⑫ EUROPEAN PATENT APPLICATION

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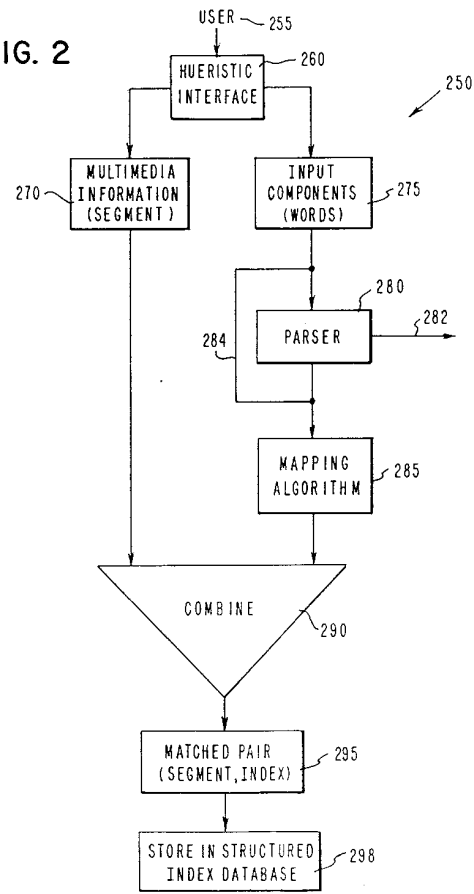
�54 **Indexing multimedia objects.**

�57 To archive information, a phrase or sentence describing the information, typically expressed in a natural language and conforming to the rules of a grammar (like a natural language grammar) is used to create a structured index which also conforms to the natural language grammar. The structured index has structure because the words in the index have a function and a relationship among each other as determined by the grammar. The index is combined with a location pointer of information to be cataloged, preferably multimedia information, to form a matched pair, i.e., a structured index and a segment (or a pointer to a multimedia object). The matched pair is stored in a database for later retrieval. A heuristic interface presents the multimedia information along with a template in order to prompt the user into describing the multimedia information with a string of words so that they conform to the grammar.

To retrieve the information, a user can use a query which is parsed according to the rules of grammar into a query structure in a way identical to or similar to the way the structured index was formed. This query structure is used to create a key which is used along with a searching algorithm to search the database of matched pairs. The search may be broadened to include words related to the words in the key. A list of matched pairs that match the key is returned. The segment of matched pairs in the list is used to locate and retrieve the archived multimedia information.

EP 0 609 517 A2

FIG. 2

USER ~ 255

HUERISTIC INTERFACE — 260

250

MULTIMEDIA INFORMATION (SEGMENT) — 270

INPUT COMPONENTS (WORDS) — 275

PARSER — 280

282

284

MAPPING ALGORITHM — 285

COMBINE — 290

MATCHED PAIR (SEGMENT,INDEX) — 295

STORE IN STRUCTURED INDEX DATABASE — 298

FIELD OF THE INVENTION

This invention relates to the field of using an index to archive and retrieve information on a computer. The information includes multimedia objects, such as video clips and audio segments.

BACKGROUND OF THE INVENTION

There are many methods known in the computer art which can archive and retrieve textual expressions (words and phrases) in natural language. Primarily, these methods use key words as indexes to archive and retrieve these textual expressions. However, many things, particularly things in the area of multimedia (images and sounds), are not easily described using key words indexes. Often multimedia information like the sound of a dog barking, images shown in certain pictures, or the steps performed in a dance require more descriptive indexes than the prior art key words can provide. Key word indexes have failed to be descriptive enough because they can not easily identify the difference between a thing and an action, describe what agent performs a given action, or describe what object is acted upon. These key word failures, and others, create ambiguities when key words are used to identify and catalog information.

The key word indexes of the prior art lack the grammatical structure needed to make them more descriptive. Key word phrases have no structure because the words in the phrases lack two things: 1. a function and 2. a relationship. In a natural language, (i.e., languages spoken by humans) function and relationships of the words are provided by the language grammar (grammar rules). For example, in the English natural language phrase "a man will fall into the pool", each word has a function and a relationship to the other words in the phrase dictated by English grammar. Functionally, "man" and "pool" are nouns and "fall" is a verb. Relationships exist because, syntactically, "man" is the subject of the sentence, and, semantically, it is the themeof an action;
"fall" is the predicate which describes the action;
and "pool", according to the English syntax, the locational object of the sentence, describes the the location of the action. Often, the object of a sentence is the recipient of the action of an agent; and the subject of the sentence is the agent of an action; for instance, "the woman pushed the ball". The word "agent" is used to describe the typical subject; that is, by default subjects are assumed to be agents. The explicit distinction between agent-subject and theme-subject is not made, since it does not affect the logic of the proposal. Similarly, we will use the word "object" to cover several syntactic functions, such as direct object, object of a preposition, and indirect object. Notice that this slot can have multiple fillers when there is more than one object as in "The child dropped the ball into the pool", where "the ball" is the direct object and "into the pool" the locational object of the action. (In all our examples we will use only single fillers). Natural languages use different kinds of grammatical rules to affect the meaning of the words. These include: defining parts of speech, ordering words in the phrase, and using word prefixes or endings, etc. Since key words, even in phrases, lack these grammatical rules, they can be less descriptive and ambiguous. For example, when the phrase "man will fall into the pool" is parsed into words, the key word "fall" has no function (it could be a verb or a noun) and could be ambiguously interpreted as "drop" or a "season of the year". Furthermore, splitting the key word phrase "cat eats mouse" into "cat", "eats", and "mouse", yields a sequence of key words with no relationship. Because there is no way to tell which word is the subject and which is the object, the interpretation becomes ambiguous. The phrase could mean: "cat eats mouse", "mouse eats cat", or "cat and mouse eats".

The problem is compounded when synonyms, hypernyms (words of a broader genus which include the key word) or hyponyms (words within the key word genus) of key words are used to expand a key word search to retrieve data. This is frequently required in Information Retrieval systems because often users use slightly different words that are not found via a direct match. For example, a synonym (hypernym) of "fall" like autumn (season) would give erroneous results when searching a database for a match to the key word "fall" which really meant "drop".

OBJECTS OF THE INVENTION

An object of this invention is an improved method of archiving and retrieving data on a multipurpose computer by using structured indexes.

Another object of this invention is an improved method of archiving and retrieving multimedia information on a multipurpose computer by using structured indexes.

Also an object of this invention is an improved method of archiving and retrieving multimedia objects on a multipurpose computer by using structured indexes related to a lexical database.

An additional object of this invention is an improved method of archiving and retrieving multimedia objects on a multipurpose computer by using structured indexes and natural language queries.

SUMMARY OF THE INVENTION

This invention is an efficient method for assisting computer users in the creation and use of structured indexes for archiving and retrieving information using a general purpose computer. The index structure is based on a grammar (grammatical rules) and is particularly descriptive for the archiving and retrieving of multimedia objects.

In a preferred embodiment, a heuristic interface is presented to the user. The heuristic interface presents information, like a film clip, to the user and receives strings of input, like a word phrase, from the user. The heuristic interface helps the user organize the input string into components having a structure according to a set of grammatical rules. Alternatively, a parser can parse natural language descriptions to identify components and their structures based on rules.

To archive information, a matched pair is created using a structured index. Using a mapping algorithm, the structured index is made of input string components (e.g. words) which now have a function and a relationship with one another. This structured index is then combined with a pointer to the information to be archived to create the matched pair. Therefore, the matched pair has two parts: 1. the pointer, called a segment number or segment, correlated to the storage location of the (multimedia) information to be archived and 2. the structured index describing the information. The matched paired is then archived or stored in the computer memory.

To retrieve the archived information, the system is queried using an input string, such as natural language string query. In a preferred embodiment, a heuristic interface assists the user in providing an input string query that conforms to a grammar. Alternatively, a parser can parse the query string into a structured query which has a structure that is identical to or related to that of the structured index in the archived matched pairs. A search algorithm is selected and used to make a key. The key is compared to the index part (or a component(s) of the index part) of the matched pairs in the database. This comparison generates a list of the matching pairs that match the key. Therefore, this matching pair list contains the matched pairs corresponding to archived information that matches the query within the parameters defined by the search algorithm. Finally, the (multimedia) information segment number, part of each matched pair on the matching pair list, is used to retrieve the archived (multimedia) information associated with the segment number from the storage location pointed to by the segment number.

The retrieval search can be expanded by changing the search algorithm. Parts of the key can point to classes of words that are stored in a lexical database. These lexical database words are somehow related (synonym, etc.) to the word(s) in the key. Words can be chosen from the lexical database using criteria defined by the search algorithm. These words, chosen from the lexical database, are also used to search the matched pair database for a match. Any matched pair that matches one of the chosen lexical database words is returned on the matching list as well.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1　　shows preferred structured indexes, of the present invention, as part of a matched pair record.

Fig. 2　　is a flow chart of the method of archiving information, like multimedia information, by using a structured index.

Fig. 3　　shows a computer screen display which uses a template and a multimedia display as a heuristic interface with a user.

Fig. 4　　is a flow chart of the method of retrieving information, like multimedia information, by using structured indexes.

Fig. 5　　shows a computer system using structured indexes to archive and retrieve information, particularly multimedia information.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is capable of running on any general purpose computer which has the ability to present multimedia information to a user. One preferred embodiment, shown in Fig. 5, uses an IBM Personal System/2 (PS/2) Model 8595 Microchannel Floor Standing 486 System 500 (described in the Quick Reference supplied with the system unit). An IBM Personal System/2 (PS/2) ActionMedia II Display Adapter 510 (described in the ActionMedia II Technical Reference) is used for audio/video capture 520A and playback 520B. This preferred embodiment also uses an IBM Operating System/2 (OS/2) 2.0 (described in the OS/2 2.0 Quick Reference), an IBM Multimedia Presentation Manager/2 (described in the IBM Multimedia Presentation Manager/2 ActionMedia(R) II Media Control Interface Programming Guide and Reference), and a Smalltalk/VPM (described in the Smalltalk/VPM Tutorial and Programming Handbook). Other multimedia hardware 530 known in the art that can be connected to a general purpose computer can also be used. This hardware 530 may include video cassette recording devices, laser disc player adapter, audio capture playback adapter,

etc. The marks OS/2 and PS/2 are trademarks of the IBM Corporation, the mark ActionMedia II is a trademark of the Intel Corporation, and the mark Smalltalk/VPM is a trademark of Digitalk Inc..

The present invention uses structured indexes to archive and retrieve information in a computer database. Because structured indexes are much more descriptive than prior art key word indexes, structured indexes are particularly useful in archiving and retrieving information about multimedia objects. Generally, multimedia includes information having a sensory quality that is presented as an input or output of a computer. Multimedia information (objects) 550 includes audio 532 and visual 534 information like audio and video clips, musical recordings, speech, typed text, still pictures, drawings, animation, choreographed dance steps, etc. One reason that a structured index is useful in describing multimedia objects is that actions, agents performing actions, and recipients of actions can be included in the index.

The structured index has a structure because it carries information about 1. the function of components of the index and 2. the relationship among the index components. The function and relationship are defined by rules of a grammar. In the preferred embodiment, the components of the index are words which describe a multimedia object. The rules of grammar used to give function and relationship to the words in the index are given in a natural language grammar that uses the words. However, the invention is not limited to words as index components nor to a natural language grammar. The index can be made of any type of component which might be descriptive of the information to be archived or retrieved and any rules that define component functions and relationships can be a grammar. For instance, an index could be created for a musical clip using a series of tones given structure by rules concerning rhythm and frequency. An index into textual information like a telephone directory could be made from a series of tones, representing a phone number, which are given structure by rules concerning the frequency of the tones (the numeric value of the digits), number of tones (digits in the phone number), and the order of a tone sequence.

A structured index of one preferred embodiment takes the form:
[relation : component (function or attributes)]
As an example, this form as applied to a word index, for a single word component, becomes:
[action: word (verb, third person, future tense)]
The relation (action) and function (verb) of this index are defined by the rules of the applicable grammar, i.e. English grammar. Attributes of the word (component) are represented as the information within the parenthesis of the index. These

attributes include the function of the word but may include additional information. In this example, the attributes include the word function (verb) and additional information about the verb, person and tense. Attribute information can include grammatical descriptions about a word (like person, number, tense, gender) or other descriptive information (like color, size, weight). An index like this, that is descriptive of just one word (component), is called a simple index.

To create an index that is more descriptive of a word (component) phrase than a one word simple index, a compound index is used. A compound index contains simple indexes for more than one word (component) in the phase. For example, in the English language phrase "Dad will fall into a pool", a compound structured index could take the form:
[[agent: Dad (noun, human)], [action: fall (verb, third person, future tense, drop)], [object: into the pool (prepositional phrase, object, swimming pool)]].

In this example, the compound structured index generated from the natural language word phrase, based on English grammar, defines the relationship (agent, action, and object or location) of the structured index word components "Dad", "fall", and "into the pool" respectively. The function of each component is given by the grammar (noun, verb, prepositional phrase). In addition, along with the function, other attribute information is included. Here the attributes give information about the component/word useful in associating it with other components/words. Attributes include synonyms ("drop"), and hyponyms ("swimming pool").

Grammar is the set of rules which gives components in a sequence a function and relationship, i.e. a structure. The rules of grammar organize and/or identify the components in a sequence in such a way to give them specific functions. For example, the grammar used in the preferred embodiment is a natural language grammar of English, which has subjects (nouns and noun phrases), predicates (verbs), and objects (nouns, noun phrases, prepositional phrases, etc.) arranged in a sequence determined by grammatical rules to create a phrase or sentence. Altering the function and relationship of the words according to the grammatical rules can change the meaning of the word phrase or sentence. Although a natural language grammar and a word sequence (phrase or sentence) are used in the preferred embodiment, practice of the invention is not limited to natural language grammar. The invention can use as a grammar any set of rules used to give structure to a sequence of components in order to create a sensory meaning (auditory or visual). This might include the rules of music applied to a sequence of

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