International Journal of Engineering & Technology, 7 (4) (2018) 4544-4549

SPC

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET
doi: 20870
Research paper

Review of summarization on chart data

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Abstract

To summarize documents worths to summation of the main points. A summarization is this kind of summing up. Elementary school book reports are big on summarization. To provide a comprehensible declaration of the significant points is nothing but summarization. In current years, natural language processing (NLP) has stimulated to statistical base. Many tribulations in NLP, e.g., parsing, word sense disambiguation, and involuntary paraphrasing. In recent times, robust graph-based methods for NLP is also a lot of scope, e.g., in clustering of words and attachments of prepositional phrase. In proposed paper, we will take in account of graph-based summarization techniques, approaches used for that etc. We will talk about how arbitrary traversing on images of graphs can help in making of question answer based summarization. In current exploration work, the extraction procedure is completely computerized using image processing and text recognition methods i.e. done with the help of OCR. The extracted information can be used to improve the indexing component for bar charts and get better exploration results. After generating questions, questions are rank the according to frequency or priority and answer of the ranked question is summary of given input.

Keywords: *Graph Summarization; OCR; Automatic Graph Summarization; Types; Stepwise Methodology.*

1. Introduction

Summarization is the procedure of display the original ideas of the text in as less words as possible. It can be done theoretically, verbally, through play, through song, in groups and independently. Extensive range of research in the area of summarization shows that it is well-liked and broadly used techniques in knowledge field. There is widespread research that shows that summarization is among the top most effective teaching strategies in the history of education. Summarization is an ephemeral and precise illustration of i/p text such that the o/p covers the utmost essential conceptions of the source in an abbreviated fashion.

Text summarization is procedure of extraction of important information from source text and presents that in form of short summary. To select information from large amount of information from various sources is difficult for human beings [2].

Automatic summarization is the method of grease a text manuscript with ready software, in mandate to generate a summary with the foremost ideas of the unique document.

Query - Based Summarization technique consists only answered the thing which is asked by the user. These queries are generally natural language queries or keywords which are relevant to a particular area under discussion [54]. Automatic graph summarization is nothing but produce a Question Answer based graph summary. To provide a comprehensible declaration of the significant points is nothing but summarization.

In current years, natural language processing (NLP) has stimulated to statistical base. Many tribulations in NLP, e.g., parsing, word sense disambiguation, and involuntary paraphrasing. In recent times, robust graph-based methods for NLP is also a lot of scope, e.g., in clustering of words and attachments of prepositional phrase.

In this research work, we review graph summarization mostly from a methodological perspective, answering how we can algorithmically obtain summaries of graph data.

2. Types of graph summarization

Graph Summarization can be categorized into different types depending on input image type and its contents and resolution of input image. . Below we give the main types of graph summaries. It provides detailed information for each approach.

- Input: Static or Dynamic. Most summarization methods operate on static networks, leveraging graph structure (links) and, if available, the node/edge attributes. Despite the prevalence of large dynamic networks, only recent research efforts address their efficient summarization. In some cases, static methods are adapted to handle dynamic networks seen as series of static snapshots. In other cases, new methods for graph streams are devised. In this survey, we first categorize summarization methods based on their input type.
- Input: Homogeneous or Heterogeneous. The well-studied instance in Graph summarization, and graph mining more generally, is the homogeneous graph With one entity and one link type. However, some approaches apply to heterogeneous graphs by treating various types of nodes (e.g., students, instructors) and relations between them (e.g., teacher, friends, and classmates) differently. These methods tend to be more complex, but also more expressive.
- Core Technique. Across the literature, graph summarization methods employ a set of core techniques:

1) Grouping- or aggregation-based: This is the most popular technique. Some node-grouping methods recursively aggregate nodes into “supernodes” based on an application-dependent optimization function, which can be based on

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structure and/or attributes. Others employ existing clustering techniques and map each denselyA:4connected cluster to a supernode. Edge-grouping methods aggregate edges into compressor or virtual nodes.

2) Bit compression-based: This approach, a common technique in data summarization, minimizes the number of bits needed to describe the input graph via its summary. Some methods are lossless and can perfectly reconstruct the original graph from the summary. Others are lossy, compromising recovery accuracy for space savings.
3) Simplification- or sparsification-based: These methods streamline an input graph by removing less "important" nodes or edges, resulting in a sparsified graph.
4) Influence-based: These approaches aim to discover a high-level description of the influence propagation in large-scale graphs. Techniques in this category formulate the summarization problem as an optimization process in which some quantity related to information influence is maintained.

- Output: Summary Type. The output of a summarization approach can be: (i) a supergraph, which consists of supernodes or collections of original nodes, and superedges between them; (ii) a sparsified graph, which has fewer nodes and/or edges than the original network; or (iii) a list of (static or temporal) structures or influence propagations, which are seen independently instead of in the form of a single summary graph. Moreover, the summary can be: (a) flat, with nodes simply grouped into supernodes, or (b) hierarchical, with multiple levels of abstraction.
- Output: Non-overlapping or Overlapping Nodes. In its simplest form, a summary is non-overlapping: each original node belongs only to one summary element (e.g., supernode, subgraph). Overlapping summaries, where a node may belong to multiple elements, can capture complex inherent data relationships, but may also complicate interpretation and visualization.

2.1. History of graph based summarization

Mutual theme by sculpting text documents as weighted undirected graphs. It primarily forms undirected graphs with vertices expressing the sentences of documents and edges shows the likeness between sentences. Then, by implementing Page Rank algorithm, we should construct salient scores for sentences. Sentences are ranked according to its salient scores and selected based on maximal marginal relevance to form the summaries. These summaries are combined and applied the same process one more time to form the final extractive summary of the document set. New approach for single document summarization based on graph traversal technique with constraint to improve cohesion. The assortment of features plays a vital role in the sentence withdrawalance. By considering both the structured and the unstructured features, better summary can be generated.

Graph summarization has received some courtesy. The SumTime project use pattern recognition techniques to generate textual summaries of automatically generated time-series data; The iGRAPH-Lite system [42], whose main aim is to make the information in a graphic handy to sightless users through keyboard instructions, it use templates to give a little textual summary of how the graphic looks like, but their summary is not related with the high level knowledge provide by the graphic. The objective of Futrelle's assignment [51] is to produce a summary graphic that collects the content of single or more than one graphics.

Graph-based methods for sentence ranking productively exploit repetition in the input, both on the word and sentence level. Sentence similarity is measured as a function of word overlap, so frequently occurring words would link many sentences, and similar sentences give support for each other's importance. In this way, graph approaches combine advantages from word frequency and sentence clustering methods [39].

Graph-based approaches are concerned only with pinpointing important content and do not make any special decisions about sentence ordering, for example, even though the topic words system does perform some linguistic processing of the input text. Graph-based approaches have been shown to work well for both single-document and multi-document summarization [56, 35]. At the same time, incorporating syntactic and semantic role information in the building of the text graph leads to superior results over plain TF"IDF cosine similarity [29].

Graph representations for summarization had been explored even before the PageRank models became popular. For example, the purpose of a graph-based system for multi-document summarization developed by Mani and Bloedorn [15] is to identify salient regions of each story related to a topic given by a user, and compare the stories by summarizing similarities and differences. The vertices in the graph are words, phrases and named entities rather than sentences and their initial weight is assigned using TF"IDF. Edges between vertices are defined using synonym and hypernym links in WordNet, as well as coreference links.

The graph-based approach of Erkan and Radev [56] has also been adapted for query-focused summarization with minor modifications. For query-focused summarization, cosine similarity is computed between each sentence and the user query as a measure of the relevance of the sentence to the user need. Their experiments indicate that emphasizing the user query leads to better overall performance of the Page Rank model for sentence weighting. The graph formulation of the query-focused task significantly outperforms competitive baseline which chooses sentences based on their word overlap similarity with the user topic.

Graph-based summarization methods are very flexible and allow for the smooth incorporation of discourse and semantic information. For example, graph representations of a text that are more linguistically informed than simply using sentence similarity can be created using information about the discourse relations that hold between sentences. Wolf and Gibson [19] have demonstrated that such discourse-driven graph representations are more powerful for summarization than word or sentence level frequency for single document summarization. In their work, sentences again are represented by vertices in a graph, but the edges between vertices are defined by the presence of discourse coherence relation between the sentences.

Wolf and Gibson claim that their method outperformed summarization approaches using more restricted discourse representations such as RST. Both the RST approach and the Graph Bank work rely on the structure of the text, be it a tree or a general graph, to define importance of sentences. In recent work [11], the RST and Graph Bank Methods Using Semantics and Discourse methods were again compared directly with each other.

3. Approaches used in text extraction from graph

3.1. Region-based approach

Color or gray-scale properties in a text region or their differences with the corresponding properties of the background used in Region-based approach [53], [54]. These methods divided into two sub-methods: connected component (CC)-based and edge-based. These two approaches work in a bottom-up fashion; by finding sub-structures, such as CCs or edges, and then merge those sub-structures to make bounding boxes for text. Sometimes the approaches use combinable CC-based and edge-based methods.

3.2. CC-based approach

CC-based approaches containing four processing stages: (i) preprocessing (ii) CC generation, (iii) separation of non-text components, and (iv)grouping of component. A CC-based method separates a character into the number of CCs. Further, the performance of a CC-based method [53,55] is affected by component grouping, such as text line selection. In addition, to filter out the non-text

components threshold values are needed, and that threshold values are depends on the database of image/video.

3.3. Edge-based approach

Edge-based approach [57] focused on the contrast values between the background of the image and text in the image. The edges around the text boundary are located and then merged, then some rules are applied to take out the non-text regions. Generally, an edge filter (e.g., a Canny operator) is applied for the edge detection. A morphological operator or a smoothing operation is used for the merging stage.

3.4. Texture-based approach

The observation that texts in images have distinct textural properties that distinguish them from the background is used in Texture Based approach. To detect the textural properties of a text region in an image, the techniques based on Gabor filters, Wavelet, FFT, spatial variance, etc. can be used.

3.5. Binarization approach

Binarization approach are the simplest approach for text localization. These methods are widely used for document image segmentation, as the images generally have a white background with black characters, so thereby based on thresholding successful segmentation is done. This approach used for many specific applications like address location for postal mail, courtesy amount on checks, etc.

3.6. Hybrid approaches

This approach takes both region-based approaches which nearly cover text regions and texture-based approaches which may estimate text location in scenes. [6] merged the connected component (CC)-based approach with the texture-based approach.

4. Methodologies for text recognition in charts

There are normally used approaches in the text recognition and detection systems: stepwise and integrated. Stepwise methodologies have accomplished detection and recognition units, and for identificaion of text regions use a feeder channel to detect, segment. In divergence, integrated methodologies have the aim to diagnose words where the detection and recognition processes share some info with character classification, and then used joint optimization policies.

4.1. Stepwise methodologies

Stepwise methodologies have four basic steps: localization, verification, segmentation, and recognition. The localization step categorizes components and groups them into candidate text regions, during certification which we further classified into text or non-text regions. The assumption is, various text regions might be regarded as unvarying pattern.
In the segmentation step, it separates the characters so that accurate outlines are remaining of image blocks for the recognition step. Finally, image blocks are converted into characters in the recognition step. In some approaches, the verification and/or segmentation step could be ignored, or additional steps might be contained within to carry out text enrichment and/or refinement. A stepwise method including detection, tracking, segmentation, recognition, and correction was proposed. Text detection is performed with a convolutional neural network trained on raw pixel values, and the components which are detected of local maximal responses are gathered as text. To regulate the start and end frame of localized text a tracking process is integrated. To calculate separations that enable precise CNN based character recognition. A segmentation step is proposed based on the Shortest Path method. The language model is used to remove ambiguities of recognition and segmentation errors. Stroke pixels are grouped into connected components (CCs), which are filtered with a decision rest trained on component features of shape, occupation ratio, axial ratio, width variation, and component density.

4.2. Integrated methodologies

Integrated methodology includes character classification responses are considered and shared with detection and recognition modules [40]. As primary feature, a character classification response requires the difference of characters from the background as well as from each other. Holistic matching, i.e., "word spotting" [42], joint optimization [43] and/or decision delay [41], [44] these are some solutions. To match specific words in a given lexicon with image patches by character and word models, Word spotting looks for this. They use the pictorial model which takes the scores and locations of characters as input to determine an optimal configuration of a particular word from a small lexicon. Wang et al. [43] proposed combining a multi-layer CNN with unsupervised feature learning to train character models, which are used in both text detection and recognition procedures.
Matas [44] and Neumann, by keeping multiple segmentations of each character until the last stage when the context of each character proposed a decision delay approach. They detect character segmentations using extremal regions. Based on the segmentations, a directed graph is constructed with character classification scores, character intervals and language priors. To select the path on the graph with the highest score a dynamic programming algorithm is used.

4.3. Comparison of the methodologies

Stepwise methodologies generally used a coarse-to-fine strategy, which first localizes text, and then verifies, segments, and recognizes them. Mostly the background is filtered in the coarse localization step, which greatly reduces the computational cost, and consequently guarantees computational efficiency is one of the attractive features. It processes oriented text as the text orientations are estimated in the localization step is the other attractive features. Given language independent features or multilingual OCR modules [48], [47], [46], it processes multilingual text. There are two disadvantages; the first is when integrating different techniques from all steps it increase in complexity. The second is the difficulty in optimizing parameters for all steps. With HOG features characters are recognized, and words are modeled with a pictorial structure model.
By contrast, to identify specific words in imagery with character and language models is the goal of integrated methodologies. In the step of segmentation or optimize it with character and word recognition, which makes it less sensitive to complex backgrounds and low resolution text can be avoided in Integrated methodologies. The disadvantage lies in that the multi-class character classification procedure is expensive when considering a large character class number and a large amount of candidate windows.

5. Related work

Mainly the existing algorithms for text recognition are designed for scanned document images. There are number of algorithms for text recognition in chart images; Generally they all consist of the similar steps: (1) image binarization (local, global or adaptive) [2], [7], (2) text detection and localization (region based, edge based or texture based) [5], (3) text line detection [2], [7], [9], (4) character extraction and image enhancement,(5) character recognition [9]. Whereas implementation of every step of a particular algorithm shows image properties of the target images.
For any images, usually the following observations are true: all text lines should be parallel; text size should be uniform; Separa-

tion of the background and foreground is easy; paragraphs of text are present [1], [2], [9]. Hence, text detection and localization techniques depend on the properties of a paragraph of text (for example, horizontal orientation of text lines) rather than separate words. Therefore, the performance of text detection algorithms designed for scanned document images is not good for chart images. As compared to the complexity of document images algorithms the complexity of text recognition algorithms for natural scenes is higher, where the accuracy is lower. Chart images have unique features, which are not common for natural scenes. Small text regions are typical for chart images as they are for natural scenes. Thus the problem of text detection in chart images requires an individual approach.

A research done by [38], they proposed an algorithm for text separation of strings for engineering drawings and diagrams. This algorithm might be applied to solve text detection problem in chart images, but it has number of limitations for an input document. It should be binary and of high resolution. There are rules for font size and distance within character.

This paper has three parts: 1) text detection and recognition has same features and classification scheme; 2) the main consideration of horizontal texts, the proposed system is able to localizing and reading texts of various orientations; and 3) used a modified dictionary search technique supports Levenshein distance edition [4], to correct the errors of recognition generally caused by confusions among similar character yet not get totally different characters.

Scene Text Recognition applying Structure-Guided Character Detection [13] proposed work is completely unique scene in text-recognition technique combination of structure-guided character detection and linguistic info. For word recognition, mix the detection scores and language model into the posterior likelihood of character sequence from the Bayesian decision tree and the final word recognition result's obtained by finding most likelihood character sequence utilized by Viterbi algorithm and thus to eliminate the word recognition probable ambiguities the various information a bit like the language model is used. The [14] work done on technique for text detection in natural scene photos. In this paper proposed a Maximally Stable Extremal Regions MSER-based scene text detection technique. A heuristic strategy- the forward-backward algorithm is used for Multi orientation text detection algorithm.

Table1: Review on Techniques Used for Data Extraction

Author and Year	Paper Title	Method	Rule	Limitations
Chaddha N., Sharma R.,Agrawal A., & A. Gupta A.(1994),v.d.Schaar-Mitrea and P. de With(1998), F. LeBourgeois(1997).	Text Segmentation in Mixed-mode type Images, Systems and Computers Textual loom For Indexing And repossession of Image And Video	Text detection method using Texture Features	Frequent color transition on image	Computationally complex when there are many edges.
Sato T., Kanade T., Hughes E. K., and Smith M. A. (1998)	Digital News collection needs Video OCR, Proc. Of IEEE practicum on Content based admittance of Image and Video Databases	Segmentation Methods using Character Contours	Measure exact character boundaries.	Sow & may generate incomplete or distorted contour.
Zhong Yu, Karu Kalle, and J.K. Anil (1995), Lee and Kankanhalli(1995)	Text recognition In difficult Color Images, Pattern Recognition, Zoning methods for handwritten character recognition	Character Recognition Methods Using Pixel Connectivity	Use cc- component	Fails to extract all the characters when there are joined or broken.
Forssen Erik P. and D. G.Lowe,(2007), J.Matas, O.Chum, M. Urban & T. Pajdla (2002)	Figure Descriptors For MSER, vigorous large baseline stero from MSER.	MSER method	remove non-text regions, threshold value needed	
Hase H., Shinokawa T., Yoneda M., and C. Suen(2001), Sakai M., & Maruyama H., M.Gennert(1986)	Extraction of strings of characters from Color Documents, Pattern Recognition,	Edge(text boundaries, strong edges), Compression	Use kernel matrix, threshold value needed	Garbage values taken

5.1. Review of question generation system

A system for producing questions routinely from certain Punjabi text [69]. This structure translates the declarative sentences into inquisitive matching part. The system displays decent results for some question types and express low results for other question types. It is capable of producing only shallow questions beginning with the words “what”, “where”, “when” “who” and is not capable of generating questions with “why” and “how” etc. words. A rule based question generation system from Punjabi text encompass chronological info [69]. This system uses NER tool which is used to spot the labels from a given text and produces the question bestowing to the identified objects. Punjabi corpus is also used to create the questions robotically and this corpus enclosed unlike objects like names of towns, nations, places, person name etc. to make the questions. With the help of this system various type of questions starting with “where”, “whom”, “what”, “when”, “how many/much”, “why”, “direction”, “monetary expressions” words are generated.

In the field of question generation for English a lot of work has been done with the help of numerous methods like POS taggers, SRL etc. but for Indian languages no such tools are available. A system for Question generation from sections. That system works in three steps: content selection, question formation and ranking. This system uses the predicate argument structures of sentences with semantic role labels to generate the questions. The generated questions are then ranked to pick the best six questions [10].

6. Optical character recognition for text extraction

Question Answer Based Graph Summarization is process of collecting necessary information from original text or data from given images and converts it into form of short summary.

An automated system for Question Answer Based Graph Summarization is desired for specific applications. Under the domain of Natural Language Processing and Image Processing an OCR (Optical Character Recognition) system works. To convert all the text information that is present in image form, to text format OCR is used. General OCR systems are not capable to detect and recognize small strings of few characters text, commonly when a text line in vertical or diagonal .we use such a OCR system which able

to detect small text regions with no issue of string alignment and font size or style. We propose to use an algorithm as a pre-processing step for text recognition with a common OCR system. From last 300 years, charts, graphs, and other visual data plays a vital role in communicating the quantitative information. In this paper, we analyse a method to extract data values from bar charts. We use automated extraction process in image processing. For the recognition of textual or numerical values of each text region Tesseract OCR is used.

Visual data plays a vital role in many applications. It contains important information and can provide essential knowledge that is not duplicated in other data formats. Graphical representation, diagrams, charts and graphs are main types of visual data in scientific domains. Automated computer based system is needed for efficient indexing, processing and analysis of documents in these domains, which is capable of providing analysis and semantic interpretation of graphics. To detect, extract and recognize text present in graphical form it is the important step. Textual data in charts/graphs includes axes titles, tick labels, legends, captions, notes.

Common optical character recognition engines, such as Tesseract OCR, ABBYY Fine Reader [9], MODI (Microsoft Office Document Imaging) [10], are used to detect and recognize text in scanned document images and it became failure in the detection of small text regions composed of one or a few words; such text regions are typical for chart images.

We used Tesseract OCR engine [9] in our experiments. Particularly, the accuracy of recognition by Tesseract OCR is up to 97% when the scanned document images are used. After being cropped and deskewed. The detected text regions are passed to an OCR engine. When the proposed algorithm for text detection and localization is used as a pre-processing step, the experimental results show a significant increase of the recognition rate. As a starting, we begins with the scientific charts such as bar-chart, pie chart etc.

7. Conclusion

This paper includes a study of the various types of Graph summarization and also text extraction techniques used earlier. Also we have discussed the general history of graph summarization, it includes weighted graph, tree graphs and chart. The objective of this paper is to categorize and evaluate the various current papers. We have talk about judgment and recital analysis. Many researchers have already done research on text localization, text detection and tracking for images is required for use in real-time applications. To modify a text info extraction system to be used for any type of image, also for scanned document pictures and real scene pictures the text-image-analysis is required.

We have also discus about OCR system which is used for recognition of data. The further work focused on mounting an algorithm for automatic and rapid text extraction from an image.

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