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Ai- Driven Mapping In Hierarchical Heterogeneous Data For Customer Management System

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Abstract

The very fast growth of the business world insists on the demand for integration of heterogeneous data process. The mapping of data in different heterogeneous hierarchical data is complex in the business aspect and XML is considered a hierarchical structure. In the existing literature, the mapping process is done using a synonyms table in a hierarchical structure. This approach becomes complex when retrieving the data in a hierarchical structure and uses more space for the mapping process. This work explores the mapping of different heterogeneous data using AI-MKMT (Artificial Intelligence-Multiple Key feature Mapping Technique) which uses less space. First, the standard data format is generated from the user-defined hierarchical data with SAX being used for standardization. Then, the mapping process is done among heterogeneous hierarchical structures based on the AI-MKMT technique by predefined rules. The heterogeneity of the hierarchical data structure is analyzed with an enhanced ID3 machine learning approach which generates precise and consistent data that is used in the AI mapping process. This work is applied in the marketing industry for predicting the behavior of the customer.

Keywords: *Synonym table, SAX, XML Mapping process, Machine learning approach, Artificial Intelligence.*

INTRODUCTION

Nowadays industry has realized that accumulating data is difficult due to a lot of data availability. Different industries have different kinds of data for the business. A business enterprise growth is complex because of the different variety of heterogeneous data formats. Cross-organization data integration is a big challenge in the business world. The requirements of the user are increased in the improvement of the system performance model and the incorporation of the heterogeneous hierarchical model. The design of the common model is the main task for the integration of a heterogeneous system. In past heterogeneous data, the data is treated as relations and objects. In general, the heterogeneous data support all format in data categories, whether the data is ordered or partially ordered.

The machine learning approach produces accurate results in data analytical processing. Machine Learning is a model that can learn from example via self-improvement and without being openly programmed by the programmer. The vital role of the machine learning approach is that it produces accurate results. The machine learning model is related to data mining and the model

receives input and uses an algorithm that formulates the output.

Machine learning is used for a variety of tasks like Fraud recognition, analytical preservation, range optimization, automation tasks, and so on. The machine learning approach is a model that can learn the process automatically. The output predicted by machine learning can be analyzed with the help of statistical tools. The approach of the machine learning algorithm is related to the data mining technique. The machine learning model contains the following steps: Define a query, gather data as per requirements, data model visualization, train the algorithm, gather feedback, refine the technique, continue all steps until the requirement is met. The mapping of data among the hierarchical structure is vital in a web-oriented application.

The structure of the remaining paper is as follows. The literature review of this work is discussed in section 2. Section 3 summarizes the related work of the proposed approach. The experimental result of the data set is demonstrated in section 5. Section 6 illustrates the conclusion of this paper.

2. **LITERATURE REVIEW**

XML data is formally defined by the primary schema of XML. XML files are parsed by any specific model. More middleware technology is available for data transformation. This transformation is used to convert the input data from one format to another format [2-3]. The system transforms from the relational data and converts the Generalized Markup Language into a mining data format. The query is processed from XML data and integrated into a two-layered technique [10]. XML database integration is done based on the synonyms table[1]. The hierarchical structure of the model in memory is defined by the DOM mode which is used to process and traverse the node in the structure. The data preprocessing is used in the dataset to remove unwanted data.

Th**e** raw data may contain data in any format. If data contains incomplete, inconsistent, and noisy data, then the data is not able to produce an effective result. Various techniques are available to do data preprocessing. XSLT is used to convert the reduction tree into the standard format of the given input data set. The mapping relation should take the memory into account of storing data in the storage space. The path of the tree node should be unique to the given data set in the decision tree. After converting the decision tree the mapping relation is taken between keyword and features. The mapping process contains two parts. One is a feature, another one is its value. More than one heterogeneous hierarchical structure is considered for mapping processes in the agriculture domain in an existing system using a synonyms table.

The mapping process is done using a fuzzy relationship in a hierarchical structure[2]. The spatial data is represented by fuzzy relations. The elements in hierarchical structures are converted into fuzzy elements and class diagrams are used with the help of XML schema in the hierarchical XML document. The behavior of the entity is mapped with the elements of the XML document. The mapping process is done by using time parameters such as time value, time interval, etc. Fuzzy

mapping is done with the XML document element. The fuzzy spatial object is represented with the elements of the spatial region, spatial point, and spatial line. Fuzzy spatial relations are mapped with direction and topology. The extraction of data is represented by the data model of UML. This is used the mapping spatial data to the elements of XML data. That operation can not be interpreted on the spatial data. Database queries on the spatial data are inconsistent. A relational storage model is used in the node model mapping method of hierarchical structure.

Ontology system[5]: The semantic heterogeneous integration is done in multimedia content[4].In that approach, the domain knowledge of ontology is required. The ontology-based integration[5] is introduced in a hierarchical structure. By that, the method can find out whether the instance exists or not.

Clustering by Fast Search and Finding of Density Peaks (CFSFDP)[6]. The data mining techniques are used in the student's education system to improve the career information and produce intellectual support. CFSFDP calculates local density and a minimum edge based on the student learning behavior. It arises the value of the high density of the nearest location. According to that density value, the student process is mapped and grouped based on student behavior.

Cosine similarity technique[7]. The Hierarchical documents are grouped based on the similarity value between the two documents. That similarity is calculated using the cosine similarity approach. The mapping process between hierarchical structure is analyzed based on the parameters of clustering technique types, cluster categories, similarity measurement can be utilized and type of the input.

The cost function[8]: This function is used to find out the map between two categories of a real entity. Hence the value is used in the mapping process. The cost value is based on the number of items in the entity. The number of items can be split into different sets depends on the length of items. This method is not sufficient when a huge amount of hierarchical data can be used.

EIA[9]: The mapping process between enterprise meta models. It is done by the EIA approach. The semantic information is mapped between enterprises[15]. This process has more time in the process of mapping enterprise data.

Query decomposition[10]: The XML data sources integration is done by the query decomposition technique. It can identify whether two hierarchical structures are similar or not. The similarity technique of hierarchical structure is discussed in [11,12,13].In a wireless channel, the redundancy of hierarchical documents is reduced by a two-tier index structure which is discussed in [14]. The query decomposition is complex in a heterogeneous hierarchical structure.

Synonyms table structure[1]: In this approach, the hierarchical structure of the model in memory is defined by the DOM model. This model has been used to process the nodes in the structure and traverse the nodes in the structure. The data preprocessing is a vital role in the data. The raw data is an understandable format. If data contains incomplete, inconsistent, and noisy data then the data is not able to produce an effective result. Various techniques are available to do data preprocessing. XSLT is used to convert the reduction tree into the standard format of the tree. The mapping relation should be taken the memory into account of storing data in the storage space. The path of the tree node should be unique to the given data set in the decision tree. After converting the decision tree the mapping relation is taken between keyword and features. The mapping process contains two parts, one is the feature and another one is the value of the feature. More than one heterogeneous hierarchical structure is considered for processes in the agriculture domain using the synonyms table. The mapping-based relation[1] is done in two steps; the First standard format of the hierarchical document is generated. Then map the data from the hierarchical data using the

mapping relationship table. In general, there is some DOM model available such as core DOM, XML DOM, etc. In that model XML, DOM is used for the mapping process. The standard format of the given structure is generated based on the DOM (Document Object Model).DOM defines a standard protocol to access the XML document. It contains the logical structure of the input data model as XML It also supports access and manipulation of the data into the XML data. DOM consists of entities, properties, and interfaces to access the standard data format. The data from the dataset is mapped by using a synonyms table. The hierarchical structure file is parsed using DOM parsing. The records are obtained from the DOM parsed model. The reduction of standard format is framed. The mapping between the reduction tree and a standard tree is done based on the thesaurus table. XSLT is used to convert an XML document into another format based on the given style sheet requirement. The style sheet represents the output of the data to be displayed in the required format. The query is requested by the user. The query output is generated from the central XML standard model. The sharing platform is used as a SOAP(Simple Object Access Protocol). It is used to provide the sharing of XML communication among more systems. It is platform-independent. It also supports any kind of language. Hence the query is registered into the register entry. Then the query result is published to the node which is shared in the architecture. In existing the operations are manipulated in the ADO.NET platform. DOM occupies more memory. The Thesaurus table is used for mapping. Jinan and Qingdao used the agricultural XML data mapping process [16,17,18].

3. PROPOSED METHODOLOGY

This paper follows the module of Standardization of XML Model and mapping process using AI-MKMT (Artificial Intelligence-Multiple Key Feature Mapping Technique).

3.1 Standardization of XML Model.

The module of Standardization contains the parsing XML data set, Reduction of replication dataset and XSLT format generation. This module is shown in figure 1.

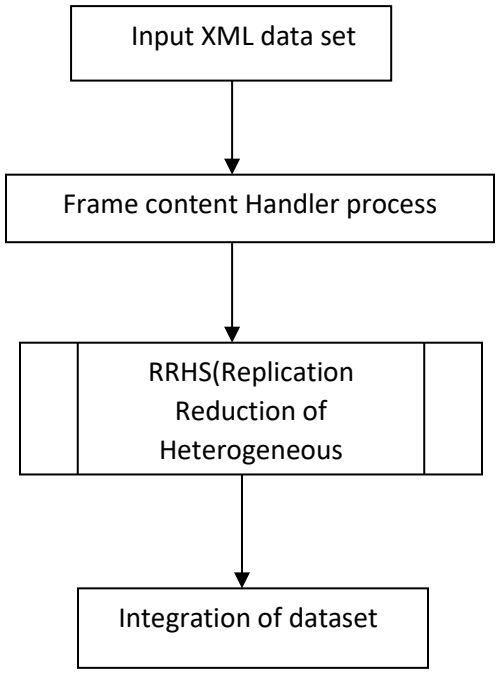

Figure 1: Model for standardization of XML data

The input is given as an XML dataset. The frame content handler gathers all information from the given input dataset by using the SAX package. If any redundancy has occurred in the given set of data set that can be removed by method of RRHS.RRHS is discussed in section 3.1.2.XSLT supports the style format to the input data set based on the requirements. Then the integration process is taken among all input datasets.

3.1.1 Parsing XML document

The standard format of the SAX is used in this research to parse the XML dataset. In the existing method, the DOM model is used for that parsing process. DOM loads whole data into memory for processing. SAX is an event-based driven model to parse XML data. In general, SAX is faster than DOM to generate the standard format of XML data. It has generated a model based on the two parameters. First is the name of the dataset another one is the content handler. The content handler has the collection of data from the given XML document. It collects all data by start element, end element, and content of element methods. The start element shows the first element of the document which is described in the input. The end element shows the end element in the input dataset. The content of the element method is used to retrieve the value of all elements in the XML dataset.

3.1.2 Reduction of Replication Heterogeneous Structure

From the XML parsing, the path of each element can be viewed. Tree pruning is a technique used to reduce abnormality in the training data due to various errors. The error may be noisy or an outlier. If the hierarchical trees are reduced, then the mapping process is less complex. In general, pre and post pruning are used in the tree pruning approach. Initially, the tree is pruned by halting the building of the structure. Then from the built tree, the subtree is eliminated. The computational cost complexity value is measured by the parameters of the length of leaves in the tree model and the noisy rate in the tree model.

Analyze whether the given input hierarchical structures are heterogeneous or not by using the approach of machine learning technique ID3. It generates a tree structure based on the class feature. A decision tree is a structure that includes a set of nodes, branches, and leaf nodes. The node indicates the element or attribute name and leaf node to define the class on the specific attribute. The starting node in the hierarchical tree is the root node. The user can easily understand the tree structure without any domain knowledge.

It is easy to realize the element in the hierarchical structure. The minimum knowledge is

required to understand the tree structu work analyzes the hierarchical structure by using pa e, F-measure, and confusion matrix.

```
Algorithm : RRHS
Input : Set of Hierarchical data set
Output : Heterogeneous  hierarchical data set
A=[ ]
C=[Classifiers ]
N=Length(C)
For i=0,i<N,i++
        If(Compare C[i],C[i+1])
        A.append(i)
Return A
```

Figure 2 : Reduction of replication heterogeneous structure

The repeated heterogeneous structure of the given data set is removed by using the approach of RRHS (Reduction of Replication Heterogeneous Structure). It is shown in figure 2. In RRHS the user can obtain the confusion matrix of each heterogeneous structure by the machine learning approach. This research used the ID3 machine learning approach for the reduction of the same structure in the given dataset. The confusion matrix has the sample classification in the given dataset. The following parameters are analyzed in heterogeneous structures.

a)Recall(R): Recall is the ratio of the total number of correctly classified positive samples divided by the total number of positive samples. It is given in equation (1).

$$R = \frac{TPs}{TPs} + FNs \qquad (1)$$

Where TP rate(TPs): Number of true positive in a given input and FN rate(FNs) is the number of false negatives.

b)Precision(P) :P is the precision, obtained by dividing the total number of correctly classified positive samples by the total number of predicted positive samples. This is presented in equation (2).

$$P = \frac{TPs}{TPs} + FPs \qquad (2)$$

c)F-measure: It is measured by P and R of the sample data sets. This is manipulated by equation 3.

$$F = \frac{2 * R * P}{R + P} \qquad (3)$$

Where R and P are defined in equations 1 and
2. The parameters in XML data is analyzed by a confusion matrix.

Table 1:Structure of the confusion matrix

Dataset /classification	cm_1	cm_2	..	cm_m
ds_1	$cv_{1,1}$	$cv_{1,2}$	..	$cv_{1,m}$
ds_2	$cv_{2,1}$	$cv_{2,2}$	..	$cv_{2,m}$
----				
ds_n	$Cv_{n,1}$	$cv_{n,2}$	..	$cv_{n,m}$

Confusion matrix(CM): A confusion matrix is an outline of the number of correct and incorrect predictions made by a classifier. It shows the average values are combined from the classification. Table 1 shows the structure of the confusion matrix values of the different heterogeneous structures.

Here ds_1,ds_2,ds_3,……, ds_n are the n number of data set is taken by the user. cm_1,cm_2,cm_3,…..,cm_m is the class label in data set ds_1,ds_2,ds_3,……,ds_n respectively. $cv_{n,m}$ is the number of samples obtained in the n^{th} data set with cm_m class label. The sample data sets are demonstrated in the Result and Experiment section. Equation 4 shows the number of instances in the data set1(ds_1)

$$a = \sum cv_{1,1} + cv_{1,2} + cv_{1,3} + \cdots + cv_{1,m} \quad (4)$$

the number of instances in the data set2(ds_2) is given in equation 5.

$$b = \sum cv_{2,1} + cv_{2,2} + cv_{2,3} + \cdots + cv_{2,m} \quad (5)$$

$$hgs_{ds1,d2} = \begin{cases} if\ a == b & 1 \\ othrewise & 0 \end{cases} \quad (6)$$

Equation 6 ensures whether ds_1 and ds_2 are heterogeneous or not.Equation6 return 1 if both ds_1 and ds_2 heterogeneous hierarchical structure otherwise return 0.

3.1.3 XSLT format generation

The XSLT format is generated based on three templates. They are the start element, end element, and the content handler contents. That template generates the required format of the XML data set.

3.2AI-MKMT (Artificial Intelligence-Multiple KeyFeature Mapping Technique)

In this research the proposed approach is AI-MKMT.

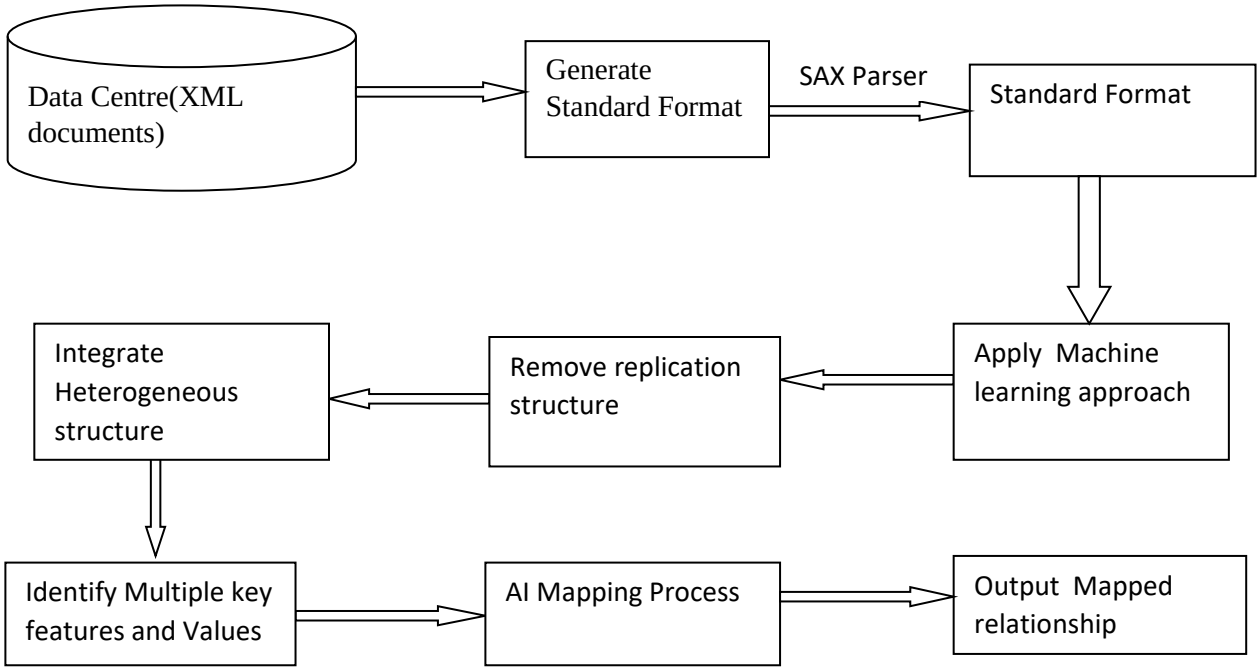

Figure 3.The system architecture of the proposed technique AI-MKMT.

The proposed approach is used to map the data element in a heterogeneous hierarchical structure. Hence the raw heterogeneous data is retrieved from various data sources. The data may contain inconsistent, incomplete, and noisy data. The data may be dirty due to hardware error/failure, network error, or human error. That should be removed by the data preprocessing technique. In the real-world, data cleaning ensures the customers make good and more accurate decisions.

The system architecture of the proposed technique AI-MKMT is given in figure 3. In the proposed model more than one key-value is interpreted among n number of hierarchical data structures. The different hierarchical data set is retrieved from data sources. The AI mapping process is done by automated rules generation of customer behavior**.**Initially, the data set is collected in a hierarchical format. The hierarchical data is retrieved from the data center. The standard format of the XML dataset is retrieved using the SAX (Simple API for XML parsing) model. The XSLT process is

done as per user sufficient data format. The replication hierarchical structure is removed from the data set by the approach of RRHS which is discussed in section 3. The integration process of the hierarchical structure is done by the index value of all structures. The user identifies more than one key feature which can be used to map the data between different structures. The key set is denoted by two parts. One is key and another one is value of the key {key1-value1,key2-value2,key3-value-3,…,key-valueN};

```
<?xml version="1.0" encoding="utf-8"?>
<Customer>
</Information>
<Cus_ID>1 </Cus_ID>
<Cus_name> C# 000001 </Cus_name>>
<Cus_address>IVhzIApeRb </Cus_address>
<Cus_nationkey>15 </Cus_nationkey>
<Cus_accbal>711.56</Cus_accbal>
<Cus_mktsegment> BUILDING</Cus_mktsegment>
</Information>
<Information>
<Cus_ID> 2<Cus_ID>
<Cus_name>> C# 000002 </Cus_name>>
<Cus_address>XSTf4,NCwDVaWNe</Cus_address>
<Cus_nationkey>13 </Cus_nationkey>
<Cus_accbal>121.65</Cus_accbal>
<Cus_mktsegment>AUTOMOBILE</Cus_mktsegment>
</Information>
</Customer>
```

Algorithm:
Input : Heterogeneous hierarchical data sets
Output : Mapped data based on the features key labels
Step 1).Input the heterogeneous XML data
Step 2). Find Whether document are heterogeneous or not using RRHS
Step 3). Integrate the heterogeneous hierarchical data
Step 5). Convert into standard format using SAX
Step 6).Apply XSLT format to ContentHandler
Step 7).Identify the key feature and value(key1-value1,key2-value2,key3-value3,…….,keyN-valueN)
Step8)Mapping of data with more than one key and key values
Step9) View required information
Step10)Analyze the parameters

Figure 4: Algorithm for Multiple Key feature Technique

The mapping process is explained with the help of two datasets which can be shown in figure 4 and figure 5. In the dataset, consider the element Cus_mktsegment in dataset1 and Cus_segment in dataset2. And also consider the value of the element. Both will be the same implication. This model should give that two elements as key features. The mapping is done based on the key features or the value of the features of both. In the examples, the path of the key feature is in the first dataset /Customer/information/Cus_id,/Customer/information/Cus_name

,/Customer/information/Cus_address, /Customer/information/Cus_accbal,
/Customer/information/nation key
/Customer/information/Cus_mktsegme

Figure 5 data set1(ds_1

```
<?xml version="1.0" encoding="utf-8"?>
<Customer>
</Information>
<Cust_ID>800 </Cust_ID>
<Cust_name> C# 00800</Cust_name>>
<Cust_address>mpI6pkdnWLZsBbQi4</Cust_address>
<Cust_nationkey>14</Cust_nationkey>
<Cust_accbal> 9443.15</Cust_accbal>
<Cust_segment> AUTOMOBILE</Cust_segment>
</Information>
<Information>
<Cust_ID> 901<Cust_ID>
<Cust_name>> C# 000901 </Cust_name>>
<Cust_address>UQ67hfDJlxgX68</Cust_address>
<Cust_nationkey>16 </Cust_nationkey>
<Cust_accbal>5200 </Cust_accbal>
<Cust_segment>FURNITURE</Cust_segment>
</Information>
</Customer>
```

Figure 6: Data set1(ds_2)

The tree structure of the hierarchical data is given by the number of nodes. Each node represents the element in the given structure. The root node represents the root element of the structure. The leaf node represents the children nodes of the parent node. The tree structure of all document is generated based on the path of each node from the root node.

4.RESULT AND EXPERIMENTS

In this research, a two-sample customer dataset is considered. The experiment is using Weka for analyzing Machine learning approach ID3. The parameter values of the hierarchical dataset are obtained by the machine learning approach ID3. MKFT is implemented using the R

environment. For heterogeneous structure, verification parameters are discussed in the confusion matrix which is discussed in section 3.

Table 2. Classified features in ds1

Feature name	Classified feature values				
BUILDING	284	13	11	11	18
AUTOMOBILE	254	10	11	12	11
MACHINERY	240	10	14	12	12
HOUSEHOLD	244	11	7	15	17
FURNITURE	243	8	8	9	11

Table 3. Classified features in ds2

Feature name	Classified feature values				
BUILDING	47	29	24	28	27
AUTOMOBILE	33	36	29	32	17
MACHINERY	29	28	33	30	17
HOUSEHOLD	33	33	29	34	32
FURNITURE	35	23	23	43	26

In this paper, the heterogeneous structure is analyzed with the help of a confusion matrix. From the table2 and table, 3 both ds1 and ds2 are distinct, and ds1 and ds2 are integrated for the mapping process.

Table 4.Comparison between existing and proposed technique

Level	Key Feature size(KB)	Existing Model (With Synonyms Table)	The proposed model (Without Synonyms Table)
1	10	10	10
2	19	29	19
3	24	53	24
4	11	64	11
5	15	79	15

The sample size key size is given in table 4. The key feature size denotes the number of bytes in the given query.

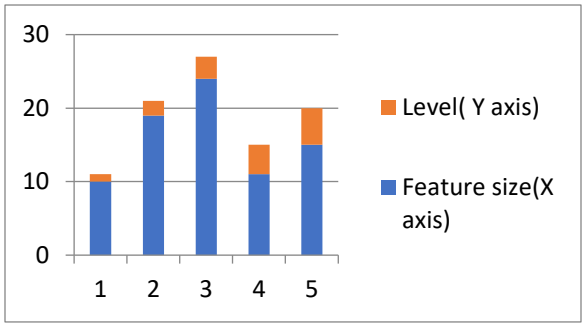

Figure 8 (a) Existing Model

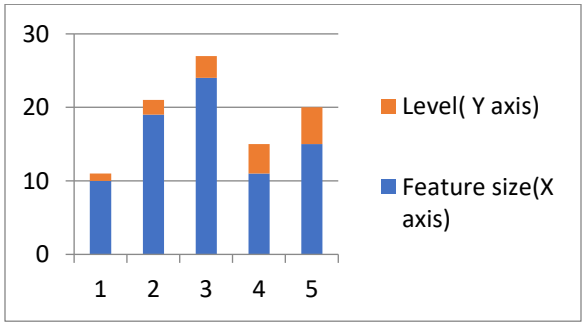

Figure 8 (b) Proposed Model

In figure 8 (a) the existing model shows a synonyms table structure based on the query request which is given by the user. Figure 8 (b) gives the key features and values not stored in the memory space while mapping the data. The synonyms table is not considered for using memory space to map relationship data among hierarchical data. In both figures, the process is analyzed between two parameters. One is the size of the key(x-axis) and another parameter is the space to be occupied by the key feature(y-axis). From figure 8(a) and 8(b), it can be concluded that the proposed approach occupies less memory space than the existing approach in the mapping process. Automatically the time of the process is reduced in the query processing of hierarchical data.

5. CONCLUSION

In this paper, a novel technique is presented to integrate the mapping process between the heterogeneous hierarchical structure of XML data. The existing model occupies more space due to the usage of DOM and mapping relation which is based on the synonyms structures. In particular, the proposed model has achieved the mapping between hierarchical XML data without using synonyms table structure using the AI-MKMT technique. Also, SAX is used for data standardization which is faster than DOM. In this research, customer behavior is predicted for

improving business performance. In future work, it is proposed to use deep learning algorithms and analyze the result.

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