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# A Novel Approach of Text Document Clustering by using Clustering Techniques

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**Abstract -** *Clustering is one of the best important unsupervised data analysis technique, which divides data objects into clusters based on similarity and summarization of datasets. Clustering has been studied and applied in many different fields, including pattern recognition, Advanced data mining, computational data science and Machine learning, information retrieval. This research focused on text document which are containing of similarities word. The combination of two algorithm methods, improved k-means and traditional k-means algorithm use to improving quality of initial cluster centres.*

***Key Words*: Text Clustering, K-means, Clustering Text Document, Text similarity.**

## 1. INTRODUCTION

Clustering is important data analysis technique, which divides data objects into clusters based on similarity and each cluster contains objects that are similar to other objects within same cluster [7]. Now a days there are many data on internet is dramatically increasing every single day by bay, clustering is considered an important data mining technique in categorizing, summarizing, classifying text documents. The data mining is extracting meaningful information or data from large datasets, the data mining techniques contains many fields like text mining, information extraction, document organization, information retrieval. Data mining is the process of analyzing data from different perspectives and summarizing it into useful information.

Data clustering refers to an unsupervised learning technique, which offers refined and more abstract views to the inherent structure of a data set by partitioning it into a number of disjoint or overlapping (fuzzy) groups. Clustering refers to the natural grouping of the data object in such a way that the objects in the same group are similar with respect to the objects present in the other groups. Document clustering is an important research direction in text mining, which aims to apply clustering algorithm on the textual data such that text documents can be organized, summarized and retrieved in an efficient way [7]. There are broadly three types of clustering, namely, Hierarchal clustering, Density based clustering, and Partition based clustering.

Hierarchical clustering involves creating clusters that have a predetermined ordering from top to bottom. There are two types of method hierarchical clustering as Divisive and Agglomerative. The Divisive method is top-down clustering method and the observation to single cluster and then partition the cluster to two least similar clusters. The Agglomerative method is bottom-up clustering method and then compute the similarity between each of the clusters and join the two most similar clusters. The partitional clustering algorithm obtain k clusters of a set of data point without any hierarchical structure. Each cluster contains at least one object and each object belongs to exactly one cluster. Clustering methods used to classify observation, within data set, into multiple groups based on their similarity. Partitional clustering algorithm contains algorithm like k-means, k-medoids or PAM **(**partitioning around medoids**)** etc.

The procedure of synthesizing the information by analyzing the relations, the patterns, and the rules among textual data - semi-structured or unstructured text. Why Text Mining? Massive amount of new information being create 80-90% of all data is held in various unstructured formats Useful information can be derived from this unstructured data.

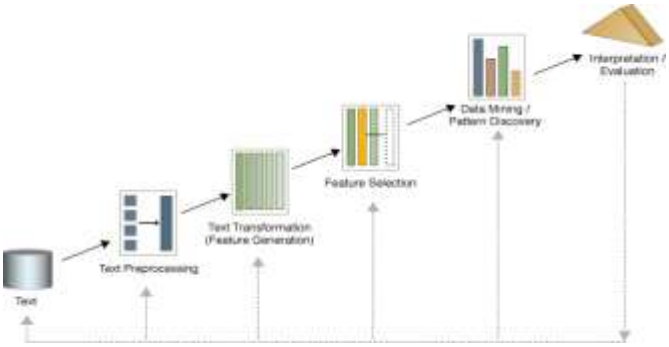


***Fig -1***: Text Mining Process[28]

### 1.1 PARTITIONAL CLUSTERING ALGORITHMS

Partitional clustering algorithms divide a dataset of n objects into k clusters such that each partition represents a particular cluster. In this scheme, clusters are formed to optimize the chosen criterion, such as minimizing the sum of squared error [1]. In partitional clustering algorithms, all possible partitions are enumerated to achieve a global optimum. The enumeration of all possible partitions is not a computationally feasible task. Hence, heuristic methods have been frequently applied in partitional clustering. These heuristic approaches include, K-means, K-modes and K medoids algorithms. In the following subsections, important partitional clustering algorithms (namely, K means, K means++ and K-medoids algorithms) utilized in the empirical analysis are briefly introduced [7].

#### *A. K-means algorithm*

K-means algorithm is a very popular clustering algorithm owing to its easy implementation, simplicity and efficiency. It takes the number of clusters (*k*) as the input parameter. It initiates with the random selection of *k* objects as centres of clusters. Each of the remaining objects are assigned to the clusters with the closest centres based on similarity. The algorithm continues to compute new mean of clusters until the stopping criterion. The algorithm gives promising results on clusters with well-aligned and compact shapes. It is an efficient clustering method with scalability. However, it may suffer from several shortcomings, such as being highly dependent on the position of randomly selected initial cluster centres [7].

#### *B. K-means++ algorithm*

As indicated in advance, the performance of K-means algorithm has been greatly affected by randomly selected initial cluster centres. Hence, K-means++ algorithm employs a randomized seeding mechanism to obtain more consistent clustering results. In the randomized seeding mechanism, a heuristic function is employed so that the initial centres for Kmeans algorithm are carefully selected. The heuristic function utilizes a probabilistic distribution, which is obtained from the distance of data points to already selected initial centres [7].

## 2. METHODS

### I. Similarity measures

Before clustering the documents, the similarity measure be-tween the documents should be determined. There are two ex- tended ways which are being used to measure the correspondence among two documents [4].

### II. Euclidean distance

Euclidean distance is a typical metric for many kinds of data analytical problems. It is also the normal distance between two arguments and so it can be measured in a multi-dimensional space Let the documents be d 1 and d 2 the Euclidean distance of these two documents is defined as

*EDist* (d 1, d 2) = | d 1 −d 2 | [4].

### III. Clustering Validation Techniques

#### 1) V-Measure

The V-Measure is defined as the harmonic mean of homogeneity $h$ and completeness $c$ of the clustering. Both these measures can be expressed in terms of the mutual information and entropy measures of the information theory[26].

$$V_\beta = (1+\beta)\frac{h \cdot c}{\beta \cdot h + c}$$

Homogeneity $h$ is maximized when each cluster contains elements of as few different classes as possible. Completeness $c$ aims to put all elements of each class in single clusters[26].

**vmeasure (*assign1, assign2; β = 1.0*)**

Compute V-measure value between two clustering assignments.

**Parameters:**

- assign1 – the vector of assignments for the first clustering.
- assign2 – the vector of assignments for the second clustering.
- β – the weight of harmonic mean of homogeneity and completeness.

- Returns: A V-measure value.

#### 1) Silhouette

Silhouette refers to a method of interpretation and validation of consistency within clusters of data. The technique provides a succinct graphical representation of how well each object has been classified [27].

The silhouette value is a measure of how similar an object is to its own cluster (cohesion) compared to other clusters (separation). The silhouette ranges from −1 to +1, where a high value indicates that the object is well matched to its own cluster and poorly matched to neighboring clusters. If most objects have a high value, then the clustering configuration is appropriate. If many points have a low or negative value, then the clustering configuration may have too many or too few clusters. The silhouette can be calculated with any distance metric, such as the Euclidean distance or the Manhattan distance[27].

## 3. RELATED WORK

The classical K-means algorithm selects K initial cluster centres randomly and calculates text similarity by Euclidean distance. The improved algorithm is based on the maximum distance method to pre-process and select K initial cluster centres, and the KL divergence is used to calculate the similarity and As per experiment on both algorithm final output is to improve time consumption and the improve time consumption of improved k-means algorithm is lower than traditional k-means algorithm[12].

The clustering on Arabic document with different types of datasets like BBC news, CNN news and the create VSM (vector space model) model and apply on TF-IDF weighting and normalize results. The after all process applying clustering algorithm is k-means and combined algorithm with LDA to validate cluster and to compare with clustering validation techniques like purity, entropy, F-measure and evaluation index like rand index, Jaccard index. The new method with new dataset uses which contain large data and the combined method in terms of improve clustering quality for Arabic text documents and the result shows that purity is **0.933** compared to **0.82** K-means algorithm [2].

The k-means++ algorithm apply on web services topic vectors on topic model documents. The similarity calculation between services is based on the TF-IDF and LDA is also similarity calculation between services is based on their probability topic vectors. There are many clustering measurements of methods like recall, precision, purity, entropy but the LDA-PK of F-measure is 0.7499 are best result than other evaluation index [8].

The proposed approach of PAM++ algorithm is compared with other partitional clustering algorithm, such as K-means and k-means++ on text document clustering and evaluated of F-measure. At the end of result improving the performance of PAM algorithm on text document clustering [7].

The using spectral clustering with particle swarm optimization to improve text document clustering with large data sets as to compare with other algorithms. The similarity measures use for distance measures like Euclidean, cosine, document representation, maximum likelihood estimation to improve cluster quality and accuracy. At the end of result SCPSO getting better performance result as to another algorithm constant 0.82 accuracy [4].

## 4. PROPOSED WORK

As far as research is done so far, small data set is used in K-means algorithm which restrict its applicability to traditional K-means algorithm. Accuracy varies according to initial cluster medoids. Sensitive to noise and outliers, so a small number of such data can substantially influence the mean value. Provides local optimum solution.

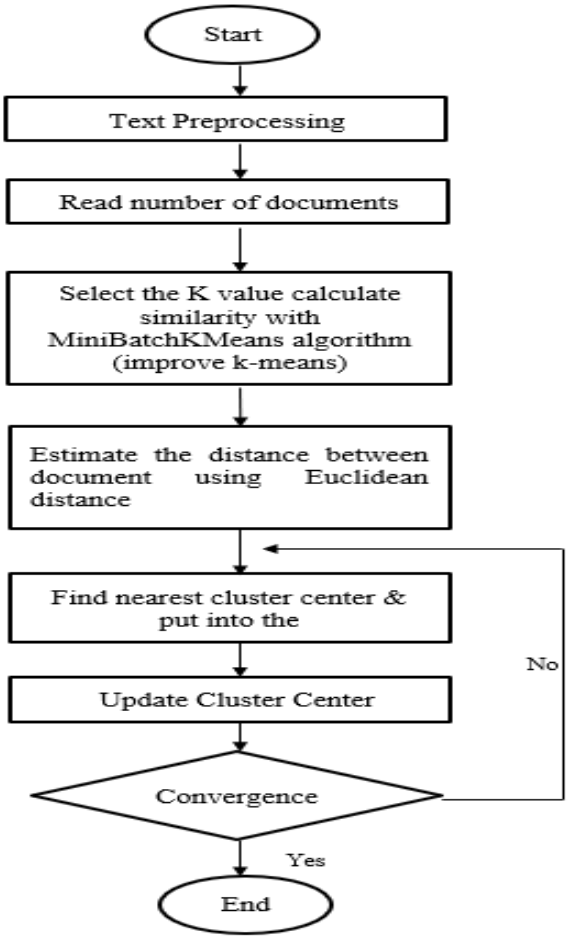


***Fig -2***: Proposed model

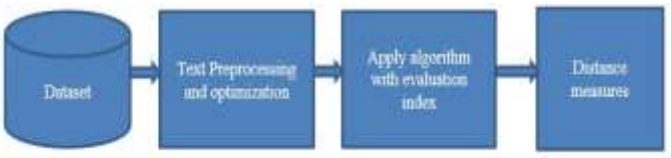


***Fig -2***: Proposed model steps

As shown above the proposed model is divided in to four stages:

**Stage 1:** Dataset: text document dataset is taken as input data.

**Stage 2:** Preprocessing and optimization: Here the profiling is done by optimizing the dataset by reducing the noise and normalizing the values to reduce unusual semantic of data.

**Stage 3:** Apply algorithm with evaluation index-: the applying large dataset and optimizing data, after algorithm applying with indexes like v measure score, silhouette score etc. and distance measures with Euclidean distance, Manhattan distance etc.

**Stage 4:** Distance measure: to measure distance of datasets of data with Euclidean distance and improve cluster quality.

## 5. IMPLEMENTATION

### 5.1 Data Preprocessing:

we taking dataset from Newsapi website which are containing thousands of datasets for different fields like Education, News, Politics etc. we crawled data from Newsapi.org to get api and download a dataset. This dataset containing nine fields and we containing two fields from this dataset one is category and another one is description. The shape of data is 9 column and 4,72,545 rows.

**Step 1: Text Preprocessing with Textual data**
**Step 2: Applying Tokenizer on description with reduce function.**
**Step 3: Applying TF-IDF Vectorization**
**Step 4: Applying Truncated SVD method**
**Step 5: Applying T-NSE with SVD method**
**Step 6: Applying MiniBatchKmeans with Distance Measures formula**
**Step 7: Result**

**Table:** Comparison Table

| PUBLICATION | TITLE | METHOD | LIMITATIONS |
|---|---|---|---|
| ELSEVIER 2019 | Text Document clustering using spectral Clustering algorithm with Particle Swarm Optimization | PSO Algorithm | This method is implemented on multi-core CPU. It can be also applied to spectral and optimization. |
| IEEE 2018 | K-means Text Dynamic Clustering Algorithm Based on KL Divergence. | K-MEANS | To optimize and improve the sensitive defects of isolated data points by basic K-means algorithm. |
| IEEE 2018 | A Prior Knowledge based Approach to Improving Accuracy of web Services Clustering. | K-Means++(PK-Means) | Web Services clustering method is working with fuzzy clustering in multiple functional requirements. |
| IEEE 2018 | Revisiting k-means and Topic Modeling, a Comparison Study to Cluster Arabic Documents. | K-Means | Word embedding model for Arabic text and large size of text in order acceptable results. |
| IEEE 2017 | A K-medoids Based Clustering Scheme with an Application to Document Clustering. | K-Means with PAM++ Algorithm | Taking more datasets to improve clustering quality with hybrid algorithm. |

### 5.2 Result

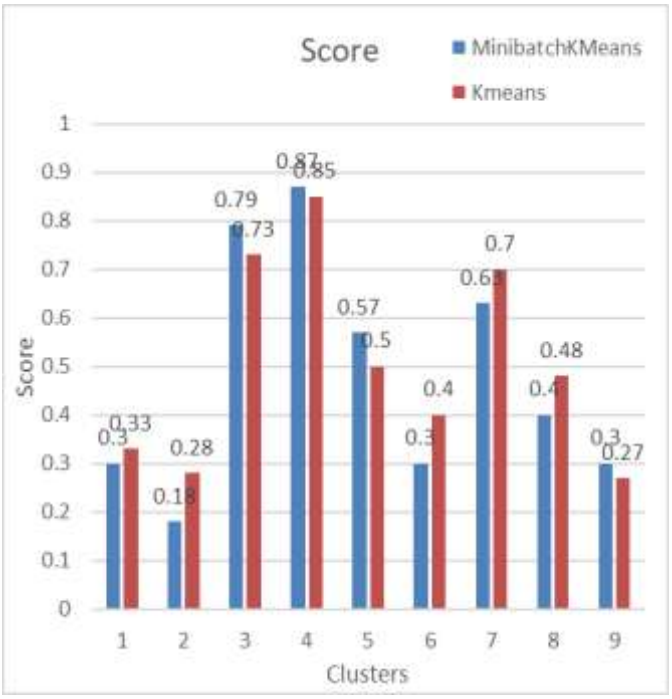


**Chart -1**: Accuracy Comparison Graph

## 6. CONCLUSION

The proposed system will definitely help in improving the text document clustering with MiniBatchKMeans algorithm by increasing its accuracy and by reducing the unusual data. The existing systems are focused on using large data sets with improved k-means algorithm only, whereas the proposed system is working with combined stacking approach which is quite advantageous for improving the accuracy. The Euclidean distance method as dissimilarity measure, compute the distance between every pair of all objects.

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