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Faster Access Of Credit Cards Through Data Cube Technology

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ABSTRACT

From the past years, it is observed that Online Analytical Processing (OLAP) became more popular among the people for accurate analysis of data through the complex structure of servers. It is due to fast growing of internet and increasing the size of data files. Therefore, it is necessary to represent the data in a simple form because it consists of multidimensional, which can be very simple through the traditional table representation. In the current scenario, the size of database is increasing and many organizations are storing the data over on the cloud servers. The present work is an attempt to store the complex database into the data cube technology, thereafter extracted the desired database within fraction of time. Further, correlation coefficient is obtained for analysis of data. The proposed technique is efficient and less time consuming for the long database, considered in the form of credit card information. That proposed technique can be used for decision-making process in banking industry.

Keywords: Complex database, Data cube, OLAP, Pivot table, Correlation.

1. INTRODUCTION

Due to change of technology, reducing the size of chip and increasing the size of database, it is necessary to be develop a robust system which can tackle the above, astraditional database has been failed to handle complex database, then object-oriented database has been invented and many software's have already been converted from the traditional software, towards the object-oriented software. The complex files may be in the form of large text, images, audio, video, etc. The old database system was very slow on the complex database but object- oriented database system can handle the complex database. By the object-oriented system, large files may be stored by the concepts of data warehouse. In the current days, customers are doing online shopping and transfer the information in the online mode, but for the storage of large files, still challenges are there which can reduce the access time, hence scientists and engineers are continuously working on the complex database. Therefore, it is necessary to explain some of the important references related to the present work.

Codd et al.(1993a;1993b) have developed the concept of OLAP cubes on the given information of enabling architecture of OLAP cube and rules are applied on the counter Galley. (Chaudhuri and

Dayal, 1997) have described the data cubes and data warehouses, which are important for decision support system.(Gyssens et al., 1997) have presented multidimensional database model for OLAP by the use of algebra and calculus. (Samtani et al., 1998) have described some important advancement and various kinds of research with reference to data warehouse. (Buzydlowski et al., 1998a; 1998b)have presented a design methodology for getting a multidimensional database from the operational database, which has implemented by translating into multidimensional database. (Kimball,1998)also wrote a book on the OLAP technology.(Cabibbo et al.,1998)have discussed the object-oriented system and proposed the OLAP system and it is observed that interaction increases between online analytical processing and multimedia data base. (Trujillo et al., 1998) provided a framework of analytical processing for object-oriented system.(Vassiliadis, 1998) have proposed a model for multidimensional database and dimension hierarchy and introduced a cube operation, which was applied in dimension hierarchy. (Hurtado et al., 1999) have presented model for dimension update and its effects on the cube operation and proposed the maintenance system. (Connolly et al., 1999) have also discussed logical model for OLAP system and implemented a model in real world for the translation into relational table and multidimensional array.(Nguyen et al., 1999) have described object-oriented multidimensional, in terms of class of facts and converted into cube classes as a basic storage, which is used for analysis of different data storage in the system, by the use of Unified Modeling Language(UML). (Hurtado et al., 1999) have presented a formal model of effect of change of dimension structure in multidimensional model, and a collection of primitive operator were performed and observed the effect of these update on a class of materialization view. (Mangisengi et al., 1999) introduced a different extended relationship concept to model and OLAP data query.

(Rumbaugh, 2006) have described the history of UML,which is used by programmer whereas earlier entity relationship diagram has used by database designer. (Kumar et al., 2012) have designed a framework of OLAP data cube, which is used to analyze the Vehicle Insurance Policy (VIP) for customer to identify the entity.(Cristescu, 2016) tried to develop a business Intelligence system for medium and by size of organization to handle the large database. (Mihai, 2017) presented the strength and weaknesses of using OLAP Cube in the data analysis. (Letrache et al.,2017) tried to develop Model Driven Architecture (MDA) solution through a set of meta model and automatically transformed by creation of OLAP cube. (Neha and Garg, 2017)discussed the use of multidimensional cube for retrieval of efficient information and perform a comparative analysis for Sequential Query Language (SQL) queries of Multidimensional Expression Language (MDX) and relational database for OLAP cube on its execution time. (Boutkhoum and Hanine, 2017) have developed an integrated prototype using OLAP cube and multicriteria analysis for decision-making. (Bimonte et al., 2017) developed the prototyping methodology by combining the different data miningalgorithms. (Akushko, 2017) have also discussed the comparison of traditional method of reporting and principals of OLAP technology with its cost. (Yin. et al., 2017) investigated the heterogeneous information network by using a novel cube model. (Xu et al., 2017) developed multidimensional model for highly pathogenic avian influenza by the use of data cube and data mining techniques. In2017, Business Intelligence System (BIS) has reviewed which uses

the different components for analysis purpose in which one component is OLAP cube and data mining technique is used. (Kuijpers and Vaisman, 2017) presented a set of operation for manipulating data cube, defined an algebra of an OLAP cube, and produced a formal proof.(Latuszko, 2017) presented the problem of storage of view materialization of cube cost effectively. (Rabbi et al., 2017) have used Extensible Karagugh Array (EKA) for implementing incremental aggregation on multidimensional Online Analytical Processing (MOLAP) cube with n dimension. (Alzeini et al., 2017) have introduced a novel heterogeneous approach for textual OLAP cube efficiently used in pattern recognition problem.

(Zhanget al., 2018) have introduced new concept of network cube that was performed on multidimensional text database for OLAP analysis. (Gallinucci et al., 2018) have approached Interactive Multidimensional Mode lining of Linked Data (I MOLD) that enable data enthusiastic to enrich Resource Description Framework(RDF) language cube with aggregation hierarchy by exploratory linked data. (Zhang et al., 2019) have introduced a novel fusion OLAP model to fuse the relational model and multidimensional computing model to produce a best effective for MOLAP and ROLAP world. (Letrache et al., 2019) have introduced approach for creation of OLAP cube automatically and its implementation through a set of meta models.(Lamani et al.,2019) have introduced improvement of OLAP cube analysis for decision-making by the use of data mining technique for automatic learning with the help of clustering and thereafter decision tree method has used for each sub cluster.(Djiroun et al.,2019a)have addressed the problem of designing and creation of cube as per the need of decision-making and its implementation with the help of case study.(Djiroun et al.2019b) have introduced a creation of cube based on query tool that is RD cube tool that satisfy the need of decision-making process. (Zhang et al., 2019) have introduced query optimization for materialization of percentage cube, which is used in analytical analysis, evaluating of percentage cube as a generalized data cube. (Siddika, 2019) have worked on ROLAP, MOLAP, and its comparisons with computation time by the use of data volume.

(Tardioet al., 2020) designed OLAP cube from Big Data with goal with validated benchmark by a case study. (Xie et al., 2020) have applied a total set of technique for creating cube based on probability, which is obtained from cube aggregation over cube materialization to query evaluation. (Kang et al., 2020) have presented a naive graph and TDC graph algorithms. (Dehdouh et al., 2020) have focused to define cube operator that called Map Reduced columnar CUBE (MC-CUBE), this cube taking into account of the non- relational and distributed aspects of data warehouse. (Queiroz-Sousa and Salgado, 2020) have presented a review of applications of the OLAP technology used in the analysis of information network data and defined several criteria such as OLAP operator, network selection, materialization aggregation model and its analysis accuracy to each criteria.

(Mathur et al., 2021) have presented the OLAP cube tool which is used for a high speed information processing , bank and loan approval process .(Fracia et al.,2021)have introduced a frame work which is called as COnventional OLap (COOL) that interprets and templates the natural language for OLAP session with a generalized projection ,selection and join the query and it is found that COOL average accuracy is 94% for a real dataset.(Francia et al., 2021) have

contributed a proof of the concept of the Intelligence Analytics Model (IAM) and access the validity of the approached efficiency, effectiveness and scalability. (Kasprzyk et al., 2021) tried to define real data cube in UML and this meta model is used in relational data warehouse and validated by operational tool, which is designed for a case study of social economy of Belgium and France.

In the Present work, a novel approach of OLAP cube has been implemented for the complex database of credit and debit cards and performed the various queries by the use of SQL. Before development of cube, data dependencies have been constructed, thereafter, a cube has been developed by taking sample size of database and finally correlation value is obtained for checking the validity of complex database.

2. METHODOLOGY

When data becomes so complex due to storage of large data files then it is necessary to segment the data for easy analysis of data. Lots of methods are available in the literature but in the present works online analysis processing technique is proposed which consists of multidimensional data. For increasing the user's accuracy, the concept of OLAP cube is used in the reference of large data sets of debit cards as represented in the following Table 1.

Table 1 Data Set of Debit Cards of Customers

	id	Name	Age	card#1	card#2	card#3
1	101	Cchoudhary	52	4200778927351909	4492907363241343	4423916322437565
2	102	Jjaydeep	32	4351245711358471	4853263951256209	4139636597873048
3	103	Pawan	44	4200101521325817	4682817921471078	4384717548838975
4	104	Arvind	38	4050453813353887	4503946857111577	4934193188723189
5	105	Jjohn	35	4361664384555668	4426437886798505	4331593599718935
6	106	Smith	28	4183026391245038	4009911666236675	4053467692969289
7	107	Deelip	25	4874657217235482	4690062165422426	4129564158434533
8	108	Deena	43	4682574991178931	4053057452828781	4086269975915992
9	109	Richa	36	4153727943447131	4367062511982554	4071956557833216
10	110	Rruchi	27	4275688577132568	4800024388761151	4392132741528102
11	111	Amit	45	4809729378151418	4247913936211597	4490293574881728
12	112	Hemant	42	4009162922114070	4750324891411777	4194291258997538
13	113	Rajive	30	4445466134688487	4828609892739939	4154868788586044
14	114	Prashant	47	4782495158244838	4853907545314318	4629317268614881
15	115	Ravi	53	4926851896119889	4414018673565275	4338473626563559
16	116	Rrahul	55	4321402897333953	4366718211745069	4124422612745058
17	117	Ravindra	50	4819825422548530	4148244593838039	4079566211668551
18	118	Mohan	48	4476131559731104	4165021232865682	4811964665957914
19	119	Sohan	25	3733803757525576	4190874265258939	4510461921512967
20	120	Sita	33	4449521734654078	4148815184118608	4148931417744027
21	121	Geeta	39	4843288947855130	3728929234194848	4472372596232144
22	122	Neena	44	4906992218896509	4252335329317215	4471986288784897
23	123	Sangita	34	4758977475625997	4070622149611665	4085046159573388
24	124	Rakesh	29	4912716221948540	4121866593879091	4471306376741891
25	125	Satyendra	40	4605826661673474	4314679136824103	4038581676739029

In the above table , a sample size of 25 customers are considered to elaborate the concept of online analytical processing, but when sample size is increased up to finite numbers of records then the desired information of customer may be accessed in the minimum time frame. In the above table, the three cards of one customer is considered however a customer may have more than three debit cards of different bank account numbers or multiple cards of single bank. The above table can be created in Microsoft Excel and its feature allows the data in the Oracle form and customers can inserted with this data through Graphical User Interface (GUI). On the basis of above table 1, OLAP cube is designed by considering the three fields as Card#1 ,Card#2 and Card#3 through data source view as represented in the following Figure1.

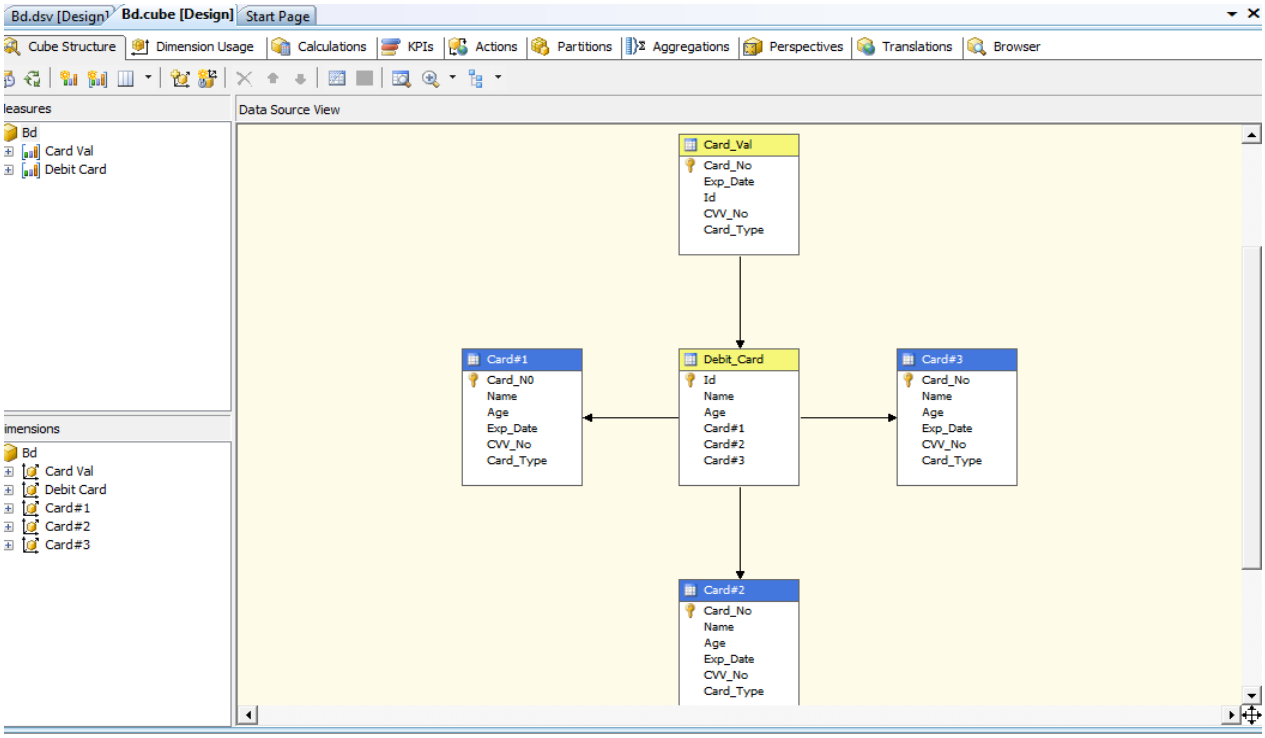


Figure 1 Data Source View of Debit Cards

By the use of above data source view Statistical Package for the Social Science (SPSS) is used for designing the data cube by converting the three important dimensions as Card#1, Card#2 and Card#3. The representation of data cube is shown below in **figure 2.**When the large finite database is stored into the above database then one can make queries to obtain the desired database and these queries are called data cube queries. Let us consider the following two variables having finite values as

$X=\{x1, x2, x3, x4\ldots\ldots\ldots\ldots\ldots xn\}$ (1)

$Y= \{y1, y2, y3, y4\ldots\ldots\ldots\ldots\ldots yn\}$ (2)

A relation between the two data sets may be developed after obtaining the pivot table, which can be developed from table 1 by considering the pivot element as shown below in **Table 2**.

Table 2 Representation of Pivot Table

Row Labels	2021	2022	2023	2024	Grand Total
(blank)	1				1
4009162922114070			1		1
4009911666236670		1			1
4050453813353880		1			1
4053057452828780			1		1
4053467692969280			1		1
4071956557833210				1	1
4086269975915990			1		1
4129564158434530				1	1
4139636597873040	1				1
4153727943447130	1				1
4154868788586040				1	1
4183026391245030			1		1
4194291258997530			1		1
4200101521325810		1			1
4200778927351900		1			1
4247913936211590			1		1
4275688577132560	1				1
4331593599718930	1				1
4351245711358470		1			1
4367062511982550	1				1
4384717548838970	1				1
4392132741528100				1	1
4423916322437560		1			1

For establishing the relationship between two data sets, linear correlations obtained by using the following formula:

$$\mathbf{r_{xy}} = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sqrt{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2}\sqrt{n\sum_{i=1}^{n} y_i^2 - \left(\sum_{i=1}^{n} y_i\right)^2}} \qquad (3)$$

The reason to observed the correlation coefficient is to check whether the relation between the two data set is weak, medium or strong. Generally range of correlation coefficient lies between 0 and 1. The representation of r given by equation (3) signifies that when r is 0 then there is no relation between two data sets, whereas 1 shows the perfects relationship between two data sets. When the size of database is too long then observed correlation must be stronger.

3. RESULTS AND DISCUSSION

After collecting, the data of debit cards as shown in the table 1.OLAPCube is designed through following steps.

Step 1: Create data source view as Bd.dsv with input fact Table Created in the Microsoft SQL server

Step2: Select fact table and dimension to create a cube as Bd.Cube.
By the use of above two steps, a cube with three dimensions as Card#1, Card#2 and Card#3 is created and shown below in the following figure 2 by the use of SPSS.

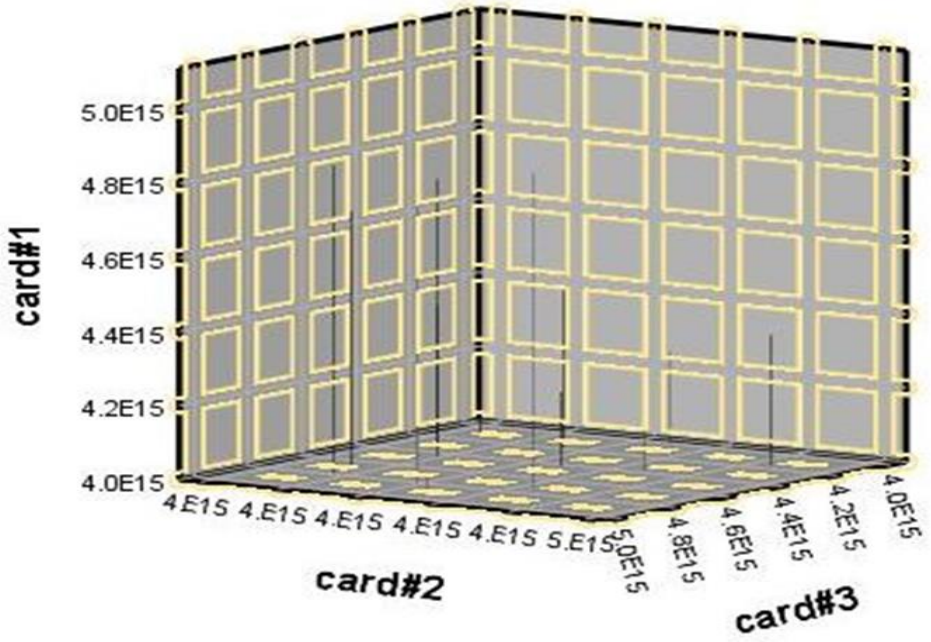
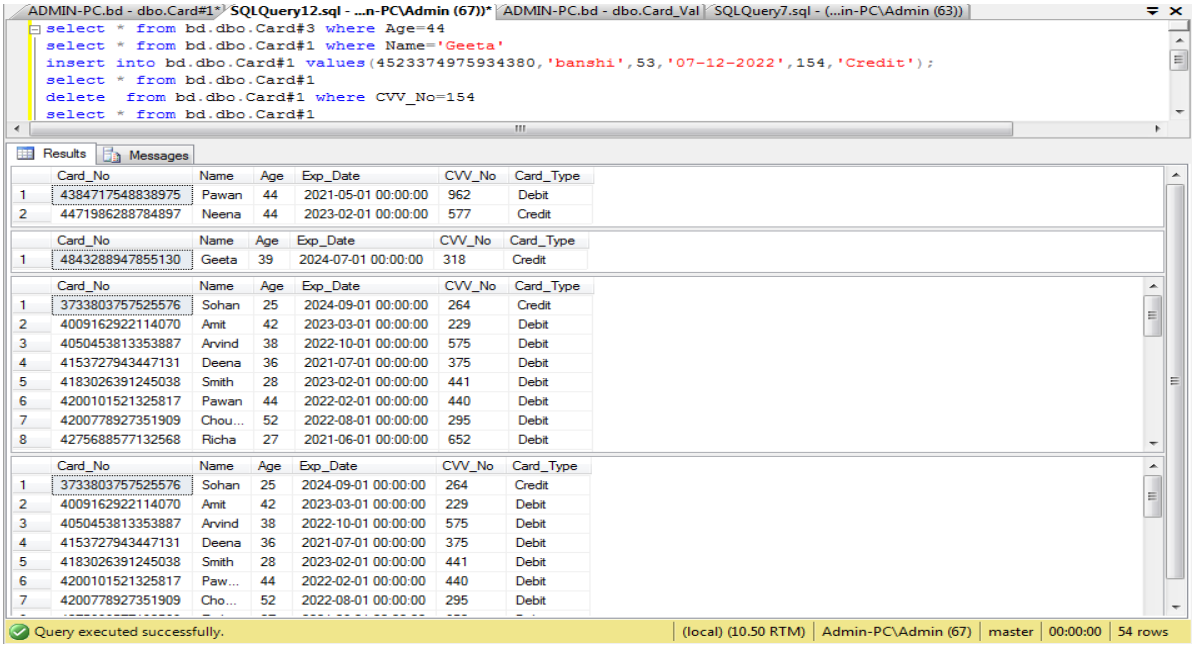


Figure 2 Data Cube Representation of Debit Cards

Now the above-mentioned cube is ready to perform the queries to find the desired Card number for authentication purpose from the large sets of database of debit cards. The desired information is completely based upon the decision-making about the bank entity as represented in the following Figure 3.



	Card_No	Name	Age	Exp_Date	CVV_No	Card_Type
1	4384717548838975	Pawan	44	2021-05-01 00:00:00	962	Debit
2	4471986288784897	Neena	44	2023-02-01 00:00:00	577	Credit

	Card_No	Name	Age	Exp_Date	CVV_No	Card_Type
1	4843288947855130	Geeta	39	2024-07-01 00:00:00	318	Credit

	Card_No	Name	Age	Exp_Date	CVV_No	Card_Type
1	3733803757525576	Sohan	25	2024-09-01 00:00:00	264	Credit
2	4009162922114070	Amit	42	2023-03-01 00:00:00	229	Debit
3	4050453813353887	Arvind	38	2022-10-01 00:00:00	575	Debit
4	4153727943447131	Deena	36	2021-07-01 00:00:00	375	Debit
5	4183026391245038	Smith	28	2023-02-01 00:00:00	441	Debit
6	4200101521325817	Pawan	44	2022-02-01 00:00:00	440	Debit
7	4200778927351909	Chou...	52	2022-08-01 00:00:00	295	Debit
8	4275688577132568	Richa	27	2021-06-01 00:00:00	652	Debit

	Card_No	Name	Age	Exp_Date	CVV_No	Card_Type
1	3733803757525576	Sohan	25	2024-09-01 00:00:00	264	Credit
2	4009162922114070	Amit	42	2023-03-01 00:00:00	229	Debit
3	4050453813353887	Arvind	38	2022-10-01 00:00:00	575	Debit
4	4153727943447131	Deena	36	2021-07-01 00:00:00	375	Debit
5	4183026391245038	Smith	28	2023-02-01 00:00:00	441	Debit
6	4200101521325817	Paw...	44	2022-02-01 00:00:00	440	Debit
7	4200778927351909	Cho...	52	2022-08-01 00:00:00	295	Debit

Figure 3 Data Cube Queries

Let us complete the relation between the datasets by finding the correlation as explained by equation (1) to (3). For finding the correlation between the data sets, the following sample of data is considered and represented in the following table 3. In this table 101 is treated as 1 and in similar fashion, 125 is represented as 25. This variable is considered as X while the Y variable denotes number of cards, which are issued to single customer by the bank. Therefore correlation coefficient is evaluated and represented below in Table3

Table 3 Computation of Correlation Values

Customer_Id (X)	Number_of_cards(Y)	X*Y	X*X	Y*Y
1	1	1	1	1
2	1	2	4	1
3	1	3	9	1
4	1	4	16	1
5	1	5	25	1
6	1	6	36	1
7	1	7	49	1
8	1	8	64	1
9	1	9	81	1
10	1	10	100	1
11	1	11	121	1
12	1	12	144	1
13	1	13	169	1
14	1	14	196	1
15	1	15	225	1
16	1	16	256	1
17	1	17	289	4
18	2	36	324	4
19	2	38	361	4
20	2	40	400	4
21	2	42	441	4
22	2	44	484	4
23	2	46	529	4
24	2	48	576	4
25	2	50	625	4
325	33	497	5525	49

From the equation (3) r is computed as 0.80860754, which shows that the data sets are reliable and having excellent relation between the cards, numbers issued to the customers by the bank.

4. CONCLUDING REMARKS

From the above work it is concluded that the size of database of cards is increasing day by day, whether it may be debit card or credit card and one bank is issuing more than, One Card to the customer and millions of banks along with card database are attached around the globe over the network communication; therefore the above work is useful for fetching the desired and authenticate card information from the database of debit cards from the data cube after performing the optimized queries. The above work further can be expanded towards authentication of cards by the use of fuzzy techniques for encryption and decryption at the time of fetching card information across the communication thereafter.

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