated in the next section.

Security issues:

For multimedia data base management information systems there is a need of secure system because this system has a huge effect on the applications like multimedia data mining, digital libraries, document publishing, and e-commerce etc.

The security issues related to above stated applications have been discussed in the paper; which are shown in Figure 3.

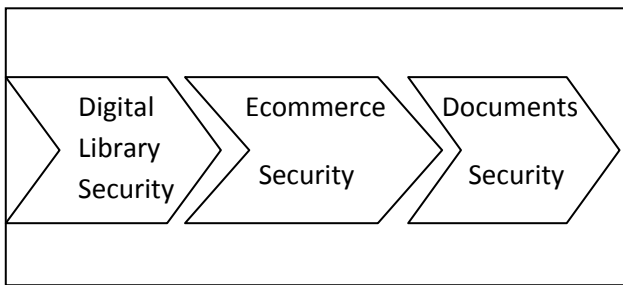


Fig 3: Security Issues of Multimedia Databases

The author presents the security issues shown in Figure 3 as the major issues faced by multimedia database management system and their description is as follows:

- **Secure Digital Libraries:**

These libraries contained digital documents which can be added, deleted, modified, and processed as required. The issue is that these documents which can be in the form of audio, video, text or images; can be accessed via traversing of the links. Therefore, safe and secure processing of queries, storage of data and management of this data is a big issue in digital libraries.

- **Secure Publication of Multimedia documents:**

The user should always get data to which he is authorized and also that some encryption technique should be adopted in order to forward exact data to the authorized user. So, the issue is to publish XML documents on web in the presence of untrusted third parties which may have unauthorized access to data and may modify it.

Yu and Brandenburg et. al [3] proposed the issues related to Multimedia DBMS in teaching in the classroom environment and the challenges faced by multimedia DBMS have also been proposed. Due to the large quantity of multimedia data being used by everyone now a days; it has also become a challenge for educators to do the best use of this data while teaching i.e. to efficiently access, browse, search and store data.

The problems associated with the applications used in classroom environment as discussed by the author are as follows:

- Face to Face courses
- E-Learning
- Distant education courses

The challenges faced by multimedia DBMS proposed in the paper are shown in Figure 4.

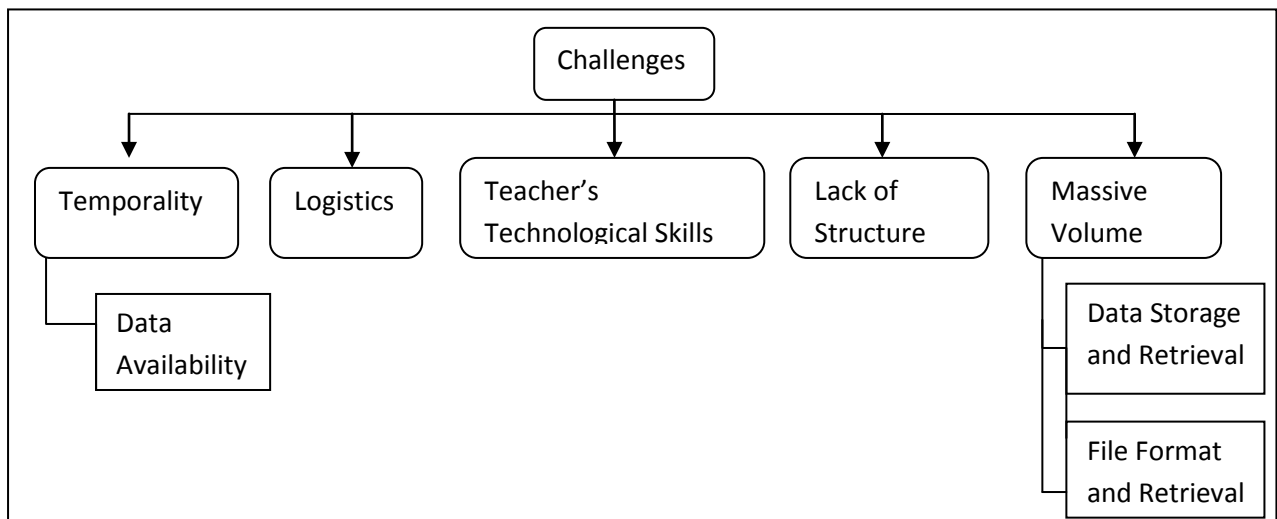


Fig 4: Challenges faced by MMDBMS

- **E-Commerce Security:**

In MMDBMS e-commerce is called multimedia commerce. The issue here is to have a secure process of interchanging the documents and transaction data. For that purpose XML and SMIL i.e. Synchronized Multimedia Language, have been suggested in order to have secure transaction and it is assured that this data will be examined by authorized users only.

The issues which author has summarized in Figure 4 are as follows:

- **Temporality:**

The multimedia databases which have time related requirements may have problems in storage, and presentation of data in contrast to spatial data.

- **Logistics:**

The processing of multimedia databases can be problematic if non standard media is used, but if some kinds of compression algorithms are used then security is assured.

- **Teacher’s Technological Skills:**

Due to the increase in the development of multimedia databases it is very much required that he should have latest upgraded knowledge according to the advancement in media.

- **Massive Volume:**

Multimedia databases need a device having huge capacity for storage of data.

- **Lack of Structure:**

There is the structure lack in multimedia databases due to which there is problem in searching and retrieval of data from multimedia databases.

The author concludes that if a teacher uses an efficient method for using applications of multimedia information then he will be able to achieve the goals required.

A. Natsey, J. R. Smith et.al [4] explained the problems associated with high level querying of multimedia data types. The problems have been identified by checking the multimedia data objects by applying certain conditions on that data. The author presented a model which was based on querying by concept method, where there was no criterion for searching in search engines.

Some key factors and challenges faced by the multimedia frameworks have also been suggested by the author which are as follows:

- Multimedia Querying
- Knowledge Representation
- Fuzzy Joining
- Extraction
- Storage and
- Matching

S. Lian et.al in the paper [5] provided a comprehensive evaluation of security of multimedia information system. A general architecture of multimedia information systems has been introduced, and also a mechanism for investigation of security issues for these systems has been provided.

In the first phase the security issues have been described in the paper, and in the second phase the latest security solutions have been provided to handle those problems. According to author in multimedia database systems the major factor is to handle the security protection. It has been proposed to do the protection in multimedia contents, service interaction and privacy must be ensured.

Security Issues:

The issues discussed in this paper are as follows:

- Confidentiality i.e. Security protection.
- Eavesdropping which may be active or passive
- Intrusion i.e. Unauthorized access (Access control)
- Forgery i.e. Modification of multimedia data

- Piracy i.e. Unauthorized use of material
- Privacy i.e. Traitor tracing (when data is sent to an un authorized customer)
- Ownership protection i.e. Watermarking
- Secure User Interfaces

The above described issues have been shown in Figure 5.

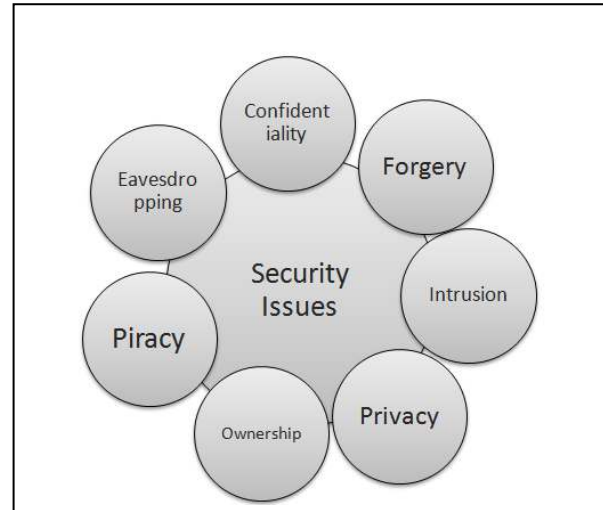


Fig 5: Security Issues

A general architecture of multimedia information system has also been proposed in this paper and also the solutions to above problems have been discussed in detail.

H. Kosch et.al explained during the study [6] a list of open issues that have developed due to the progression of Multimedia Database System. According to author, two main issues regarding Multimedia Databases should be taken into consideration which is as follows:

- **Issues on Multimedia Data modelling**

It comprises of storage mechanism, Querying and Representation for logical media structure, Meta data storage in database, and Interoperability for data sharing.

- **Issues on Multimedia Indexing, Querying and Presentation**

It comprises of Data storage and retrieval i.e. exchange of information, access control, efficient search, temporality, large volume.

The aim was to highlight the importance for a multimedia database system to use multiple representations of data for different Users and profiles, for Intellectual Property Management and for adaptation purposes.

Ozsu et.al [9] proposed the problems which a multimedia database might have while managing a huge amount of multimedia data. The multimedia data requires completely different kinds of specifications as compared to traditional database application requirements. In this paper some issues

related to MMDBMS have been discussed and a detailed overview of all the issues described is proposed.

Some of the challenges discussed in this paper are as follows:

- Access requirements of multimedia data and storage issue
- Huge volume of multimedia data
- Structure complexity
- Temporality
- Extensible Database management system requirement
- Access Control
- Shared Transaction handing competence

The author argued that the above mentioned required characteristics from multimedia databases were difficult to be maintained by relational database management systems due to a number of architectural issues. These architectural issues faced are as follows:

- Interoperability
- Scalability
- Integrity
- Querying and Fuzziness in querying
- Distributed databases functionality
- Quality of support

In the paper the concluded remarks were given representing that multimedia databases are rich of a lot of problems to be catered.

Adjeroh et al. during a research [10] proposed the requirements and challenges faced by multimedia databases during their management. The basic nature of multimedia data has first been described, and then the need for MMDBMS has been illustrated. After that the basic issues which are vital for the development of these MMDBMSs have been discussed in detail.

Security Issues:

The issues which should be taken into consideration while developing MMDBMS explained by the author are as follows:

- Temporality
- High volume of data
- Integration
- Privacy
- Integrity control
- Query Support

- Information retrieval capabilities
- Interface interactivity
- Quality of support
- Distributed architecture

The author concluded that the above mentioned issues are to be solved efficiently in near future so that there remains no data manipulation fault.

4. EMPIRICAL ANALYSIS

In this section the different issues and challenges faced during Multimedia Databases Management will be focused. These issues and problems are listed one by one and their frequency in the reviewed literature is also given in the tabular form.

• **Frequency:**

The frequency is calculated in such a way that the paper which has an issue not common in some other paper is evaluated as having frequency “1” whereas the papers which have the common issues have been given frequency equal to the number of papers having that issue. The frequency calculation has been shown in Table 1.

• **Percentage:**

The percentage of the challenges has been founded out of 7 research papers reviewed as shown in Table 1.

• **Criticality [11]:**

To find the measure of frequency of occurrence of an issue the Criticality factor is divided into four parts i.e. Medium, Moderate, High and Very High. The percentage range for criticality is defined in Table 1:

Table 1: Percentage of Criticality

Percentage	Criticality
10-20 %	Medium
20%-50%	Moderate
51%-80%	High
81%-100%	Very High

The detail of the MMDBMS Challenges is shown in the Table 2 with the frequency of occurrence. The Percentage out of 7 papers, frequency and criticality has been shown in Table 3.

Table 2: Frequency of occurrence

MULTIMEDIA DATABASE MANAGEMENT CHALLENGES	Paper [2]	Paper [3]	Paper [4]	Paper [5]	Paper [6]	Paper [9]	Paper [10]
1. Security Protection	✓			✓			

2. Privacy	✓			✓			✓
3. Access Control	✓			✓	✓	✓	✓
4. Integrity	✓					✓	
5. Distributed Architecture	✓					✓	✓
6. Lack of Structure		✓				✓	
7. Temporality		✓			✓	✓	✓
8. Massive Volume		✓				✓	✓
9. Logistics		✓					
10. Interoperability					✓	✓	
11. Data Storage and Retrieval		✓	✓		✓	✓	✓
12. Query Support			✓		✓	✓	✓
13. Quality of Service						✓	✓
14. Interface interactivity				✓			✓
15. Efficiency					✓		
16. Eavesdropping				✓			
17. Intrusion				✓			
18. Forgery				✓			
19. Piracy				✓			
20. Ownership				✓			
21. Fuzzy Joining			✓			✓	
22. Extraction			✓				
23. Knowledge representation			✓				
24. Teacher's technological skills		✓					

The Table 2 presents the papers which have common and uncommon issues related to multimedia databases.

With the help of data obtained in Table 2 we can calculate the percentage and criticality also as shown in Table 3.

Table 3: Empirical Analysis of Multimedia Database Management Issues

MULTIMEDIA DATABASE MANAGEMENT CHALLENGES	FREQUENCY Out of 7 papers	PERCENTAGE	CRITICALITY
1. Security Protection	2	28.57 %	Moderate
2. Privacy	3	42.86%	Moderate
3. Access Control	5	71.43 %	High
4. Integrity	2	28.57 %	Moderate
5. Distributed Architecture	3	42.86 %	Moderate
6. Lack of Structure	2	28.57 %	Moderate
7. Temporality	4	57.14 %	High
8. Massive Volume	3	42.86 %	Moderate
9. Logistics	1	14.28 %	Medium
10. Interoperability	2	28.57 %	Moderate
11. Data Storage and Retrieval	5	71.43 %	High
12. Query Support	4	57.14 %	High
13. Quality of Service	2	28.57 %	Moderate
14. Interface interactivity	2	28.57 %	Moderate
15. Efficiency	1	14.28 %	Medium
16. Eavesdropping	1	14.28 %	Medium
17. Intrusion	1	14.28 %	Medium
18. Forgery	1	14.28 %	Medium
19. Piracy	1	14.28 %	Medium
20. Ownership	1	14.28 %	Medium
21. Fuzzy Joining	2	28.57 %	Moderate
22. Extraction	1	14.28 %	Medium
23. Knowledge representation	1	14.28 %	Medium
24. Teacher's technological skills	1	14.28 %	Medium

4.1. Graphical Representation:

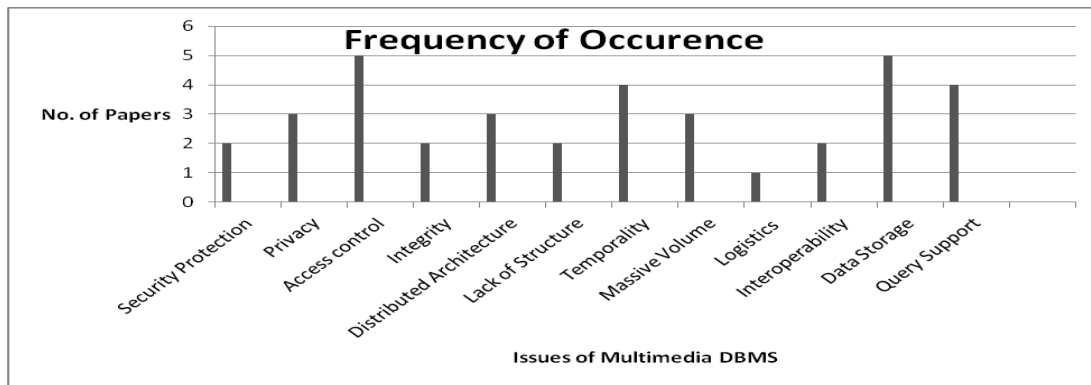


Fig 6: Frequency of Occurrence of the Issues

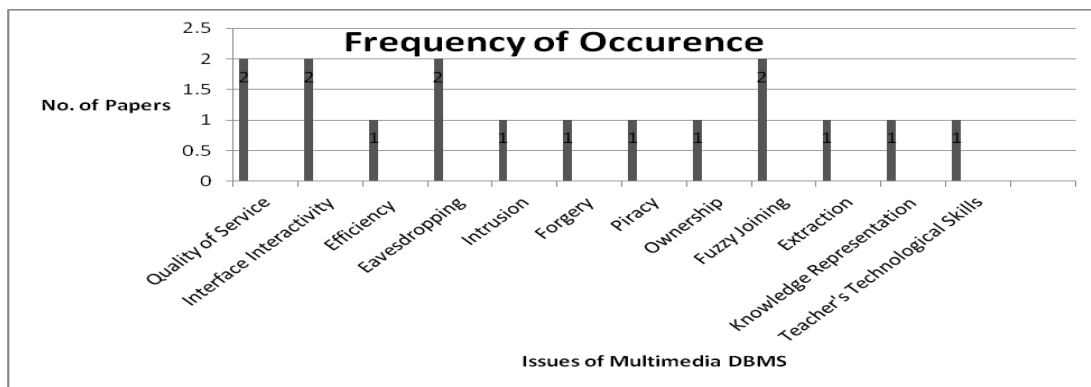


Fig 7: Frequency of Occurrence of the Issues

The frequency statistics obtained in Table 2 have been shown graphically in Figure 6 and Figure 7.

5. CONCLUSION AND FUTURE WORK

In this paper we analyzed some typical important security issues from various research papers. An empirical analysis has been done for measuring the frequency, percentage and criticality of the issues in the literature. It is concluded that there are various issues which have been discussed in most of the papers and must not be touched again in future thus, preventing from reinvention of wheels. There are a lot of security issues which might be missed because all of them cannot be contained in one paper. This paper is a guideline for those researchers who want to do work in the field of multimedia database security so that they can have the knowledge of majority papers merged in this one.

In Future this survey can be modified by adding more recent issues. The survey of the solutions provided by the researchers can also be done so that it may be useful for catering those problems which arise in Multimedia database management.

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